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Applicability of Intrinsic Value Models at the Segmented Chinese Stock Market

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II. Summary of Abbreviations

ADF	Augmented Dickey Fuller test
ADR	American depository right
APT	Arbitrage pricing theory
AR(1)	First-order autoregressive process
bn	Billion
BPS	Book value per share
CAPM	Capital asset pricing model
CBRC	China banking regulatory commission
cf.	Confer (compare)
CIA	Central Intelligence Agency
CIM	Capitalization of income method
CIRC	China insurance regulatory commission
CNY	Chinese Yuan
Co.	Company
CSI 300	Chinese stock index
CSR	Clean surplus relation
CSRC	China securities regulatory commission
DCF	Discounted cash flow model
DDM	Dividend-discounted model
DJIA	Dow Jones industrial average index
Ed.	Editor / Edition
EGC	Engle Granger Cointegration test
EPS	Earnings per share
et al.	Et alii (and others)
et seq.	Et sequens (and the following)
EVA	Economic Value Added
FAR	Financial asset relation
FDI	Foreign direct investment
FOM	Model according to FELTHAM/OHLSON (1995)
FTSE	Financial Times Stock Exchange index
GDP	Gross domestic product
GDR	Global depository right

GM	Model according to GEBHARDT/LEE/SWAMINATHAN (2001)
HKD	Hong Kong Dollar
HKEx	Hong Kong stock exchange
HKSSAP	Hong Kong Statement of Standard Accounting Practice
HSCE	Hang Seng China Enterprise Index
I/B/E/S	Institutional Brokers Estimate System
ICBC	Industrial and Commercial Bank of China
IFRS	International financial accounting standards
iid	Uncorrelated, identically, normally distributed
Int.	International
IPI	International portfolio investment
IPO	Initial public offering
KOF	Konjunkturforschungsstelle der Eidgenössischen Hochschule Zürich
LID	Linear information dynamics
LID2	Linear information dynamics 2
Ltd.	Limited
MGM	Modified model according to GEBHARDT/LEE/SWAMINATHAN (2001)
MOF	Ministry of finance
NASDAQ	National Association of Securities Dealers automated Quotations
NDRC	National Develop and Reform Commission
NIR	Net interest relation
NYSE	New York stock exchange
OAR	Operating asset relation
OJM	Model according to OHLSON/JUETTNER (2003)
OLS	Ordinary least squares
OM	Model according to OHLSON (1995)
OMX	Aktiebolaget Optionsmäklarna / Helsinki Stock Exchange
OTC	Over-the-counter
p. / pp.	Page / pages
P/E	Price earnings
PBOC	People’s bank of China
PCBC	People’s construction bank of China
PPP	Purchasing power parity theory
PRC	People’s Republic of China
PRC GAAP	People’s Republic of China generally accepted accounting standards

QDII	Qualified domestic institutional investor
QFII	Qualified foreign institutional investor
R^2	Coefficient of determination
RIV	Residual income valuation model
ROE	Return on equity
S&P	Standard and Poor's
SAFE	State Administration of Foreign Exchange
SARS	Severe acute respiratory syndrome
SE	Stock exchange
SOE	State-owned enterprise
SSE	Shanghai stock exchange
SZSE	Shenzhen stock exchange
T-bond	Treasury bond
Topix	Tokyo Stock Price Index
US GAAP	United States generally accepted accounting principles
USA	United States of America
USD	United States of America Dollar
WFE	World Federation of Exchanges
WSJ	The Wall Street Journal

III. Summary of Symbols

$A_{d/f}$	risk aversion (domestic/foreign)
b	book value of equity
c	country risk vector
c	constant term
d	dividend
D	average duration
dis	distribution
e	earnings
e_a	abnormal earnings
fa	financial assets
g	growth rate
H_0	Null-hypothesis
iid	uncorrelated, identically, normally distributed
int	interest payment
k	discount rate
K	discount factor
M	market portfolio
$N_{d/f}$	number of shares outstanding (domestic/foreign)
oa	operating assets
oc	operating cash flows
ox	operating earnings
p	price
q	undefined variable for model according to OHLSON/JUETTNER (2003)
r	risk-free rate
r_{av}	long-term average risk-free rate
r^d	risk-free rate for domestic investors
r^f	risk-free rate for foreign investors
r_f	return of risk-free asset
r_m	return of market portfolio
r_s	stock's return
U	utility
v	value

x	deterministic factor
y	dependent variable
z	capitalization object
z_T	terminal value
α	intercept term
β	slope parameter
Γ	covariance with other assets
δ	constraint term for model according to EUN/JANAKIRAMANAN (1986)
δ	trend parameter in Chapter 8
ε	disturbance term
ζ	factor loading for lag parameter
λ	factor loading vector
μ	expected return
ν	information variable
ξ	foreign share discount
ρ	factor loading for Augmented Dickey Fuller test
σ^2	variance
σ_{im}	covariance between individual stock and market return
σ_m	market return's standard deviation
υ	growth in operating assets
ω	variable for model according to OHLSON (2001)

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1 Problem statement

FISHER (1912) appoints the central subject of Economics by simply defining the discipline as the "Science of Wealth".[1] Any particular item of wealth can be referred to as an asset, which is typically subdivided into tangible and financial assets.[2] According to KOOPMANS (1951), the creation and extension of wealth is crucially determined by the efficient allocation of available factors (labor, land and capital) for the production of goods and services.[3] Hence, channeling these factors to agents with productive use can be regarded as a key issue for the formation of wealth.[4] The medium for coordination can be seen in financial assets that are exchanged between savers and borrowers. This leads to the extraordinary function of the financial system within an economic system.[5] As a result, financial systems have become a popular field of economic research, summarized under the term Finance.[6] Being positioned in this field, within the remainder of this thesis the term capital is not to be understood in the tangible sense as production factor, but refers to financial capital or equivalently financial assets.[7]

Generally speaking, research on financial systems advances from two directions: the micro level considers the behavior and consequences of individual agents, whereas the macro level regards their economy-wide aggregate and its consequences on the financial system as a whole or subsets of it such as the banking system or the stock market.[8] Eventually, both levels are complementary and interdependent. This thesis follows a bottom-up analysis by regarding valuation of investment opportunities with the purpose

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1 FISHER, Principles, 1912, p. 1. Obviously, other definitions are conceivable. For a discussion cf. WOLL, Volkswirtschaftslehre, 2007, pp. 3-6.

2 Cf., SAMUELSON/NORDHAUS, Economics, 1998, p. 212. Instead of asset, FISHER (1912) uses the term „instrument", FISHER, Principles, 1912, p. 4.

3 Cf. KOOPMANS, Allocation, 1951. The term capital used as production factor includes only tangible assets such as buildings, machines, roads. It does however, exclude financial assets such as money, deposits, stocks, foreign exchanges, derivatives, securitized obligations such as bonds, MANKIW, Economics, 2008, p. 24, WOLL, Volkswirtschaftslehre, 2007, pp. 32-33. Additional production factors could be considered such as human capital or knowledge, cf., BODIE/KANE/MARCUS, Investment, 1999, p. 2. However, for the purpose of this thesis this broad perception can be discounted.

4 Cf. MISHKIN/EAKINS, Markets, 2009, p. 4, HUBBARD, Money, 1997, pp. 36-37 and FAMA, Efficient Market, 1970, p. 383.

5 Cf. MANKIW, Economics, 2008, pp. 376-379 and MISHKIN/EAKINS, Markets, 2009, p. 19.

6 For a discussion of the role financial systems play in economies cf. LEVINE, Views, 1997.

7 This distinction follows BODIE/MERTON, Finance, 2000, p. 6. Correspondingly, the term capital market is used as a synonym for financial market as in FRANKE/HAX, Kapitalmarkt, 2004, pp. 30-31. This can be regarded as a prevalent definition for capital markets in Finance, cf. PENMAN, Valuation, 2007, pp. 9-12 and PALEPU/HEALY/BERNARD, Valuation, 2000, pp. 1-2.

8 Cf. MANKIW, Economics, 2008, pp. 28-29.

of providing benefit to academics, practitioners and policymakers. Because of a unique research environment offered in the stock market in the People's Republic of China (PRC), this thesis focuses on a subset of a capital market - the stock markets - defined as primary and secondary markets where equity stock is exchanged. Narrowing down further, the term stock exchange refers to organized secondary markets.[9] Furthermore, it is confined to common shares of stock, that is to say ownership claims on a part of the corporation's wealth and income.[10]

When it comes to investing in stock markets, overall researchers and practitioners do not share corresponding positions.[11] In general, academics draw upon consistency with economic theory as a benchmark, whereas practitioners focus on applicability under real market conditions. This thesis scrutinizes deductive theory by focusing on the applicability of models based on economic theory with respect to empirical observations.[12] Consequently, it is believed that results will be beneficial for both positions.

In the neoclassical framework, portfolio theory attributed to MARKOWITZ (1952) can be considered the most acclaimed.[13] By identifying risk and return as key factors, the theory suggests how individuals should make optimal portfolio investment decisions in an environment of rationality, risk-aversion and non-satiation. Based on optimal individual behavior, SHARPE (1964) and LINTNER (1965) aggregate individual decisions yielding a model that explains how equilibrium prices are attained – the capital asset pricing model (CAPM).[14]

Besides the portfolio-theory based CAPM, a value-oriented alternative outside of the neoclassical framework has been suggested by a number of authors.[15] Refraining from restrictive assumptions, this approach is rooted in an algebraic equation – the capitalization of income method (CIM). Accordingly, investment decisions can be based on the value of all future income streams that are yielded from a specific stock.[16] Models

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9 This definition is in accordance with BODIE/KANE/MARCUS, Investments, 1999, G12.

10 Cf. MISHKIN/EAKINS, Markets, 2009, p. 5. Preferred stock is neglected since it does not exist in the Chinese stock market, BAI et al., China, 2004, p. 31.

11 Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 268-269.

12 In this respect it closes the gap between the deductive school and the institutionalists as demanded by HARROD, Method, 1938, p. 385.

13 MARKOWITZ, Selection, 1952.

14 SHARPE, Capital, 1964 and LINTNER, Valuation, 1965.

15 Cf. OHLSON, Valuation, 1995, BRELAEY/MYERS/ALLEN, Finance, 1996, pp. 113-114, PENMAN, Valuation, 2007, pp. 88-98 and PALEPU/HEALY/BERNARD, Valuation, 2000, p. 11-1.

16 This refers to economic income in gerenal and not some specific accounting income.

that apply this method are termed intrinsic value models.[17] Obviously, the absence of assumptions imposes intricacy when it comes to application, which will be thoroughly discussed below.

When dropping the single-market perspective and extending the scope to an international investment environment, additional aspects, such as segment specific characteristics, have to be taken into account.[18] Dealing with both neoclassical and the value-oriented approach, this thesis discusses investing in an international environment using the example of the Chinese stock market.

In recent decades, economic reforms in the PRC, summarized under the term reform and opening-up, have led to a gradual restructuring of the financial system that has taken the Chinese economic system from being a centrally planned to a socialist market economy.[19] On the Chinese stock markets two legally separated market divisions for Chinese citizens and foreign investors have been established.[20] Although shares traded in both segments essentially entitle shareholders to equal rights, domestic investors pay premiums as high as three times what foreign investors pay. Contradicting findings from other legally segmented markets where foreigners pay premiums, the situation in the Chinese market is unique and has become known as the Chinese discount puzzle.[21]

The Chinese discount puzzle appears to violate a fundamental rule in economics: the law of one price, attributed to JEVONS (1888). It stipulates that in an open market at any one moment for a single good there cannot be two different prices.[22] However, the conclusion of the Chinese discount puzzle being a violation of the law of one price is attached to the assumption of perfect capital markets, while given legal segmentation, the existence of a single perfectly integrated capital market cannot simply be assumed. International portfolio investment deals with the augmentation of the standard portfolio selection problem and implications on asset valuation models in the absence of perfect market integration.[23] Consequently, this provides the explanatory framework in which

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17 Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 386 and PENMAN, Valuation, 2007, p. 86.
18 Cf. SOLNIK/MCLEAVY, International, 2004, p. 100.
19 Cf. NAUGHTON, Plan, 1995, HEILMAN, China, 2000 and WEI, Sector, 2000.
20 For a broad discussion of the stock market reform cf. GREEN, Stock, 2002 and DENG, Market, 2002.
21 Cf. FERNALD/ROGERS, Puzzles, 2002, KAROLYI/LI, Puzzle, 2003 and DARRAT/WU/ZHONG, Puzzle, 2007.
22 JEVONS, Theory, 1888, p. 66.
23 Cf. BARTRAM/DUFEY, International, 2001, pp. 85-155 and SOLNIK, Theory, 1983b.

the price differences in the Chinese stock markets could nevertheless be consistent with the law of one price.

The examination of the Chinese discount puzzle has been the subject of a number of theoretical and empirical economic studies. Theoretical considerations essentially lead to the following explanations: speculative behavior in the domestic segment, asymmetric information, unequal alternative investment opportunities and illiquidity in the foreign segment.[24] However, empirical results are controversial and it appears reasonable to conclude that there is more than only one cause.[25] Among the suggested explanations, the so-called speculation hypothesis has unique implications. According to this hypothesis, investment decisions in the domestic segment are made regardless of fundamental information and merely based on speculation.[26] The absence of rational behavior implies that economic theory is unable to provide useful insights into how stock prices are attained. Consequently, observations cannot provide confirmation for either the neoclassical framework or the value-oriented approach. Therefore, the following analysis examines the speculation hypothesis as a fundamental proposition.

Augmentations of neoclassical asset pricing models for an international environment require understanding of the cause that leads to deviation from the assumptions of the perfect capital market. This considerably impairs their applicability for the Chinese stock market, where the cause of price differences is unclear. On the other hand, as opposed to equilibrium models that deal with aggregated market behavior, intrinsic value models can be applied on both an individual and an aggregate level. As a consequence, these models can be applied in segmented markets without requiring clear information on the deviation from perfect capital markets. By solving them for the discount factor, implicit values can be computed from market data without specifying the actual cause for the price differences.[27]

However, while implied discount factors are merely the result of an algebraic restatement of the intrinsic value model equations, it is crucial whether obtained results thus can be found consistent with economic theory. Only if affirmed can it be considered

[24] Cf. CHAN/KWOK, Segmentation, 2005, pp. 43-61, BERGSTRÖM/TANG, Differential, 2001, pp. 407-426 and CHEN et al., Discounts, 2004.
[25] Cf. KAROLYI/LI, Puzzle, 2003 and CHEN et al., Discounts, 2004.
[26] Cf. MEI/SHEINKMAN/XIONG, Speculative, 2005, p. 26 and CHAN/KWOK, Segmentation, 2005, p. 44.
[27] Cf. DAMODARAN, Valuation, 2006, p. 38 and STEHLE, Risikoprämie, 2004, pp. 916-919.

well-founded to apply these models to segmented markets in practice. In this respect this thesis aims at the academic, practitioner and policymaker alike. For the academic the results are believed to shed light on a relatively little examined field in international portfolio investment theory. To the practitioner it is believed to provide enhanced guidance on business valuation in segmented markets and the Chinese stock market in particular. Lastly, benefit to policymakers can induce from how legally segmented markets influence business valuation and hence the financial system as a whole and by anticipating the consequences of a merger of both segments as well. In all three respects this thesis will be confined to positive analysis and essentially refrain from making normative judgments.[28]

In order to gather information on the applicability of intrinsic value models this thesis can be divided into a theoretical and an empirical part. The theoretical analysis commences by comparing equilibrium to intrinsic value models in Chapter 2, where the principles of stock valuation and the most common asset valuation models are discussed. The focus is set on models based on economic theory. Subsequently, the general structure of the discount rate and its decomposition is discussed in Chapter 3. The focus on the discount rate results from the fact that later on implied rates are drawn upon as segment specific explanatory variables. In Chapter 4 the standard Finance perspective is extended to an international setting, supplying the tools for analyzing the segmentation effect in the Chinese stock market. In order to characterize the specific research environment, the Chinese financial system and implications on asset valuation are outlined in Chapter 5 and Chapter 6. In Chapter 7 research on the Chinese discount puzzle is discussed, upon which subsequent interpretations are built.

The empirical analysis, presented in Chapter 8, attempts to find evidence on the applicability of value-oriented models. It covers the period from 1998 to 2008, owing to data availability. Since in emerging markets data availability is less extensive and quality often inferior, the empirical analysis follows a stepwise approach that is arranged on four levels. On the first level the speculation hypothesis is tested, that is to say whether investors in the foreign and domestic market segments make investment decisions in an associated manner. This is regarded a necessary condition for a common valuation method. On the second level the question of whether prices of stocks in both segments

[28] This approach follows FISHER (1912), who points out that while economics' chief interest lies in practical applications to public problems, economic principles have to be understood first, FISHER, Principles, 1912, pp. 1-2.

are related to the input variables for intrinsic value models is tested. Only if the input variables can be considered relevant with respect to prices, can intrinsic value models be considered relevant. On the third level, the issue of whether segment specific variables are related to price differences is examined. This relationship is considered a basis for consistent application despite factual segmentation. On the fourth level output data from applying different specifications of intrinsic value models is tested for a relationship with price differences between both segments. If a relation can be shown, this will be considered evidence for the relevance of intrinsic value models in segmented markets.

2 Financial asset valuation and pricing

A fundamental distinction of capital markets can be seen in the value-price relation. As in any market place, when disregarding any sort of regulation, prices in capital markets are determined by supply and demand.[29] However, as opposed to consumption goods that are demanded for the satisfaction of needs, and production goods whose demand is determined by the obtainable monetary gain at the end of the production chain, the utility of financial assets is more straightforward, since monetary income is yielded directly through dividends to the owner or capital return upon sale.[30] For this reason it can be argued that financial assets contain a monetary intrinsic value.[31] However, without making further assumptions value and price equivalence cannot simply be concluded.

Consequently, value and price can be seen as two different starting points for the development of valuation or pricing models respectively. Firstly, equilibrium models are primarily concerned with prices and assume assets to be priced fairly, and hence assume observable market prices to be a tangible representation of value. Secondly, intrinsic value models are foremost concerned with value without drawing compelling conclusions on prices. In this respect, the first approach leads to a comprehensive framework where prices on capital markets represent the outcome of a complex decision-making process among financial agents. The aggregation of individual decisions requires additional assumptions to be discussed in Section 2.2.

The second approach disregards the pricing mechanism and focuses on the individual valuation of return flows.[32] Accordingly, the sum of all income streams, capitalized by the investor, is the basis of its intrinsic value. Since true value is unknown, intrinsic value is a concept that represents a stock's risk-adjusted expected present value.[33] In this chapter, agents are explicitly excluded from the framework of intrinsic value models, which is accounted for in Chapter 3. Consequently, intrinsic value models are introduced without explicitly elaborating on the issue of risk. In this generic form,

[29] FISHER, Principles, 1912, p. 15.
[30] Cf. SCHOLES, Prices, 1972.
[31] The term intrinsic is sometimes used as a synonym of true, cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 523.
[32] Cf. PENMAN, Valuation, 2007, p. 98.
[33] This is discussed in more detail in Section 2.3.

intrinsic value models are based on no exogenous assumptions. However, when subject to empirical research, assumptions on terminal value, value-price relation and capitalization object are required.

In empirical capital market research a third inductive approach can be distinguished, which is particularly popular among practitioners. Initially disregarding the value-price relation, corresponding models essentially attempt to identify the stochastic process stock prices adhere to and only subsequently evaluate results regarding economic theory.[34] Since this approach is not deduced from economic theory but from real world observations, obtained models thus are referred to as ad-hoc.[35]

In this chapter all three approaches are outlined. Furthermore, the most popular models for each theory are introduced followed by a discussion of their drawbacks - both theoretically and empirically. Ad-hoc models will only briefly be covered since their decoupling from economic theory makes them less useful in contributing to the purpose of this thesis.

It is frequently suggested to incorporate the effect of taxes in valuation and pricing models.[36] Since consistently both the corporate and the individual income tax level in addition to tax deductions and exemptions are to be considered, including taxes in valuation models considerably increases complexity.[37] Furthermore an international perspective impairs practicability since multiple tax codes have to be considered and a marginal investor with a representative tax rate is to be assumed.[38] Controversy concerns moreover the detection of a tax effect in empirical data.[39] With respect to the specific situation in the Chinese stock market where heterogeneous tax treatment, insider expropriation and signaling is theorized to obscure the tax effect, and empirical

[34] Cf. SHARPE/ALEXANDER/BAILEY, 1999, Investments, pp. 256-276.

[35] Cf. DECHOW/HUTTON/SLOAN, Empirical, 1999, p. 32. The borderline to intrinsic value models is not trivial since factors in ad-hoc models can often be interpreted as proxies for the intrinsic value.

[36] Cf. WAMELING, Steuern, 2004, p. 119, WIESE, CAPM, 2006, p. 4, DRUKARCZYK, Unternehmensbewertung, 2003, p. 21, FRANKE/HAX, Kapitalmarkt, 2004, p. 205, DAMODARAN, Investment, 2002, p. 673 and MOXTER, Unternehmensbewertung, 1983, p. 177.

[37] For a discussion cf. HELBLING, Steuern, 1998, pp. 474-483, BODIE/MERTON, Finance, 2000, p. 134, BRELAEY/MYERS/ALLEN, 2006, p. 473, MILLER, Taxes, 1977, p. 267, FRANKE/HAX, Kapitalmarkt, 2004, p. 207, MOXTER, Unternehmensbewertung, 1983, p. 177, Wagner, Besteuerungswirkungen, 1997, p. 202 and ELTON/GRUBER, Clientele, 1970, p. 69.

[38] Cf. SIALM, Changes, 2005, pp. 1-11.

[39] Cf. BLACK/JENSEN/SCHOLES, Dividend, 1974, FAMA/FRENCH, Taxes, 1998a, HARRIS/HUBBARD/KEMSLEY, Tax, 2001 and MICHAELY, Reform, 1991. Supportive evidence is obtained from LITZENBERGER/RAMASWAMY, Taxes, 1979 and ELTON/GRUBER, Clientele, 1970.

results on the tax effect are non-supportive, it is therefore not regarded as promising to extend this thesis to the tax perspective.[40]

2.1 Ad-hoc models

Ad-hoc models can best be understood from an econometric perspective. Instead of dealing with intricate portfolio selection problems and aggregating individual behavior to obtain market prices they are used in order to attempt to identify a return-generating process that explains true returns as accurately as possible.[41] The reason that returns instead of prices are examined is mainly due to more appealing statistical characteristics of stationarity and ergodicitiy.[42]

An elementary approach is based on the martingale model. Accordingly, past observations are reasoned to have no influence on predictions. Consequently a return-generating process can be modeled using white noise, where every element has a time-independent zero expected value, a constant variance and zero covariance.[43] From this model the famous random walk hypothesis – with respect to stocks attributed to FAMA (1965) - has been derived, which can be separated into several levels.[44] The most radical hypothesis exceeds the requirements of the martingale model by assuming independent and identically normal distributed increments. Weaker forms gradually release the assumption of identical and independent distribution.[45] However, empirical research is not supportive for the martingale as return-generating process.[46] It is generally found that stock returns tend to be associated with various factors. So-called factor

[40] In March 2008 the government exempted mutual funds from income tax in order to revitalize the stock market, CHINA DAILY, Tax, 2008. No dividend or capital gain tax exists in Hong Kong, cf. FRANK/JANNATHAN, Taxes, 1998, p. 162. Secondly, particularly in Asian countries, the tax effect is argued to be significantly obscured due to an agency conflict between corporate insiders and outside shareholders known as insider expropriation, cf. LAPORTA et al., Agency, 2000 and FACCIO/LANG/YOUNG, Expropriation, 2001. Non-supportive evidence for the Chinese stock market has been obtained by LEE/XING, Tunneling, 2006 and EUN/HUANG, China, 2007.

[41] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 256.

[42] Cf. CAMPBELL/LO/MACKINLAY, Econometrics, 1997, p. 9.

[43] Cf. GREENE, Econometric, 2008, pp. 638-639.

[44] FAMA, Random, 1965.

[45] Cf. CAMPBELL/LO/MACKINLAY, Econometrics, 1997, pp. 27-33.

[46] Cf. CAMPBELL/LO/MACKINLAY, Econometrics, 1997, pp. 65-79, LO/MACKINLAY, Random Walk, 1988, pp. 61-62 and FAMA/FRENCH, Prices, 1988.

models try to identify the driving factors and sensitivity of stock return towards them, using regression analysis.[47]

A popular starting point is the classical multiple linear regression model.[48] Accordingly, the relationship of return and corresponding determining factors, as summarized in Equation (2.1), can be expressed as a function of the dependent variable y that depends on a number of deterministic factors x and a disturbance term ε, typically assumed to be identical and independent distributed (iid) with zero mean and constant variance. The disturbance accounts for omitted determining variables and measurement errors. The slope parameters β scales the relation of regressors and regressand. Both y and ε are random variables, while x and their corresponding β-factors are assumed to be non-random.

$$y = \beta_1 x_1 + ... + \beta_N x_N + \varepsilon, \text{ with } \varepsilon \sim iid \tag{2.1}$$

A popular application is the so-called market model. It models the relation of an individual stock with market development in a linear way. The underlying reasoning is that market return r_m and individual returns r_i are correlated. This relation is expressed in Equation (2.2). The intercept term α shows the share's return in case the beta-factor is zero. The sensitivity of the linear dependence is defined by the relative covariance of the stock to the market return σ_{im} and the market return's variance σ_m^2 (systematic risk). Moreover, the return has also an unsystematic risk component, resulting from the variance of the error term ε.[49]

$$r_i = \alpha + \beta r_m + \varepsilon_i, \quad \text{where } \beta = \sigma_{im} / \sigma_m^2 \tag{2.2}$$

The market model is an exemplary one-factor model for security returns with market movements as the only determining variable. An abundance of one- and multifactor

[47] Cf. CASTANIAS, Prices, 1979, FRENCH, Returns, 1980 and SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 256.

[48] For a discussion of the model and underlying assumptions cf. GREENE, Econometric, 2008, pp. 8-19.

[49] SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 181-190. While the systematic risk is non-diversifiable, the unsystematic risk can infinitely be reduced to zero using diversification, provided no perfect correlation.

models with various independent variables have been developed.[50] Factors can be set by first identifying determining factors and subsequently evaluating sensitivity measures or by factor-analytics, in which case historical data is applied in order to identify factors and sensitivities.[51]

Factor models are limited in various respects. Although out-of sample tests are typically performed to reassess the relation, choosing factors provides room for subjective judgment. In the short term stock prices only react to changes in expectations. If factors change in a fully anticipated way no effect on prices will be observable. Obviously, applying historical data implicitly assumes that present and future are appropriately represented by past observations. Most importantly, however, factor models aim at identifying a relation between factors and returns, but not at explaining it. Consequently, there is no reason to assume the identified relation to be stable in a timely manner.[52]

2.2 Equilibrium models

2.2.1 Portfolio selection

The theoretical basis on which equilibrium models rely is the concept of perfect capital markets. Essentially, three constitutional criteria can be differentiated. Firstly, homogenous expectations of all investors. Secondly, all investors can borrow or lend money unlimitedly at an equal interest rate without the risk of incurring a loss. And lastly, neither transaction costs, taxes, nor any other kind of restraint exists (frictionless).[53] Based on this concept, normative finance theory has examined the subject of optimal investment decisions.[54] The result is summarized in the so-called portfolio theory. The equilibrium models discussed subsequently aggregate individual investment decisions and try to explain how prices are attained in perfect capital markets.

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[50] Relevant factors include size, market-to-book ratio and an overall market factor, FAMA/FRENCH, Cross-Section, 1992, pp. 449-450 and FAMA/FRENCH, Factors, 1993. Also unorthodox factors, such as information from the chief executive officer's personal life, are suggested. As an example, chief executive officers who bought especially large houses and had fatalities in the family have been shown to influence their company's performance, cf. WSJ, CEOs, 2007, p. 8.

[51] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 270-275.

[52] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 265-268. To account for earnings' instability over time see LEV, Earnings, 1989, pp. 167-169.

[53] FISHER, Theory, 1930, pp. II.V.4-7 and II.VI.1 and SHARPE/ALEXANDER/BAILEY, Investments, 2001, pp. 227-228. Another assumption often added is that no investor is large enough to dominate the pricing mechanism, cf. MILLER/MODIGLIANI, Dividend, 1961, p. 412.

[54] For detailed discussion cf. DRUKARCZYK, Finanzierungstheorie, 1980, pp. 15-21.

The fundamental problem in portfolio theory is the trade-off between risk and return.[55] It results from the assumptions of rational behavior, non-satiation and risk aversion as formulated by MARKOWITZ (1952).[56] Rational behavior and non-satiation imply that investors prefer more wealth, that is to say perform profit-maximizing behavior, and are indifferent to both cash or market value.[57] Given that risk is appropriately measured by standard deviation, an investment decision should therefore be evaluated by expected returns and standard deviation. However, MARKOWITZ (1952) argues that it is not simply expected returns which are to be maximized, but that securities with high covariances are to be avoided due to their limited diversification effect. The portfolio theory concludes that while keeping expected returns constant, forming a portfolio can substantially reduce the total risk an investor is exposed to.[58] This is because by diversifying the systematic risk the total risk of a portfolio can asymptotically be reduced to the market risk. Since thus a set of efficient portfolios called an efficient frontier can be identified, not all possible combinations of stocks need to be examined. A portfolio is considered efficient, when – as long as the portfolio's standard deviation is equal - no other portfolio provides higher return and vice versa. By combining the efficient frontier and an investor's individual indifference curve, derived from his utility function, the individual optimal portfolio can be gained. Because in a graphical form this portfolio is equal to the point where the utility curve tangents the efficient frontier, it is also called the tangential portfolio. The process of identifying this point is called optimizing.[59]

In a second step the risk-free asset is introduced, as assumed in perfect capital markets. In this situation the efficient set can be reduced to a single efficient portfolio of risky assets, termed market portfolio. This portfolio is efficient regardless of individual utility functions. Mixing it with risk-free lending or borrowing, depending on the risk preferences, extends the efficient set to a straight line known as the security market line. This is because the risk-free asset allows the investor to form portfolios with a given expected return but a lower variance – hence a more efficient portfolio.[60]

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55 Cf. MARKOWITZ, Portfolio, 1959, pp. 3-7.
56 MARKOWITZ, Selection, 1952, p. 77.
57 Cf. MILLER/MODIGLIANI, Dividend, 1961, p. 412.
58 Cf. MARKOWITZ, Selection, 1952, pp. 77 and 89.
59 Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 139-156 and 171-190.
60 Cf. FRANKE/HAX, Kapitalmarkt, 2004, pp. 322-325.

Consequently, the optimal portfolio selection can be divided into two steps, known as the separation theorem ascribed to TOBIN (1958).[61] Firstly, the market portfolio is to be identified. Secondly, the optimal combination of the market portfolio and the risk-free lending/borrowing according to the utility function is to be brought together.[62]

2.2.2 Capital asset pricing model

Based on the conclusion that all investors hold the same market portfolio, by aggregating from the individual to the entire market, asset returns are independent of individual preferences and can be described by the capital market pricing model (CAPM). This model - attributed to SHARPE (1964) and LINTNER (1965) - states that expected returns are fully determined by the relative risk of an asset and the level of the risk-free rate.[63] This relationship between risk and return is expressed in Equation (2.3), which constitutes the security market line.[64] The return of a security is represented by r_i, the variable r_m is the return of the market portfolio, and r_f is the return of the risk-free investment. σ^2_m is the market portfolio's variance and σ_{im} the covariance between the share and the market portfolio return.[65]

$$r_i = r_f + (r_m - r_f)\beta + \varepsilon_i, \qquad \text{where } \beta = \frac{\sigma_{im}}{\sigma_m^2} \tag{2.3}$$

The CAPM equation appears similar to the market model as shown in Equation (2.2). However, despite the parallel structure, both models are different in their theoretical reasoning. The market model presumes market return as the only important determinant for stock returns. On the other hand the CAPM is derived as the aggregation of optimal individual portfolio selection based on the notion of equilibrium. Hence, it claims to explain the pricing mechanism within the theoretical framework of portfolio selection. Furthermore, the market model and the CAPM also differ with respect to all indepen-

61 TOBIN, Risk, 1958.
62 Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 204-219 and 228-229 and LINTNER, Returns, 1975, p. 262.
63 SHARPE, Capital, 1964 and LINTNER, Valuation, 1965.
64 Security market and capital market line are distinct. The former explains what return an individual stock should have independent of its risk, whereas the latter is constituted by all efficient portfolios.
65 Following SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 235.

dent variables. The role of the intercept term α in the market model represents return for zero-beta stocks, without further specifying it. On the other hand the CAPM states this return to be equal to the risk-free rate. Also the beta-factor is defined differently with respect to the market portfolio. Since the market model results from empirical data, the market portfolio must be an existing market index. In the case of the CAPM it is defined as the much broader market portfolio, encompassing all available financial assets. Lastly, the market model includes an error term in the return-generating process - emphasizing its stochastic nature. In contrast, the CAPM states that the risk-free rate and correlation with the market portfolio fully suffice in explaining stock returns.[66]

Despite the CAPM's appealing while consistent framework, drawbacks become apparent when applying the CAPM empirically.[67] A major weakness is the impracticality of identifying the market portfolio.[68] ROLL (1977) argues that as long as the market portfolio is unknown, the CAPM cannot be tested and the relationship between the beta-factor and return cannot be assumed correct.[69]

Nevertheless, a plethora of empirical research deals with the implications of the CAPM. Essentially, three implications can be drawn from the model. Firstly, a linear relation between the beta-factor and return exists, with no other variable having explanatory power. Secondly, assets without market correlation have a return equal to the risk-free rate. Thirdly, all assets with a correlation different from zero have a positive risk premium.[70]

Early empirical research on the CAPM identified a positive relation between stock return and market beta-factors, such as BLACK/JENSEN/SCHOOLS (1972), who examine the time period from 1931 to 1965 and FAMA/FRENCH (1973), who use average returns as proxies and find supportive evidence for a linear relation with beta in a sample ranging

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66 Certainly, provided both market portfolios could be reconciled the outcome of both models could nevertheless be equal. However, this would not remedy the theoretical difference.

67 The market portfolio is often proxied by using the market model beta-factor. For this purpose typically broad indices are applied such as the S&P 500 or the Wilshire 5000, cf. MALKIEL, Returns, 1995.

68 The market portfolio has consistently to account for all kinds of financial assets. However, this includes all kinds of investments such as bonds, preferred stocks, real estate, human capital and possibly even more remote forms of investments such as art. For a discussion cf. DAMODARAN, Valuation, 2006, p. 69.

69 ROLL, Critique 1977, pp. 137-140.

70 Cf. FAMA/FRENCH, Evidence, 2004, p. 30. Theoretically, it could be added that stocks with equal expected returns should have equal prices. However, practically exact equal correlations are unlikely.

from 1926 to 1954.[71] However, more recent research has found beta's explanatory power weak in comparison with other variables.[72]

Besides critique on the applied market portfolio and beta-factor estimation, other shortcomings of tests on the CAPM have been formulated.[73] Being a single-period model, controversy surrounds the inclusion of time-varying betas.[74] Furthermore, it is argued that mean and variance do not exhaustively characterize return distribution. Higher moments such as skewness and kurtosis are also relevant, since only downside risks require a positive premium.[75] An intertemporal CAPM that extends the one-period perspective has been developed by MERTON (1973). Accordingly, investment decisions are not only dependent on the beta-factor, but also on uncertainty regarding future investment opportunities.[76] Another extension is suggested by BREEDEN (1979), who includes consumption in the utility function.[77] An international extension has been suggested by GRAUER/LITZENBERGER/STEHLE (1976), GLASSMAN/RIDDICK (1994) and EUN/JANAKIRAMANAN (1986) which are discussed in Section 4.1.3.[78] The most popular extension that accounts for personal income tax has been suggested by BRENNAN (1970).[79] Other augmentations attempt to account for additional market imperfections.[80] Generally speaking, modifications show miscellaneous results.[81]

While the validity of the CAPM remains disputed, FAMA/FRENCH (2004) conclude, "the CAPM's empirical problems probably invalidate its use in applications."[82] Due to the

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71 BLACK/JENSEN/SCHOLES, Tests, 1972, pp. 79-121 and FAMA/MACBETH, Tests, 1973. For a rejection in the early period cf. JENSEN, Evidence, 1972, p. 391.

72 For instance size (measured by market value of equity) and book-to-market equity are found superior, FAMA/FRENCH, Cross-Section, 1992 pp. 449-450. On the other side the behavioral economic theory explains the empirical failure of the CAPM by overreaction in the market, DE-BONDT/THALER, Overreaction, 1987. From their point of view, modifications based on rational behavior are destined to fail also. Due to the problems with implementing irrational behavior in an applicable valuation model this idea is not pursued in this work.

73 For critique cf. FAMA/FRENCH, Evidence, 2004, pp. 32 et seq.

74 Cf. FABOZZI/FRANCIS, Beta, 1978, pp. 101-116 and DEJONG/COLLINS, Instability, 1985. A sensitivity analysis with five different betas is performed by FERSON/HARVEY, Premiums, 1991, p. 390.

75 Cf. MARKOWITZ, Portfolio, 1959, pp. 193-194. The CAPM is exceeded by skewness and kurtosis by FANG/LAI, Co-kurtosis, 1997.

76 MERTON, Intertemporal, 1973.

77 BREEDEN, Consumption, 1979.

78 GRAUER/LITZENBERGER/STEHLE, International, 1976, GLASSMAN/RIDDICK, International, 1994 and EUN/JANAKIRAMANAN, Model, 1986.

79 BRENNAN, Taxes, 1970.

80 For a summary of various models cf. DAMODARAN, Valuation, 2006, pp. 57-61.

81 A review of extended tests of the CAPM can be found in GALAGEDERA, Review, 2004, p. 15.

82 FAMA/FRENCH, Evidence, 2004, p. 44.

closed theoretical framework, it nevertheless remains the most elementary equilibrium model available. Its major contribution can be seen in the seminal theory on which it is based, which shifted the focus of asset pricing from the idiosyncratic risk to the portfolio perspective.

2.2.3 Models based on arbitrage pricing theory

A prominent alternative to the CAPM can be seen in the model based on arbitrage pricing theory (APT), attributed to ROSS (1976).[83] Being also an equilibrium model, it shares the concept of diversifiable and non-diversifiable risk with the CAPM. Also the assumptions of rational behavior, risk aversion and non-satiation are alike. However, instead of the complex pricing mechanism, on which the CAPM is based, the foundation of APT is simpler. It is argued that any investor would take an opportunity to make excess profit without increasing risk. If many investors pursue arbitrage opportunities, they will diminish and equilibrium prices will result. In equilibrium, the expected value of any arbitrage portfolio is equal to zero. This straightforward theory constitutes the equilibrium nature of the APT.[84] As a result, APT does not rely on the restrictive assumptions of a perfect capital market. Instead of requiring expectations on probability distribution to be homogenous for all investors, matching expectations on the factor loadings suffice to attain equilibrium.[85] Moreover, typically insignificant arbitrage costs are assumed, although they are not crucial to the formation of equilibrium prices.[86]

The APT model states that the price of a specific security must be a function of all relevant risk factors. Transformed to returns, Equation (2.4) summarizes this relation. Return r_i depends on N risk factors, constituting the vector X with N columns for each risk factor. The corresponding factor loading vector λ has also N rows.[87] When assuming x_1 to be one, λ_1 becomes the intercept term, which can be interpreted as the risk-free rate.[88] The remaining elements of λ can be interpreted as the expected factor risk premiums. Extending the equation to multiple securities, and defining λ to be equal for all

[83] ROSS, Arbitrage, 1976.
[84] Sometimes models based on the APT are referred to as multifactor CAPM or multi-beta CAPM. Cf. MACKINLEY, Multifactor, 1995.
[85] Cf. ROSS, Arbitrary, 1976, pp. 355-356 and ROLL/ROSS, Empirical, 1980, p. 1074.
[86] Cf. LEE/MYERS/SWAMINATHAN, Dow, 1999, pp. 1693-1694.
[87] ROLL/ROSS, Empirical, 1980, pp. 1076-1077 and ROSS, Arbitrage, 1976, pp. 341-343.
[88] The existence of a risk-free rate is not constitutional for the APT, since instead λ_1 could be interpreted as the zero-beta parameter without making further economic interpretations.

securities, the deterministic linear relationship implies that two securities that have the same factor sensitivities must also have the same expected return.[89] While the CAPM considers correlation with the market portfolio as the only risk factor that determines stock returns, the APT model specifies neither number nor economic reasoning behind the determining factors.[90]

$$r_i = \lambda X + \varepsilon \tag{2.4}$$

When applying the abstract model in an empirical context, the first step is to identify determining risk factors. Usually, those factors are obtained by either statistical or economical factor analysis.[91] Economic considerations can be macroeconomic or individual to the specific company.[92] This process corresponds to the identification process with ad-hoc models as discussed in Section 2.1. In an empirical study, CONNOR (1995) comes to the conclusion that firm characteristics have better explanatory power than both the statistical and the macroeconomic approach.[93] Regarding the number of factors, applying the statistical approach CONNOR/KORAJCZYK (1993) conclude that one to six factors are fitting.[94] However, the most popular representative of models based on APT is the three-factor model by FAMA/FRENCH (1993) with size, book-to-market and an overall market factor as explanatory variables.[95] The second step concerns the coefficient estimation from historical data. In the third step the null-hypothesis is tested, which states that all N-1 factors jointly do not fully explain changes in the dependant variable - is tested.[96]

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89 Linear empiric research usually allows for an idiosyncratic risk component by adding an error term referred to as the weak equilibrium condition, GARMAN/OHLSON, Arbitrage-Free, 1980, p. 421.

90 Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 283-297 and ROLL/ROSS, Empirical, 1980, pp. 1073-1074. Therefore, both CAPM and the APT model could be reconciled in a one-factor relation.

91 Cf. CAMPBELL/LO/MACKINLAY, Econometrics, 1997, pp. 239-240.

92 Examples for macroeconomic factors are: industrial production growth, inflation, long- and short-term or high- or low-grade yield spread, CHEN/ROLL/ROSS, Forces, 1986, p. 402. For bonds cf. ELTON/GRUBER/BLAKE, Variables, 1995. Individual factors can be: size, book-to-market value or dividend yield, FAMA/FRENCH, Size, 1995, pp. 143-146. The size-effect was originally identified by BANZ, Value, 1981.

93 CONNOR, Factor, 1995, pp. 43-46.

94 CONNOR/KORAJCZYK, Number, 1993, pp. 1275-1283.

95 FAMA/FRENCH, Factors, 1993. This model is based on the two-factor model suggested in FAMA/FRENCH, Cross-Section, 1992.

96 Cf. BARUCCI, Theory, 2003, pp. 137-140 and ROLL/ROSS, Empirical, 1980, pp. 1078-1082.

However, rejection of the null-hypothesis is to be interpreted with caution, since it is not certain whether the identified factors are actual drivers of return or simply correlate with the true drivers. In general the basis of APT is that return is only determined by risk. Consequently, if factors such as size are broadly found to correlate with returns, according to theory this would be because of their relation to risk factors.[97] Factors that are unrelated to risk contradict the APT and the identified relation is either spurious or those factors simply happen to be correlated with other risk factors, which should be included instead. This constitutes the major difference between models based on APT and ad-hoc models, where principally all factors can be included, provided they contribute to the overall explanatory power of the model.

From empirical results it can generally be concluded that, while an exact linear relation is rejected by most studies, models based on APT appear to explain stock returns somewhat better than the CAPM.[98] Nevertheless, an identified relation cannot be assumed fixed. In this respect, FERSON/HARVEY (1999) reject the three-factor model suggested by FAMA/FRENCH (1993) due to time varying factor loadings.[99]

Both kinds of equilibrium models discussed above are only concerned with prices. When taking valuation into consideration this is typically be done by arguing that according to equilibrium models, assets are priced fairly, yielding to equivalence between value and prices. This equivalence assumption is not to be regarded as additional but as a conclusion from assumptions already made. Risk-averse rational investors with homogenous expectations are determined to pay at most the value of a security, while the agents that are selling, assigned with the same characteristics, will not be willing to sell for less. Differences between value and price can only be due to frictions or significant arbitrage costs, which are by definition precluded.

The question of whether assumptions upon which equilibrium models are based impair the model's relevance, is discussed controversially, without a conclusion being reached.[100]

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97 Cf. FAMA/FRENCH, Size, 1995, p. 131.
98 Cf. BARUCCI, Theory, 2003, p. 140.
99 FERSON/HARVEY, Variables, 1999, p. 1354.
100 Cf. MILLER/MODIGLIANI, Capital, 1958, JENSEN, Evidence, 1972 and COPELAND/WESTON/SHASTRI, Theory, 2005, pp. 353-355.

2.3 Intrinsic value models

2.3.1 Capitalization of income

The theoretical ground that intrinsic value models are based on, differs fundamentally from the neoclassical economic theory that equilibrium models are based upon. Intrinsic value models disregard the individual, as economic agent, and his behavior, in order to develop universal guidelines. Essentially, these models put an objective value at the center of attention, which is independent from individual preferences and other characteristics. As a result value models are not concerned with prices, since this would require assumptions on price generating behavior.

Structurally, intrinsic value models are simple algebraic rearrangements of a common underlying relation without a broader underlying economic theory. The models' foundation is the CIM.[101] This deterministic relation, illustrated in Equation (2.5), states that the value v of a financial asset in t = 0 is equal to the sum of all return flows z from it, discounted at a rate k.[102] The discount factor expressed with a capital letter K is defined as one plus the discount rate k. ROSS/WESTERFIELD/JAFFE (1999) plainly define the discount rate as "rate used to calculate the present value of future cash flows".[103] In the generic sense of the CIM, the discount factor is not further specified. That is to say, without additional assumptions on the agent's perception of value, the discount rate can be considered to be zero, leading to equivalence of present and future value. In Chapter 3 when the agents are introduced into intrinsic value models the discount rate is discussed in detail. The statement that value can thus be expressed is the common assumption of further specifications that constitute the group of intrinsic value models. No assumptions are made about either agents or market characteristics, since both are abstracted from.

[101] In finance theory the CIM is often called discounted cash flow model, cf. BODIE/MERTON, Finance, 2000, p. 234. In order to make a distinction with cash flow models based on the accounting term the terminology, CIM is used as in SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 386-388.

[102] Cf. BRELAEY/MYERS/ALLEN, Finance, 1996, pp. 113-114. For shares as financial assets, z does not only include dividends paid, but all kinds of capital transfer including capital reduction, repurchase of stock and right issues, DAUSEND/LENZ, Residualgewinnmodell, 2006, p. 722. This variable k is used in order to differentiate the discount rate from the return variables used for equilibrium models.

[103] ROSS/WESTERFIELD/JAFFE, Finance, 1999, p. 857.

$$v_0 = \sum_{t=1}^{\infty} \frac{z_t}{K^t}, \text{ where } K = 1 + k \tag{2.5}$$

However, this high level of abstraction concurrently impairs practical application. Equation (2.5) brings along at least two obvious limitations. Firstly, where stock investment is concerned future return flows are uncertain.[104] For this reason x has to be replaced by a random variable.[105] Provided no assumptions on the individual risk preferences are made, thus computed value equals expected value, while variance has no impact.[106] Secondly, replacing the deterministic with a random variable yields implications on the time frame. It requires expectations to comprehend an infinite time frame. For illustration, Equation (2.5) is often rearranged into two components as shown in Equation (2.6).[107] The first component encompasses return flows until T-1, while the second component represents the present value of all subsequent return flows consolidated in the terminal value variable z_T. The stipulation that the terminal value component has to account for infinity is referred to as the terminal value conundrum.[108]

$$v_0 = \sum_{t=1}^{T-1} \frac{z_t}{K^t} + \frac{z_T}{K^{T-1}} \tag{2.6}$$

In summary, the CIM is considered a generic method that requires complementation with economic theory in order to lead to a model. A variety of such models have been developed. They essentially differ in two respects. Firstly, the income variable that is capitalized and secondly, the way the terminal value conundrum is dealt with. The following sections discuss the most popular models and their drawbacks. A summary is provided in Fig. 1, which also illustrates the role of assumptions. The models will be described subsequently.

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[104] PENMAN (2007) defines intrinsic value as „the worth of an investment that is justified by the information about its payoffs." PENMAN, Financial, 2007, p. 4.

[105] Cf. MILLER/MODIGLIANI, Dividend, 1961, p. 427.

[106] That is to say the relation of risk and return does not apply for the CIM since value can be expressed objectively. Assumptions about the individual can also affect capitalized income when for instance taxes are involved and investors face different marginal tax rates.

[107] GORDON, Valuation, 1962, pp. 65-66 and PENMAN, Valuation, 2007, pp. 118-128.

[108] Cf. RICHARDSON/TINAIKER, Models, 2004, p. 240 and BOTOSAN/PLUMLEE, Alternative, 2005, p. 22.

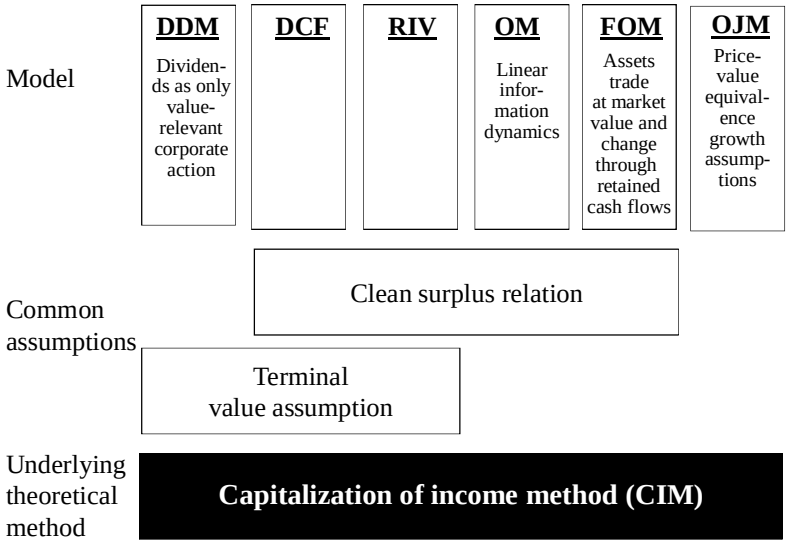

Fig. 1 Framework of intrinsic value models (own illustration)

2.3.2 Dividend-discounted model

When it comes to valuing common shares the most straightforward application of the CIM is the dividend-discounted model (DDM) attributed to WILLIAMS (1938).[109] Accordingly, return flows to be capitalized are simply substituted by expected dividend payments. The value relevance of dividends is argued to be supported by the fact that cum-dividend prices decrease approximately by the amount of the dividend paid.[110]

With respect to the terminal value conundrum, the DDM does not provide a uniform solution. Frequently, arbitrary assumptions on the terminal value are made. While these are sometimes referred to as self-contained models, in the scope of this thesis they are considered specifications. It could be considered to assume the company's liquidation value or return from selling the stock. However, on the one hand identifying a liquidation value is intricate since the typical focus on going-concern considerations obscure corresponding information. On the other hand setting a price requires assumptions on the price generating process, which lie outside of the theoretical framework of intrinsic value models.

[109] WILLIAMS, Theory, 1938, pp. 55-57. This model is also often referred to as the present value of expected dividend (PVED) model, cf. OHLSON, Valuation, 1995, pp. 663-666.
[110] Cf. OHLSON, Synthesis, 1990, p. 667.

Instead of including exogenous variables, other procedures suggest assumptions on the original variables. A popular way is by assuming perpetuity of the expected dividends at a specific time - an annuity that continues indefinitely.[111] However, this solution arbitrarily defines a time when dividends are assumed constant. An alternative to assuming constant dividends, the growth model, suggested by GORDON (1962), applies a growth assumption to dividends. This is performed by including a growth rate g in the original equation, yielding Equation (2.7).[112] The growth rate can be either constant or time-variant.[113] Corresponding to the liquidity value and the price upon the stock's sale, the growth factor can also be considered exogenous making its definition arbitrary. Furthermore, the growth assumption causes a considerable restriction in its application, since economically useful results can only be obtained given the growth rate is less than the discount rate, in order to preclude infinite values. Consequently, the GORDON (1962) specification of the DDM is not applicable for companies with strong growth, thus significantly limiting its usefulness in emerging markets.[114]

$$v_0 = z\sum_{t=1}^{\infty}\frac{(1+g)^t}{K^t}, \text{ where } g < k \tag{2.7}$$

In addition to objections regarding suggested specifications, the DDM is based on the implicit assumption that dividends are the only value relevant factor. That is to say a value-impact by other corporate actions is precluded. Furthermore, for practical application in order to compute a specific share's value, expected return flows must be specified. However, dividends are argued to provide a poor basis for expectations. The reason is not that dividends are an inappropriate variable of capitalization; it is rather the notion that dividends posses inferior characteristics with respect to predicting. This does not mean that errors of predicting dividends from historical realizations are large, but that historical realizations can be unrelated to value. That is to say while a company is increasing dividend payments, it can in fact be diminishing value. Obviously, regard-

[111] Cf. PENMAN, Valuation, 2007, p. 108.
[112] GORDON, Valuation, 1962.
[113] A special case can be constructed by setting g equal to zero. This zero-growth specification assumes constant dividends yielding perpetuity of next period's expected dividends. This implies full payout of earnings, since otherwise dividends would grow due to investment of retained funds, SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 527.
[114] Cf. PENMAN, Valuation, 2007, pp. 118-128.

ing the total period higher or lower dividends will eventually equal out. Nevertheless an influence on predictions cannot be precluded.[115]

This objection is formulated in the controversial proposition of dividend-payment irrelevancy, suggested by MILLER/MODIGLIANI (1961). The authors assert that in frictionless markets the value of a security is not affected by distribution policy. This is because investors are able to emulate dividend payments by selling or reinvesting.[116] This assertion is frequently questioned with reference to observable effects of changes in dividend policy on share prices. However, the dividend-payment irrelevancy does not deny correlation between dividends and value but simply rejects causality. Dividend policy is regarded as a decision by a company's management that may or may not adequately reflect the underlying changes in value. Changes in prices could consequently be ascribed to their signaling effect.[117] Therefore MILLER/MODIGLIANI (1961) stress only "real" considerations to determine value, such as earnings power or investment policy and not value distribution.[118] Dividends could only appropriately be applied as a capitalization variable, given a peg to true value-generating factors, such as those established by a fixed payout ratio.[119] However, in this case it can be argued that instead of dividends, the actual value-generating factor should be used.

2.3.3 Clean-surplus relation

This represents a shift of perspective. The DDM applies the CIM from the perspective of an investor by regarding only payouts. However, due to the fact that payouts can temporarily be decoupled from changes in value the focus has turned to value-generation instead of value-distribution. What the company earns is equal to what the investor earns without possibly obscuring effects due to dividend policy. This shift has put financial accounting information in perspective. Empirical evidence on the association between earnings and stock return is plentiful. The most prominent examples are

[115] Cf. PENMAN, Fundamentals, 1992, pp. 466-467.
[116] MILLER/MODIGLIANI, Dividend, 1961, pp. 413-414 and 428.
[117] An increase in dividends can be interpreted a signal that management has increased assessment of future earnings, SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 567-568. In this respect it is not the higher dividend that generates value but the information transmitted by the increase, MILLER/MODIGLIANI, Reply, 1959, pp. 666-668. However, evidence against the signaling theory states that dividends contain no information about future profitability, cf. GRULLON et al., Signal, 2005.
[118] Cf. MILLER/MODIGLIANI, Dividend, 1961, p. 414.
[119] Cf. BODIE/MERTON, Finance, 2000, pp. 234-248 and PENMAN, Valuation, 2007, pp. 118-128.

the studies by BALL/BROWN (1968) and BEAVER (1968).[120] However, the early wave of accounting related valuation research did not yield supportive results.[121] The theoretical explanation can be seen in the fact that commonly used accounting systems are not exclusively focused on fair value. Instead they attempt to balance the trade-off between prudence and fair value. Furthermore, its ex-post perspective opposes the future-oriented CIM. Consequently, accounting book value of equity can be considered systematically to be understating its fair value.[122]

Nevertheless, lately, a renaissance has taken place, to a considerable extent attributable to OHLSON (1990).[123] A major improvement concerns the drawback with former research that applied current earnings instead of future expected earnings. Supportive empirical evidence on analysts' forecast accuracy caused strong momentum.[124]Its conceptual theory – the clean surplus relation (CSR) - can be attributed to EDWARDS/BELL (1961).[125] Accordingly, balance sheet and income statement must always be reconcilable.[126] Consequently, current book value b_t can be related exactly to last period's book value b_{t-1} by adding current earnings e_t and subtracting current dividends d_t as expressed in the equation below. As a result, when regarding the total period, accounting earnings will equal all return flows to be capitalized by the investor.

$$b_t \equiv b_{t-1} + e_t - d_t \qquad \text{(CSR)}$$

2.3.4 Discounted cash flow model

While from an investor's perspective dividends represent the central capitalization variable, on the company level the cash flow statement is drawn upon.[127] Hence, free cash flow - the difference between cash flows from operations and outflows for invest-

[120] BALL/BROWN, Empirical, 1968 and BEAVER, Earnings, 1968.
[121] Cf. GORDON, Valuation, 1962, pp. 56-59 and MILLER/MODIGLIANI, Dividend, 1961, p. 420. An overview of empirical correlation measures is given in LEV, Earnings, 1989, pp. 160-161.
[122] Cf. MYERS, Accounting, 1999.
[123] OHLSON, Synthesis, 1990, pp. 669-670.
[124] Cf. O'BRIEN, Forecasts, 1988.
[125] EDWARDS/BELL, Theory, 1961.
[126] Cf. FELTHAM/OHLSON, Valuation, 1995, p. 691.
[127] Cf. LIU/NISSIM/THOMAS, Cash, 2007 and OHLSON, Synthesis, 1990, p. 667.

ments – can be used as capitalization object, yielding the so-called discounted cash flow model (DCF). In order to consistently apply this accounting information the CSR must hold.[128] While the term DCF is also used as a synonym for the CIM, in the scope of this thesis it is used for a model based on the CIM with free cash flows as capitalization variable.[129] Since free cash flows are also used to pay off debt financing, unless the zero-debt assumption is made, thus computed value must be adjusted for the value of debt.[130] Moreover, when specifying the discount rate it must be noted that in the DCF it represents the cost of capital and not only the cost of equity.[131]

With respect to the terminal value conundrum, additional assumptions, parallel to the DDM can be made, with corresponding downsides. Analogously to the DDM, the decoupling of free cash flows and value generating factors is curtailing. The impact of distribution policy on the DDM is replaced by an impact of investment and financial leverage in case of the DCF.[132] For instance, a company that invests heavily will be significantly undervalued in the short term.

2.3.5 Residual income valuation

The residual income valuation model (RIV) represents an attempt to establish a connection between CIM and generation of value.[133] It decomposes a share's value into two parts: present book value of equity and abnormal earnings as excess profit. This is consistent with the investment and opportunities approach presented in MILLER/MODIGLIANI (1961), which suggests that value depends on a normal and an abnormal return component.[134] In order to derive the RIV from the CIM two additional assumptions are necessary. Firstly, CSR is assumed as the only restriction on the account-

[128] Cf. LUNDHOLM/O'KEFEE, Value, 2001, p. 332 and PENMAN/SOUGIANNIS, Comparison, 1998, pp. 349-350.
[129] Cf. BODIE/MERTON, Finance, 2000, p. 216. Sometimes instead the term free cash flow model is used, cf. FRANCIS/OLLSON/OSWALD, Comparing, 2000.
[130] The comprehensive perspective is also referred to as the enterprise DCF, cf. COPELAND/KOLLER/MURRIN, Valuation, 2000, pp. 131-155.
[131] Cf. COPELAND/KOLLER/MURRIN, Valuation, 2000, pp. 131-155. The cost of capital refers to all capital (equity, debt and hybrids) used by the company. The computation of the cost of capital is not in the scope of this thesis. Regarding this cf. DAMODARAN, Valuation, 2006, pp. 62-77.
[132] Cf. PENMAN, Valuation, 2007, p. 118-128 and PENMAN/SOUGIANNIS, Comparison, 1996, p. 350.
[133] It is based on the principle that a company's value is equal to capital value and the present value of all future wealth-creating activities, LEE, Valuation, 1999, pp. 415-416.
[134] MILLER/MODIGLIANI, Dividend, p. 416.

ing system.[135] In order to arrange book value of equity, the second assumption requires book value to grow less than the discount factor.[136] Solving CSR for dividends and inserting in (2.5) yields the RIV equation as shown in equation (2.8). Accordingly, a share's value can be expressed as the sum of current book value of equity per share b_0 and the present value of future abnormal earnings per share e_a. Abnormal earnings are defined as the difference between expected earnings e_t and a charge for capital used, which can be interpreted as opportunity costs for lock-up of the equity over one period.[137]

$$v_0 = b_0 + \sum_{t=1}^{\infty} \frac{E(e_{at})}{K^t} \quad \text{,where} \quad e_{at} \equiv e_t - kb_{t-1} \quad \text{and} \quad K^{-t} E(b_t) \xrightarrow{t \to \infty} 0 \tag{2.8}$$

With current book value of equity as primary value component, dividend payments are integrated with accounting data and a relation to future earnings is established. That is to say the effect of dividends on future earnings is factored in. Thus, dividend irrelevancy is maintained. The abnormal earnings component amounts to a premium over book value by accounting for future book values. In other words, the difference between book value and intrinsic value is the expected future abnormal profitability.[138]

Despite its relation to value creation, the RIV involves intricate input variables. This is because beyond the need for future earnings, abnormal earnings require predicting future book values, which is based on future dividends.[139] Consequently, in order to apply the RIV practically, it is necessary to predict dividends. That is to say, one of the major weaknesses of the DDM is also inherent in the RIC. Moreover, the terminal value conundrum remains - identical to models previously discussed. Consequently, additional assumptions have to be made. An appealing solution is to set abnormal income to zero at the end of the forecast horizon arguing competition to eventually ebb

[135] That is to say, for the validity of the RIV it does not matter if the accounting system is accrual or cost based, LO/LYS, Limitations, 2000, p. 340.
[136] Cf. LO/LYS, Limitations, 2000, pp. 340-341 and OHLSON, Valuation, 1995, pp. 666-667.
[137] Cf. PENMAN, Valuation, 2007, pp. 161-166 and OHLSON, Valuation, 1995, pp. 661-667.
[138] OHLSON, Valuation, 1995, p. 664-667. It can be demonstrated that securities with high price-to-book ratios are also characterized by high residual income, PENMAN, Valuation, 2007, pp. 165-167.
[139] Cf. DECHOW/HUTTON/SLOAN, Empirical, 1999, p. 5.

excess profits.[140] However, since the time when excess profits ebb cannot consistently be predicted, this solution remains arbitrary.[141]

Taking all that into considerations it can be concluded that none of the discussed models can be considered superior from a theoretical point of view. This result is little surprising since under the assumptions made, de facto all three models are simply algebraic rearrangements of the same underlying method. Therefore, in the next section the three models are regarded from an empirical perspective.

2.3.6 Empirical tests of intrinsic value models

Due to the parsimonious design of the DDM and DCF, the elementary functional relation between value and the infinite series of dividends or cash flows respectively, is linear. Since an infinite number of regressors violate the identification condition, a practical solution is to comprehend the present value of all future dividends into one factor.[142] Consequently, this factor is hypothesized to have a coefficient of unity and no other factor to have explanatory power. In the case of the RIV the regression equation could be bivariate with current book value of equity b as first regressor and present value of all future abnormal earnings x as second regressor, as illustrated in Equation (2.9). A possible null-hypothesis could state that both coefficients γ_1 and γ_2 are not significantly different from zero.[143] Alternatively it could be tested whether other factors have explanatory power, by hypothesizing the intercept term α to be different from zero.

$$y = \alpha + \gamma_1 b + \gamma_2 x + \varepsilon \text{, where} \qquad x = \sum_{t=1}^{\infty} K^{-t} e_{at} \tag{2.9}$$

[140] Cf. GORDON/GORDON, Model, 1997, pp. 52-61 and GEBHARDT, Implied, 2001, pp. 141-142. Alternatively a fading rate can be assumed that fades residual income to industry medium after a specific time, LEE/MYERS/SWAMINATHAN, Dow, 1999, p. 1701.

[141] Cf. PENMAN, Terminal, 1998.

[142] In order to enable parameter estimation (without further restrictions) the number of observations cannot be less than the regressors because the data matrix would not have full column rank, GREENE, Econometric, 2008, pp. 14-15.

[143] Both coefficients should be unity, if the original RIV equation holds, LO/LYS, Limitations, 2000, p. 341.

$$H_0 : \gamma_i \neq 1, \text{ for } i = 1,2 \text{ or } H_0 : \alpha \neq 0$$

With respect to methodology, it can be differentiated between level of aggregation (portfolio or individual shares) and type of data (forecast or realizations).[144] All three models specifically require forecasts; however, many studies nevertheless apply realizations as proxy for forecasts.[145] Obviously, when using proxies the coefficients could be different from zero due to the weakness of the proxy, which may not be misinterpreted as evidence against the hypothesis. Therefore, when examining unobservable variables so that proxies have to be used instead, hypothesizing coefficients to be unity can be considered disproportionally restrictive.

As previously pointed out, intrinsic value is typically unobservable. Since the unrestrictive framework of intrinsic value models does not provide a consistent proxy, it is not possible to test any of the intrinsic value models without making additional assumptions. Empirical research breaks out of this quandary by assuming value-price equivalence or by assuming prices to be an adequate proxy for value.[146]

An attempt to establish a relation between value and price can be seen in the theory of informational efficiency. The concept attributed to FAMA (1970) states that all available information about the economical determinants is reflected in the price.[147] However, this relation does not require equivalence. It is therefore significantly less restrictive than the assumption of perfect capital markets, discussed in Section 2.2.1, which implicitly encompasses information efficiency since expectations are homogenous and behavior rational.[148] Informational efficiency, essentially implicitly only assumes that markets are rational.

While the equivalence assumption of value and price is the linkage between equilibrium and intrinsic value models it is questionable how close the relationship is in reality. In the long-run over a company's life time, dividends can only be paid out of

[144] Cf. FRANCIS/OLLSON/OSWALD, Comparing, 2000, p. 68.
[145] A deeper discussion of using forecasts will follow in Section 3.2.4.
[146] Cf. LO/LYS, Limitations, 2000, p. 340.
[147] FAMA, Efficient Markets, 1970. The theory does not rely on all investors evaluating all information. The existence of a few professional investors who seek arbitrage opportunities already leads to fair pricing.
[148] Cf. COPELAND/WESTON/SHASTRI, Theory, 2005, pp. 353-355.

earnings of the underlying company's activities, provided there is legitimate conduct.[149] When terminating the enterprise, capital return will comprise principal and previously retained earnings. However, in the short term irrational behavior, speculation or non-value based investment could influence the way prices are attained.[150] Although a close relation is often assumed, a direct convergence of prices with intrinsic value is disputed.[151] Therefore, empirical research on intrinsic value models is dependent on the validity of the value-price assumption made.

Effectively, in both cases value is proxied by market price, making subsequent tests joint-tests of both the model and the additional assumption. In this case a non-unity R^2 can nevertheless be consistent with the intrinsic value model, by attributing the deviation to the value proxy on top of measurement error. LO/LYS (2000) argue that therefore, intrinsic value models are not constructively testable.[152] Consequently, it can be suggested to accept the model's general validity and focus on a comparative approach. The notion is to empirically test different intrinsic value models against each other. This approach is seen as controversial. Some authors consider it to be completely superfluous, because of the theoretical identity of the three models.[153] However, as discussed above, the identity depends on the CSR. If this assumption is found to be violated, both DCF and RIV loose theoretical backing. Provided the CSR holds and assuming no measurement error, differences among the three models can only be ascribed to the terminal value conundrum. That is to say because it requires additional assumptions on the terminal value the question regarding model superiority comes down to the matter of input variable providing the best circumstance for prediction on available information. With respect to historical realizations the model whose input variable's realizations contain most value relevant information will be found superior. Alternatively, with respect to forecasts, the model that most accurately incorporates value relevant information in their input variables will be found to be best. RICHARDSON/TINAIKAR (2004) conclude the best model to be the one that is least problematic with the terminal value conundrum.[154] Consequently, comparative studies do not pro-

[149] This assertion explicitly excludes illegitimate behavior where management disappropriates creditors.
[150] Cf. FAMA, Random, 1965, p. 55 and KOTHARI, Research, 2001, p. 171.
[151] Cf. FRANKEL/LEE, Valuation, 1998, p. 315 and KOTHARI, Research, 2001, p. 109.
[152] LO/LYS, Limitations, 2000, pp. 343-345. Regarding the coefficient of determination R^2 see GREENE, Econometric, 2008, pp. 34-37.
[153] Cf. LUNDHOLM/O'KEFFE, Value, 2001, p. 311 and LEE, Valuation, 1999, p. 419.
[154] RICHARDSON/TINAIKAR, Models, 2004, p. 240.

vide evidence on which capitalization variable is better, but merely test which variable has more information in the short term and is hence better for deriving estimators.

Such a comparative study has been performed by FRANCIS/OHLSON/OSWALD (2000), who compute individual stock's present value from forecasted dividends, cash flows and abnormal earnings. The authors look at a five-year horizon assuming zero and four percent growth rates afterwards. Subsequently the authors compare the explanatory power of the value estimates in cross-sectional regressions based on an equation such as illustrated in (2.10), where the regressor v is computed according to the specified model. Performing multiple regression the authors find the value according to RIV to have the greatest explanatory power followed by DDM. After separating terminal value from the regression the authors find value computed in accordance with RIV to be affected significantly less. FRANCIS/OHLSON/OSWALD (2000) explain the superiority of residual earnings by the information content of book value on intrinsic value and the comparable ease of forecasting abnormal earnings.[155] However, problems relating to possible multicollinearity are not discussed.

$$p = \alpha + \gamma_1 v^{DDM} + \gamma_2 v^{DCF} + \gamma_3 v^{RIV} + \varepsilon \tag{2.10}$$

Analogously, most comparative research finds the RIV to be superior.[156] However, this straightforward conclusion is misleading. This is because when applying an equivalent growth assumption for computing terminal value, implications on the three models are not the same.[157] In order to perform an unbiased comparison terminal value assumptions must be consistent and hence they must be an equal under- or overstatement of the true value among all three models. Although heavily discussed, it is broadly accepted that, provided unbiased comparison and CSR, the models are all the same.[158]

However, it must be noted that testing intrinsic value models, with the benchmark of predicting observable stock prices, evaluates the models outside of their framework.[159]

[155] FRANCIS/OLLSON/OSWALD, Comparing, 2000, pp. 51-69.
[156] Cf. FRANCIS/OLLSON/OSWALD, Comparing, 2000 and PENMAN/SOUGIANNIS, Comparison, 1996, pp. 355-376.
[157] Cf. LUNDHOLM/O'KEFEE, Value, 2001, p. 316 and LUNDHOLM/O'KEFEE, Response, 2001, p. 695.
[158] Cf. PENMAN, Response, 2001, pp. 684-685.
[159] Cf. FRANKEL/LEE, Valuation, 1998 and BERNARD, Empiricists, 1995, pp. 737-738.

This is because the value-price relation effectively assumes that investors share common expectations on value so that equilibrium prices are attained.

2.3.7 Ohlson model

A large number of studies confuse the RIV with the valuation model suggested by OHLSON (1995) (OM).[160] Although, directly derived from the RIV, the OM can be considered a modification in order to crack the terminal value conundrum. OHLSON (2001) states it can be considered independent of the RIV, basically being a combination of CIM, CSR and a third assumption called linear information dynamics (LID).[161] DECHOW/HUTTON/SLOAN (1999) emphasize that the key empirical advantage becomes manifest due to the third assumption.[162]

The starting point is the acknowledgment that the RIV does not incorporate all information available from accounting data and dividends. That is to say, earnings, book value and dividends are not regarded as comprehensive in explaining goodwill.[163] In order to account for information about future residual income not contained in current data, the additional assumption of LID is made by letting abnormal earnings follow a one-period lagged linear autoregressive process, as illustrated in Equation (2.11). Accordingly, this period's abnormal earnings e_{at+1} depend on last period's abnormal earnings e_{at} and other information v, which is assumed following a first-order autoregressive process – AR(1).[164]

$$e_{at} = \omega e_{at-1} + v_{t-1} + \varepsilon_{1t}, \qquad v_t = \gamma v_{t-1} + \varepsilon_{2t}, \qquad (2.11)$$

where

$$E(e_{at} \mid v_t) = 0,$$

$$\omega > 0 \text{ and } \gamma > 0$$

OHLSON (1995) sets the parameters (γ,ω) to be time-invariant and assumes them to be non-negative and less than one. Moreover, the author assumes earnings to be indepen-

[160] Cf. BERNARD, Empiricists, 1995. Ohlson himself refers to the model as EBD, cf. OHLSON, Empirical, 2001, p. 108.
[161] OHLSON, Valuation, 1995, p. 663 and OHLSON, Empirical, 2001, p. 111.
[162] DECHOW/HUTTON/SLOAN, Empirical, 1999, p. 5, see also LO/LYS, Limitations, 2000, p. 340.
[163] Cf. OHLSON, Empirical, 2001, pp. 110-111 and 115-116.
[164] OHLSON, Valuation, 1995, pp. 667-669.

dent of this non-accounting information in order to keep the regressors uncorrelated, which he explains by the fact that this information has not yet affected the balance sheet.[165] Consequently, the OM valuation formula can be stated as in Equation (2.12), with q being the market value of the investment. Essentially, this can be regarded as augmentation of the RIV hypothesis, which claims residual income to exclusively explain goodwill.[166]

$$q_t = b_t + \gamma_1 e_{at} + \gamma_2 v_t, \qquad \text{where } \gamma_1 = \omega / (1+k-\omega) \geq 0 \text{ and} \qquad (2.12)$$

$$\gamma_2 = (1+k) / [(1+k-\omega)(1+k-\gamma)] > 0$$

This extension changes perspective since RIV deals with future abnormal earnings, whereas the LID enables using current abnormal earnings.[167] This approach neither requires the forecast of future dividends nor the computation of a terminal value - provided other information is known. Although additional information is not observable, OHLSON (2001) points out that data for it can be obtained by evaluating analysts' 1-year ahead forecast.[168] Subsequently solving Equation (2.12) for the scalar variable ν, it can be expressed as the difference between the forecast and the weighted current abnormal earning.[169] On this basis OLS estimators for (γ,ω) can be computed.[170]

Interestingly, a variety of empirical research examining the OM did not pay attention to the information dynamics, thus actually testing RIV.[171] However, tests that did examine the information dynamics so far do not provide optimistic results. BAR-YOSEF/CALLEN/LIVNAT (1996) focus on the LID by dividing abnormal earnings into their components and examining whether book value, earnings and dividends can be approximated using AR(1). They find evidence for a one-lagged autoregressive process.[172] On

[165] OHLSON, Valuation, 1995, p. 668.
[166] OHLSON, Empirical, 2001, p. 110.
[167] OHLSON, Empirical, 2001, p. 110.
[168] $vt = ft - \omega e_{at}$, where ft is the analysts' forecast for abnormal earnings in t+1.
[169] OHLSON, Empirical, 2001, pp. 112-116.
[170] DECHOW/HUTTON/SLOAN, Empirical, 1999, p. 6.
[171] See exemplarily BERNARD, Empiricists 1995 and FRANCIS/OLLSON/OSWALD, Comparing, 2000.
[172] BAR-YOSEF/CALLEN/LIVNAT, Dynamics, 1996.

the other hand the test on a multi-lagged structure performed by MOREL (1999) found strong support for multi-period autocorrelation instead.[173]

A comprehensive test of the OM, including information dynamics, is performed by DECHOW/HUTTON/SLOAN (1999). The authors examine the explanatory power of the information dynamics estimators for (γ,ω) obtained by evaluating historical earnings. In the first step the authors test whether the coefficient (ω) is significantly different from the polar extremes zero and one. Secondly, they compare the one-lagged with multi-lagged processes. The authors conclude that the information dynamics are empirically descriptive, particularly an AR(1) process which appears to suffice. However, when testing the ability to explain value the comprehensive OM appears inferior than the RIV model, which makes terminal value assumptions.[174]

BEGLEY/FELTHAM (2002) argue that the study by DECHOW/HUTTON/SLOAN (1999) applied insufficient data for analysis. Observations for expected earnings can be obtained by historical data as proxies or by analysts' forecasts. Provided analysts include information in addition to current earnings in their earnings forecast, the explanatory power of (γ,ω) cannot be tested by using historical observations since they simply do not contain this information. However, they acknowledge that in practice, using analysts' forecasts is problematical due to the fact that such data is not available for a long forecasts horizon.[175] LO/LYS (2000) underline that differences in earnings persistence or accounting systems cannot be aggregated in cross-sections. More importantly the bias that comes from the omitted correlating variable has to be taken into account. This can be achieved by dividing all variables at the beginning by the market value of the firm or otherwise allow for a scale proxy.[176]

Besides technical critique concerning empirical realizations, the OM is generally considered to have a conceptual shortcoming.[177] Just like dividends and cash flows are biased due to distribution and investment decisions, incentives for conservative accounting investment decisions influence the quality of earnings. In this case investment can actually reduce earnings since all possible investments are expensed instantly. Con-

[173] MOREL, Multi-Lagged, 1999, p. 159, see also CALLEN/MOREL, Linear, 2001.
[174] DECHOW/HUTTON/SLOAN, Empirical, 1999, p. 32.
[175] BEGLEY/FELTHAM, Forecasts, 2002, pp. 7-8.
[176] LO/LYS, Limitations, 2000, pp. 360-362.
[177] Ohlson also acknowledges this shortcoming, FELTHAM/OHLSON, Valuation, 1995, p. 710.

servative accounting attempts to keep book values as low as possible, thus creating undisclosed reserves.[178] Although the effect will only be temporal, it possibly affects the information content of earnings and can therefore not be omitted.[179]

2.3.8 Feltham Ohlson model

The effect of biased accounting on the informativeness of earnings complicates valuation, since it can increase the spread between book and market value, thus piling-up unrealized gains or losses. Because conservatism and accrual practices differ among companies, accounting earnings are biased. FELTHAM/OHLSON (1995) enhance the OM by including biased accounting and growth as information variables. The result is a model that is designed to be unaffected by accounting choices referred to as the FELTHAM/OHLSON (1995) model (FOM). If biased accounting is removed from the model it is the equivalent of the OM.[180]

In a first step, in order to align wealth creation with wealth distribution, operational and financial activities are separated.[181] Book value of equity b is therefore expressed as the sum of financial assets *fa* and operational assets *oa* as stated in Equation (2.13).

$$b_t = fa_t + oa_t \tag{2.13}$$

In the next step two additional assumptions are made. Firstly, the net interest relation (NIR) states that net financial assets generate zero net present value.[182] Accordingly, interest payments *int* at time t are equal to financial assets *fa* at time t-1 multiplied by interest rate k.[183] It is based on the assumption that financial assets are traded at market value. This simplifies the forecasting since not free cash flows need to be considered but operating cash flows.[184] Secondly, the financial asset relation (FAR) asserts that financial assets change only through retained cash flows. Consequently, financial assets

[178] In order to encompass both directions the term biased accounting is used.
[179] Cf. FELTHAM/OHLSON, Valuation, 1995, pp. 692-693 and PENMAN/ZHANG, Conservatism, 2002, pp. 237-240.
[180] FELTHAM/OHLSON, Valuation, 1995, p. 692.
[181] FELTHAM/OHLSON, Valuation, 1995, pp. 692 and 721.
[182] This assumption is rather restrictive since it is tantamount to assuming equilibrium.
[183] The interest rate k can be different from the discount rate r. However, since financial assets are assumed to be traded at market value their costs will be equal to what is earned from them.
[184] Cf. KAPLAN/RUBACK, Analysis, 1995.

fa are increased by interest payments (int) and operating cash flow (oc) and reduced by distributions (dis).[185]

$$\text{int}_t = k \cdot fa_{t-1} \qquad \text{(NIR)}$$

$$fa_t = fa_{t-1} + \text{int}_t - (dis_t - oc_t) \qquad \text{(FAR)}$$

Inserting NIR and FAR into the CIM, value v_0 can be expressed as current book value of financial assets (fa_0) plus the sum of expected future operating cash flows (oc), as shown in Equation (2.14).[186] In order to arrange financial assets, they are assumed to grow less than the discount factor (K).

$$v_0 = fa_0 + \sum_{t=1}^{\infty} \frac{E(oc_t)}{K^t}, \text{ where} \qquad K^{-t} E(fa_t) \xrightarrow{\infty} 0 \qquad (2.14)$$

When combining the above with the CSR, operating assets (oa) are increased by operating earnings (ox) and decreased by operating cash flows (oc). This can be expressed in the operating asset relation (OAR).

$$oa_t = oa_{t-1} + ox_t - oc_t \qquad \text{(OAR)}$$

Combining OAR and (2.14) leads to a valuation model on the basis of operating earnings as in (2.15).[187] It is based on three additional assumptions: CSR, NIR and FAR.[188] This model gained popularity among practitioners under the trademark Economic Value Added (EVA).[189]

[185] FELTHAM/OHLSON, Valuation, 1995, pp. 694-695.
[186] FELTHAM/OHLSON, Valuation, 1995, p. 697.
[187] The discount rate k is the cost of capital for operations, which does not encompass risk of equity but operational risk, cf. PENMAN, Valuation, 2007, pp. 465-467.
[188] OAR is not an additional assumption but simply implied by FAR and CSR, cf. FELTHAM/OHLSON, Valuation, 1995, p. 697.
[189] Accordingly, residual income for assets that are measured at market value will be equal to zero. Therefore financial assets can be disregarded, STEWARD, Value, 1999, pp. 118-178.

$$v_0 = b_0 + \sum_{t=1}^{\infty} \frac{E(ox_t)}{R^t}, \text{ where } R^{-t} E(b_t) \xrightarrow{\infty} 0 \tag{2.15}$$

In accordance with the FOM, EVA considers the use of reported accounting earnings for valuation to be inappropriate. Instead the term economic earnings is used.[190] However, reconciling economic earnings from accounting information is subjected to subjective judgment. STEWARD (1999) describes a set of accounting customizations, such as adjustment for research and development, strategic investments, expense recognition, depreciation, restructuring charges and taxes.[191] However, it could be argued that if adjustments can be made on reported earnings that yield economic earnings, it might be just as possible to adjust book value of equity to equate company's value.[192] Furthermore empiricists question the accuracy of these adjustments.[193]

The FOM involves linear information dynamics LID2 similar to LID used in the OM as additional assumptions in order to develop economic earnings within the model's theoretical framework. LID2 are stochastic processes, expressing accounting and non-accounting information's temporal interdependence.[194] In this respect, Equations (2.16) and (2.18) are analogous to the OM and include the relevance of other information.[195] Equations (2.17) and (2.19) show the growth in operational assets with υ_{it} representing operational asset.

$$e_{at+1} = \omega_{11} e_{at} + \omega_{12} b_t + \upsilon_{1t} + \varepsilon_{1t+1} \tag{2.16}$$

$$b_{t+1} = \omega_{22} b_t + \upsilon_{2t} + \varepsilon_{2t+1} \tag{2.17}$$

$$\upsilon_{1t+1} = \gamma_1 \upsilon_{1t} + \varepsilon_{3t+1} \tag{2.18}$$

$$\upsilon_{2t+1} = \gamma_1 \upsilon_{2t} + \varepsilon_{4t+1} \tag{2.19}$$

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[190] Economic earnings are defined as the change in market value over one period, cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 570.

[191] STEWARD, Value, 1999, pp. 118-178.

[192] Cf. OHLSON, Valuation, 1995, p. 666 and LO/LYS, Limitations, 2000, pp. 341-342.

[193] Cf. NOWAK, Unternehmensbewertung, 2000, pp. 156-157.

[194] Cf. RICHARDSON/TINAIKAR, Models, 2004, p. 226. The contribution is to be seen in the information dynamics and not in the separation between operational and financial activities, LO/LYS, Limitations, 2000, p. 353.

[195] FELTHAM/OHLSON, Valuation, 1995, p. 702.

Inserting LID2 in (2.15) yields the FOM equation as expressed in Equation (2.20).[196] Analyzing the coefficients shows that α_1 and α_2 must be greater than zero since book value and present abnormal earnings are assumed to positively affect value. The non-negative assumption of β_1 and β_2 suggests other information has no negative effect. Conservative accounting is to be separated from unbiased accounting. In this respect, unbiased accounting means that α_2, β_2 and ω_{12} equal zero. It can easily be seen that this will reduce (2.20) to (2.6). Therefore conservative accounting will generate a higher valuation since book value cannot be negative.[197]

$$v_0 = b_t + \alpha_1 e_{at} + \alpha_2 b_t + \beta_1 \upsilon_{1t} + \beta_2 \upsilon_{2t}, \quad \text{where} \quad \alpha_1 = \omega_{11}/(K-\omega_{11}) \geq 0 \qquad (2.20)$$

$$\alpha_2 = \omega_{12} K/[(K-\omega_{22})(K-\omega_{11})] \geq 0$$

$$\beta_1 = K/[(K-\omega_{11})(K-\gamma_1)] > 0$$

$$\text{and} \quad \beta_2 = \alpha_2/(K-\gamma_2) \geq 0$$

The FOM specified in Equation (2.20) does not deal with how exactly the variables can be measured. For instance no specification of financial assets is given.[198] It is also not specified how a measure for operational asset growth is to be identified, since no such analysts' forecasts are made.[199] Because of a lack of specification, tests of the FOM are complicated to perform. Some tests simply neglect LID2 effectively becoming a joint test of RIV, NIR and FIR, yielding little supporting evidence.[200] Also comprehensive tests do not lead to significantly better results.[201] Criticism is leveled at the suggested one-lagged structure. LEE (1999) emphasizes that LID2 is an additional assumption that might as well be made very differently.[202]

Beyond discussing whether LID and LID2 can be considered appropriate, the CSR underlying RIV, DCF, OM and FOM is subject of reappraisal. OHLSON (2000) argues

[196] For consistency the notation in the original paper by FELTHAM/OHLSON (1995) is modified in correspondence with LO/LYS, Limitations, 2000, p. 352.
[197] FELTHAM/OHLSON, Valuation, 1995, p. 706 and LIU/OHLSON, Empirical, 2000, p. 324.
[198] All assets could be assumed operational, equating net financial assets to financial obligations.
[199] Earnings growth forecasts could be used as proxies, cf. LIU/OHLSON, Empirical, 2000, p. 328.
[200] Cf. BERNARD, Empiricists, 1995 and MYERS, Dynamics, 1999.
[201] Cf. RICHARDSON/TINAIKAR, Models, 2004, p. 227. An important problem is identifying the correct lag structure since long time series data (not satisfactorily available) is needed to estimate the LID2. See also BEGLEY/FELTHAM, Forecasts, 2002.
[202] LEE, Research, 1999, pp. 417-418. BAR-YOSEF/CALLEN/LIVNAT (1996) find the AR(1) to be analytically useful, but not empirically relevant, however. BAR-YOSEF/CALLEN/LIVNAT, Dynamics, 1996, p. 222.

that this assumption is usually violated when capital contributions occur due to discrepancy with true market values. The author argues that this conceptual fragility proposes a different approach not based on the assumption of CSR.[203] This argument is carried forward by OHLSON/JUETTNER (2003) who develop an alternative based on expected earnings plus a short- and long-term growth measure termed the Ohlson Juettner model (OJM).[204]

2.3.9 Ohlson Juettner model

The authors commence by constructing a sequence of undefined variables (q) that satisfies the transversality condition as in (2.21).[205]

$$0 = q_0 + K^{-1}(q_1 - Kq_0) + K^{-2}(q_2 - Kq_1) + \ldots \tag{2.21}$$

Substituting (2.21) as capitalization object in the CIM yields a valuation formula with an undefined variable.[206] Assuming value-price equivalence, the relation between price of an asset p and the undefined variable q can be expressed as in (2.22). This equation is independent from the CSR.

$$p_0 = q_0 + \sum_{t=1}^{\infty} K^{-t} z_t \text{ , where } \qquad z_t = q_t + d_t - Ky_{t-1} \tag{2.22}$$

The specification that constitutes the OJM defines the variable as capitalized earnings ($q_t = e_{t+1}/k$) since this allows practical interpretations. As a consequence, the variable z can be interpreted as the valuation premium over the earnings perpetuity (e_1/k). The premium could be due to conservative accounting as well as expected investment projects with positive net present value.[207] The OJM relation is illustrated in Equation (2.23).

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[203] OHLSON, Problems, 2000, pp. 6-14.
[204] Due to the double-barrelled name of Beate E. Juettner-Nauroth, this model is sometimes referred to as the Ohlson Juettner-Nauroth model (OJN), cf. GUAY/KOTHARI/SHU, Implied, 2005, p. 10.
[205] OHLSON, Problems, 2000, pp. 11-14.
[206] OHLSON, Problems, 2000, pp. 11-14.
[207] OHLSON/JUETTNER, Value, 2003, pp. 5-9.

$$p_0 = \frac{e_1}{k} + \sum_{t=1}^{\infty} K^{-t} z_t \tag{2.23}$$

However, Equation (2.23) does not provide a solution to the terminal value conundrum. The OJM proceeds by making an additional assumption regarding the development of the valuation premium z. This assumption states that the valuation premium grows at a constant rate γ, independent of dividend policy. In order to produce useful results, γ is defined as less than K but greater than 1. Furthermore, the premium is defined as positive, since otherwise future performance would affect value negatively.[208]

$$z_{t+1} = \gamma z_t \text{ , where } 1 \leq \gamma < K \text{ and } z_1 > 0 \tag{2.24}$$

Substituting (2.24) in (2.23) yields the OJM pricing equation shown in (2.25). The model is based on two growth measures: short-term growth represented by g_2 and long-term growth represented by γ. The short-term measure is a function of earnings, discount rate and dividends. The short-term growth measure can be company specific or universal.

$$\frac{p_0}{e_1} = \frac{1}{k} \frac{g_2 - (\gamma - 1)}{k - (\gamma - 1)} \text{ , where } \qquad g_2 \equiv (e_2 - e_1)/e_1 + k(d_1/e_1) \tag{2.25}$$

It must be noted that the evolution of earnings, as suggested by the model, is an arbitrary assumption that could be made very differently. Frequently, positive earnings follow years of negative earnings.[209] Consequently, empirical tests of the OJM are essentially tests of the additional assumption (2.24). As is apparent, currently the only empirical application of the OJM deals with computing the implied cost of capital. GODE/MOHARAN (2001) estimate implied cost of capital by solving the model and computing an internal rate of return that would result in a net present value of zero. Tests of statistical robustness of the results support the model's soundness.[210]

[208] OHLSON/JUETTNER, Value, 2003, pp. 9-10.
[209] An example is the new market companies, see OHLSON/JUETTNER, Value, 2003, pp. 20-22.
[210] GODE/MOHANRAM, Ohlson-Juettner, 2001.

2.4 Concluding remarks

Besides the algebraic structure, a fundamental difference between equilibrium and intrinsic value models can be seen in their underlying assumptions. With restrictive assumptions on both capital markets and agents, equilibrium models provide an encompassing theoretical system, where prices correspond to agents' perceptions of value. On the other hand, in their generic form, intrinsic value models refrain from comprehensive assumptions both on markets and agents.

For practical application, equilibrium models on the one hand involve the severe challenges of defining market portfolio, risk-free rate with respect to the CAPM and exhaustively identifying relevant risk factors concerning APT. Intrinsic value models on the other hand require assumptions on the capitalization object and additional assumptions in order to deal with the terminal value conundrum, caused by the infinite perspective. Furthermore, in the generic framework of intrinsic value models the relation between value and price is not constituted. While this conceptually allows for mispricing, the structure of tests for intrinsic value models typically requires the definition of such a relation, since the explained variable's value is unobservable. However, this involves specification of markets and agents, requiring additional assumptions. This is often ignored by implicitly making assumptions underlying equilibrium models.

For this reason it can be concluded that, while the relationship between value and capitalization object is consistent, the open framework of intrinsic value models makes the models effectively impractical. However, by including assumptions on agents, the framework of intrinsic value models can be augmented to provide useful guidance. In this respect the assumptions of portfolio theory can be drawn upon, so that the characteristics of rationality, risk-aversion and non-satiation are ascribed to the agents and intrinsic value models are adjusted correspondingly. Explanatory variables of intrinsic value models can broadly be differentiated into the capitalization object and the discount factor. While agent-specific characteristics could theoretically be accounted for in any of these variables, typically the discount factor is chosen. Therefore, the following chapter focuses on the discount rate and illustrates how portfolio theory assumptions factor in both equilibrium and intrinsic value models.

3 Discount rate

When it comes to valuation and pricing of stocks in the field of Finance, the term discount rate differs from the money market definition, where it is defined as the rate financial institutions have to pay for borrowing from the central bank.[211] As pointed out in the previous chapter, the discount rate in the scope of this thesis relates to the concept of present value. It originates in the notion of time value of money, according to which a certain amount of money today is perceived to be worth more than the same amount to be received at a future date. This perception can be explained by opportunity costs due to missed interest payments, a decrease in purchasing power due to inflation and general uncertainty about future events that might affect the retrieval of the capital investment.[212] In this respect the definition by SHARPE/ALEXANDER/BAILEY (1999) is followed, which states: „The discount rate reflects not only the time value of money but also the riskiness of the cash flows.“[213]

Correspondingly, in the absence of uncertainty, the discount rate is simply the return of a risk-free asset, which only accounts for the time value of money. This return is referred to as the risk-free rate.[214] If uncertainty is involved, actual return is unknown and agents form expectations. These are assessments of future returns based on evaluating past and current economic information.[215] In order to be willing to take the risk that expectations do not meet actual returns - assuming risk aversion - agents require compensation in addition to time value of money. Consequently, for analytical purposes, the discount rate can be decomposed into two components: risk-free rate and risk premium.[216]

The CAPM explicitly illustrates this decomposition by differentiating between return on risk-free asset and market return. Moreover, when transforming the CAPM from the return to the price notation price will be introduced as excess return over the risk-free

[211] Cf. FEDERAL RESERVE BOARD, Discount, 2007, p. 1.
[212] Cf. BODIE/MERTON, Finance, 2000, pp. 101-102 and FISHER, Theory, 1930, pp. I.I.32-39 and pp. II.IV.3-4.
[213] SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 912.
[214] This is also referred to as base interest rate or risk-less rate, FABOZZI, Bond, 2007, p. 89.
[215] Cf. DAMODARAN, Valuation, 2006, p. 29. A discussion between hoped and expected returns is given in ARNOTT/BERNSTEIN, Premium, 2002, pp. 65-66.
[216] Some researchers reject the usage of a risk premium in the discount rate due to the impossibility of identifying their true value. Instead they suggest including uncertainty in a subsequent risk analysis, cf. WAMELING, Steuern, 2004, p. 183.

rate. Factor models based on APT account for the time value of money within the intercept term. The risk premium is included in the risk factor, so that an asset with zero factor exposure will have a return equivalent to the risk-free rate. Intrinsic value models combine both risk-free rate and risk premium in a comprehensive input variable – the discount rate.[217]

Regardless of the considerable influence of the discount rate in both equilibrium and intrinsic value models, it is frequently defined arbitrarily and even in contradiction to economic theory.[218] Therefore, this chapter discusses both discount rate components, how they can be obtained and their influence on the different models.

3.1 Risk-free rate

3.1.1 Defining the risk-free rate

As defined above, the risk-free rate represents the rate of return of a risk-free asset and accounts for the time value of money. However, its conception differs between equilibrium and intrinsic value models. For the CAPM the definition from the portfolio selection theory made by MARKOWITZ (1959) can be drawn upon, which characterizes a risk-free asset as contributing zero variation to the portfolio, implying zero covariance with the market portfolio.[219] Similarly, APT defines a risk-free asset as having no sensitivity to the risk factors, which also implies zero covariance.[220] The assumption of perfect capital markets and arbitrage free markets respectively, requires all risk-free securities to have the same rate of return. Since intrinsic value models require no assumptions on markets the risk-free security can simply be characterized by persistent equivalence of actual and expected return.[221] Consequently, equilibrium models define the risk-free rate by having zero-covariance with risky assets, while intrinsic value models require zero-variance. However, since according to the CAPM the market

[217] For intrinsic value models uncertainty of the payments can be accounted for by deducting the risk premium in absolute terms from future payments subsequently discounting using the risk-free rate. Alternatively, adding a risk premium to the risk-free rate yields a comprehensive discount rate. If consistently applied, both lead to the same result because it is merely a shift between nominator and denominator. For a discussion, cf. MOXTER, Unternehmensbewertung, 1983, pp. 155-158.

[218] Cf. WENGER, Basiszins, 2003, KNOLL/DEININGER, Basiszins, 2004 and STEHLE, Risikoprämie 2004.

[219] MARKOWITZ, Portfolio, 1959, pp. 112-115.

[220] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 288-289.

[221] Cf. DAMODARAN, Risk Free, 2007, p. 3.

portfolio by definition includes all risky assets and the APT exhaustively includes all risk factors, zero covariance determines zero variance. Obviously, reversely, zero variance involves zero covariance, so that both equilibrium and intrinsic value models ultimately necessarily imply identical requirements on a risk-free asset.

While the theoretical definition is straightforward and unambiguous, identifying a zero-variance security for practical purposes turns out to be problematic. The following two sections discuss related problems and provide suggestions on second-best solutions.

3.1.2 Identifying a risk-free asset

Identifying a zero-variance asset can be performed by distinguishing factors that are theorized to cause realizations to deviate from objective expectations. Typically the following factors can be considered: counterparty risk, inflation risk, exchange rate risk and reinvestment risk.[222] For an asset to be truly risk-free, these risk factors would have to be zero.

Counterparty risk, which is also termed credit or default risk, measures the probability that interest and repayment from an asset fail to occur in a timely fashion.[223] In this respect securities issued by the government are typically considered risk-free, since governments are in principle able to fulfill obligations by issuing currency.[224] However, this ability does not apply when independent central banks are assigned the monopoly on the issuance of currency. In addition, sovereign debt is not free of adverse selection and moral hazard problems.[225]

From sovereign financial distress a link to inflation risk can be seen, since increasing money supply will ceteris paribus affect the practical value of money. Inflation risk, also referred to as purchasing power risk, requires return flows to be non-variable, not in nominal but in real terms.[226] The introduction of inflation-indexed securities has

[222] Cf. FABOZZI, Bond, 2007, p. 6. Other risk factors, such as liquidity or volatility risk are disregarded, since these stem from trading the risk free asset, which is excluded for simplification.
[223] Cf. FABOZZI, Bond, 2007, p. 7.
[224] For example, US-Treasuries „are backed by the full faith and credit of the U.S. government." FABOZZI, Bond, 2007, p. 127.
[225] Cf. EATON/GERSOVITZ/STIEGLITZ, Risk, 1986, p. 485. A recent example can be seen in Argentina's sovereign bankruptcy at the beginning of this century, cf. FELDSTEIN, Fall, 2002.
[226] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 110.

established an asset class that aims at excluding inflation risk.[227] However, inflation risk is particularly severe in high-inflation markets, typically markets where inflation-indexed securities are yet to be issued.[228] Furthermore, inflation-linked securities adjust for a predefined inflation measure, which does not necessarily correspond to actual inflation.[229] It can be argued that inflation risk affects all time-equivalent investments of the same currency alike.[230] In this respect in a single-country and single-currency environment it can be considered sufficient to apply matching real or nominal values for all input variables.[231] However, when the perspective is extended to an international level, inflation risk cannot be neglected.

The exchange rate risk stems from the fact that while the foreign currency return flows are known, possible changes regarding the exchange rate make the domestic currency returns variable.[232] Consequently, the risk-free asset is to be denominated in the same currency as the compared assets. Otherwise, values will differ, which is called the consistency problem.[233]

Lastly, reinvestment risk arises when the examined asset's horizon and the maturity of the risk-free security do not coincide. With respect to stock, the assumed time frame is typically infinite. However, government securities have finite maturity. Emulating an infinite horizon with finite securities requires continuous roll forward. However, unless the unrealistic assumption of constant interest rates is made, uncertainty regarding interest rate changes subjects the risk-free security to reinvestment risk.[234] Furthermore, coupon payments must consistently be reinvested being also subjected to the risk of changing interest rates. Reinvestment risk could only be theorized away when assuming a zero-coupon bond with infinite maturity.[235] Reinvestment risk can therefore be

[227] Since 1997 treasury inflation protected securities with a maturity of 5, 10 and 20 years are offered in the USA, BUREAU OF PUBLIC DEBT, TIPS, 2007. See also CHEN/TERRIEN, TIPS, 1999 for a broad discussion.
[228] Cf. DAMODARAN, Valuation, 2006, pp. 35-36.
[229] For a discussion of core inflation measure cf. CLARK, Inflation, 2001.
[230] It is also argued that stock is not subjected to inflation risk since companies will raise prices in the face of inflation, which investors mistake for an earnings increase which will lead to stock price increase, OYEFESO, Review, 2006, p. 201.
[231] This is also called the homogeneity principle MOXTER, Unternehmensbewertung, 1983, p. 192.
[232] Cf. FABOZZI, Bond, 2007, p. 8.
[233] Cf. DAMODARAN, Risk Free, 2007, p. 7.
[234] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 204-205.
[235] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 225.

considered a function of coupons and maturity with a compound effect.[236] In this relationship interest-rate risk and reinvestment risk affect the overall risk conversely.[237]

Taking all these risk-factors into account it can be consistently concluded that a truly risk-free security is non-existent. Consequently, when conveying the theoretical models on an empirical level, the risk-free rate can only be approximated by what MOXTER (1983) refers to as a quasi-risk-free rate.[238] This second-best solution is the security where the spread to a true risk-free rate is irreducible. Since the risk-free benchmark is unobservable, a solution should be approached by collectively minimizing the four risk components. In this respect government securities are widely considered most adequate.[239] However, their popularity is predominantly due to their superior characteristics regarding default risk. With respect to all risk factors, their quality is to be measured by their joint risk level.

Regarding inflation and currency risk, this problem can be limited. Currency risk can be negated by subsequently regarding risky and risk-free assets of the same currency area only. Regarding inflation risk this straightforward solution is not consistently possible. This is because the risk-free asset is by definition a fixed income instrument while the risky asset for the purpose of this thesis is an equity investment. A commonly held belief is that equity investment can be considered to be a hedge to inflation risk, since income from the underlying business activities fluctuates with inflation. However, empirical results suggest that this relation is questionable.[240] Therefore, subsequently inflation risk is disregarded, leaving reinvestment risk to be closely investigated.

3.1.3 Dealing with reinvestment risk

As mentioned above, reinvestment risk results from the fact that duration matching of a risk-free asset and stock fails due to the latter's theoretically infinite horizon. Despite the general recognition of reinvestment risk, no standard incorporating procedure has

[236] Cf. FABOZZI, Bond, 2007, pp. 46-49
[237] Cf. FABOZZI, Bond, 2007, p. 7.
[238] MOXTER, Unternehmensbewertung, 1983, p. 146.
[239] For a discussion of alternatives such as average stock-return cf. METZ, Kapitalisierungszins, 2007, pp. 21-35.
[240] Cf. JAFFE/MANDELKER, Risky, 1976, BODIE, Inflation, 1976 and SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 330-332.

been set.[241] Therefore, analogously to the discount rate's division into risk-free rate and risk premium, for analytical purposes the risk-free rate itself can be decomposed. The first component concerns the alternative investment with a finite horizon and the second component adjusts this rate in order to approximate for infinity.

With respect to the first component, controversy concerns the appropriate maturity. Among economists there is general agreement on using the longest possible maturity.[242] It is argued that by applying shorter maturities, available information embedded in market prices is omitted. Therefore, the usage of securities with the common longest maturity of 30-years is suggested.[243] This suggestion is challenged by two arguments. Firstly, illiquidity of the 30-year maturity segment is claimed to disturb its benefits.[244] However, others argue that while relevant directly after their first issuance, liquidity has become sufficient only shortly thereafter.[245] The second argument concerns the converse aspects of reinvestment risk: while uncertainty regarding interest rates after maturity is regarded as being in favor of the longest-available maturity security, uncertainty with respect to reinvesting coupon payments supports the application of zero bonds.[246] However, this trade-off is predominantly regarded as being in favor of the 30-year security.[247]

The difficulties with the second component are similar to the terminal value conundrum discussed in Section 2.3.1. Assumptions on the time beyond maturity are necessary, for which various arbitrary suggestions exist. In order to relate these post-maturity assumptions to economic theory, the term structure, which traces interest rates to maturity, can be drawn upon. An empirical aggregation is expressed in the yield curve.[248] This curve can be upward or downward sloping, flat or humped. A variety of theories deal with the

[241] For a discussion cf. WENGER, Basiszins, 2003.
[242] Cf. DAMODARAN, Valuation, 2006, p. 3, DRUKARCZYK, Unternehmensbewertung, 2003, pp. 353-358, BALLWIESER, Zins, 2003, pp. 21-33 and SIEGEL, Premium, 2005, p. 63.
[243] Some countries such as France and the United Kingdom have recently issued 50-year treasuries (Methuselah). Alternatively the use of interest swaps has been discussed, which usually last as long as 50 years and empirically show a parallel structure, GEBHARDT/DASKE, 2005, pp. 653-654.
[244] Cf. BALLWIESER, Zins, 2003, pp. 28 and 33 and WENGER, Basiszins, 2003, p. 481.
[245] Cf. METZ, Kapitalisierungszinssatz, 2007, pp. 57-58. For instance, in Germany the market has exixted since 1986. In the USA the Bureau of Public Debt stopped issuing 30-year bonds in 2001 but resumed in 2006, BUREAU OF PUBLIC DEBT, Treasury, 2007.
[246] While the US Treasuries does not issue zero coupons, the private sector has created them through coupon stripping, FABOZZI, Bond, 2007, p. 146.
[247] Cf. BALLWIESER, Zins, 2003, pp. 28-30.
[248] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 120 and FABOZZI, Bond, 2007, pp. 101-103.

effects on the shape of the yield curve.[249] The unbiased expectation theory claims an equal distribution of upward and downward instances. It simply assumes rates to reflect market consensus expectations.[250] Accordingly, upward sloped yield curves suggest augmented expected interest rates and downward-sloped curves suggest decreasing interest rates. However, an equal distribution cannot be observed in real world data where upward sloping predominates and the downward yield curve is considered inductive for weakening economic growth. Another theory that attempts to describe the term structure is the liquidity preference theory. Accordingly, investors prefer shorter fixed interest horizons since interest rate risks are smaller. Consequently, longer bonds must pay a liquidity premium to entice investors.[251] This theory explains the trend towards upward sloping yield curves since expectations on falling interest rates must outdo the liquidity premium before the yield curve turns around. Hence, forward rates actually overstate future interest rates.[252] Although not undisputed, empirical evidence suggests the liquidity theory describes the reality better.[253] Despite its specific formation, the yield curve represents an empirical illustration of market expectations. Consequently, applying risk-free rates that contradict the yield curve are hard to justify.

A simplistic post-maturity assumption is to apply a 30-year Treasury bond (T-bond) rate as proxy for the infinite rate. However, this implies a flat yield curve, hardly observable in reality. Applying historical averages instead eliminates information on future expectations that constitute the yield curve.[254] GEBHARDT/DASKE (2005) conclude that using historical averages implies changing the valuation date of the alternative investment to the past.[255] Also combinations of both assume reversion to an historical

[249] For a discussion cf. FABOZZI, Bond, 2007, pp. 116-122.
[250] Cf. CAMPBELL/LO/MACKINLAY, Econometrics, 1997, pp. 413-423.
[251] Cf. FABOZZI, Bond, 2007, pp. 119-120.
[252] Note that two other popular theories exist with outcomes similar to the liquidity hypothesis: The preferred habit theory suggests a certain laziness to invest outside of the habited maturity segment. The market segmentation theory suggests that the markets for different maturities are not integrated.
[253] For a discussion cf. SARNO/THORNTON/VELENTE, Expectation, 2007, SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 120-128 and BODIE/KANE/MARCUS, Investments, 1999, pp. 446-453.
[254] Cf. METZ, Kapitalisierungszinssatz, 2007, p. 58.
[255] GEBHARDT/DASKE, 2005, pp. 650-653.

mean after maturity.[256] However, all these assumptions provide broad room for subjective judgment.[257]

An alternative heuristic, consistent with the yield curve, is suggested by WENGER (2003). The author computes a constant long-term average risk-free rate denoted r_{av} as the rate under which a 30-year T-bond r_{30} would be sold at face value. By inserting market data for the 10- and the 30-year T-bond in Equation (3.1), the unknown average risk-free rate can be computed. Since this equation cannot be solved analytically, WENGER (2003) provides a numerical example, concluding that an additional one fifth of the spread between 30 and 10-year T-bonds on top of the 30-year rate would be a reasonable approximation under the specific circumstance.[258]

$$\sum_{t=1}^{10} \frac{r_{30}}{(1+r_{10})^{10}} \left[\sum_{t=1}^{20} \frac{r_{30}}{(1+r_{av})^{t}} + \frac{1}{(1+r_{av})^{20}} \right] = 1 \tag{3.1}$$

However, applying only a single rate disregards the reinvestment risk from coupon payments.[259] It also contradicts the fact that a T-bond will not be traded at present value based on a constant rate, but in dependence of the specific term structure.[260] Consequently, coupons ought to be discounted in accordance with the yield curve resulting in a zero bond discount rate for the whole T-bond referred to as the spot rate.[261] The spot rate represents the yield-to-maturity of the zero-bond.[262] Consequently, using spot rates incorporates the reinvestment risk of coupon payments.[263] However, when it comes to infinite horizons no analytical solution has yet been identified.

[256] Cf. DRUKARCZYK, Unternehmensbewertung, 2003, p. 355, BALLWIESER, Zins, 2003, pp. 25-26. This procedure is consistent with the perception that a time series' best long term forecast is its own average.

[257] Different choices can be made with respect to the data basis of the long-term forecasts. For instance in order to obtain an unbiased time series, periods considered non-representative for future development (e.g. extremes such as world war) can be excluded from the sample. Cf. WENGER, Verzinsungsparameter, 2005, p. 20.

[258] WENGER, Basiszins, 2003, pp. 486-487.

[259] Coupon payments can only consistently be disregarded if the yield curve is assumed to be flat, KNOLL/DEININGER, Basiszins, 2004, pp. 371-372.

[260] A coupon paying bond can therefore be considered a package of zero coupon instruments, FABOZZI, Bond, 2007, pp. 146-147.

[261] Cf. GEBHARDT/DASKE, 2005, p. 655 and FABOZZI, Bond, 2007, pp. 103-112.

[262] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 110-114.

[263] Cf. FABOZZI, Bond, 2007, p. 112.

A duration heuristic that accounts for coupon payments has been developed by KNOLL/DEININGER (2004). Their approximation generates an average discount rate that both accounts for a non-flat yield curve and the development of payments. The authors compute an average duration denoted D, weighted with the relation between the discounted payment (x) in t and the sum of all payments as expressed in Equation (3.2). The risk-free rate ($r_{t)}$ is time varying, indexed with t, and depends on the specific position on the yield curve.[264]

$$D = t \frac{x_t /(1+r_t)^t}{\sum_{t=1}^{T} x_t /(1+r_t)^t} \tag{3.2}$$

However, empirical evidence on this complex procedure is yet to be obtained. Particularly with empirical analysis of stock pricing and valuation, this level of exactness is not necessarily constructive regarding the broad subjective judgment with respect to the terminal value conundrum.[265] Consequently, instead of identifying a theoretical optimum, an appropriate approximation can be considered sufficient.[266] However, the interpretation of what can be regarded appropriate differs considerably among empirical studies.[267] A desirable solution could be seen in a best-practice risk-free rate such as the 30-year T-bond yield.

Nevertheless, due to the objective of many studies results can be unaffected. For example, FAMA/FRENCH (2002) justify their choice with irrelevancy in absolute terms, since as a result of their model construction the risk-free rate is merely an additive constant.[268] In this respect, depending on the specific test design, inferences are unaffected if the risk-free rate is consistently higher, since thus computed risk premiums will simply be equally lower.[269] Regarding the empirical part undertaken in Chapter 8, the analysis is mostly concerned with changes instead of levels, so that absolute deviations cancel each other out.

[264] KNOLL/DEININGER, Basiszins, 2004.
[265] Cf. WENGER, Basiszins, 2003, p. 488.
[266] KNOLL/DEININGER, Basiszins, 2004, p. 373.
[267] For instance 30-day US T-bill, BLACK/JENSEN/SCHOLES, Tests, 1972, p. 85 and 6-month commercial papers, FAMA/FRENCH, Premium, 2002, p. 642.
[268] FAMA/FRENCH, Premium, 2002, p. 642. The same argument is put forward by GEBHARDT/LEE/SWAMINATHAN, Implied, 2001, p. 149.
[269] Cf. GARMAN/OHLSON, Arbitrage-Free, 1980, p. 425.

3.2 Risk premium

3.2.1 Defining the risk premium

Risk premium can be regarded as compensation for the assumption of risk.[270] It is therefore viably connected to the assumption of risk aversion. In the scope of portfolio theory, MARKOWITZ (1959) describes it as return that must be sacrificed in order to decrease uncertainty.[271] Risk premiums can be expressed in absolute or relative terms. Commonly, the relative expression is used, since this allows incorporation into the discount rate.[272] In a broader sense, the term risk premiums is also used for fixed income, being also subjected to risk, as discussed in the previous section. However, for the purpose of this thesis the term is used interchangeably with equity risk premiums.

In the framework of the CAPM two kinds of risk premiums can be differentiated. Firstly, the market risk premium is defined as the difference between average return on a risky security and a risk-free rate.[273] Secondly, multiplying the market risk premium with a stock's beta-factor yields the premium for a specific stock.[274]

With respect to models based on APT the concept of risk premium is less obvious but nevertheless implied. If the price equation includes an intercept term, it is equivalent to the risk-free rate and the remaining factors can be considered systematic risk factors. They represent the average risk premium corresponding to each factor.[275] Risk premium can be gauged by each factor by considering a pure factor asset; that is to say an asset with unit sensitivity to that particular factor and zero sensitivity to all other factors.[276] Without an intercept term, the risk premium will be mixed with the risk-free rate when estimators are created from the sample.

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[270] It is referred to as "the single most important contemporary issue in finance." DIMSON/MARSH/STAUNTON, Risk, 2000, p. 2, also BODIE/MERTON, Finance, 2000, p. 337 and SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 155.
[271] MARKOWITZ, Portfolio, 1959, p. 6.
[272] Cf. FABOZZI, Bond, 2007, p. 96 and SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 912.
[273] This is also referred to as risk premium for an average-risk asset, DAMODARAN, Valuation, 2006, pp. 32 and 38.
[274] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 238 and DAMODARAN, Valuation, 2006, p. 32.
[275] Cf. GEBHARDT/LEE/SWAMINATHAN, Implied, 2001, pp. 139-140.
[276] Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, pp. 288-289.

For intrinsic value models risk premiums are exogenous, since they lie outside of their framework. These models are only concerned with expected value without regarding deviation from it. Consequently, the discount rate accounts only for the time value of money. However, when introducing risk aversion the definition of intrinsic value is to be extended. In this respect intrinsic value is to be understood as the risk-adjusted present value of expected future payments.[277] Obviously, since no assumption about the agent's homogeneity is made, intrinsic value is subjective. The difficulties that accompany this exogeneity have induced researchers to revert to premiums based on equilibrium models. OHLSON (1995) rejects this procedure as being ad-hoc, since including risk in the concept of CIM is exogenous "to the extreme". The author questions that risk can be properly accounted for by simply adjusting the discount rate.[278] Instead OHLSON (1995) suggests endogenously including risk, based on correlation among disturbance terms as proposed by GARMAN/OHLSON (1980).[279] However, no comprehensive elaboration has yet been developed. Acknowledging the lack of an alternative to the ad-hoc approach, OHLSON (1995) accepts it for empirical and practical purposes.[280]

While the amount an agent requires as compensation for assumed risk depends on individual risk preferences, to establish a relation with market prices, empirical analysis is concerned with market risk premiums. That is to say, the aggregate of individual risk premiums resulting from the interplay of supply and demand. Therefore, subsequently the term risk premium refers to the market aggregate. In order to identify risk premiums empirically, one can differentiate between methods of obtaining them and data being used. Furthermore, premiums can be regarded ex-post as realized or ex-ante as expected premiums.[281] The following sections deal with methods of obtaining suitable risk premium gauges. Fig. 2 illustrates the relationships. Subsequently, empirical research is reviewed, and conclusions for empirical application are drawn.

[277] Cf. WELCH, Controversies, 2000, p. 501, PASTOR/STAMBAUGH, Model, 1999, p. 67 and SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 523.
[278] OHLSON, Valuation, 1995, pp. 679-680.
[279] GARMAN/OHLSON, Arbitrage-Free, 1980.
[280] OHLSON, Valuation, 1995, p. 680.
[281] Cf. OYEFESO, Review, 2006, p. 201.

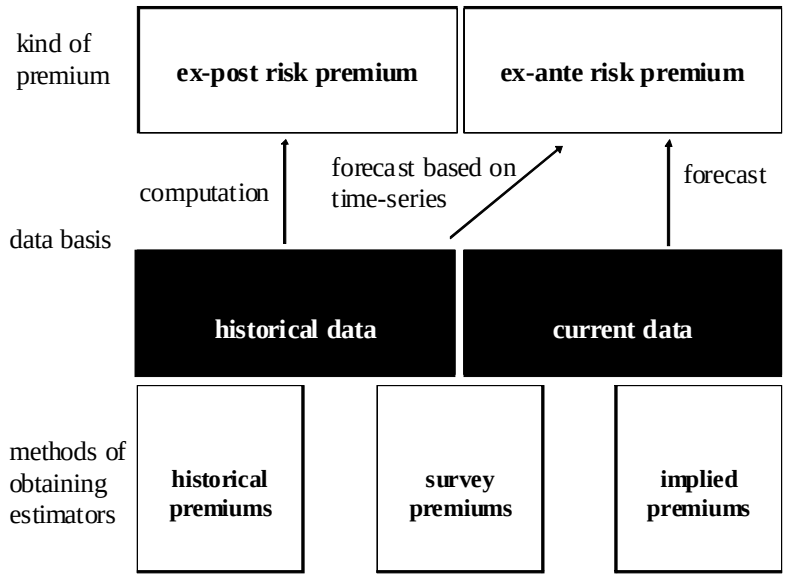

Fig. 2 Methods of obtaining risk premiums (own illustration)

3.2.2 Identifying risk premiums

Unlike the risk-free rate, which is the subject of contracts on markets, the risk premium is not directly observable but an implicit component of stock prices.[282] Because it is interwoven with future cash payments, there is no straightforward way of measuring it. DAMODARAN (2006) distinguishes three common methods of obtaining risk premiums. Firstly, survey premiums are obtained by inquiry at specialists, typically the largest investors because of their large weight. Secondly, historical premiums are obtained by evaluation of historical market data. Lastly, implied premiums can be computed from current market data.[283]

For premiums derived from surveys, essentially three groups of respondents are questioned: academics, institutional investors or other professionals and individual investors. In a broad survey among over 200 finance professors, WELCH (2000) finds thus estimated risk premiums to be slightly lower than historical premiums.[284] GRAHAM/HARVEY (2005) perform a survey among chief financial officers and obtain similar premiums.[285] Typically, results from surveys among small investors vary significantly

[282] Cf. DAMODARAN, Valuation, 2006, p. 28.
[283] DAMODARAN, Valuation, 2006, p. 38 and STEHLE, Risikoprämie, 2004, pp. 916-919. Twelve different ways of extracting risk premiums are presented by HARVEY, Cost, 2005.
[284] WELCH, Controversies, 2000.
[285] GRAHAM/HARVEY, Premium, 2005, also BURR, Again, 1998.

from professional investors.[286] However, the practical use of premiums derived from surveys can be regarded as low. Limitations can be seen in the reliability of answers due to a lack of incentives for quality, the extreme volatility of those results, the short-term perspective and the general representativeness of the sample.[287] For this reason survey premiums play a minor role in Finance and will not be covered in the remainder of this thesis.

Alternatively, using historical premiums is based on the notion that the best long-term forecast of a time series is its historical average.[288] However, estimates depend on the selection of a risk-free alternative investment, the time period, the choice between arithmetic and geometric averages and further assumptions on the stochastic characteristics.[289] Difficulties regarding the risk-free rate are discussed in Section 3.1.2. Regarding the time frame a trade-off between long- and short horizons exists. It is argued that longer periods are preferable, since standard errors are reduced.[290] However, empirical results suggest that the risk premium cannot be assumed time-invariant. Regarding the kind of average, the choice depends on assumptions regarding the distribution of returns.[291] Computing an arithmetic average could only be considered if the market return realizations were independent and identically distributed. Otherwise, deviations would have a mounting effect and the discount factor would be overstated.[292] Instead, the geometrical average would be accurate in case of perfect dependence. Since both extremes are not likely describing actual data, the better approximation can be considered superior.[293] WENGER (2005) shows that over long sample horizons differences between

[286] Cf. CLAUS/THOMAS, Empirical, 2001, p. 1631 and WELCH, Controversies, 2000, pp. 506-507.
[287] Cf. DAMODARAN, Valuation, 2006, p. 38 and WELCH, Controversies, 2000, p. 509.
[288] The most popular historical premiums are published by Ibbotson Associates, cf. BARAD, Yearbook, 2005 and CLAUS/THOMAS, Empirical, 2001, p. 1630.
[289] The arithmetic mean is used by MEHRA, Premium, 2003. The geometric is used in DIMSON/MARSH/STAUNTON, Irrational, 2004. Most databases apply the geometric mean, cf. FULLER/HACKMAN, Historical, 1991, p. 47. A comparison of geometric and arithmetic mean finds no advantage in using the more elaborate geometric procedure, CLAUS/THOMAS, 2001, pp. 1642-1643.
[290] Cf. DAMODARAN (2006) shows in a numerical example how the standard errors in risk premium estimates vary according to the estimated period, DAMODARAN, Valuation, 2006, p. 40. Opposing, FULLER/HACKMAN (1991) argue that accounting for a time structure in risk premiums would probably not be worthwhile, FULLER/HACKMAN, Historical, 1991, p. 48.
[291] Most investors use the geometric mean, SIEGEL, Premium, 2005, p. 62.
[292] Cf. NEUBAUER/BELLGARDT/BEHR, Methoden, 2002, pp. 66-72. This also corresponds to the empirical results in JONES/WILLSON, Controversy, 2005, pp. 38-39 and SIEGEL, Premium, 2005, p. 63.
[293] A numerical example can be found in: WENGER, Verzinsungsparameter, 2005, pp. 18-19.

arithmetic and geometric average diminish.[294] Essentially, when empirically dealing with risk premiums, an econometric process is to be identified that approximately explains risk premiums. While econometric methods are able to model instable processes, seemingly unpredictable non-reverting changes in the fundamentals of risk premiums impair this ability.[295] As a result, considerable leeway in specifying the procedure exists, leading to various historical risk premiums.

Finally, intrinsic value models can be used to attain implied premiums. Accepting risk premiums as exogenous, essentially any model based on the CIM can be solved for the denominator.[296] Subsequently inserting market data, an implied discount rate can be computed, which encompasses compensation for the time value of money and the assumed risk. By subtracting the risk-free rate, the risk premium can be isolated. This procedure does not rely on any historical data but is fully market based.[297] However, it must be noted that results depend on the assumptions of the specific intrinsic value model as well as on a relation between value and price.[298]

The categorization by DAMODARAN (2006) classifies methods of obtaining risk premiums. By doing so it leaves open which economic model to use. Essentially, an intrinsic value model can be used to compute historical risk premiums if historical data is put in.[299] Also the CAPM is not an ex-post model but explains the current state by assuming equilibrium, so that by using expectations instead of realizations forward-looking instead of historical premium can be obtained.[300] Both perspectives can be reconciled by assuming a stationary probability distribution. That is to say risk premium's expected value and variance are said to be time-invariant.[301] In this respect an alternative classification by JONES/WILSON (2005) differentiates between ex-post and ex-ante risk

[294] WENGER, Verzinsungsparameter, 2005, pp. 19-20. A numerical example that illustrates the differences between risk premiums computed on different assumptions on time, risk-free security and kind of average is presented in DAMODARAN, Valuation, 2006, p. 41.
[295] Cf. JONES/WILSON, Controversy, 2005, p. 38, cf. SIEGEL, Premium, 2005, p. 62.
[296] Since the discount rate is implied in both in the nominator and denominator the result is a T-degree polynomial equation, which has T solutions of which one is economically useful, BOTOSAN, Disclosure, 1997, p. 339.
[297] Cf. DAMODARAN, Valuation, 2006, pp. 45-48 and GEBHARD/LEE/SWAMINATHAN, Implicit, 2000, p. 136.
[298] Cf. GEBHARD, Implicit, 2000, p. 137 and HIRSHLEIFER, Investment, 1970, pp. 51-56.
[299] Strictly speaking, the ex-ante perspective for models that are based on CSR, such as RIV and DCF, can be considered inconsistent, since analysts often exclude items affecting the book value of equity, KOTHARI Research, 2001, p. 142.
[300] Cf. FULLER/HICKMAN, Historical, 1991, p. 45.
[301] Cf. GREENE, Econometric, 2008, p. 631.

premiums.[302] Accordingly, ex-post refers to premiums computed on the basis of historical realizations, whereas ex-ante refers to the "conditional equity premium, given the current state of the economy."[303] Consequently, ex-post risk premiums also include those that are based on stochastic processes where parameters have to be estimated using historical data. The following sections discuss empirical implications of ex-post and ex-ante risk premiums.

3.2.3 Ex-post risk premiums

Since risk premiums are unobservable, empirical research aims at yielding estimates from market data. The concept of risk premiums theorizes that they are encompassed in the difference between market price and expected return. Since the time value of money is to be accounted for also, the difference effectively pools both. Consequently, the risk premium can be obtained by subtracting the risk-free component. However, since expected returns are unobservable, they need to be represented by a proxy.

The most straightforward approach is to equate expected return to ex-post realizations. Hence, equity premiums are computed on the basis of historical data. As an illustration, DIMSON/MARSH/STAUNTON (2000) compute stock's historical excess returns over T-bonds and present this as a forecast of future risk premiums.[304] Alternatively, CAPM and factor models are used to compute risk premiums.[305] GRAHAM/HARVEY (2001) examine the practical relevance of the CAPM among practitioners and find it to be by far the most frequently used model to compute discount rates.[306]

The difference between realized and expected return can be illustrated by decomposition.[307] Accordingly, return r_i in period t is the conditional expected return $E_{t-1}(r_{it})$ based on the information known in t-1 plus an unexpected component ε_t as illustrated in Equation (3.3). Consequently, using realized returns as proxies for the expected return implicitly assumes the unexpected component to be uncorrelated with the return and to

[302] JONES/WILSON, Controversy, 2005, p. 40.
[303] JONES/WILSON, Controversy, 2005, p. 38.
[304] DIMSON/MARSH/STAUNTON, Risk, 2000, pp. 10-12, cf. ARNOTT/BERNSTEIN, 2002.
[305] Cf. FAMA/MACBETH, Tests, 1973, CAMPBELL/SHILLER, Discount, 1988, FAMA/FRENCH, Yield, 1988 and WELCH, Controversies, 2000, p. 505.
[306] GRAHAM/HARVEY, Corporate Finance, 2001, similar results are obtained in: BRUNER et al., Survey, 1998.
[307] A slightly more complex decomposition is suggested in CAMPBELL/SHILLER, Yield, 1991. However, for the purpose of illustration this form is less convenient.

have an expected value of zero.[308] However, since this assumption can be regarded as violated in reality, using excess profit as a proxy for the ex-ante premiums captures noise and is unrelated to the risk premium over short horizons.[309] Hence, the return process in (3.3) is instationary affecting risk premiums. As a consequence, ex-post and ex-ante premiums are not interchangeable.[310]

$$r_i = E_{t-1}(r_{it}) + \varepsilon_t \tag{3.3}$$

In an empirical study GOYAL/WELCH (2003) illustrate this drawback of ex-post premiums.[311] FAMA/FRENCH (1997) examine both CAPM and three-factor model and find varying factor loadings, leading to imprecise estimators.[312] ELTON (1999) finds significant information-surprises and concludes risk premiums based on CAPM or factor models are as biased as risk premiums based on historical returns.[313] Ultimately, obtaining risk premiums from historical data assumes that past observations suffice in explaining current premiums. Consequently, using risk premiums derived from time series models is necessarily a joint test of the stochastic process model and the true model to be examined.[314]

Historical risk premiums have furthermore been challenged by a discovery termed the equity premium puzzle, attributed to MEHRA/PRESCOTT (1985). The authors investigate risk premiums from a consumption perspective. Their objective is to compute returns sufficient to make the average investor indifferent. Examining stock prices under the common assumptions regarding risk aversion, the authors conclude risk premiums to be significantly too high than can be justified by their covariances.[315] This finding trig-

[308] Cf. ELTON, Tests, 1999, pp. 1200-1201.
[309] Cf. OYEFESO, Review, 2006, p. 200, ELTON, Tests, 1999, pp. 1200-1202 and DIMSON/MARSH/STAUNTON, Risk, 2000, p. 12.
[310] Cf. ELTON, Tests, 1999, p. 1218.
[311] GOYAL/WELCH, Predicting, 2003, pp. 642-644 and 653. This simple heuristic relation is generally considered instable LEE/MYERS/SWAMINATHAN, Dow, 1999, p. 1695.
[312] FAMA/FRENCH, Industry, 1997, p. 153.
[313] ELTON, Tests, 1999, pp. 1214-1215.
[314] Cf. KEANE/RUNKLE, Rational, 1998, p. 769.
[315] MEHRA/PRECSOTT, Puzzle, 1985. Some authors find risk premiums to be adequate and question the existence of an equity premium puzzle, for instance KANDEL/STAMBAUGH, Preferences, 1991, pp. 39-71, FAMA, Efficient, 1991, p. 1596, WEIL, Puzzle, 1989 and SIEGEL/THALER, Anomalies, 1997, pp. 192-193.

gered a controversy that questioned whether models used by economists were flawed.[316]

Theoretical considerations suggest a range of aspects that might have an effect on the puzzle. Transaction costs are often quoted as an explanation since the premium computed on the basis of stock indices does not coincide with bottom-line returns collected by the investors. However, this effect is considered to be weakening due to the growing number of exchange-traded funds.[317] Another argument is investors' unawareness regarding factual risk and returns because of unavailable long-term data in the early sample part. Therefore, underestimated long-term returns and overestimated risk lead to high required-risk premiums.[318] ARNOTT/BERNSTEIN (2002) argue that historically high risk premiums have been in part due to significant non-recurring events.[319] Consequently, risk premiums are broadly considered to keep decreasing and empirical studies have identified risk premiums around zero and even evidence for negative premiums.[320] However, since systematic risk cannot be diversified away, negative risk premiums appear inconsistent with fundamental finance theory suggesting estimation errors as an explanation.[321]

On the empirical side a number of studies have attempted to explain the puzzle. Although theoretical considerations suggest a variety of explanations, empirical studies

[316] See for example SIEGEL, Premium, 2005, p. 61 and OYEFESO, Review, 2006, pp. 201-213.
[317] Cf. SIEGEL, Premium, 2005, pp. 64-65.
[318] An overview of bias affecting historical risk premium is given in SIEGEL, Premium, 2005, pp. 64-65. Interestingly it is also argued that most empirical studies overestimate the true risk premiums. The reasoning is that this is due to evaluating only easily accessible data and choosing an index because long periods are available. Correspondingly, lower equity returns for a range of countries are found by a much broader index constructed by DIMSON/MARSH/STAUNTON, Risk 2000, pp. 5-6, Figure 5.
[319] ARNOTT/BERNSTEIN, Premium, 2002, p. 80.
[320] Cf. SIEGEL, Premium, 2005, p. 69, ARNOTT/BERNSTEIN, 2002, p. 64, BLANCHARD, Premium, 1993, p. 113, SIEGEL/THALER, Anomalies, 1997, p. 199, DIMSON et al, Risk, 2000, p. 13 and WELCH, Controversies, 2000, pp. 508-526. Negative premiums for the U.S. are found in BOUDOUKH/RICHARDSON/MATTHEW, Premium, 1993 and OSTDIEK, World, 1998.
[321] A natural downward limit of zero is considered appropriate by ARNOTT/BERNSTEIN, Premium, 2002, p. 65. Negative premiums are also empirically rejected by IBBOTSON/CHEN, Returns, 2003, pp. 95-96. "everyone would agree that it should be positive over the long run", SOLNIK/MCLEAVEY, Investment, 2004, p. 160.

focus on risk and changes in preferences.[322] Due to the incongruity among empirical results, OYEFESO (2006) calls the equity risk premium an "unresolved phenomenon".[323]

Taking both theoretical and empirical concerns into consideration, the appropriateness of ex-post premiums is doubtful. Therefore, the following section examines whether ex-ante premiums can be regarded as a preferable alternative.

3.2.4 Ex-ante risk premiums

As discussed above, since market expectations cannot be observed, they need to be proxied for. Until recently, the predominantly used method was mechanical extrapolation of past data using time-series models.[324] Basis for alternative proxies is therefore a forward-looking perspective. Essentially, three proxies are suggested: management forecasts, analysts' forecasts and forecasts based on time-series analysis. While evidence for management forecasts' information content has been found in empirical research,[325] they are not readily available and are volatile in nature.[326] Therefore, analysts' and time-series forecasts are typically preferred in capital market research. Since actual market expectations as benchmarks are unobservable, superiority cannot be measured directly. With respect to analysts' expectations it can be argued that they represent expectations of a group of highly informed specialists, not necessarily corresponding to market expectations. However, choosing a time-series model that can be accepted as representative of the market consensus is just as ad-hoc.

Therefore it is reasoned that the forecasts with historically smaller errors will be perceived superior by the market and they are therefore regarded as a better proxy for

[322] Studies focusing on risk: MEHRA/PRECSOTT, Puzzle, 1985, pp. 145-161. Studies focusing on preferences EPPSTEIN/ZIN, Risk, 1989, pp. 937-969. For a review of empirical results cf. OYEFESO, Review, 2006, pp. 208-212.

[323] OYEFESO, Review, 2006, p. 213.

[324] Cf. ELTON/GRUBER, Accuracy, 1972, p. B409.

[325] For information content of management forecasts cf. MCNICHOLS, Management, 1989, p. 25 and KOTHARI, Research, 2001, p. 49.

[326] Management forecasts include earnings warnings and pre-earnings announcements. They are commonly made in conjunction with capital market transactions, litigation and signaling, cf. HEALY/PALEPU, Disclosure, 2001, pp. 420-431 and BRENNAN, Bids, 1999. WAYMIRE (1986) finds them more accurate then prior analysts' forecasts, WAYMIRE, Accuracy, 1986, p. 141. BRENNAN (1999) identifies a significant good-news bias in management forecasts, BRENNAN, Bids, 1999, pp. 911-912. A general study found a mean absolute deviation from actual results by 13%, KPMG/ECONOMIST INTELLIGENCE UNIT, Forecasting, 2007. IMHOFF/PARE (1982) cannot find them superior to either analysts' forecasts or time-series, IMHOFF/PARE, Comparison, 1982.

market expectations. Unlike the term forecasts error, computed as the difference between forecast and realization, represents the unexpected component.[327] In this respect, high forecast errors are not interpreted as a deviation from market expectations but as a large unexpected component.

Theoretical considerations support analysts' forecasts' relative superiority. SHIPPER (1991) argues that since analysts can base their forecasts on time series analysis, while adding further information, it would be surprising if their forecasts were actually inferior.[328] BROWN/ROZEFF (1978) express the relative quality in more rigid terms: the authors argue that basic economic theory unambiguously demands analysts' forecasts to be superior. That is to say the mere existence of analysts' forecasts plus the fact that they are costly is only justified by economic theory if they generate superior forecasts.[329]

Also a broad range of empirical studies focus on relative usefulness. FRIED/GIVOLY (1982) evaluate the quality of analysts' forecasts compared to those made by time-series analysis. The authors compare association between forecasts error and abnormal stock return and find stronger correlation with errors by analysts' forecasts than based on time series models.[330] Hence analysts' forecast appear closer related to actual perceived expectations. BROWN ET AL. (1987) also find superiority of analysts' forecasts compared to univariate time-series, attributing it to better utilization of existing information and acquisition of additional information due to a timing advantage.[331] Both results are consistent with early empirical research performed by BROWN/ROZEFF (1978).[332] Comparing both individual and average analysts' forecasts with a random stochastic process as well as an autoregressive process, O'BRIEN (1988) identifies much smaller errors by the analysts.[333] On the other hand, IMHOFF/PARE (1982) find no significant difference between analysts' forecasts and forecasts based on autoregressive integrated moving average models.[334] Also ELTON/GRUBER (1972) find no

[327] Cf. SCHIPPER, Forecasts, 1991, p. 106.
[328] SCHIPPER, Forecasts, 1991, p. 107.
[329] BROWN/ROZEFF, Superiority, 1978, pp. 1 and 13.
[330] FRIED/GIVOLY, 1982.
[331] Since analysts' forecasts are made after earnings announcements, information becoming public shortly afterwards but before forecasts are published can be utilized also, BROWN et al., Relative, 1987.
[332] BROWN/ROZEFF, Superiority, 1978.
[333] O'BRIEN, Forecasts, 1988.
[334] IMHOFF/PARE, Comparison, 1982.

difference when comparing analysts' forecasts to a variety of mechanical extrapolation models.[335]

Despite ambiguous results, the majority of empirical research concludes analysts' forecasts to be superior.[336] In regard to studies using time-series data as a proxy for expected earnings, KOTHARI (2001) states: "I believe this literature is fast becoming extinct. The main reason is the easy availability of a better substitute: analysts' forecasts…".[337]

Despite auspicious results regarding relative accuracy, it is widely believed that analysts publish excessively optimistic recommendations and overstated earnings and growth forecasts.[338] This phenomenon is also referred to as strategic reporting bias.[339] This bias results from the institutional environment. Fundamentally, analysts that issue forecasts can be divided into buy- and sell-sides. Buy-side analysts work inside an investment firm and provide information for investment decisions within that company or to advisory clients.[340] Their reports are not available to the public. On the opposite, sell-side analysts offer their reports to institutional investors. Sell-side analysts typically work for brokerage firms, dealer houses or investment banks and often do not charge for research reports. Lastly, independent analysts, who can be seen as a subset of sell-side analysts, sell their reports typically on a subscription basis.[341]

The financial analyst publishes a report with a detailed description of the firm and its environment (geographic, industry, segment, etc.). The core of the report is the bottom-line recommendation (buy, sell, hold, etc.), which summarizes the analyst's opinion. Fundamental to this recommendation is usually an earnings and a growth forecast, which are both part of the report and can be considered interstage products.[342] Buy-side analysts do not necessarily make their own forecasts, instead they use sell-side forecasts as input for their recommendations. For this reason, restricted availability to third parties and because both sides are assumed to face different incentives due to different

[335] ELTON/GRUBER, Accuracy, 1972.
[336] Cf. ABABANELL, Information, 1991, p. 164.
[337] KOTHARI, Research, 2001, p. 42.
[338] Cf. SCHIPPER, Forecasts, 1991, p. 112 and HODGKINSON, Broker, 2001, p. 945. In contrast, some studies find analysts' forecasts to be unbiased, cf. GIVOLY, Expectations, 1985.
[339] Cf. GU/WU, Bias, 2003, p. 6. However, the optimism appears to have decreased in recent years, cf. BROWN, Analyst, 1997, p. 81.
[340] Investment firms include mutual-, hedge- and pension funds or investment advisors.
[341] Cf. SEC, Recommandations, 2005, p. 1.
[342] An exception is Value Line forecasts that make no recommendations.

principals, capital market research usually focuses on the sell-side perspective.[343] Although the complete report is usually only available for a charge to non-institutional investors, the recommendation component by multiple analysts is published on financial websites.[344]

Empirical evidence on the strategic reporting bias is ambiguous. GIVOLY (1985) examines whether all past information is reflected in the forecasts, which he refers to as the weak form of the Muth criterion of rationality.[345] The author finds the bias to be insignificant and concludes that the forecasts are rational.[346] KEANE/RUNKLE (1998) also find strong evidence supporting the claim that analysts make rational earnings forecasts.[347] LYS/SOHN (1990) conclude forecasts to be relevant, even when made closely after corporate accounting disclosure.[348] In opposition, studies such as ALI/KLEIN/ROSENFELD (1992) find evidence for an optimism-bias and conclude that available data is not evaluated properly.[349] Also DEBONDT/THALER (1990) show that even analysts, being considered highly professional agents, overreact to changes in relevant factors.[350]

The explanation for overly optimistic forecasts is generally believed to be due to the incentive structure.[351] At the center of the discussion is whether forecasts on a company's earnings and services rendered to the company can be held independently.[352]

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[343] Cf. SCHIPPER, Forecasts, 1991, p. 106 and KOTHARI, Research, 2001, p. 50. Empirical research usually applies to sell-side forecasts, with Value Line and I/B/E/S being the most popular.

[344] Cf. http://finance.yahoo.com/. However, for the purpose of this work only the earnings and the growth forecast components are of direct interest, being input into the valuation models

[345] The original criterion requires expectations and target variables to be generated by the same stochastic process, MUTH, Theory, 1961, p. 316.

[346] GIVOLY, Expectations, 1985.

[347] KEANE/RUNKLE, Rational, 1998.

[348] LYS/SOHN, Revision, 1990.

[349] ALI/KLEIN/ROSENFELD, EPS, 1992.

[350] DEBONDT/THALER, Analysts, 1990.

[351] Cf. ABARBANELL/BERNARD, Explanation, 1992, p. 1205 and ESPAHBODI et al, Optimism, 2001, pp. 2-5.

[352] Sell-side analysts are predominantly also involved in other stock related services, creating a conflict of interest. Analysts argue that, although the major revenue-generating service is not the analysts' report for a specific stock but transactions related to it, division of authority safeguards independence. It is furthermore argued that no theory is known that explains why analysts publish forecasts instead of trading on them, LYS/SOHN, Revisions, 1990, p. 361. Moreover, positive forecasts influence revenue by augmenting demand, thus creating a potential conflict of interest, SCHIPPER, Forecasts, 1991, pp. 112-116 and DECHOW/HUTTON/SLOAN, Growth, 2000, p. 5. Regulation M restriction, which aims at keeping parties participating in the underwriting from manipulation, requires a quiet period during which publishing of recommendations is not permitted. SEC Rule 101. Furthermore, an incentive for positive recommendations can be seen in the importance of the relationship with the management of a company being followed. The management is ranked among the most important sources of information, SCHIPPER, Forecasts, 1991, p. 115. Lastly, Due to restrictions on the short-

However, IRVINE/SIMKO/NATHAN (2004) stress the positive externalities and find accuracy of the earnings forecast increases with the financial engagement in that particular company.[353] LIM (2001) shows that optimistic bias is merely the result of a trade-off to obtain management access, which actually minimizes expected forecast errors.[354] However, KOTHARI (2000) argues that overly optimistic forecasts of affiliated analysts do not necessarily show a deliberate bias resulting from the conflict of interest. The author argues that it is also possible that a company makes the underwriting decision according to past forecasts.[355] Also, DEBONDT/THALER (1990) argue that optimistic bias can be found in cases where the agency conflict does not exist.[356] An alternative explanation is suggested by GU/WU (2003). The authors argue that the bias is actually due to skewness in earnings distribution and occurs through maximizing forecast accuracy.[357] KOTHARI (2001) questions the reliability of the empirical results in general, due to possible differences in the two compared earnings numbers. That is to say, the frequently used Institutional Brokers Estimate System (I/B/E/S) data provider makes adjustments that might be responsible, at least in part, for the bias.[358]

Theoretical and empirical results can be generally considered supportive for using analysts' forecasts as surrogate for expectations. The finding that forecasts could be biased has prompted some studies to adjust for known biases.[359] However, isolating and quantifying bias is typically not straightforward and is therefore not pursued in this thesis. The fact that companies are typically followed by more than a single analyst can be used to level out individual differences. Therefore, aggregates are regarded superior

selling side sell recommendations generate less revenue than buy recommendations, ESPAHBODI/DUGAR/TEHRANIAN, Optimism, 2001, p. 2.

353 IRVINE/SIMKO/NATHAN, Affiliated, 2004. In this respect, earnings-related conference calls are found to decrease forecast errors, BOWEN/DAVIS/MATSUMOTO, Conference, 2002. Another study finds recommendations and growth forecasts by a company's underwriting firm to be more optimistic than those of non-affiliated analysts, but not earnings forecasts LIN/MCNICHOLS, Underwriting, 1998. Optimistic bias for both earnings forecasts and recommendations made by affiliated investment banks is found by DUGAR/NATHAN, Banking, 1995.

354 LIM, Rationality, 2001, pp. 369-385. Examining whether brokerage firms produce more accurate forecasts HODGKINSON (2001) cannot find any evidence. The author argues that additional information is either not obtained or not passed on through the forecasts, HODGKINSON, Broker, 2001, p. 959.

355 KOTHARI, Discussion, 2000, pp. 34-35, LIN/MCNICHOLS, Underwriting, 1998, p. 106 and KOTHARI, Research, 2001, pp. 55-56.

356 DEBONDT/THALER, Analysts, 1990, p. 56.

357 That is to say, in order to minimize the forecast error, analysts predict median instead of mean, GU/WU, Bias, 2003.

358 KOTHARI, Research, 2001, p. 53.

359 Cf. FRANCIS/PHILBRICK, Decisions, 1993, p. 229. Some authors find evidence that the market adjusts for part of the bias, GU/WU, Bias, 2003, pp. 5-29. Other authors find investors to naively accept analysts' forecast errors, DECHOW/SLOAN, Expectations, 1997.

over single forecasts.[360] Applying consensus forecasts is based on the notion that considered information differs and diversification reduces idiosyncratic error.[361]

Empirical research that applies analysts' forecasts to the computation of ex-ante risk premiums is mostly concerned with intrinsic value models. Risk premiums are thus computed as implied rates. As far as is apparent the first corresponding empirical study is by BOTOSAN (1997), who examines the effect of disclosure on the cost of capital. Emphasizing the drawbacks of historical values, the author applies the RIV in order to compute implied rates.[362]

However, apparently the first to explicitly apply this concept in order to measure the equity premium are CLAUS/THOMAS (2001), motivated by the equity premium puzzle.[363] Therefore, the study is only concerned with an upper bound for the risk premium, hence making non-conservative assumptions regarding growth rate.[364] The authors estimate discount rates that equate stock market valuation with prevailing future forecasts.[365] They apply three specifications of the CIM. Firstly, the Gordon-specification of the DDM, as discussed in Section 2.3.2. As proxy for the growth rate, analysts' forecasted long-term earnings growth is applied. Secondly, a RIV specification with five annual analysts' forecasts and a constant growth rate beyond year five. Thirdly, a specification of the RIV with time-varying discount rates, accounting for stochastic discount rates.[366] By subtracting the interest rate of 10-year T-bonds from thus obtained implicit discount rates, results for the risk premium are obtained. The authors conclude

[360] In this respect results can be significantly different if the most current, the single most active, or a mean forecast is used. The most recent forecast is used by BROWN, Analyst, 1997, the mean is used by BARRON et al., Forecasts, 1998.

[361] Cf. O'BRIEN, Forecasts, 1988.

[362] The author computes the cost of capital while testing her actual hypothesis that higher disclosure relates to lower cost of capital, BOTOSAN, Disclosure, 1997, p. 338.
LEE/MYERS/SWAMINATHAN (1999) stopped short before employing the RIV in order to identify whether value and price are cointegrated processes, LEE/MYERS/SWAMINATHAN, Dow, 1999.

[363] Due to the earlier publishing date of the study by GEBHARD/LEE/SWAMINATHAN (2001), it is often falsely attributed, cf. KWAK, Recalculating, 2002, p. 13. However, the correct order is recognized by GEBHARD/LEE/SWAMINATHAN, Implied, 2001, p. 137. Both studies were published as working papers in 1998.

[364] The purpose of the paper is to show that commonly estimated risk premiums on the basis of ex-post returns are excessively high, CLAUS/THOMAS, Empirical, 2001, p. 1630.

[365] The original study differentiates the implied discount rates by adding a star to the rate based on DDM k*.

[366] CLAUS/THOMAS, Empirical, 2001.

that historical premiums computed on the basis of historical data are inflated by approximately three percent.[367]

A similar study by GEBHARDT/LEE/SWAMINATHAN (2001) also applies the RIV and assumes a mean reverting process after three years of forecasted residual earnings. Through an algebraic restatement, the abnormal earnings variable is substituted by the forecasted return on equity.[368] The terminal value is simply computed as perpetuity at the end of the twelve year forecast period. Future book values are computed using the historical dividend payout ratios, specifically the quotient of dividend paid and earnings of the most recent fiscal year. Furthermore, share repurchases are excluded and negative earnings are approximated using a total asset heuristic, based on long-run averages. As opposed to CLAUS/THOMAS (2001), the study by GEBHARDT/LEE/SWAMINATHAN (2001) is not concerned with levels but with cross-sectional differences. The authors find evidence that four specific factors affect the discount rate implied by the market. Those factors are: industry affiliation, leverage, growth rate and dispersion in analysts' forecasts. The authors conclude that including these factors in investment decisions will help in identifying mispriced stocks.[369]

A third study by GARROD/VALENTINCIC (2005) investigates the time structure of interest rates for the United Kingdom. Using RIV, the authors apply the growth assumptions based on GORDON (1962) for the terminal value.[370] As specified in Equation (3.4) the discount factor K is allowed to vary in the first T-1 periods, subsequently being assumed constant.[371] If estimates for K_1 differ from estimates for K_2, a sloped term structure can be concluded. Abnormal earnings (e_a) are applied as capitalization object. Results show a positive linear trend. However, the trend is only significant beyond the first four periods. GARROD/VALENTINCIC (2005) argue that this is specific to the longest forecast windows for same-sample estimates, which is buttressed by the fact that when

[367] The authors find only small differences between risk premiums from constant and from time-varying discount rates, CLAUS/THOMAS, Empirical, 2001, p. 1630.
[368] For the fifth year the authors assume the 5-year growth forecasts. For the years beyond five, a reversal to the industry mean is applied.
[369] GEBHARDT/LEE/SWAMINATHAN, Implied, 2001.
[370] GORDON, Valuation, 1962, pp. 65-66.
[371] Usually the risk-free rate is assumed to be time-variant but the risk premiums are assumed to be constant, cf., LEE/MYERS/SWAMINATHAN, Dow, 1999, p. 1702.

omitting the last estimates the trend diminishes overall. Consequently, they conclude that using a flat term structure does not significantly impair empirical results.[372]

$$p_0 = b_0 + \frac{e_{a1}}{K_1} + \frac{e_{a2}}{K_1 K_2} + \frac{e_{a3}}{K_1 K_2 K_3} + \ldots + \frac{e_{aT}}{(k-g) K_1 K_2 K_3 \ldots K_{T-1}} \tag{3.4}$$

As broadly discussed in Section 2.3, all intrinsic value models require additional assumptions in order to be applied in econometric analysis. Empirical tests are unable to examine appropriateness straightforwardly, since true risk premiums are unobservable. Therefore typically three methods are used to gauge the quality of ex-ante premiums. The first two deal with the general appropriateness of a model, while the latter uses one of the first two methods to compare results from different specifications.[373]

Firstly, it is tested whether discount-rate estimators are positively related to common risk proxies. This approach follows the notion that high-risk exposure requires high compensation for risk, hence high deduction for assumed risk. However, this approach is determined by a risk factor's quality in capturing risk.[374] An empirical example is given by GODE/MOHANRAM (2001), who estimate the discount rate based on the OJM. In order to test the estimator's robustness, a pooled regression with a number of risk factors is performed. Factors considered relevant are return volatility, the number of analysts covering the particular firm as a proxy for the information environment, earnings volatility and leverage. The results show significant correlation with all variables even after controlling for industry effects.[375]

Secondly, it is tested for a positive relation with realized stock returns.[376] This approach is based on the fact that high-risk securities will gain higher returns. Since this assertion only holds on average, instead of individual stocks, average portfolio returns are examined. However, realized returns can be considered a noisy and biased proxy, since

[372] GARROD/VALENTINCIC, Implicit, 2005, pp. 1237-1243 and 1258. This result contradicts the finding that time-varying interest rates are essential for valuation, LEE/MYERS/SWAMINATHAN, Dow, 1999, pp. 1695-1696.
[373] Cf. GUAY/KOTHARI/SHU, Implied, 2005, pp. 6-7.
[374] Cf. BERK, Critique, 1995, pp. 284-285 and EASTON/MONAHAN, Evaluation, 2005, p. 503.
[375] GODE/MOHANRAM, Implied, 2001 pp. 6-8 and 15-16. Their results are consistent with BOTOSAN (1997), who find a positive relation between the estimators and the market beta as well as market value, which tests the consistency with the size-effect, BOTOSAN, Disclosure, 1997 p. 341.
[376] Cf. GUAY/KOTHARI/SHU, Implied, 2005, p. 7.

they can contain unexpected components.[377] An example for the second approach can be seen in GEBHARDT/LEE/SWAMINATHAN (2001), who divide their sample into quintiles based on discount rate estimators and subsequently examine the relation with observed returns. [378] Supportive results are also obtained by CLAUS/THOMAS (2001) and GODE/MOHANRAM (2003).[379] On the other hand, opposing results are derived by EASTON/MONAHAN (2005), who conclude analysts' forecasts to be inappropriately precise, due to a lack of timeliness.[380]

Thirdly, results from different specifications are tested against each other, regarding correlation with risk and realizations, being referred to as horse races. The most popular models examined are: DDM, a model based on the price-earnings-growth ratio derived from the DDM; OJM and a variety of RIV specifications that include GEBHARDT/LEE/SWAMINATHAN (2001), CLAUS/THOMAS (2001) and the finite Gordon Model. [381] As far as is apparent, currently three comprehensive studies are available: GUAY/KOTHARI/SHU (2005), BOTOSAN/PLUMLEE (2005), and EASTON/MONAHAN (2005).[382] Further studies such as CLAUS/THOMAS (2001) and GODE/MOHANRAM (2001) are less comprehensive.[383]

BOTOSAN/PLUMLEE (2005) investigate the ability of different specifications to explain a firm's risk. The authors compare the relation between implied risk premiums and the following risk proxies: unlevered market beta, leverage, information risk, firm size represented by market value of equity, book-to-price and earnings growth.[384] The earnings growth variable is emphasized due to the comparably strong effect on the OJM due to construction. For the entire sample period the authors find strong and persistent correlation among the estimates of all variations, which they interpret as evidence that the underlying construct is captured similarly. When evaluating the correlation between specific premium estimates and the explanatory risk variables, the authors conclude

[377] Cf. EASTON/MONAHAN, Evaluation, 2005, p. 531.
[378] GEBHARDT/LEE/SWAMINATHAN, Implied, 2001, pp. 150-154.
[379] CLAUS/THOMAS, Empirical, 2001 and GODE/MOHANRAM, Ohlson-Juettner, 2003.
[380] EASTON/MONAHAN, Evaluation, 2005, p. 503.
[381] GORDON/GORDON, Model, 1997, pp. 52-61.
[382] GUAY/KOTHARI/SHU, Implicit, 2005, BOTOSAN/PLUMLEE, Alternative, 2005 and EASTON/MONAHAN, Evaluation, 2005.
[383] CLAUS/THOMAS, Empirical, 2001 and GODE/MOHANRAM, Implied, 2001.
[384] By using unlevered instead of market beta, the leverage effect is isolated in the leverage variable. Information risk is proxied by the spread between the minimum and maximum analysts' forecast, which is acknowledged to capture more than just information risk, BOTOSAN/PLUMLEE, Alternative, 2005, p. 35.

that the DDM, as used in BOTOSAN/PLUMLEE (2002), and the price-earnings-growth model are consistently and persistently related. However, when using R^2 as a measure, the OJM would rank second. BOTOSAN/PLUMLEE (2005) neglect this measure and argue that it is not necessarily consistent with economic theory. That is to say, it only captures the correlation but does not judge whether the estimator follows the variables in the predicted manner.[385]

GUAY/KOTHARI/SHU (2005) examine the correlation with realized returns as gauge.[386] The authors use a regression model suggested by FAMA/MACBETH (1973), where the one-period percentage return on a security is explained by its implied discount rate.[387] The authors test the null-hypothesis that the average intercept coefficient for the implied discount rate is equal to zero and find none of the coefficients to be significantly different from zero. GUAY/KOTHARI/SHU (2005) suggest this to be due to the short sample period, the high level of error for the discount rate estimators due to terminal value, or growth assumptions. Lastly, the authors argue that sluggish analysts' forecasts include new information which is deferred compared to the market.[388]

The study by EASTON/MONAHAN (2005) includes two more variables than GUAY/KOTHARI/SHU (2005) in the regression, in order to prevent problems caused by inherent bias and noise of realized returns as proxy.[389] The authors regard these two variables as irrefutable drivers for stock returns: cash flow news and return news.[390] The idea is based on VUOLTEENAHO (2002), who decomposes compounded returns into three components: expected return, changes in expectations regarding future cash flows and changes in expectations regarding future discount rates.[391] However, EASTON/MONAHAN (2005) conclude that none of their estimates has a positive relation with realized returns for the entire sample. Only in some subsets, such as firms with low consensus long-term forecasted growth, do they find significant correlation.[392]

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385 BOTOSAN/PLUMLEE, Alternative, 2005.
386 The study includes: OJM, Gordon model, price-earnings growth, GEBHARD/LEE/SWAMINATHAN, Implied, 2001 and CLAUS/THOMAS, Empirical, 2001.
387 FAMA/MACBETH, Tests, 1973, pp. 611-612 and GUAY/KOTHARI/SHU, Implied, 2005.
388 GUAY/KOTHARI/SHU, Implied, 2005.
389 The models used are: P/E, four specifications of the OJM as described by EASTON, Implied, 2004, pp. 78-81, CLAUS/THOMAS, Empirical, 2001 and GEBHARD/LEE/SWAMINATHAN, Implied, 2001.
390 EASTON/MONAHAN, Evaluation, 2005, p. 504.
391 VUOLTEENAHO, Returns, 2002.
392 EASTON/MONAHAN, Evaluation, 2005.

Studies that compare a smaller number of models also yield relevant implications. In a comparison of the OJM and the RIV, GODE/MOHANRAM (2001) find higher explanatory power of the RIV before controlling of industry effects. Afterwards, the explanatory power drops considerably below that of the OJM.[393] However, it must be noted that comprehending the terminal value conundrum is not applied consistently. For RIV a flat rate terminal value assumption as in GEBHARDT/LEE/SWAMINATHAN (2001) is applied, with an industry growth rate.[394] The OJM is instead based on an individual growth rate, proxied by analysts' long term forecasts. Similarly, CLAUS/THOMAS (2001) conclude that results based on RIV are superior to the DDM and explain this by the greater weight of available data included in book value, which reduces the weight of the growth assumption.[395] Likewise, their implementation of DDM is not consistently equivalent to the implementation of RIV making conclusions regarding ordinal ranking questionable.

3.3 Concluding remarks

Both risk-free rates and risk premiums are theoretical concepts without a consistent counterpart for practical application. While the risk-free asset is defined objectively by zero-variance, conceivable candidates involve risk factors that cannot exhaustively be eliminated. Consequently, it is concluded that the risk-free rate can only be approximated by minimizing residual risk, yielding a quasi risk-free rate. With respect to an alternative risk-free investment for common shares, long-maturity government bonds are broadly considered satisfactory.

Risk premiums reflect how much monetary compensation agents require for the assumption of risk. Determined by specific risk preference, this varies from individual to individual. When regarding the market as a whole, the interplay of supply and demand leads to market risk premiums, reflected in prices. Consequently, risk premiums can be obtained indirectly from identifying the difference between expected value and market prices. It is theorized that this difference compensates for the time value of money and the assumed risk. Therefore, risk premiums result after correcting for the objective risk-free rate. The central shortcoming is the fact that expected value is equally unobserva-

[393] GODE/MOHANRAM, Implied, 2001, pp. 10-12.
[394] GEBHARD/LEE/SWAMINATHAN, Implied, 2001, pp. 141-142.
[395] CLAUS/THOMAS, Empirical, 2001, p. 1644.

ble. Therefore, risk premiums are categorized according to the perspective of the expectation surrogate. Ex-post risk premiums, assume that historical realizations can appropriately act as a proxy for expectations. However, while this requires identifying an approximate stochastic process, it disregards unexpected components. Alternatively, ex-ante risk premiums apply specialist expectations as surrogates, assuming that this group shares a perception representative for the market as a whole.

The most promising empirical method can be seen in the computation of a comprehensive implicit market discount rate, based on analysts' forecasts as ex-ante expectations, which can subsequently be decomposed into risk-free rate and risk premium. However, it must be noted that thus obtained discount rates depend on the model's underlying assumptions and the goodness of the proxies used.

4 International portfolio investment

Globalization of financial activity, which comprehends cross-border trades in financial assets, has initiated the formation of a world financial market. Clearly, this process has not been concluded since the establishment of a single global capital market has not been finalized.[396] While political and macroeconomic developments go beyond the scope of this thesis, the impact on portfolio investment is part of its theoretical basis since it encompasses investments by agents from different nations.[397]

The affect of financial globalization on Finance is the subject of international portfolio investment (IPI).[398] The central part of IPI is the augmentation of the institutional framework of classic portfolio theory.[399] Consequently, IPI deals foremost with prices in a global environment.

Under the classical portfolio theory assumption of perfect capital markets, investing internationally is a natural consequence of optimal portfolio theory and leads to a perfectly integrated world capital market. A central consequence is price and portfolio equivalence among countries, also referred to as country-irrelevance.[400] While classical portfolio theory does not explicitly address other countries and currencies, those can nevertheless be consistently comprehended, by assuming a neutral effect on investment decisions. However, relaxing this assumption yields changes in specific aspects due to additional benefits and risks.

The first part of this chapter deals with implications of an international perspective. Therefore, supplementary risk will be discussed in the following section. Benefits that stem from extended opportunities of diversification are discussed in Section 4.1.2. Subsequently, equilibrium models are augmented to an international perspective. The

[396] For a discussion cf. BEDDOES, International, 1999, pp. 16-17.
[397] For a balanced view of this politically and economically highly controversial issue cf. STULZ, Limits, 2006 and STULZ, Globalization, 1999.
[398] Cf. BARTRAM/DUFEY, International, 2001, p. 86. Alternatively, the term international asset pricing (IAPM) has been suggested by SOLNIK, Theory, 1983b, p. 449.
[399] IPI only releases assumptions on the institutional aspect of perfect capital markets. Assumptions regarding agents are not relaxed.
[400] Cf. STULZ, Limits, 2006, p. 1595. In this paper countries are separated in the monetary economics' sense of having different currencies. Sovereignty of subsets within a currency area is also considered a separate country. In this context, the international CAPM by SOLNIK (1974a) can be considered to be particular, since it understands a country to be a region with common purchasing power, ADLER/DUMAS, International, 1983, pp. 925-926.

second part deals with the integration of world markets and examines to what extent a global integrated capital market can be presumed. Finally, equilibrium and intrinsic value models are augmented to account for segmented markets.

4.1 Investing in a global environment

4.1.1 International-investment specific risks

When the assumption of neutrality of multiple countries and currencies for investment decisions is dropped, investors will be subjected to exchange and country risk. The former is concerned with the changes in relative currency values, also called currency risk. The latter deals with the particular political jurisdiction also referred to as political risk.[401]

Because of scientists' profound understanding of foreign exchange markets, exchange rate risk is manageable and estimated on average around 10-15% of total risk for equities.[402] Exchange rate risk is partly diversifiable, if investments in different currencies with non-unity correlations are made, and hedging instruments such as currency forwards are available.[403] In this respect, exchange rate risk can be conceived as variability and covariance with other currencies.[404]

The impact of country risk is due to government policies that take effect after an investment is made, also termed political risk. It is typically divided into three subcategories: risk of being able to transfer investments cash flows (transfer risk), risk due to constraints on management (operational risk) and risk that policies are prolonged that affect the ownership of the investment or that management acts differently from expectations, possibly due to a lack of corporate governance means (ownership-control risk).[405] Furthermore information barriers, for instance due to language problems or transparency, can be regarded as a factor of country risk. Since country risk is consti-

[401] BIEG (1999) splits country risk into economic and political risk. Accordingly, economic risk is defined as the risk that the foreign state will not be able to make payments to foreign creditors due to a lack of foreign exchange. Political risk is defined as the risk that, despite being able to pay, a state withholds the payments, BIEG, Kreditinstitute, 1999, pp. 193-194.
[402] Cf. DUMAS/SOLNIK, Exchange, 1995.
[403] Cf. BARTRAM/DUFEY, International, 2001, pp. 113-116 and EUN/RESNICK, Exchange, 1988, p. 214.
[404] Cf. EUN/RESNICK, Exchange, 1988, p. 202.
[405] Cf. BARTRAM/DUFEY, International, 2001, pp. 115-116.

tuted by a number of factors which are intricate to quantify, which include both economical and political developments, an operationalization is complicated. Therefore, appraisal and diversification of country risk remains difficult.[406]

4.1.2 Augmentation of the standard portfolio selection

Limitations of the classical portfolio theory have become obvious from empirical findings of apparent arbitrage opportunities in foreign markets. These findings, referred to as market phenomena, appear to contradict classical theory. An example can be seen in the Chinese discount puzzle, discussed in detail in Chapter 7. Motivated by these phenomena, IPI augments classical portfolio theory by ascribing deviations to certain market imperfections. Being part of Finance, IPI is not a comprehensively exhaustive theoretical framework, but a compendium of isolated hypotheses, each of which explains the consequence of one or more market imperfections from a global perspective.

As discussed in Section 2.2.1, the perfect capital market can be considered to be the basis of classical portfolio theory. It is based on three major assumptions: homogenous expectations, existence of universal interest rates and absence of frictions. These assumptions cannot be made unambiguously wherever an international environment is concerned.

The existence of different currencies precludes a nominal risk-free rate that is universal to all investors.[407] However, a common risk-free rate could nevertheless be assumed, provided a security with zero risk in real terms.[408] This reasoning is based on the purchasing power parity theory (PPP), which changes perspective regarding value of money from external (foreign trade) to internal (buying power). The theory, attributed to CASSEL (1916), results from the law of one price, which is discussed in detail in Chapter 7.[409] PPP states that the real price of goods must be equal throughout countries due to arbitrageurs' activities.[410] Aggregated to an economic level, inflation differentials

[406] This procedure is in accordance with BARTRAM/DUFEY, International, 2001, pp. 115-116.
[407] The pricing of foreign exchange rate risk among international investors has been shown by DUMAS/SOLNIK, Exchange, 1995.
[408] Cf. SOLNIK, International, 1977, p. 506.
[409] CASSEL, Exchange, 1916.
[410] ADLER/DUMAS (1983) distinguish PPP from commodity price parity. The authors argue that the latter requires the price of individual goods to be equal, whereas PPP deals with weighted average price levels, ADLER/DUMAS, International, 1983, p. 929.

between two countries must be perfectly offset by a change in corresponding exchange rates, making real prices equal. With respect to financial investment, real asset returns are therefore independent of an investor's currency zone.[411] However, the theoretical validity of PPP is controversial. Criticism can be summarized in a consumption as well as a market segmentation argument.

The consumption argument reasons that individuals essentially face two channels where income can be allocated: consumption and financial investment. Since only consumption contributes to utility, financial investment is considered a means to transform consumption according to the individual's time preferences and maximize available income for consumption through positive net-present-value investments.[412] This is summarized in the Fisher separation that theorizes that optimal consumption and investment decisions are made independently.[413] However, when national consumption preferences differ, it is not consistent to consider the financial investment problem isolated. Thus a link between security and commodity market is established. The reasoning is that goods will be valued - and hence priced - differently. As a result, consumption preferences affect the foreign exchange rate risk, which determines the willingness to pay. From this perspective, it makes a difference whether an investor spends his income only on domestic goods or consumes global goods also.[414] For an investor who consumes foreign goods as well, investing in foreign securities can have a hedging effect for the internationalized consumption basket.[415] Consequently, exchange rate risk on the consumption side can affect international investment decisions and thus influence security prices. From this violation of the PPP, the existence of a universal risk-free rate cannot be assumed. In this respect IPI augments classical portfolio theory by allowing the demand for foreign assets to depend on the objectives and habits of investors, summarized as inhomogeneous consumption preferences.[416]

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411 Cf. SOLNIK/MCLEAVEY, Investment, 2004, pp. 49-51.

412 Cf. FRANKE/HAX, Kapitalmarkt, 2004, pp. 150 and 216-217 and BARTRAM/DUFEY, International, 2001, p. 88.

413 FISHER, Theory, 1930. The separation holds because unlimited borrowing and lending enables an investor to arrange his pattern of consumption, so that both the kinds of goods consumed and the timing is independent of investment decisions.

414 Cf. CHOI, Consumption, 1984.

415 Cf. BARTRAM/DUFEY, International, 2001, pp. 97-100.

416 It can be noted that inhomogeneous consumption preferences are not among the necessary conditions for perfect capital markets. However, where different currencies are concerned, market segmentation can yield violation of classical portfolio theory.

The segmentation argument is based on the fact that the classical portfolio theory assumes frictionless markets without restraints on investment. While this assumption is typically understood as direct impediments such as taxes, tariffs and transaction costs, it ultimately also has an indirect implication. On the one hand, transaction costs eliminate the possibility of trading infinitesimally small fractions of the market portfolio. On the other hand, taxes and tariffs can lead to effective market segmentation, deterring investors from perceiving the same efficient frontier.[417] As a consequence, in a multi-currency perspective, inhomogeneous consumption preferences yield an outcome akin to market imperfections. This indirect market segmentation is not consistently referred to as a form of segmentation since no barriers for international investment exist.[418]

Theoretical arguments against the PPP are also supported by empirical research.[419] While short-term results are not supportive, attributed to extreme volatility in foreign exchange markets, evidence in the long-term is mixed and overall not promising.[420] SOLNIK/MCLEAVEY (2004) conclude that "virtually all studies indicate that purchasing power parity does not hold."[421] However, since homogenous consumption preferences as well as integrated markets are merely necessary conditions for PPP, the causing factor is unknown. Consequently, theoretical extensions typically assume only a single deviation in order to remain operationalizable. In either case, implications for portfolio theory stem from the fact that deviations from PPP cause investors to earn different real returns, thus affecting their investment perception and ultimately causing them to hold different portfolios.[422] For this reason equilibrium models have been extended in order to allow for deviation from perfect capital market assumptions. The following section provides an overview of selected extensions without being comprehensively encompassing.[423]

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417 Cf. BARTRAM/DUFEY, International, 2001, pp. 108-109.

418 Cf. STULZ, Model, 1981, p. 385.

419 The popularity of this field is due to important implications in different fields of economic theory and its central role for IPI.

420 Supporting results are ROGOFF, Purchasing, 1996, SOLNIK/MCLEAVEY, Investment, 2004, LEVICH, International, 2001, p. 121, LOTHIAN/TAYLOR, Exchange, 1996 and KRUGMAN, Purchasing, 1978. For negative results cf. ENGEL, PPP, 2000 and ADLER/DUMAS, International, 1983. Empirical problems arise when the price level is proxied with published consumer price indices, since those must reflect consumption possibilities and preferences accurately.

421 SOLNIK/MCLEAVEY, Investment, 2004, p. 164.

422 Cf. ADLER/DUMAS, International, 1983, pp. 929-931.

423 The violation of PPP can be regarded as highly relevant with respect to China. This is because PPP is naturally unlikely to hold because of the peg between CNY and USD throughout most of the sample period. The purchasing power of USD 1 exchanged in CNY and spent in China is said to buy more

4.1.3 International equilibrium models

By abstracting from existing financial markets, both standard CAPM and APT do not specifically address the issue of international investment or the existence of different currencies.[424] In order to close this gap, a variety of extensions from the standard CAPM have been suggested, uniformly termed international CAPM.[425] Generally, their development is equivalent to the standard model. Firstly, individual optimal portfolios are formed on the basis of assumptions regarding capital markets and agents. Subsequently, aggregation and market clearing leads to equilibrium prices and mean-variance trade-off.[426]

The most straightforward CAPM that explicitly comprises international investments adopts all assumptions of the standard CAPM, hence differing only in the more specific definition of the market portfolio as a broad world market portfolio.[427] It can be attributed to GRAUER/LITZENBERGER/STEHLE (1976).[428] The universal world market portfolio, held by any investor depending on the individual investor's degree of risk aversion, includes all securities, which do not perfectly correlate with the market portfolio, in proportion to their market value.[429] In an attempt to empirically test this internationalized version of the standard CAPM, KORAJCZYK/VIALLET (1989) obtain no clear difference between the usages of international or domestic benchmark portfolios.[430] The restrictive assumptions are harshly challenged, since, with respect to IPI, they imply all

than the exact same dollar in the USA. For instance in 2003 the PPP conversion factor of one USD for CNY was equal to 1.8, while the exchange rate is around 8.28 USD/CNY, WORLDBANK, Indicators, 2005, p. 1. For problems with estimates of real exchange rates cf. DUNAWAY/LEIGH/LI, China, 2006. The decade-long peg to the US-Dollar was ended July 21st 2005. According to official statements by the PBOC, it has been substituted by a basket of currencies, including Euro, Yen, British Pound and Korean Won.

424 Cf. STEHLE, International, 1977, p. 495 and SOLNIK, Theory, 1983b, pp. 449-451.

425 Since there is not a single international CAPM the often-used abbreviation ICAPM is not applied in this thesis.

426 Cf. ADLER/DUMAS, International, 1983, p. 925.

427 Cf. SOLNIK/MCLEAVEY, Investment, 2004, pp. 143-144, AGAR, Investment, 2005, pp. 184-186 and IBBOTSON/CARR/ROBINSON, International, 1982. BRELAEY/COOPER/KAPLANIS (1999) emphasize that this model effectively equals the standard CAPM, BRELAEY/COOPER/KAPLANIS, International, 1999, p. 104. LEVICH calls this a CAPM that is "made to 'look' international", LEVICH, International, 2001, p. 578.

428 GRAUER/LITZENBERGER/STEHLE, International, 1976. Referring to its founders, it is also referred to as GLS international CAPM.

429 Cf. SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 876, BODIE/KANE/MARCUS, Investments, 1999, p. 787 and STEHLE, International, 1977, p. 493.

430 KORAJCZYK/VIALLET, International, 1989. Similar results are obtained by STEHLE, International, 1977. Non-supportive evidence for a world portfolio are found in JORION/SCHWARZ, Segmentation, 1986.

investors in the world have identical consumption patterns and real prices of consumption goods to be identical throughout those countries.[431] LEVICH (2001) rejects this as obviously unrealistic.[432]

Relaxing the standard assumptions reveals three major aspects to account for. Firstly, exchange rate risk is regarded differently in different countries.[433] Secondly, consumption preferences differ, subjecting countries to different inflation risks.[434] Thirdly, country specific barriers or obstacles for international investment, such as taxes, preclude universal mean-variance efficiency.[435] Attempting to account for all three aspects, including interdependencies, necessarily leads to substantial intricacy. Therefore, augmentations typically focus on a single aspect. Since perfectly integrated capital markets are a necessary condition for PPP but not the other way around, it is less complex to commence with the latter.

SOLNIK (1974A) allows for violation of PPP, revoking country-irrelevancy. Exchange rate risk emerges, since investors are concerned with returns in their domestic currency. Therefore, investors do not uniformly consider assets to have identical characteristics. Maintaining the assumption of homogenous expectations preserves consensus regarding the return in the asset's currency. However, fluctuations in the exchange rate and disappearance of a universal risk-free asset require adjustment of the standard CAPM. Consequently, the SOLNIK (1974A) international CAPM takes exchange rate risk and different interest rates into account.[436] Accordingly, the expected return of an asset is defined analogous to the standard CAPM, with the difference that the world market portfolio determines the risk premium on the market portfolio and a second risk premium for the currency risk RP_j. The premium accounts for the covariance of each asset with all exchange rates involved and is measured in the investor's domestic currency.[437] It is expressed as the sensitivity χ_j of an asset's return to the J various exchange rates. The portfolio selection problem broadens, since the position held by an investor extends from the domestic risk-free asset and the proportion of the world market portfolio

[431] Cf. SOLNIK/MCLEAVEY, Investment, 2004, p. 147.
[432] LEVICH, International, 2001, pp. 577-579.
[433] Empirical tests support models that account for exchange rate risk. Cf. ZHANG, International, 2006.
[434] Cf. BODIE/KANE/MARCUS, Investments, 1999, p. 803.
[435] Cf. BARTRAM/DUFEY, International, 2001, p. 89.
[436] SOLNIK, Model, 1974a.
[437] Cf. SOLNIK/MCLEAVEY, Investment, 2004, pp. 153 and 162-164.

to a second component, concerned with hedging currency risk.[438] The equilibrium risk-pricing relation can therefore be stated as in Equation (4.1). Exchange risk for both the risky asset and the risk-free security are enclosed in the exchange risk premium, depending on the average investor's risk exposure.[439] Analogous to the standard CAPM, this model is also driven by all investors' mean-variance optimization. However, every investor will hold two portfolios: the world market portfolio, as a universal risky portfolio, and a country-specific hedge portfolio.[440] This second portfolio depends on relative wealth, foreign investment position and average country risk aversion.

$$E(r) = r_f + \beta(r_m - r_f) + \sum_{j=1}^{J} \chi_j RP_j \tag{4.1}$$

However, the variables constituting the hedge portfolio are unobservable, impairing the practical use of the SOLNIK (1974A) international CAPM.[441] Furthermore, it must be noted that the extension inherits the general drawbacks of the standard CAPM: the elusiveness of the market portfolio and the stochastic nature of the sensitivity parameters β and χ.[442] Empirical results are mixed and predominantly not supportive.[443]

The second aspect of PPP, the heterogeneity of investors' consumption preferences across different countries, is accounted for in an alternative international CAPM suggested by STULZ (1981).[444] The model asserts that investors from different countries, who have identical utility functions, will value assets differently, if available consumption opportunity sets differ. According to the model, real expected returns are explained by the covariance of the assets' home country return with changes in world real con-

[438] Cf. BARTRAM/DUFEY, International, 2001, p. 89.
[439] Cf. SOLNIK/MCLEAVEY, Investment, 2004, p. 156.
[440] Cf. ADLER/DUMAS, International, 1983, pp. 939-944.
[441] SOLNIK/MCLEAVEY, Investment, 2004, pp. 152-158, BARTRAM/DUFEY, International, 2001, pp. 89-90 and ADLER/DUMAS, International, 2004, pp. 949-950.
[442] SOLNIK/MCLEAVEY, Investment, 2004, pp. 160-162 and 169 and ZHANG, International, 2006, p. 302. The elusiveness of a market portfolio remains for international CAPM also, cf. ROLL, Critique, 1977 and ADLER/DUMAS, International, 1983, p. 954. Cf. HARVEY, World, 1991 and BARTRAM/DUFEY, International, 2001, p. 90.
[443] Cf. ENGEL, International, 1993, BARTRAM/DUFEY, International, 2001, DUMAS, International, 1994, DUMAS/SOLNIK, Exchange, 1995 and ZHANG, International, 2006.
[444] An international extension of the intertemporal CAPM, which does not require PPP, has been suggested by NG, International, 2004. The consumption preference issue is also addressed in ENGEL, International, 1993, p. 19, BARTRAM/DUFEY, International, 2001, p. 90 and STULZ, Model, 1981, pp. 384-385.

sumption rates.[445] However, the author does not specifically model these consumption differences and recommends the development of a simpler model. He further concedes that the supply of consumption data is not suited for an empirical analysis and consumption factor loadings are likely to be stochastic.[446] As far as is apparent, the international CAPM suggested by STULZ (1981) does not appear to have been the subject of empirical research.

In general, empirical application of international CAPM extensions appears not to be particularly operationalizable. A major limitation is clearly the necessary assumption of perfectly integrated markets. From this perspective it is understandable that, instead of dealing with comprehensive models, research has primarily focused on partial hypotheses. In this respect the SOLNIK (1974A) international CAPM can be decomposed into three assertions: currency risk is priced, no pricing of domestic but only global market risk and no other firm's attributes are priced.[447] Evidence for the pricing of currency risk is obtained by DUMAS/SOLNIK (1995).[448] Tests that compare the pricing of global and domestic risk factors show mixed results. While studies that focus primarily on developed markets tend to be supportive, studies that include emerging markets are not.[449] With respect to other firm's attributes, FAMA/FRENCH (1998B) find a value premium that contradicts the fundamental concept of the standard CAPM.[450] However, as GRIFFIN (2002) points out, this approach is always a joint test of a market integration hypothesis.[451]

Aside from the CAPM, the reasoning of APT can also be conveyed on an international level.[452] In general, necessary assumptions remain unaffected when extended to a global context. Since the ideal model based on the APT contains all risk factors, no adjust-

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445 Another alternative that assumes full integration, allows for consumption preferences to be heterogeneous across nations and does not require PPP to hold is suggested by ADLER/DUMAS, International, 1983.
446 STULZ, Model, 1981.
447 SOLNIK/MCLEAVEY, Investment, 2004, pp. 169-170.
448 DUMAS/SOLNIK, Exchange, 1995.
449 Supportive results are obtained by DESANTIS/GERARD, 1997 and HARVEY, World, 1991. Unsupportive results by GRIFFIN, Global, 2002 and BEKAERT/HARVEY, Integration, 1995.
450 FAMA/FRENCH, International, 1998b.
451 GRIFFIN, Global, 2002, pp. 786-787.
452 Suggested factors include: GDP growth, since common factors are regarded differently for countries in varying states of the economic cycle. Foreign exchange rates play an important role since firms that rely heavily on exporting are more affected, SOLNIK, Theory, 1983b, pp. 453-454 and SOLNIK/MCLEAVEY, Investment, 2004, pp. 292-293.

ment is necessary.[453] However, empirical results on international factor models are unable to identify common factors that would support an international universality of the APT.[454] GRIFFIN (2002) compares the explanatory power of the FAMA/FRENCH (1995) three-factor model with the domestic, world and international three-factor model following FAMA/FRENCH (1998B).[455] The author concludes that it does not appear beneficial to extend the three-factor model to a global context.[456]

Violation of APT could be conceived twofold. Firstly, inhomogeneous consumption preferences could violate PPP leading to a country-specific risk component. Consequently, a universal linear relationship will not exist.[457] Secondly, differing arbitrage costs across countries due to market segmentation challenge the APT in its foundation. For these reasons an international APT does not appear promising.

While theoretical specifications of an international CAPM are able to remain consistent when PPP cannot be assumed, deviations from perfectly integrated markets preclude the existence of the universal market portfolio as common ground for the CAPM.[458] Both the SOLNIK (1974A) and the STULZ (1981) international CAPM have been developed under the assumption of perfect integration. In the other extreme, in perfectly separated markets, the standard CAPM could consistently be applied.[459] In this respect, applying either one of them implicitly assumes either perfect segmentation or integration. Consequently, deviations from the two poles can be partly drawn upon to explain amendable results obtained by empirical tests.

STULZ (2006) argues that the country of incorporation remains the most important factor for asset returns - an observation hardly compatible with perfect market integration.[460] Consequently, the subject of global financial market integration can be considered central for IPI. The following sections address the issue of market integration.

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[453] Note that factors based on accounting information are heterogeneous due to dissimilar accounting principles across countries and therefore only of limited use, LEVICH, International, 2001, pp. 581-582.

[454] Cf. CHO/EUN/SENBET, International, 1986, pp. 313-329, KORAJCZYK/VIALLET, International, 1989, pp. 553-585 and SOLNIK, Empirical, 1974b.

[455] FAMA/FRENCH, International, 1998b. The domestic version uses only domestic factors, the world version only global factors and the international version uses both.

[456] GRIFFIN, Global, 2002.

[457] This problem might also apply on the risk-free rate due to the lack of a universal risk-free rate, SOLNIK, Theory, 1983b, p. 451.

[458] Cf. STULZ, Model, 1981, p. 383.

[459] Cf. BARTRAM/DUFEY, International, 2001, p. 89.

[460] STULZ, Limits, 2006, p. 1596.

4.2 Integration of world markets

4.2.1 Market segmentation hypothesis

As mentioned above, market integration has extensive implications on equilibrium models. Furthermore, it also affects the application of intrinsic value models. Although, when abstracting from agents value is universal and both country and currency independent, these environmental characteristics become important when separated market segments are concerned.[461] Because of its pervasive effect, capital market integration has become a popular area of both theoretical and empirical research.

The assumption of perfectly integrated capital markets, which derives from the assumption of frictionless markets, can be challenged theoretically. An intuitive argument against the assumption that all national financial markets are integrated can be seen in countries such as the Democratic People's Republic of North Korea, whose capital market can be regarded as highly separated from the rest of the world.[462] While the area between those two poles can be regarded as continuous, typically two intermediate categories are distinguished: partial and mild segmentation. Both forms differ in the set of available securities termed eligible and ineligible securities. In this respect, mild segmentation describes a market where one subset of the investors can invest in all securities while the other can only invest in the eligible subset. Correspondingly, in a partially segmented market, all investors can purchase eligible stocks but ineligible securities are restricted to one of the two groups.[463] In order to describe the institutional environment the empirical analysis of this thesis is concerned with, a third sort of segmentation is to be defined. In this respect imperfect integration refers to a market where both groups of investors are partly kept from investing in the other group's segment, without further specifying the cause or the intensity.[464] It hence covers the area between the two poles.

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[461] Cf. SOLNIK/MCLEAVEY, Investment, 2004, p. 141.

[462] North Korea took the last position in the 2008 index of economic freedom by the Wall Street Journal and the Heritage Foundation. Accordingly, business freedom, investment freedom, trade freedom, financial freedom, freedom from corruption and labor freedom are nonexistent, WSJ/WHF, Index, 2009.

[463] Cf. ERRUNZA/LOSQ, Segmentation, 1985, p. 107 and CHAIEB/ERRUNZA, Segmentation, 2007, pp. 553-554.

[464] Constitent with SOLNIK/MCLEAVEY, Investment, 2004, p. 111.

The theoretical centerpiece is the so-called market segmentation hypothesis.[465] However, the term is misleading since it is not a clearly defined hypothesis but a buzzword for the field of research that deals with financial market segmentation. Its application is typically twofold: evaluation of impediments and adherence to the law of one price.[466] The law of one price requires two securities that posses equivalent risk characteristics to have equivalent expected return in real terms and independent of the location of trading, and is discussed in detail in Chapter 7.

With respect to the former, SOLNIK (1977) suggests the "efficient way to test for segmentation would seem to be to specify the type of imperfection which might create it and study its specific impact on portfolio optimality and asset pricing".[467] In this manner SOLNIK/MCLEAVEY (2004) ascribe segmentation to existing impediments, which can be individual or institutional. The authors argue that these constraints inhibit capital mobility. Among the first kind are psychological barriers, language differences and subjective perception of transparency. Institutional factors considered relevant are legal restrictions, transaction costs, discriminatory taxes, the absence of legal protection and the predictability of legal decisions.[468]

A popular point of departure is to consider financial globalization, since it can be considered to be an international process that reduces impediments. Caused by global financial liberalization measures, interdependence among markets can be considered to be considerably increased. However, due to its dynamic nature, measuring globalization is not uncontroversial. The most straightforward approach is to evaluate legal barriers.[469] The annual report on exchange arrangements and exchange restrictions by the International Monetary Fund provides relevant data.[470] However, this report is indistinctive, since it does not quantify the level of restriction and does not account for indirect barriers, such as taxes.[471] The Index of Economic Freedom, published yearly by the World Heritage Foundation and the Wall Street Journal, includes a national ranking

[465] Cf. SOLNIK, International, 1977, p. 505.
[466] Accordingly, if two securities posses equivalent risk characteristics, their expected return must be equivalent in real terms and independent of the location of trading.
[467] SOLNIK, International, 1977, p. 505.
[468] SOLNIK/MCLEAVEY, Investment, 2004, pp. 140-143 and BARTRAM/DUFEY, International, 2001, pp. 116-125.
[469] "over the last 50 years, the legal and regulatory barriers to international investment have largely disappeared among developed economies", STULZ, Globalization, 1999, p. 8.
[470] IMF, Exchange, 2006.
[471] Cf. WALTER, Global, 2002, p. 2.

regarding financial and investment freedom. Its solely institutional perspective is based on policies toward foreign investment and internal capital flows, as well as restrictions on opening and operating financial services firms.[472]

However, the inhomogeneity of the relevant impediments cannot consistently be accounted for in the weighting methodology, making results heuristic. When conclusions regarding the overall integration are to be made, it should be noted that the liberalization of trade in financial assets can be considered a necessary condition for integration, since it establishes opportunities, while other factors might inhibit investors from exploiting them. In this respect, STULZ (2006) distinguishes between the reduction of formal barriers and de facto integration. Country-irrelevancy can consequently only hold in the absence of both kinds of barriers.[473] HARVEY (1998) distinguishes official regulatory liberalization and indirect access through investment vehicles such as American or Global Depository Receipts (ADR/GDR). The author points out that despite regulations that technically close a market to foreign investors, it could nevertheless be effectively open.[474] In this respect BEKAERT/HARVEY/LUNBLAD (2003) emphasize that liberalization actions can be conceived to have no effect, because the market has previously been integrated or the action is not regarded as sustainable.[475] Supportive empirical evidence has been obtained by BEKAERT/HARVEY (1995), who identify markets that appear comparably accessible for foreigners to be effectively segmented.[476] It is therefore expedient to differentiate between globalization of the financial system and financial market integration.[477] In response STULZ (2006) introduces a theoretical framework - the twin agency problem - as an explanation for effective limited financial market integration in the absence of legal cross-border barriers. He argues that rulers of sovereign states and corporate insiders cause expropriation risk, thus making investment for foreigners less attractive.[478]

[472] Cf. BEACH/KANE, Methodology, 2008, pp. 39-55.
[473] STULZ, Limits, 2006, pp. 1595-1598. The importance is also stressed in BEKAERT/HARVEY/LUNDBLAD, Emerging, 2003, p. 276.
[474] HARVEY, Emerging, 1998, p. 7.
[475] BEKAERT/HARVEY/LUNDBLAD, Emerging, 2003, p. 276.
[476] BEKAERT/HARVEY, Integration, 1995. Consistent empirical results are obtained by NISHIOTIS, Segmentation, 2004.
[477] Cf. NORMANDIN, Integration, 1999, p. 16.
[478] STULZ, Limits, 2006.

Since the absence of legal impediments cannot be equated to market integration, it appears practical to pursue an indirect method.[479] A suggested approach is to conclude integration from the amount of international capital flows. However, this method is merely a relative measure and subjected to double counting, substantially impairing its usefulness. Instead the most popular alternative gauge for financial market integration is the adherence with the law of one price.[480] Two approaches are typically followed: a direct approach, comparing equivalent assets in different markets, and an indirect approach, identifying a universal price relation. While the former can theoretically measure the level of integration, the latter can only yield binary results of either perfect integration, in cases when a universal relation is identified, or segmentation in cases when it cannot be identified.

A practical subject for the former approach can be seen in international cross-listings. Cross-listings enable a company to expand access to funds by mitigating investment barriers.[481] If a company issues securities with equivalent rights at stock exchanges in different countries, given a fully integrated market, both prices will be identical after adjusting for exchange rate and transaction cost differences.[482] While, due to additional placing costs, the pure existence of cross-listings is only economically justifiable in the absence of perfect integration, the price differential could be considered a gauge for the level of integration.[483] Besides classical cross-listings, foreign companies face alternative ways such as the issuance of ADR/GDR, which have become a popular cross-border trading instrument.[484] While ADR/GDR can theoretically be exchanged for the underlying common stock, nevertheless several reasons justify variation from the law

[479] This approach has also been suggested by BRELAEY/COOPER/KAPLANIS, International, 1999, p. 105.
[480] Cf. WALTER, Global, 2002, p. 2.
[481] Cf. FOERSTER/KAROLYI, Segmentation, 1999, p. 988 and SOLNIK/MCLEAVEY, Investment, 2004, pp. 214-215, For an extensive review of motivations for cross-listings cf. PAGANO/RÖELL/ZECHNER, Listing, 2002.
[482] Cf. SOLNIK/MCLEAVEY, Investment, 2004, p. 217. An example can be seen in the first global registered share certificates: Daimler Chrysler GRS. in 1998 the security was effectively traded on 21 different stock exchanges. Shares bought in Frankfurt can be sold in New York, so that arbitrageurs can be expected to maintain price equivalence, cf. KAROLYI, Global, 2003. Others include UBS AG and Deutsche Bank AG.
[483] The argument of cross-listings being perceived as increasing the international image of a firm is sometimes regarded as an example for cross-listings in perfect integrated markets, PAGANO/RÖELL/ZECHNER, Listing, 2002, p. 2659. BAKER/NOFSINGER/WEAVER (2002) find a significant increase in visibility, measured by journalists' and analysts' coverage of cross-listed firms, BAKER/NOFSINGER/WEAVER, Visibility, 2002. However, it can be argued that a positive effect from cross-listings could be due to different perception and hence psychological segmentation, SOLNIK/MCLEAVEY, Investment, 2004, pp. 214-217.
[484] Cf. KAROLYI, Global, 2003, p. 409.

of one price. This is because ADR/GDR are partly traded over the counter. Consequently, lower liquidity can cause increasing bid-ask spreads. Furthermore, ADR/GDR are based on a different cost structure than common stocks because of intermediaries.[485] For this reason it is not apparent how country risk can be isolated from comparing stock prices and ADR/GDR, without relying on broad heuristics.

Instead of examining ADR/GDR, another heuristic method that deals with prices directly is conceivable. It is based on the reasoning that, ceteris paribus, integration leads to higher stock prices, since investors get access to extended diversification opportunities and information.[486] This relation was examined by ALEXANDER/EUN/JANAKIRAMANAN (1988), who evaluated a broad sample of securities from several foreign countries that are dual-listed in the U.S. and abroad. Hypothesizing that cross-listings should lead to a decline in expected returns in segmented markets, while the price should remain constant in completely integrated markets, the authors find significant evidence for their hypothesis.[487] In a study that compares abnormal returns of emerging markets with those in developed markets MILLER (1999) finds significantly higher returns in the emerging market part of the sample. He attributes those to lower levels of integration.[488] Although the authors obtain consistent evidence, FORESTER/KAROLYI (1999) argue that the lower expected returns could be due to a larger shareholder base or increased liquidity.[489] The former explanation has been coined as investor recognition hypothesis and can be attributed to MERTON (1987). That is to say, if information is distributed asymmetrically among investors, return will depend on the number of investors who know about that security, referred to as investor recognition.[490] The influence of liquidity on stock returns, the second explanation, has been theorized by AMIHUD/MENDELSON (1986). The authors argue that higher bid-ask spreads, as proxies for

[485] Cf. SOLNIK/MCLEAVEY, Investment, 2004, p. 217.
[486] Cf. FOERSTER/KAROLYI, Segmentation, 1999, p. 989. The increase in information is concluded from the duty to meet the disclosure requirements on both markets. Since switches from single to dual listing are typically directed from a less to a more developed market an increase in information disclosure can be assumed.
[487] ALEXANDER/EUN/JANAKIRAMANAN, Empirical, 1988. The theoretical model is developed in ALEXANDER/EUN/JANAKIRAMANAN, Listing, 1987, pp. 151-158. Consistent results are obtained by JORION/SCHWARTZ, Segmentation, 1986 and FOERSTER/KAROLYI, Listings, 1993.
[488] MILLER, Cross-Listings, 1999.
[489] FOERSTER/KAROLYI, Segmentation, 1999.
[490] MERTON, Equilibrium, 1987. Significant empirical evidence for the investor recognition hypothesis has been obtained by LEHAVY/SLOAN, Recognition, 2007 and KADLEC/MCCONNEL, Segmentation, 1994.

liquidity, correlate with higher returns – effectively causing a required liquidity premium.[491]

Responding to these findings, further empirical research applies alternative approaches in testing the segmentation hypothesis. SHACKMAN (2006) shows that the intuitively less integrated subsample of emerging market countries generate significantly higher excess returns. The author tests the hypothesis that degrees in segmentation determine the excess return differential between emerging and developed market countries and finds supportive evidence.[492] BEKAERT/HARVEY/LUMBSDAINE (2002) examine a diverse sample of emerging market countries and attempt to identify the date on which they become effectively integrated in the world financial market. The authors observe structural breaks in time-series data of several variables. The authors argue that since return volatility in emerging markets is higher than the covariance with world markets, prices should jump when sudden liberalization policies are introduced.[493] This binary approach deals with integration in absolute terms. It therefore hinges on the definition of the integration criterion.

Conventional opinion has been substantially challenged as a consequence of the observation that investors appear to prefer domestic securities and tend to overweight them in the international portfolio. This phenomenon has become known as the asset allocation home bias.[494] Although the reasons have not been fully deciphered, it is broadly believed to be due to information asymmetry.[495] ADLER/DUMAS (1983) suggest that it could be explained by the hedging against deviations from the PPP.[496] However, COOPER/KAPLANIS (1994) test this relation and fail to find supportive evidence.[497] While often interpreted as evidence for segmented markets, SOLNIK/MCLEAVEY (2004) point out that this conclusion does not necessarily result, since international capital flows could nevertheless be sufficient to generate efficiency.[498] This is consistent with KAROLYI (2003),

[491] AMIHUD/MENDELSON, Pricing, 1986. Empirical evidence for the liquidity hypothesis has been obtained by KADLEC/MCCONNEL, Segmentation, 1994.
[492] SHACKMAN, Integration, 2006.
[493] BEKAERT/HARVEY/LUMBSDAINE, World, 2002.
[494] Cf. BARTRAM/DUFEY, International, 2001, pp. 112-113 and STULZ, Model, 1981, p. 402. A quantitative overview of the home bias in a variety of countries is provided in COOPER/KAPLANIS, Home Bias, 1994, p. 46.
[495] Cf. CHAN/MENKVELD/YANG, Asymmetry, 2006, p. 3. For an alternative explanation cf. GLASSMAN/RIDDICK, Home, 1996.
[496] ADLER/DUMAS, International, 1983.
[497] COOPER/KAPLANIS, Home Bias, 1994.
[498] SOLNIK/MCLEAVEY, Investment, 2004, p. 169.

who investigates the first-ever global registered share, and finds a flow-back to the home market.[499] While some interpret the home bias as reason to reconsider the definition of perfect integration others question the existence of an international pricing mechanism in general.[500] Nevertheless, where only relative integration is concerned, correlation with world events can be a consistent measure.[501]

Alternatively, the indirect approach of evaluating adherence to the law of one price by identifying a universal price-risk relation has been studied in detail.[502] SOLNIK/MCLEAVEY (2004) suggest that capital markets are integrated if a universal security pricing relation existed for all securities.[503] However, testing this assertion relies on the accuracy of the applied equilibrium model with all inherent drawbacks.[504] Consequently, before the degree of segmentation can be measured, an equilibrium model that accounts for all kinds of segmentation must be available. Since such a comprehensive model is elusive, empirical research applies the known equilibrium models finding significant evidence for segmentation.[505] However, being a joint-test, rejection does not allow immediate conclusions on the subjects of examination, the segmentation hypothesis and equilibrium model validity.

While the existing empirical results are altogether valued as evidence for mild or partially effective segmentation with differences across bilateral relations, BRIS/CANTALE/NISHIOTIS (2007) emphasize the difficulty of isolating the causal factors, since the price increase is consistent with all of them.[506] In this respect, recent studies are primarily concerned with the influence of individual impediments. LANG/LINS/MILLER (2003) attempt to disentangle the different effects of cross-listings and conclude that an increase in information causes higher valuations.[507] This finding is consistent with the bonding hypothesis suggested by COFFEE (1999). According to this hypothesis, controlling shareholders from countries with less exacting disclosure stan-

499 KAROLYI, Global, 2003.
500 Cf. EUN, Globalization, 1991, p. 284. Consequently, home bias can be either evidence for the absence of integration or evidence for an unknown international pricing mechanism, BRELAEY/COOPER/KAPLANIS, International, 1999, p. 106.
501 Cf. BEKAERT/HARVEY/LUMBSDAINE, World, 2002, p. 206.
502 Cf. STEHLE, International, 1977, KORAJCZYK/VIALLET, International, 1989 and HIETALA, Segmented, 1989.
503 SOLNIK/MCLEAVEY, Investment, 2004, p. 169.
504 Cf. BEKAERT/HARVEY/LUMBSDAINE, World, 2002, pp. 205-206.
505 Cf. SOLNIK, International, 1977, p. 511.
506 BRIS/CANTALE/NISHIOTIS, Cross-Listing, 2007, p. 500.
507 LANG/LINS/MILLER, Information, 2003. See also LEUZ, Information, 2003.

dards can pursue listings in more developed countries in order to bond themselves to greater transparency, thus making the investment more attractive for minority shareholders.[508] While BRIS/CANTALE/NISHIOTIS (2007) regard this as an alternative to the separation hypothesis, it can also be considered part of it. SOLNIK/MCLEAVEY (2004) quote transaction cost as an institutional impediment and specifically include the cost of information access. However, this broader definition of the segmentation hypothesis impairs the ability to comprehensively incorporate it in a theoretical asset valuation framework.[509] BRIS/CANTALE/NISHIOTIS (2007) examine the bonding, liquidity, and market segmentation hypothesis separately. With respect to the market segmentation hypothesis, the authors only look at legal impediments that restrict access. They find significant evidence for all three hypotheses with the segmentation effect being predominant.[510] This result has important implications, since it proposes legal restrictions to be the most profound cause for effective segmentation. While consistent with conventional opinion, empirical results of this rather new field of research are still fragmented and limited.

Taking the diversity of empirical results into account, it is reasonable to conclude that markets can predominantly be considered in between perfect integration and perfect segmentation with substantial cross-country differences.[511] This is consistent with the conclusion of BRELAEY/COOPER/KAPLANIS (1999) who state: "Different markets appear to be segmented to different degrees and in different ways at different times".[512] At the same time, a development towards integration can be observed. In this context HARVEY (1998) emphasizes the lack of a theoretical model that dynamically incorporates the integration process.[513] In this light it is therefore expedient to reconsider valuation models. BRELAEY/COOPER/KAPLANIS (1999) state that if international capital markets are not perfectly integrated, "international finance becomes potentially very different from domestic finance".[514] Because market imperfections leading to segmentation are various, the complexity of asset valuation surges.[515] The following two sections illustrate

[508] COFFEE, Global, 1999, pp. 23 and 71 and DOIDGE, Cross-Listing, 2004, p. 520.
[509] SOLNIK/MCLEAVEY, Investment, 2004, pp. 142 and 157-158.
[510] BRIS/CANTALE/NISHIOTIS, Cross-Listing, 2007.
[511] Cf. BARTRAM/DUFEY, International, 2001, pp. 110-112, SOLNIK/MCLEAVEY, Investment, 2004, p. 143 and BRELAEY/COOPER/KAPLANIS, International, 1999, pp. 115-116.
[512] BRELAEY/COOPER/KAPLANIS, International, 1999, p. 105.
[513] HARVEY, Emerging, 1998, p. 8.
[514] BRELAEY/COOPER/KAPLANIS, International, 1999, p. 105.
[515] It is argued that benefits from investing internationally have not adequately been accounted for. It is intuitive that geographic diversification opportunities from the less-than-perfect correlation between

attempts to augment equilibrium and intrinsic value models in an international context that allows for unequal levels of market integration.

4.2.2 Segmentation and equilibrium models

Incorporating market imperfections in equilibrium models adds additional dimensions. Market segmentation especially leads to considerable difficulties. This is particularly apparent with the APT, since arbitrage opportunities can by definition not freely be exploited in segmented markets. Obtaining equilibrium prices would therefore require aggregation of the pricing equation for every segment. For this reason, no extension of the APT that accounts for segmented markets is apparent. Nevertheless, a variety of CAPM specifications that allow for segmentation have been proposed. In order to limit complexity, most specifications neglect deviation from PPP. However, since market segmentation will necessarily cause violation of PPP, implications from those specifications have to be regarded with caution.

As mentioned above, in the extremes of perfect segmentation or perfect integration the standard CAPM can consistently be applied. In the former expected returns will be determined exclusively by correlation with a domestic market portfolio and the domestic risk-free rate. In the latter, prices will depend on correlation with the world market portfolio and the universal risk-free rate.[516] However, if the level of separation lies in between, this simple relation will not hold. In order to limit complexity, incorporating partial or mild segmentation is typically confined to a bilateral perspective with one domestic and one foreign country.[517]

GLASSMAN/RIDDICK (1994) propose two basic methods of including partial segmentation in the CAPM. The first method is an adoption of the equilibrium equation by including a segmentation factor. The second accounts for segmentation in the expected returns.[518] While for the second approach investment prohibitions could alternatively be modeled by infinitely high transaction costs, far more attention has been paid to the first ap-

national economies reconstitute the efficient frontier. This effect is shown in SOLNIK, Diversify, 1995 and GRAUER/HAKANSSON, Diversification, 1987 and LEVY/SARNAT, Diversification, 1970.

[516] Cf. BEKAERT/HARVEY, Integration, 1995, p. 403.

[517] An exception can be seen in ERRUNZA/LOSQ, Multi-Country, 1989.

[518] GLASSMAN/RIDDICK, International, 1994, p. 76.

proach. The first version of an international CAPM that specifically loosens the assumption of perfectly integrated markets is suggested by BLACK (1974). The model accounts for explicit barriers in the form of taxes that discriminate between foreign and domestic investors.[519]

An alternative is suggested by EUN/JANAKIRAMANAN (1986). Their model defines two countries, with the domestic investors being restricted to foreign investments to own at most a specific amount symbolized by δ. In contrast, no restrictions on the foreign investors are made.[520] By separately deriving foreign and domestic demand and subsequently aggregating them under the assumption of market clearing, the authors show that two prices will be attained, with the restricted domestic investor paying a premium. The size of the premium depends on the relative risk aversion and the severity of the constraint.[521] The model operationalizes the notion that the ability to diversify is priced. In a fully segmented market an asset's price depends on the typical portfolio selection framework, where expected return μ is balanced with risk. Since investors are principally able to diversify, not the idiosyncratic risk but the covariance Γ with other assets matters. The investment horizon is defined by the number of foreign shares outstanding (N_f) and the number of domestic shares outstanding (N_d). Finally, due to the elusiveness of actual utility functions, the Pratt-Arrow measure for risk aversion A is used for both foreign and domestic investors, correspondingly subscripted.[522] Equation (4.2) shows the relation for the price of the domestic investor, subscripted with d and the foreign investor subscripted with f.

$$\begin{bmatrix} p_d \\ p_f \end{bmatrix} = \frac{1}{k}\left\{\begin{bmatrix} \mu_d \\ \mu_f \end{bmatrix} - A_w \begin{bmatrix} \Gamma_d \Gamma_{df} \\ \Gamma'_{df} \Gamma_f \end{bmatrix} \begin{bmatrix} N_d \\ N_f \end{bmatrix}\right\}, \text{ where } \quad \frac{1}{A_w} = \frac{1}{A_d} + \frac{1}{A_f}, \qquad (4.2)$$

$$A_j = -U_j'' / U_j' \text{ and } j \in d, f$$

When the segmentation assumption is released and a constraint term δ is introduced, the equilibrium becomes augmented further. Domestic stocks are priced unaltered as in

[519] BLACK, International, 1974.
[520] The model disregards exchange rate risk, by assuming a fixed exchange rate regime.
[521] EUN/JANAKIRAMANAN, Model, 1986, pp. 897-914, for the relevant formula refer to p. 909.
[522] ARROW, Risk, 1971 and PRATT, Risk, 1964.

(4.2), while foreign stocks are priced differently by domestic (4.3) and foreign investors (4.4).[523] However, the level of integration, expressed by the constraint term δ, cannot be set straightforwardly. This impairment in operationalization shifts the contribution of this model primarily to allow a formulation of theory-based hypotheses in respect to cause and effect for segmented markets.

$$p_{df} = \frac{1}{k}\left[\mu_f - A_w(\Gamma_{df}^{'} N_d + \Gamma_f N_f) + (A_w - A_d\delta)(\Gamma_f - \Gamma_{df}^{'}\Gamma_d^{-1}\Gamma_{df})N_f\right] \quad (4.3)$$

$$p_{ff} = \frac{1}{k}\left[\mu_f - A_w(\Gamma_{df}^{'} N_d + \Gamma_f N_f) + (A_f(1-\delta) - A_w)(\Gamma_f - \Gamma_{df}^{'}\Gamma_d^{-1}\Gamma_{df})N_f\right] \quad (4.4)$$

$$\text{with } 0 < \delta < A_w / A_d$$

An alternative model has been suggested by ERRUNZA/LOSQ (1985), who incorporate restrictive access for foreign investors.[524] They divide the investor population into two subsets of perfect capital markets, with one group having unrestricted access to both markets, subscripted with d, and the other being restricted, subscripted with f. The authors conclude that while the eligible security will be priced as if markets were completely integrated, a super risk premium will be required for the ineligible security.[525] The super risk premium RP_s for a security will depend on investors' aggregated risk aversion A, the market portfolio of ineligible securities M and its conditional covariance between the specific security and the market portfolio returns r_M under a given return of the eligible security r_e. [526] This relation is illustrated in Equation (4.5). Because the super premium depends on the non-observable risk-aversion differential, the model can only be operationalized as a gauge for relative separation. In an extension ERRUNZA/LOSQ (1989) broaden the theoretical model to N ineligible securities. In this framework, equilibrium prices are determined jointly by international and national risk premiums.[527] Correspondingly, operationalization is restricted by the problem of gauging risk aversion.

[523] EUN/JANAKIRAMANAN, Model, 1986.
[524] Nevertheless, a universal risk-free rate is assumed.
[525] ERRUNZA/LOSQ, Segmentation, 1985.
[526] The authors emphasize the inclusion of conditional market risk to be the key augmentation to former models, ERRUNZA/LOSQ, Segmentation, 1985, p. 105.
[527] ERRUNZA/LOSQ, Multi-Country, 1989.

$$RP_s = (A_d - A)M \cdot Cov(r, r_M \mid r_e) \quad \text{, with } A^{-1} \equiv A_d^{-1} + A_f^{-1} \tag{4.5}$$

A similar model has been suggested by ALEXANDER/EUN/JANAKIRAMANAN (1987). As opposed to the ERRUNZA/LOSQ (1985) international CAPM, this model deals with the dual listing of a single security in two otherwise completely segmented markets. The authors conclude that the return of the dual-listed stock depends on the covariance with both the domestic and the foreign market portfolio. On the other hand, the return of the purely domestic stock is subjected to an indirect integration and therefore depends on the indirect covariance with the return of the foreign market portfolio. The magnitude of this indirect effect on any given domestic security depends on its covariance with the dual-listed security. [528]

The first model that releases the PPP assumption in a mildly segmented market has been developed by CHAIEB/ERRUNZA (2007). Assuming a two-country environment, the authors conclude that while the eligible security requires the world market risk premium, it also requires an inflation risk premium. Correspondingly, the ineligible security requires two additional premiums: a conditional market risk premium and a segflation premium, a premium for bearing inflation risk in the presence of barriers. The authors also extend the model to a partially segmented market and find that both sides require a conditional cross-market premium for the ineligible security.[529]

While the above-mentioned models incorporate different forms of market segmentation, a model that comprehensively incorporates all kinds of impediments in a single comprehensively appears impractical. Moreover, the elusiveness of some market-segmenting factors precludes the attempt to include them within the expected returns.[530]

Consistently, empirical research regarding segmented market international CAPM typically does not test the accuracy of the specific model.[531] Instead these models are

[528] ALEXANDER/EUN/JANAKIRAMANAN, Listing, 1987. In this model a universal risk-free rate is assumed
[529] CHAIEB/ERRUNZA, Segmentation, 2007.
[530] Cf. GLASSMAN/RIDDICK, International, 1994, p. 76.
[531] As an exception the exposure to different risk factors is tested in CHAIEB/ERRUNZA, Segmentation, 2007.

applied in order to test for segmentation among countries.[532] It is argued that results that are consistent with the widely accepted notion of neither perfectly integrated nor segmented markets, can be considered to be supportive evidence for the underlying model.[533] Hence the conclusion by SOLNIK (1977) is followed, who argues "international asset pricing seems to be a very fruitful area for theoretical research, not empirical".[534]

The impracticability of equilibrium models is mainly due to the associated encompassing theoretical framework. Since intrinsic value models are less restrictive, the following section discusses these models in an international scope.

4.2.3 International intrinsic value models

Research on intrinsic value models in an international setting is essentially limited to the area of international corporate finance. The main concern is to identify international cost of capital in order to provide guidance for international mergers and acquisitions as well as other international investment projects. However, findings are largely transferable to IPI. As far as is apparent, no international DDM or RIV has explicitly been developed. However, nevertheless, empirical research implicitly applies such models where prices are concerned.

When transferring the framework of intrinsic value models into an international environment by assuming different countries and currencies, the general valuation proposition of the CIM remains unaltered. However, regarding its application, country-specific characteristics of agents and markets can effectively lead to country-specific valuation differences. Provided there is perfect capital market integration, this can be considered to be just another level of agents' heterogeneity, without affecting the conclusion that aggregated averages determine attainment of prices. However, if impediments fully prevent cross-border investment, supply and demand is fragmented into segments. Across these effectively separated segments, prices diverge, if average value perception varies. In both cases the valuation equation can become individual. In cases of perfect

[532] After developing their theoretical framework ERRUNZA/LOSQ (1985) test it empirically and find tentative support, ERRUNZA/LOSQ, Segmentation, 1985. In a subsequently study ERRUNZA/LOSQ/PADMANABHAN (1992) test the capital market integration among a variety of emerging market countries and the U.S. and find significant evidence for a non-polar market structure, ERRUNZA/LOSQ/PADMANABHAN, Test, 1992.

[533] Cf. ERRUNZA/LOSQ/PADMANABHAN, Test, 1992, p. 968.

[534] SOLNIK, International, 1977, p. 511.

market segmentation the problem breaks down to segment-specific valuation and prices. If segmentation is imperfect, complexity will increase considerably, but, without altering the general functionality.

As broadly discussed above, individual-specific perceptions regarding value can be isolated in the discount rate.[535] In the single-country environment, the risk-free rate is universal and risk-premiums depend on the average market risk preferences. Therefore, country specific individuality can be straightforwardly encompassed by the framework of intrinsic value models. Consequently, the discount rate becomes a function of the cause of imperfection.[536] SOLNIK/MCLEVEAY (2004) emphasize that the discount rate must reflect all relevant risks of the specific investment. As an illustration, the risk premium can be augmented by two additional risk dimensions: exchange rate and country risk.[537] Equation (4.6) illustrates the theoretical decomposition, according to which the discount rate can be expressed as a vector **k** with N rows for each individual group or country. The risk-free rate is also a vector **r** with N rows that can be individual or, if a collective risk-free asset is assumed, universal.[538] The exchange-rate risk premium **x** is an N-row vector and the country risk vector **c** has N rows, each composed of every country risk component. The sign of the country risk premium - also referred to as sovereign spread - will depend on the net effect of his percipience regarding the opposing effects of diversification benefit and country risk.[539]

$$\mathbf{k} = \mathbf{r} + \mathbf{x} + \mathbf{c} \tag{4.6}$$

The application of this theoretical concept in empirical research is subjected to the identification problem of the risk components and their value. Implicitly making assumptions regarding efficient portfolio building, HARVEY (2001) argues that only syste-

[535] Alternatively, it could be incorporated in the capitalization variable. However, no theoretical model for this procedure is apparent, HARVEY, Cost, 2005, p. 10.
[536] Cf. BARTRAM/DUFEY, International, 2001, p. 90. See also BONDNER/DUMAS/MARSTON, International, 2003, p. 3.
[537] AGAR, Investment, 2005, pp. 184-186. BONDNER/DUMAS/MARSTON (2003) subdivide country risk and propose a total of six risk dimensions that apply in an international context: world stock market, country stock market, industry, exchange rate, political and liquidity risk, BONDNER/DUMAS/MARSTON, International, 2003, pp. 8-10.
[538] Also if no such universal security exists, **r** can nevertheless be assumed universal. In this case the exchange rate risk premium would absorb the effect.
[539] SOLNIK/MCLEAVEY, Investment, 2004, pp. 287-288.

matic risk needs to be considered.[540] For some risk dimensions systematic risk can be separated with theoretic reasoning.[541] However, when considering country risk, to what extend it could be diversified with investments in other countries becomes an intricate problem. This is because it requires the identification of the elusive country risk covariance matrix.[542] However, even provided investors create risk-efficient portfolios, such systematic risk data will remain arbitrary. Instead it appears more promising to implicitly derive international discount rates and subsequently interpret them. BONDER/DUMAS/MARSTON (2003) argue that there must be "traded securities capable of indicating to us the price of each dimension".[543] In this respect it is argued that foreign T-bonds can be used to isolate country risk.[544] Provided all risk components can be accurately proxied for, due to the additive conjunction, a multi-factor model could adequately explain the risky component of the discount rate.

Implicit discount rates can therefore be drawn upon to test for market segmentation. That is to say if cross-country differences exist, they can be interpreted as evidence against perfect integration. Presently, only two studies that incorporate the international perspective are apparent. Both apply cross-sectional analysis.

The first study that empirically tests international intrinsic discount rates is performed by LEE/NG/SWAMINATHAN (2003). On the basis of the DDM the authors compute implied risk premiums for the group of seven countries and find little cross-country variation. When regressing the implicit risk premiums with other factors, the authors find no or only little significant correlation with betas based on international CAPM. Instead, international size and book-to-market factors show significant explanatory power.[545]

A second study by HAIL/LEUZ (2006) expands the sample to 40 developed and developing countries. The authors apply four models to compute implicit discount rates: the non-conservative growth RIV suggested by CLAUS/THOMAS (2001), the industry-mean

[540] HARVEY, International, 2001, p. 2.
[541] For instance, covariances among foreign exchange rates can be used to extract systematic exchange rate risk.
[542] Due to complexity, a theoretical estimation of the country risk premium does not appear fruitful. Attempts to do so empirically require a comprehensive proxy for country risk. However, country risk can be considered multidimensional and it is not apparent that those dimensions can be sufficiently entangled.
[543] BONDNER/DUMAS/MARSTON, International, 2003, p. 51.
[544] Cf. AGAR, Investment, 2005, p186. This procedure is similar to the Goldman Model, HARVEY, Cost, 2005, pp. 5-6.
[545] LEE/NG/SWAMINATHAN, International, 2003.

reverting RIV suggested by GEBHARDT/LEE/SWAMINATHAN (2001), the OJM and the EASTON (2004) modification of the OJM.[546] The authors find supportive evidence that countries with stricter legal institutions and security regulations have lower implied discount rates. Furthermore evidence consistent to the theory that the effect diminishes as global integration increases has been found.[547]

These results can be considered evidence against perfectly segmented markets. Consequently, both equilibrium and intrinsic value models that neglect country-specific risk characteristics are likely to yield biased results.[548] It is therefore argued that in order to establish a relation between value and price, general market characteristics with respect to segmentation have to be taken into account.

4.3 Concluding remarks

IPI summarizes the international-focused subdiscipline of Finance. Yet it is not a comprehensively exhaustive theoretical framework, but a compendium of isolated hypotheses, each of which explains the consequence of one or more market imperfections in a global environment.

The effect of extending the perspective for equilibrium and intrinsic value models globally can essentially be summarized in two aspects: exchange rate risk due to different currencies and country risk caused by market segmentation resulting from impediments. Both considerably influence the application of both groups of models. Besides adding an additional risk dimension, if impediments effectively fragment markets, the pricing mechanism can effectively change.

With respect to equilibrium models, for the extremes of perfect segmentation or integration, the standard models can consistently be applied. In the former, for the CAPM expected returns will be determined exclusively by correlation with a domestic market portfolio and the domestic risk-free rate. In the latter, prices will depend on correlation with the world market portfolio and the universal risk-free rate. Correspondingly, mod-

[546] CLAUS/THOMAS, Empirical, 2001, pp. 1629-1666, GEBHARDT/LEE/SWAMINATHAN, Implied, 2001, pp. 135-176, EASTON, Implied, 2004, pp. 73-95, OHLSON/JUETTNER, Value, 2003, pp. 1-31 and HAIL/LEUZ, International, 2006, p. 487.

[547] HAIL/LEUZ, International, 2006.

[548] Suggesting guidance for practioners, HARVEY (2005) discusses twelve different ways to compute the international cost of capital. Among these are also implicit discount rates, derived from intrinsic value models, HARVEY, Cost, 2005.

els based on APT remain meaningful. However, in between those poles, substantial cross-country differences require intricate modifications, which are not exhaustive and complex to operationalize.

In contrast, intrinsic value models can be adapted for an international environment straightforwardly. As a consequence, these models remain operationalizable. Computing implicit discount rates from intrinsic value models comprehensively exhausts all risk dimensions and can be used to examine country specific differences empirically. However, disentangling selective factors requires surrogating with observable risk proxies. Furthermore, due to the terminal value conundrum, results have to be interpreted cautiously.

Empirical research on market segmentation predominantly suggests that markets can largely be considered imperfectly segmented. Consequently, where a relation of prices and value is concerned, this has to be taken into account.

5 The financial system in the People's Republic of China

As opposed to the typical role of stock markets within a market economic system, the situation in the People's Republic of China (PRC) is distinct. This is because the economic environment, in which the stock market has been established, differs considerably from the theoretical ideal of a free market economy. It reflects the process of broad transformation encompassing society, policy and economy. Within this trinity, DENG (2002) calls the transformation of China's stock market "a concrete micro epitome of the transformation of China's economy and society".[549] Hence, in order to apprehend its function and characteristics, it is essential to first and foremost place the environment in China within economic theory.

The current Chinese economic system is the result of an ongoing transformation process from a planned to a market economy, aimed at increasing wealth by improving factor productivity.[550] However, this process did not follow a blueprint but can be characterized by continuous adjustments which in retrospect appear largely coherent and resilient.[551] This transformation can elementarily be divided into two phases: The first phase transformed the Chinese economy from a fund-based state-subsidy system within a centralized planned economic system, to a banking-based system. The second phase extended the financial sector by multiple pillars including stock and bond market.

Introductorily, it is important to note that the Chinese government explicitly does not follow the objective of copying an elsewhere-existing economic system.[552] Therefore, it can be misleading to appraise implemented reforms by comparison with other countries. In this respect, this thesis does not attempt to evaluate the Chinese financial system on a normative ground.[553] Instead a positive perspective is taken that is restricted to describing the environment. An elementary distinction in the PRC is the fact that economic reform is not as being considered mechanically linked to political reform. Instead, the transformation is aimed at advancing and adjusting the economic system under the

[549] DENG, Stock, 2002, p. 3.
[550] Cf. PERKINS, Reform, 1988, p. 602.
[551] Cf. NAUGHTON, Plan, 1995, pp. 5-13 and PERKINS, Reform, 1988, p. 601.
[552] Cf. CHINA DAILY, Systems, 2009.
[553] Regarding the difficulties of comparing financial systems in different economic systems, cf. GOLDSMITH, Comparison, 1975.

terms of the existing political system. Consequently, a socialist single-party system is not considered contradictory to using market economic means for factor allocation.[554] This unconventional combination is officially termed "socialism with Chinese characteristics". In this respect the economic transformation in the PRC significantly differs from eastern European countries as well as the Union of Soviet Socialist Republics, where economic reform was linked to reforms in the political system.[555] Replacing the planned economic system by market-based allocation is argued to be a revised version of socialism in consideration of the real situation in the PRC.[556] The resulting economic system is officially termed "socialist market economy".[557]

This chapter is structured the following way. Firstly, the financial system is outlined and placed in the political system. Secondly, the stock market is characterized by deriving it from its origin and tracing its development. The analysis is based on two pillars: on the one hand legal and regulatory institutions within the PRC and on the other hand quantitative comparison to other countries stock exchanges. In order to illustrate the system change broadly, the following discussion is focused on the macrostructure.[558]

5.1 Transformation of China's economy

The turning point that initiated the transformation from a planned economy, established with the foundation of the PRC in 1949, to the socialist market economy, can be seen in the so-called reform and opening-up.[559] This expression summarizes all economic reforms subsequent to its promulgation in 1978 initiated by Deng Xiaoping. Exceeding the typical understanding of reforms as a change for the better, the reform and opening-up can be considered a paradigm change. Essentially, the objective is to replace the centralized economic system with market economic means in order to sustain a social-

[554] Cf. WEI, Sector, 2000, pp. 67 et seq. and DENG, Market, 2002, pp. 41-42. This notion has been the subject of a variety of social economic research, which can be summarized under the term mixed economies.

[555] Cf. NEE, Mixed, 1992, p. 1. It is argued that this approach will expose the PRC to significant future challenges, HEILMANN, System, 2003, p. 578 and NING, Wirtschaftstätigkeit, 2001, pp. 77 et seq.

[556] Cf. YU, Characteristics, 2004.

[557] The term was coined in 1992, NING, Wirtschaftstätigkeit, 2001, p. 57 and SCHÜLLER, Wirtschaftsplanung, p. 857.

[558] For a discussion of China's stock market microstructure cf. XU, Microstructure, 2000 and SU, Chinese, 2003, pp. 33-73.

[559] The origin goes back to the four modernizations proclaimed by Zhou Enlai in 1964, cf. KAMATH, China, 1990, p. 107.

ist society. Naturally, this change of paradigm was not embraced as uncontroversial but support nevertheless prevailed.[560]

A market economic system can be characterized by three major pillars. Firstly, resources are privately owned. Secondly, the market reaches allocation and consumption decisions. Thirdly, the allocation of resources is driven by the pricing mechanism of markets.[561] In a planned economy these three functions are fulfilled by a designated planning commission, typically organized by the government. Economic systems in between are referred to as mixed economies.[562] Most existing economies are neither fully planned nor fully free.[563] However, in order to specify the hybrid structures between both poles, terms such as social market economy are coined.[564]

Previous to the reform and opening-up, the economy was based on a centralized planning system, supervised by the Chinese State Council. Subordinated, the State Planning Commission carried out the operational administration by preparing central resource-allocation plans. The agricultural sector was formed by communes who collectively owned their land.[565] Nevertheless, economic decisions were made by local authorities based on the central government directives. In the industrial sector the State Council's ministries accounted for the management of the major industrial products.[566] Funding of the corresponding enterprises was organized by the authorities that also accounted for the distribution of products at prices appointed by the Price Commission. Most profits generated had to be surrendered to the state government.[567] Nevertheless, it must be noted that the economy was never entirely centrally planned but had continuously maintained some market economic as well as locally planned features.[568] KUEH (1984)

[560] Cf. PERKINS, Reform, 1988, pp. 602-603.
[561] Cf. CHOW, China, 1987, p. 295. Most contemporary economic systems show characteristics of both systems.
[562] Consequently, the economic system in the PRC is not directed towards becoming a free market economy.
[563] Cf. PERKINS, Reform, 1988, p. 603.
[564] The social market economy is a concept aspired to the German government, cf. ANDERSEN, Soziale, 1995.
[565] Cf. PERKINS, Reform, 1988, pp. 605-607.
[566] The organization for many less important products remained a local responsibility.
[567] Cf. CHOW, China, 1987, pp. 295-296.
[568] Examples are rural agricultural product markets that have existed all along, CHOW, China, 1987, p. 295. Also central planning in the PRC is considered less comprehensive than in eastern Europe and the Soviet Union, cf. NEE, Mixed, 1992, p. 4.

estimates that prior to the reform and opening-up approximately 80% of industrial output was integrated into the central planning system.[569]

The Chinese financial system was also an integrated part of the planned economic system. It was constituted by a monobank. Its function was restricted to organizing the transfer of funds between enterprises and the government. This was specified in the credit and budget plans. Furthermore, it controlled the circulation of currency in order to maintain stability on the basis of the cash plan.[570] The executive agencies of the financial system were the central bank - People's Bank of China (PBOC) - and a small number of banks that were actually departments of either the PBOC or the Ministry of Finance (MOF).[571] Liquidity was provided by the MOF, which itself was refinanced by fund transfers from the state-owned enterprises (SOE). Foreign investment and bank lending on the other hand had no material influence.[572] Fig. 3 depicts the financial system in the PRC prior to the reform and opening-up.

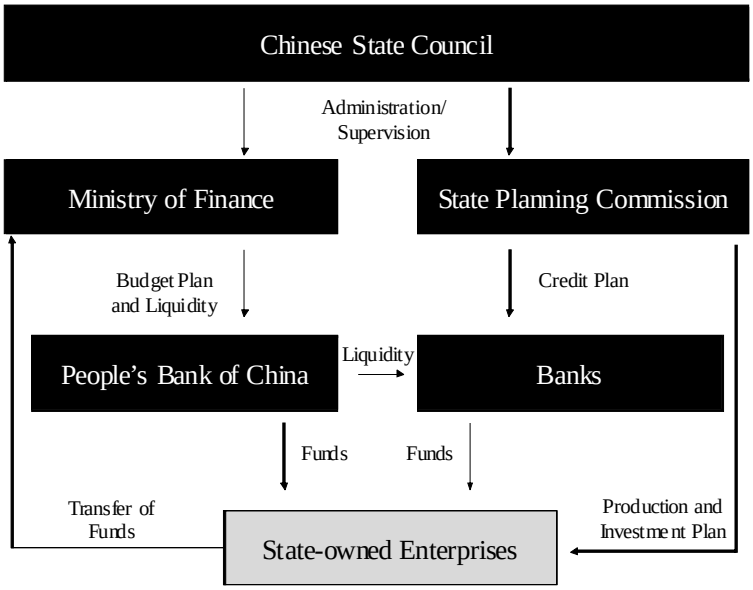

Fig. 3 The financial system in the PRC (1953-1978) [573]

[569] KUEH, Recentralization, 1984, p. 101.
[570] Cf. TAM, System, 1987, p. 100.
[571] While besides the PBOC other banks existed, legal affiliation justifies the term monobank. The Bank of China was a department of the PBOC and the People's Construction Bank of China was part of the MOF, cf. FISCHER, Aufbau, 2000, p. 112 and WEI, Sector, 2000, pp. 20-25.
[572] Cf. TAM, System, 1987, pp. 96-99 and SCHLOTTHAUER, China, 2003, pp. 188-189.
[573] Following WEI, Sector, 2000, p. 21.

Economic changes of the reform and opening-up were initiated in the agricultural sector.[574] Those were conducted mostly in a straightforward way and caused relatively little resistance. In the industrial sector on the other hand, reforms were regarded with skepticism within the administration. Therefore, reforms were limited to small SOE in the initial phase.[575] A major problem of the former system was seen in a lack of economic incentives.[576] Establishing an economic responsibility system was therefore considered crucial to improve efficiency.[577] This was accomplished by the corporatization of SOE and defining profit maximization as a corporate goal.[578]

The gradual advancement illustrates the guiding principle of the reform and opening-up.[579] As opposed to the big-bang approach pursued at the transformation of the Soviet Union's economic system, economic reforms in the PRC are conceived in an incremental way that provides the opportunity for reversal of undesired developments.[580]

The current state of the economic system in the PRC can be described as being partly marketized.[581] Derived from the Chinese terminology, this is sometimes referred to as a dual track system, where allocation is routed by a traditional plan and the market channel which coexist.[582] It is based on a market economic foundation, where a large fraction of factors is allocated through the pricing mechanism. DENG (2002) estimates that for 10% of consumption goods and 30% of production factors prices are planned centrally.[583] The Chinese economic system aims at improving efficiency and economic

[574] Cf. SCHLOTTHAUER, China, 2003, pp. 73-83.
[575] Cf. HEILMANN, China, 2000, p. 49.
[576] Cf. TAM, System, 1987, pp. 112-113 and PERKINS, Reform, 1988, p. 603.
[577] Cf. PERKINS, Reform, 1988, p. 602.
[578] Corporatization refers to transformation of public entities into private corporate entities with limited liabilities. This was officially termed decentralization of power and relinquishment of profits, CHOW, China, 1987, pp. 296-297.
[579] The concept of stepwise transformation often characterizes the initial stages of capital market integration. Accordingly, a country with relatively underdeveloped capital market allows a small number of domestic securities to be listed on a foreign capital market, while simultaneously forbidding domestic citizens to invest in foreign securities, ALEXANDER/EUN/JANAKIRAMANAN, Listing, 1987, pp. 151-152.
[580] Cf. DEWATRIPONT/ROLAND, Reform, 1996, pp. 1207-1209 and NAUGHTON, Plan, 1995, pp. 18-20. The gradual approach is summarized under the slogan "two steps forward one step backwards".
[581] Cf. NEE, Mixed, 1992, p. 1.
[582] Cf. NAUGHTON, Plan, 1995, p. 8.
[583] DENG, Market, 2002, p. 40. Among these are crude oil, charcoal, electricity and transportation.

growth under the economic priorities of the planning authorities.[584] This fact is fundamental to all aspects of the reform and opening-up.

The reform and opening-up of the agricultural and industrial sector constituted the need for a compatible financial system. This can be seen as privatized companies that left the central planning system had to be provided with new sources of funding.[585] The first key reforms in the financial system dealt with the credit system by establishing a two-tier banking system. Accordingly, the central bank is responsible for monetary policy and commercial banks are responsible for granting loans. As in the other sectors, reforms were implemented gradually by continuously abandoning restrictions.[586]

With regard to the early reform period, TAM (1987) emphasizes the need for a financial system that could "act as a vehicle to provide incentives and penalties for enterprise management, savers and investors, so that physical resources are allocated more towards promoting growth".[587] In this respect, in the late 80's the reform was extended to financing through equity, which is discussed in detail in the following section.[588] The result is a financial system structured in a similar way to most market economies with government sponsored independent regulatory institutions.[589] The overall system is supervised by the Chinese State Council. On the ministry level, the MOF is responsible for public finance and taxation. The National Develop and Reform Commission (NDRC), formerly known as the Planning Commission, has mostly consolatory functions.[590] The PBOC is concerned with conducting monetary policy, that is to say controlling money supply and setting interest rates. Subordinated to the PBOC as an administrative agency the State Administration of Foreign Exchange (SAFE) oversees

[584] Cf. KUEH, Recentralization, 1990, p. 108. The marketization within the scope of the economic planning is still formulated in the 11th 5-year plan, NDRC, Plan, 2008.
[585] Cf. HEILMANN, China, 2000, p. 49.
[586] For instance interest rate controls and entry restrictions. Strict restrictions also exist with respect to foreign capital flows.
[587] TAM, System, 1987, pp. 112-113.
[588] Cf. WEI, Sector, 2000, pp. 30-34.
[589] Independence is questioned for instance by GOODFRIEND/PRASAD, China, 2007, ROOT, China, 1996, p. 750, HEILMANN, Schlüsselakteure, 2001 and SCHLOTTHAUER, China, 2003, pp. 197-200.
[590] The 11th 5-year plan states that: "under the condition that China's socialist market economy system established is still at its initial stage, we will mainly rely on the fundamental role of markets in allocating resources to fulfill the goals and tasks set in the plan. Meanwhile, the government should properly carry out its functions of adjusting and guiding the allocation of social resources, allocating public resources in a rational way to ensure smooth and effective implementation of the plan", NDRC, Plan, 2008.

international investment flows and foreign exchange reserves.[591] On the institutional level the China Banking Regulatory Commission (CBRC) supervises the banking sector. Issuing, listing, trading of equity shares, bonds and derivatives is supervised and regulated by the China Security Regulatory Commission (CSRC). The China Insurance Regulatory Commission (CIRC) is responsible for insurance companies, whose influence on the stock market has increased since institutional investors have been allowed access. The current system is illustrated in Fig. 4. Although the State Council's direct influence on the financial system has been restricted, indirectly it still exists throughout the current system.[592]

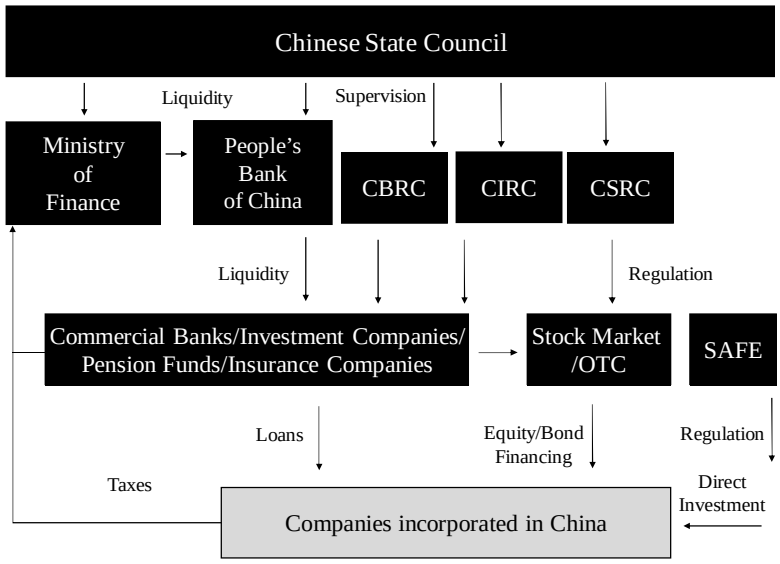

Fig. 4 Current financial system in the PRC (own illustration)

5.2 The Chinese stock market

5.2.1 Establishment and structure of the Chinese stock market

The foundation for a security market in the PRC can be seen in 1981 when the government started issuing T-bonds. Shortly thereafter, provincial, local governments as well

[591] Since 2006 part of the tremendous exchange reserves have been reinvested in various corporations such as Blackstone, Morgan Stanley and British Petroleum through three sovereign wealth funds: China Investment Corporation, National Social Security Fund and China-Africa Development Fund.

[592] An example can be seen in the fact that the leadership of CSRC is appointed by the communist party, GREEN, Capital, 2003, p. 10. For further examples cf. HEILMANN, Aktienmarkt, 2001, p. 27, HEILMANN, Schlüsselakteure, 2001, pp. 6-10 and GORDON/LI, Market, 2003, p. 287.

as enterprises were permitted to independently issue bonds.[593] Although particularly enterprise bonds were strictly controlled, by providing companies with an alternative to bank loans, this step set the groundwork for a two-tiered financial system. The securitization of debt and its subsequent sale to the public furthermore cleared the way to trade with property rights.

However, the initial phase was limited to the second and third pillar of market economies, the allocation of resources through markets steered by the pricing mechanism. Consequently, companies were granted liberty in making certain production, investment, and marketing decisions.[594] The third pillar constituted by private ownership, however, was regarded with ideological reservations.[595] A compromise was seen in allowing the separation of ownership and management, while maintaining government ownership.[596] This was accomplished by indirect ownership of joint-stock companies through SOE.[597] In this respect, when Beijing Tianqiao Department Co. Ltd. became the first joint-stock company in 1984, this step was not aimed at initiating its public sellout.[598] Instead, it was merely considered necessary as a means to separate management from government administration. At the same time, it provided the opportunity to experiment with private ownership by transferring part of the shares to private investors.[599]

In the initial phase stocks were predominantly sold to individual shareholders.[600] However, trading on a secondary market did not start before 1986 when over-the-counter (OTC) markets were set up in Shanghai, Beijing, Tianjin, Shenyang, Harbin and Guangzhou.[601] These markets, monitored under joint supervision of the PBOC and

[593] Cf. SU, Chinese, 2003, p. 5.
[594] Cf. CHOW, China, 1987, p. 296. The liberalization of markets was advocated by the reasoning that while markets controlled prices, the government would control the markets.
[595] Cf. KWONG, Ideology, 1994, pp. 249-251 and TAN, Markets, 1999, pp. 5-10.
[596] PERKINS (1988) emphasizes that it is a misconception to believe private ownership would cause enterprise autonomy. "bureaucracies can interfere with privately owned firms as well as public ones." PERKINS, Reform, 1988, p. 604.
[597] Cf. SUN/TONG, Privatization, 2003, p. 185.
[598] The company was founded July 20th, 1984, XINHUA/MILKEN, Chinese, 2006, p. 4. However, its stocks were firstly not sold to the public but only to employees and some voluntary institutions. The first company whose stocks were sold publicly was Shanghai Feile Acoustics Co. Ltd., cf. DENG, Market, 2002, pp. 89-90.
[599] Cf. COOPER/CHOW/WEI, China, 1994.
[600] In 1989 institutional investors started taking the dominant position they continue to hold, DENG, Market, 2002, pp. 106-108.
[601] Cf. SU, Chinese, 2003, p. 5.

corresponding municipal governments, were extensively dominated by bond trading.[602] Since issuing equity shares to the public spread rapidly, a quota system was implemented in order to curb the development.[603] However, compliance with the system was difficult to monitor, leading to the quota being considerably exceeded in the late 80's.[604] This development alerted the policymakers to the need for an organized stock market with centralized registration and a coordinated regulation.

However, the establishment of a stock market was constricted by reservations about the extent of the reform and opening-up. These reservations were particularly vigorous with respect to the trading of ownership over markets, regarding stock markets as symbols of capitalism.[605] While controversy surrounds the decisive factor, a variety of reasons have been discussed. The official explanation justified the stock market as useful in increasing efficiency with respect to capital allocation.[606] Another important incitement can be seen in the government's falling revenues due to on the one hand the failure of SOE to remain competitive to the newly privatized sector and on the other hand inexperience with taxing private companies.[607] HEILMANN (2001) argues that the establishment of the Chinese stock market was primarily to mobilize private savings for investment in the governmental sector.[608] Moreover, a number of representatives from both corporations, local, municipal and the central government can clearly be regarded as having financial interest in the development of stock markets.[609]

In the wake of a stock boom in the late 80's, the Shanghai municipal government in coordination with the central government prepared a plan to establish an organized market. In November 1990 the Shanghai Stock Exchange (SSE) was the first organized stock market in the PRC.[610] Shortly afterwards, in December 1990, the second stock

602 In 1988, stock accounted for only 1% of total security transactions, SU, Chinese, 2003, p. 6.
603 Cf. GREEN, Stock, 2003, p. 11.
604 Cf. WONG, Market, 2006, p. 402.
605 Cf. DENG, Market, 2002, p. 59.
606 Cf. HEILMANN, Aktienmarkt, 2001, p. 9.
607 Cf. GORDON/LI, Market, 2003, p. 287. In order to refinance the budget deficit the government started issuing long-term treasury bonds in 1981, SU, Chinese, 2003, p. 4. The development can be exemplified by comparing government revenue relative to gross domestic product, which dropped from 31.08% in 1978 to 15.73% in 1990. LIN (2000) concludes that off-budgetary revenue accounts for about 30 to 50% mostly related to various fees being widely misused, LIN, Revenue, 2000, pp. 488-489.
608 HEILMANN, Aktienmarkt, 2001, p. 9. See also WONG, Market, 2006, p. 419.
609 Officials at the local and city levels are considered to be the primary beneficiaries, GREEN, Stock, 2003, p. 11.
610 In the 19th century the SSE had already existed under the same name. At that time Shanghai had been a major financial center in Asia. However, in 1949 the SSE was closed for nearly three decades. The

exchange, the Shenzhen Stock Exchange (SZSE), was established, which had been planned and launched by the city government without the collaboration of the central government.[611] Both stock exchanges are auction markets without specialists or market makers.[612]

Accounting for ideological reservations, the privatizing of Chinese corporations was performed gradually. It was conducted in such a way that not all shares of a company would be publicly listed. Accordingly, shares were subdivided into negotiable and non-negotiable shares. For this purpose, share issuing was strictly controlled and segmented into different classes. In 1992 companies were required to issue four categories of shares each with a dedicated quota, referring to the eligible investor: state shares, legal person's shares and employee shares are non-negotiable, while individual shares are negotiable.[613] State shares are held by central and local government or by SOE.[614] Legal shares are held by domestic institutions such as stock companies, non-bank financial institutes and SOE with at least one non-state owner. Employee shares are issued to managers and workers.[615] Individual shares can be owned by individuals and legal persons.[616] While all classes are endowed with the same voting and cash flow rights, only the individual shares are freely tradable over the stock exchanges.[617] Initially used for bonds, it had later been used to trade legal person's shares. However, in the

first trading day after the reopening was December 19th, 1990, XINHUA/MILKEN, Chinese, 2006, p. 5.

611 Trading at the SZSE did not commence until July 3rd, 1991. It started operating without approval from the Chinese State Council. However, in July 1991 it also obtained an official license, HEILMANNN, Aktienmarkt, 2001, p. 11. Controversy surrounds the actual sequence in which the two exchanges were developed. It is also argued that the SZSE started a few days earlier than the SSE, cf. GREEN, Stock, 2003, p. 12. Because officially both exchanges use the abbreviation SSE, for clarity this thesis uses the above-introduced abbreviations. Alternative notations are for instance used by GORDON/LI (2003): SZSE and SHSE.

612 The SSE has signed a letter of intent to introduce the Xetra trading system, DEUTSCHE BÖRSE, Partnerschaft, 2008. In 2004 a second board for small and medium enterprises (SME board) was launched. The SME board provides finance opportunities to companies that do not originate from SOE. As of February 2008 the SME board lists 219 companies with a market capitalization of CNY 1,100.28 billion or approximately 19.72% of SZSE total domestic market capitalization, SZSE, Board, 2008.

613 CSRC, Shares, 1994. SU, Chinese, 2003, p. 8. It is argued that this division was triggered by the individual investor's stock hype at the beginning of the 90's.

614 While shares are ultimately owned by the Chinese State Commission their management is appointed to the MOF, GREEN, Stock, 2003, p. 15.

615 These shares can be made tradable after a prespecified lock-up period. XU/WANG, Governance, 1999, p. 79.

616 Cf. GREEN, Stock, 2003, p. 15.

617 In 1992 both exchanges installed a nationwide OTC trading system for non-negotiable shares, based on the Securities trading automated quotation system, an order-driven computerized matching system, which enables trading from any remote terminal in the country, SU, Chinese, 2003, pp. 6-7.

late 1990's it was terminated.[618] Shares from the other classes are only limitedly tradable and each transaction requires approval by the regulatory authorities.[619]

While effectively safeguarding state ownership, this policy also inhibited the objective to provide incentives and penalties for enterprise management due to a series of principal agent problems.[620] Moreover, CHEN/XIONG (2001) show in their empirical study on discounts on the illiquid shares that the division is also associated with significant economic costs. The authors find non-negotiable shares, exchanged via auctions, to be sold for only 22.09% of the corresponding negotiable share price. They conclude that this represents the discount for illiquidity, representing a value loss of 77.93%.[621]

Starting in 2005 the government has begun to gradually make shares for legal persons and government shares tradable over the stock exchanges, which was promulgated in the share segmentation reform. Converted shares are referred to as G-shares. It began with a pilot program compromising four companies in May 2005.[622] Shortly thereafter a second batch of 42 companies followed.[623] The main reason for this reform is seen in the necessity to raise additional capital for the Chinese retirement system due to the demographic change.[624] The conversion of previously non-negotiable shares has been the subject of ample discussion, particularly in the financial press. It is argued that the increasing supply will have a significantly negative effect on prices.[625] However, it must be noted that the conversion does not have any negative impact on the company's fundamentals.[626] Therefore, it implicitly assumes investors to have a downward sloping demand for stocks. However, SCHOLES (1972) has pointed out that the price will reflect the expected income stream and deviation from it can merely be temporary.[627] While

[618] Cf. DENG, Market, 2002, pp. 82-88 and GREEN, Stock, 2003, p. 17.
[619] Cf. GREEN, Capital, 2003, pp. 38-40. Since 2000 legal person's shares are tradable through an auction process described in CHEN/XIONG, Illiquid, 2001, pp. 6-11. Moreover, employee shares became insignificant as of August 2008, CSRC, Statistics, 2008.
[620] A description of incentive problems is provided in XU/WANG, Governance, 1999, pp. 83-84. The authors also provide empirical evidence for the inefficiency of state ownership in the PRC. See also GREEN, Capital, 2003, p. 5.
[621] CHEN/XIONG, Illiquid, 2001.
[622] The official beginning was April 30th 2005, XINHUA/MILKEN, Chinese, 2006, p. 6. The first company to convert non-negotiable shares was Sanyi Heavy Industries Ltd..
[623] Cf. YAM, Reform, 2005.
[624] Cf. KIM/HO/GILES, Investors, 2003, p. 2.
[625] Cf. GREEN, Stock, 2003, p. 31 and WONG, Market, 2006, p. 419.
[626] In contrast it could be argued that while cash flow rights remain unaltered, the ability to achieve a non-governmental control majority could be considered value enhancing.
[627] SCHOLES, Prices, 1972. Temporary deviation can be due to speculation. Studies regarding the stock market's microstructure provide alternative explanations, cf. HOPMAN, Prices, 2007.

being outside of the scope of this thesis, the transmission channel of how an increased supply affects share prices in the PRC offers an interesting opportunity for future research.[628]

Regardless of the price effect, the magnitude of the share segmentation reform is ambiguous. In 2005 and 2006 the proportion of negotiable shares to total shares increased constantly from 32.41% in January to 39.60% in June 2006. However, subsequently the proportion decreased to 30.02% as of August 2007, overcompensating for the preceding transformation process.[629] The development is illustrated in Fig. 5, for which at least two causes are conceivable. Firstly, while the number of employee and state shares decreased, the number of legal person's shares increased in November 2006, offsetting the decline. This effect is consolidated in the non-negotiable share line. Secondly, a new class of non-negotiable shares for strategic investors was introduced in July 2006, which is subject to a lock-up period. This share class is referred to as strategic investor shares. As a result, rather than increasing the negotiable market segment, at least in the short-term this policy had effectively the opposite effect.

[628] For evidence on downward sloping demand in Thailand cf. BAILEY/JAGTIANI, Thai, 1994.
[629] CSRC, Statistics, 2008 (Summary of capital structure, exclusive H-shares). At the SME board the proportion of negotiable shares accounts for 38.70%, as of April 2008, SZSE, Board, 2008.

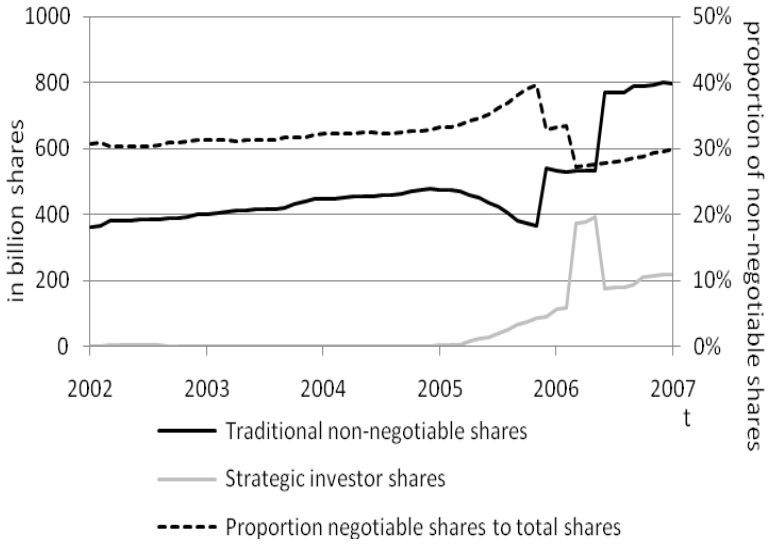

Fig. 5 Development of negotiable shares [630]

The share segmentation reform was conducted inhomogenously across companies. In general, the conversion involved giving out additional shares or funds to private investors and issuing a commitment not to sell shares during a predefined lock-up period.[631] In the initial phase the conversion required shareholders' approval.[632] In November 2005 administrative measures were promulgated that set the legal framework for the conversion.[633] It would see that neither theoretical nor empirical research has paid any attention to the repercussions of the share segment reform.

The fact that a large proportion of shares on the Chinese stock market are not tradable can be regarded as an important market feature. As a result, it can be concluded that for part of the listed companies, investors are effectively unable to obtain majority stakes when relying on markets.

630 CSRC, Statistics, 2008.

631 Companies that have finished the conversion add a prefix 'G' to their stock's name. The compensation amounts to around 3 shares per 10 shares converted. For the first 42 companies the average ratio was 3.3/10, YAM, Reform, 2005.

632 For Qinghua Tongfang shareholders' disapproval of the first proposal required the company's adjustment.

633 Among these, a conversion requires the approval of at least two-thirds of holders of non-negotiable shares and two-thirds of the holders of negotiable shares. Furthermore, a former holder of non-negotiable shares with more than 5% of total shares may only sell a maximum of 5% within twelve month after the twelve-months lock-up period and not more than 10% within 24 months. Article 5, 16 and 27, CSRC, Split, 2005.

5.2.2 Current state of the Chinese stock market

A stock market can be appraised in multiple respects. Typically it is regarded in comparison to other countries' stock markets and in comparison to other channels of corporate financing.[634] Data on the former point is summarized in Appendix: **1**, where data from the World Federation of Exchanges (WFE) is quoted for the major stock exchanges, as of January 2008. After 18 years of existence, with a market capitalization of USD 3,134.72 bn the SSE ranks 6th of the 30 exchanges and with USD 730.28 bn the SZSE ranks 18th.[635] However, it must be noted that the data from the WFE includes non-negotiable shares at the prices of negotiable shares. With respect to the number of listed companies the SSE ranks 15th with 860 and the SZSE 19th with 677 domestic companies listed. This comparison does not account for inhomogeneity of companies among markets. For example, the average company at the Bombay Stock Exchange, the exchange with the largest number of listed companies, has a market capitalization of USD 0.30 bn while the average company at the NYSE has a market capitalization of USD 6.36 bn.[636] No foreign company is listed on either of the Chinese exchanges, indicating little integration into the world capital market. With a turnover velocity of 380.40% the SZSE ranks 1st and with 204.20% the SSE ranks 5th.[637] This figure is exceptional when recalling that the majority of stocks on the Chinese stock markets are non-negotiable.[638]

The latter aspect, comparison with alternative sources of corporate funding, has also undergone significant progress. Over the course of the reform and opening-up the significance of equity as an alternative source of corporate finance has continuously increased. In 1991 total market capitalization of domestic stocks relative to GDP accounted for only 0.50%. As of December 2007 this number had increased to 104.87% excluding non-negotiable shares.[639] This development in comparison with bank financ-

634 Cf. GREEN, Capital, 2003, p. 37, WONG, Market, 2006, p. 389, NAM/PARK/KIM, China, 1999, pp. 68-69, HEILMANN, Aktienmarkt, 2001, pp. 2-3 and DREW/NAUGHTON/VEERARGHAVAN, Shanghai, 2003, pp. 122-124.

635 WFE, Focus, 2008.

636 In other words the average company on the NYSE is worth 21 times more than the average Bombay Stock Exchange company, WFE, Focus, 2008.

637 For the SZSE this implies that on average every share changes ownership 3.80 times in one year.

638 This has also been discussed in XU/WANG, Governance, 1999, p. 85.

639 For comparison domestic market capitalization relative to GDP for other markets: USA = 141.88% (NYSE Group, NASDAQ) India = 117.34% (Bombay SE, National Exchange of India), Hong Kong = 904.71% (HKEx), Japan = 109.41% (Tokyo SE Group, Jasdaq, Osaka SE), based on the es-

ing is illustrated in Fig. 6. It shows both total loans by financial institutions and domestic market capitalization relative to GDP.[640] However, it must be noted that while final verified GDP data for 2008 is not yet available, the immense stock market downturn in conjunction with the positive economic growth has reversed this development to some extent.

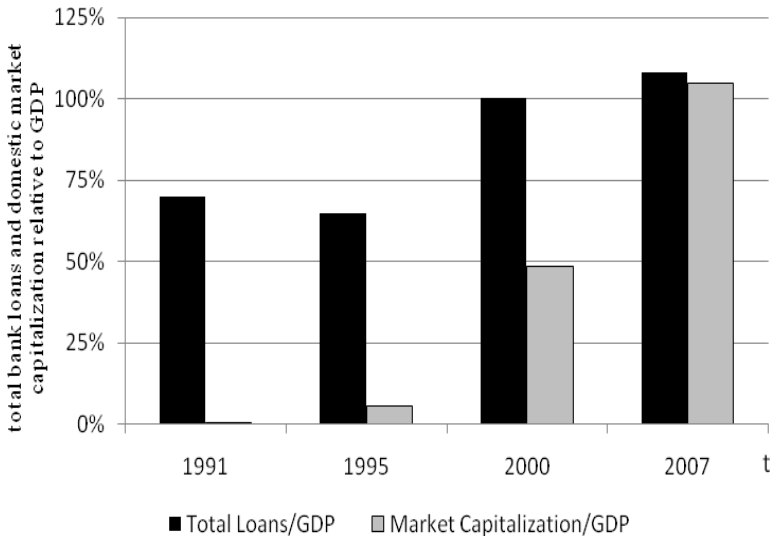

Fig. 6 Debt and equity assets to GDP in the PRC [641]

Furthermore, interpreting the results with respect to the importance of equity for corporate financing is misleading because of stock price advances and non-negotiable shares. The increase in market capitalization in the last few years that created a stock market bubble is largely due to price advances of existing shares, rather than newly invested capital. This becomes obvious when comparing the value of capital which has been risen through both initial public offering (IPO) and re-issues of shares with the total amount of new loans granted by the financial institutions as illustrated in Tab. 1.[642]

timated 2007 GDP and market capitalization as of end 12/2007, WFE, Focus, 2008 and CIA, Factbook, 2008.

640 Corporate bonds as financing instruments are not considered due to their minor significance. For an overview of the bond market cf. KPMG, Markets, 2008, pp. 17-26. Bank loans and stock market capitalization can straightforwardly be compared since no foreign companies are listed in the PRC.

641 Based on data from: NSBC, Yearbook, 2007, NSBC, Data, 2008, SSE, Market, 2008, SZSE, Fact, 2006 and WFE, Focus, 2008.

642 Total loans include loans to all sectors including the state sector.

Tab. 1 Stock issuance and lending by financial institutions

Calendar Year	New stock Issue (Billion CNY)	Total Loans (Billion CNY)	Proportion
2003	129.27	2,770.23	4.67%
2004	143.16	1,614.64	8.87%
2005	169.41	1,732.69	9.78%
2006	519.20	4,358.94	11.93%

Source: CSRC, Statistic, 2008 and PBOC, Statistics, 2008.

Secondly, since prices for non-negotiable shares cannot directly be observed, the market capitalization provided by the CSRC is obtained by putting non-negotiable shares on the same level as negotiable shares.[643] This procedure is disputable but a consistent solution is not apparent.[644] Because of the high illiquidity discounts for non-negotiable shares, GREEN (2003) suggests considering only negotiable stocks in order to avoid overstating value.[645] However, disregarding non-negotiable shares cannot be reasonably considered since those shares represent the majority of shares outstanding, and assuming a price of zero leads to an inappropriate understatement instead.

A frequently stated impression of the Chinese stock market concerns stock prices. It is argued that Chinese stocks are systematically overpriced. It is based on the finding that despite historically relatively low investment value of listed companies, shares trade at comparably high price-earnings (P/E) ratios.[646] However, depending on the point in time in which they are computed and the length of the underlying time period, P/E-ratios can be misleading particularly in markets with high-volatility. Tab. 2 illustrates this problem when only a point in time is regarded. Comparing P/E-ratios for stock indices from December 2007 with data only four months later illustrates the lack of representativeness. In 2007 P/E-ratios for Chinese stock indices are considerably higher than comparable broad counterparts, such as the Standard & Poor's 500 and the Finan-

643 Total domestic market capitalization is computed as the price of negotiable shares times the number of all negotiable and non-negotiable shares outstanding.

644 Heuristic solutions such as decomposing negotiable and non-negotiable shares and subsequently weighting non-negotiable shares in accordance with an average discount premium can be rejected, since this procedure implicitly makes general assumptions on the market value of the non-negotiable shares based on few observations.

645 GREEN, Stock, 2003, pp. 26-27.

646 XU/WANG (1999) conclude that individual investors are seeking short-term trading profits rather than dividend income or long-term growth, XU/WANG, Governance, 1999, p. 85.

cial Times Stock Exchange index (FTSE) 100 as well as other Asian indices, such as Topix and Hang Seng. However, after plunging stock prices the P/E-ratio levels converged.

Tab. 2 Price-earnings ratio for selected stock indices

Index	P/E-ratio (12/2007)	P/E-ratio (4/2008)
SSE A Share Index	47.31	26.88
SSE B Share Index	105.73	29.05
SZSE A Share Index	58.97	N/A
CSI 300 Index	45.68	27.50
Topix Index (Tokyo)	30.01	16.59
SZSE B Share Index	43.40	N/A
S&P 500 Index	18.86	22.21
Hang Seng Index	19.03	14.93
FTSE 100 Index	12.66	12.2
NASDAQ Composite Index	N/A	35.74

Source: BLOOMBERG

Correspondingly, when regarding a time period, strong deviations tend to average out. Tab. 3 shows the average P/E-ratio for a six-year period, indicating values for 2007 to be outliers. Nevertheless, based on this data it can be argued that companies in the PRC are valued high in comparison to developed countries' markets.[647] However, different economic situations across countries considerably impair informative value of P/E-ratios. This becomes apparent when comparing the annual growth rate in the PRC (13%) with that of the USA (2%) in 2007.[648] From this perspective it can be argued that while Chinese corporations are not yet living up to their high valuation, the valuation could

[647] For instance as of April 2008 the Dow Jones Industrial Average shows an average P/E-ratio of 15.58 (trailed earnings, including negative), DJI, Statistics, 2008.
[648] Estimates by CIA, Factbook, 2008.

nevertheless be justified by economic reasoning after accounting for long-term growth.[649]

Tab. 3 Average P/E-ratios (2002-2007) [650]

Stock Segment	Average P/E-ratio
SSE A-shares	30.28
SSE B-shares	26.35
SZSE A-shares	32.64
SZSE B-shares	16.51

Source: CSRC, Statistics, 2008

5.2.3 International investment in the Chinese stock market

The opportunity for foreigners to invest in the PRC was a result of the so-called open-door policy, an integrated part of the reform and opening-up. Previously, in the centrally planned, self-reliant economic system, financial relations with foreign countries were cautiously restricted to sovereign borrowing.[651] However, it was recognized that the PRC could benefit considerably from positive gains by closer interaction with foreign countries, such as exploiting regional comparative advantages, division of labor and technology transfer.[652] In the initial stage foreign investors were limited to foreign direct investments (FDI).[653] Before the establishment of organized stock markets only domestic investors were eligible to purchase shares. According to the principle of gradual reforming, in 1991 foreign investors were granted access to primary and secondary markets for foreign portfolio investments within a strictly separated segment - termed the B-share segment.[654] Nevertheless, FDI remain the predominant channel of

[649] As an illustration of absurd conclusions from focusing on the P/E-ratio can be derived, one could argue that P/E-ratios of 100 are consistent for the Chinese stock market, by multiplying the quotient of growth in the PRC and growth in the USA with the P/E-ratio of the DJIA.
[650] Computations based on monthly average from 8/2002 to 8/2007 and trailing earnings.
[651] Cf. KAMATH, China, 1990, p. 110. In 1973 the Chinese government announced that it was both internal and foreign debt free, CHINA DAILY, Bond, 2008.
[652] Cf. WU, China, 1981, pp. 449-453.
[653] For a discussion on the development of FDI cf. KAMATH, China, 1990.
[654] This categorizing distinguishes the Chinese market from other former socialist markets such as the Federation of Russia and the Socialist Republic of Vietnam, where caps on foreign investment are set. The first B-Share stock to be issued was China Southern Glass on 2/21/1992, SU, Chinese, 2003,

foreign financing. As of year-end 2006, equity capital investment accounts for 20.18% of FDI.[655] Access to foreigners is controlled by the general non-convertibility of the CNY.[656]

In the initial reform stage, a PRC-incorporated company could offer two classes of stocks: A-shares restricted to investors with Chinese nationality or entities and B-shares for foreign investors.[657] Both shares are traded in separate market segments and are non-interchangeable. Since 1993 domestic companies have been able to furthermore issue shares on the HKEx denominated in Hong Kong Dollars (HKD), referred to as H-shares.[658] Henceforth, the term Chinese stock market is used to cover SSE, SZSE and HKEx together. The structure of different share classes for Chinese companies is illustrated in Fig. 7.

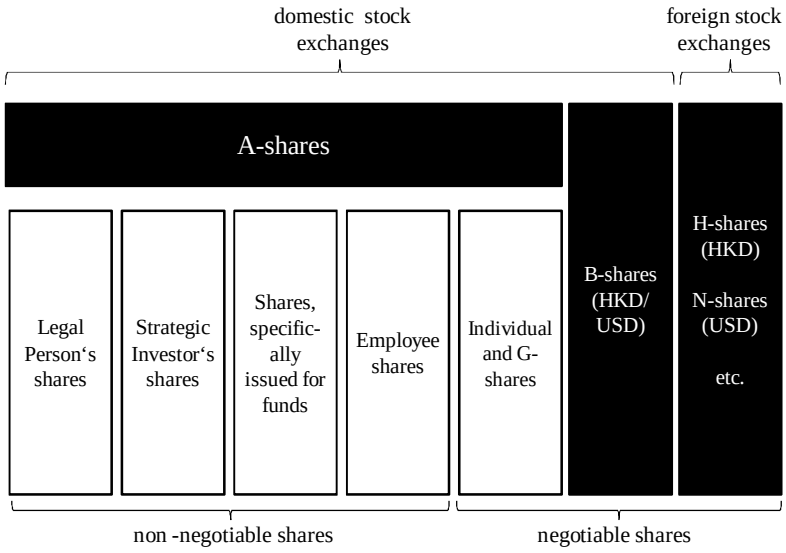

Fig. 7 Structure of Chinese shares (own illustration)

A-shares are denominated in CNY while B-shares are denominated in foreign currency, US-Dollars (SSE) or HKD (SZSE). Owing to geographical location, foreign investors

p. 125. The first company to issue B-shares was Shanghai Vacuum Co. Ltd. in January 1992, DENG, Market, 2002, pp. 94-95.

655 Cf. SAFE, Statistics, 2008.

656 Cf. PENG/BAJONA, Currency, 2008, p. 138.

657 Investors from Hong Kong and Macao also have the status of foreign investors according to the one state, two systems principle.

658 The first company to issue H-shares was Qingdao Brewery on 6/29/1993. Now foreigners can further purchase a variety of shares called according to the place of issuance: L-shares (London), N-shares (New York), S-shares (Singapore), T-shares (Tokyo), F-shares (Frankfurt). Moreover, red chips refer to companies from the PRC incorporated in Hong Kong.

at the SZSE are predominantly from Hong Kong, while at the SSE the investor structure is less concentrated.[659] Initially a company was permitted to offer both A- and B-shares simultaneously. Since 1998 approval of new IPO are restricted to either of them. The development of the different share classes is illustrated in Tab. 4. It can be seen that, while the number of companies listing B-shares peaked in 2000 (114), since 1995 the proportion has decreased continuously. As of August 2007 the total number of companies listing B-shares was at 109.[660] Instead foreign investors are increasingly offered access to the Chinese stock market through the HKEx. Since 1993 the number of companies that listed H-shares increased to 147 in August 2007. As a result, at the same time, with 9.12% the proportion of H-shares was larger than that of B-shares with only 6.76%.

[659] Cf. CHEN/FIRTH/KIM, Valuation, 2002, p. 130 and LIMA/TABAK, Random Walk, 2004, p. 255.
[660] After three years of no newly issued B-shares in 2003 Shanggong Co. Ltd. issued new B-shares.

Tab. 4 Listed A-, B- and H-shares

	12/1992	12/1998	12/2000	8/2007
Number of companies with only A-shares	53	727	955	1356
Number of companies with only B-shares	-	26	28	23
Number of companies with only H-shares	-	-	-	108
Number of companies with both A- & B-shares	18	80	86	86
Number of companies with both A- & H-shares	-	18	19	39
Total	71	851	1088	1612
Number of companies with B-shares	18	102	114	109
Number of companies with H-shares	-	18	19	147
Proportion of companies with only A-shares	74.65%	85.43%	87.78%	84.12%
Proportion of companies with only B-shares	-	3.06%	2.57%	1.43%
Proportion of companies with only H-shares	-	-	-	6.70%
Proportion of companies with both A- and B-shares	25.35%	9.40%	7.90%	5.33%
Proportion of companies with both A- and H-shares	-	2.12%	1.75%	2.42%
Proportion of companies with B-shares	25.35%	11.99%	10.48%	6.76%
Proportion of companies with H-shares	-	2.12%	1.75%	9.12%

Source: CSRC, Statistics, 2008

In 2002 the investment opportunities in the PRC were extended through the qualified foreign institutional investors (QFII) program. Accordingly, institutional foreign investors, who meet certain criteria regarding size and experience, are eligible to apply for a permit to convert a specified amount of USD into CNY, which can be used to purchase A-shares.[661] As a result individual foreign investors are indirectly granted access to the domestic A-shares market through the purchase of mutual funds.[662] However, the proportion available for foreign investors is relatively small. The total quota of this pro-

[661] Cf. PISSLER, Öffnung, 2002, p. 6.
[662] Since May 2006 under the QFII program investments in G-shares have been approved.

gram amounts to USD 30 bn. As of December 2008 this equates to only 1.69% of total market capitalization.[663]

Similar firm restrictions are levied on domestic investors. These make a distinction between investments in stocks listed in the PRC though B-shares and investments in non-Chinese companies abroad. Restrictions are enforced through non-convertibility of the CNY and administrative barriers.[664] An initial release has been conducted in the wake of the Asian financial crisis. After the trade volume in the B-share segment dropped significantly in the late 90's, the regulations governing Chinese nationals who enter the domestic B-share segment were promulgated in 2001.[665] Hence, foreign and domestic investors are jointly involved in attaining market consensus of share prices. Besides a considerable surge in prices, the opening was followed by a substantial increase in the B-share segment's trading activity. This can be seen from Fig. 8 where the B-share index and corresponding annual trading volume is plotted. However, data on domestic investors' involvement in the B-share segment is not publicly available. Therefore the extent and sustainability of this reform cannot be assessed straightforwardly. Furthermore, restrictions on the convertibility of the CNY remain, so that equivalent foreign and domestic engagement cannot be assumed.

[663] Cf. CHINA DAILY, QFII, 2008. This relation is based on total domestic market capitalization at SSE and SZSE including non-negotiable shares weighted equal to negotiable shares, WFE, Statistics, 2008. The quotas are with respect to the initial investment amount so that price increases have no influence.

[664] Nevertheless, anecdotic evidence conjectures that still a significant proportion of Chinese nationals manage to circumvent the controls and invest outside of the regulatory control in foreign securities mostly through Hong Kong. However, reliable data for this is not available.

[665] Opening of the B-share segment for Chinese citizens from June 1st, 2001. SSE B-share index rose by 9.7% and the SZSE B-share index by 12.4%. After the announcement on February 19th, 2001, trading was held until February 27th, 2001, BERGSTRÖM/TANG, Differential, 2001, p. 423.

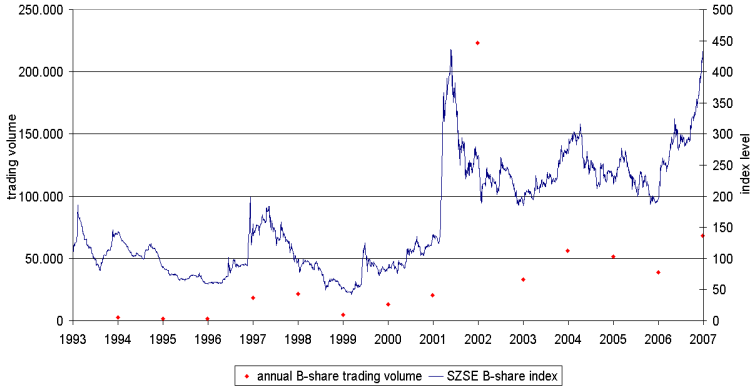

Fig. 8 SZSE B-share index and trading volume (in millions) [666]

With respect to investments outside of the PRC a partial opening was conducted in 2006. The qualified domestic institutional investor (QDII) program enables domestic institutional investors to invest in markets outside of the PRC.[667] The program is currently restricted to USD 42.70 bn. However, with only 2.40% compared to total domestic market capitalization, the diversification effect can be considered limited.[668] In the initial phase investments were restricted to low risk fixed income products, however they have subsequently been extended to stock investments.[669] Overall, reception has been moderate. This is ascribed to be due to the fact that investment products based on QFII have performed relatively poorly in comparison with the domestic market.[670] Moreover, most products invest primarily in Hong Kong and concentrate on companies relying mostly on business with the PRC, further decreasing diversification opportunities. Taking both the teething troubles and the relatively small size into account, the QDII program is unlikely to exert a large influence on prices on the Chinese stock market.

A further step towards global integration can be seen in the so-called "through train", approved by the SAFE. Accordingly, domestic investors who possess foreign currency

666 Based on data by: SZSE, Fact, 1998, SZSE, Fact, 2004 and SZSE, Market, 2008.
667 Entitled investors encompass banks, insurances companies and fund management companies. A major objective of the programs is to balance the foreign exchange inflow thus relieving pressure from the demand to appreciate the CNY.
668 As of March 2008, the QFII quotes accounts for 2.54% of foreign exchange reserves.
669 In September 2007 Southern Global was the first fund to invest 100% of assets in global stock markets. As of March 2008 four stock-oriented mutual funds were available to individual investors: JP Morgan Fund QDII, Harvests Overseas Fund, Huaxia Global Selected Stock Fund and Southern Global Enhance Balance Fund.
670 Cf. CHINA DAILY, QDII, 2008.

will be allowed to directly invest at the HKEx.[671] However, following the bursting of the stock market bubble, the beginning of this program has been postponed indefinitely.[672] Furthermore, plans to permit foreign companies to issue A-shares are said to be scheduled. This would extend domestic citizens' investment horizon.[673]

5.3 Concluding remarks

The process of reform and opening-up that transforms the Chinese economy from a centrally planned to a market-oriented system can be considered as paradigm change. Characterized by gradual adjustments, since its initiation in 1978 a financial system has been established that is structurally comparable to other developed market economies. However, owing to the proclaimed aim of creating a socialist market economy with Chinese characteristics, a range of former features, such as the general five-year economic plan, have been maintained. As a result of the economic transmission, both Chinese stock exchanges have grown considerably and are now among the biggest stock markets in terms of market capitalization.

While an opening of the stock market has been initiated, in the current state institutional regulations effectively prevent the integration of domestic Chinese with foreign stock markets. Restrictions are bilateral so that one can conclude that there is imperfect integration of both segments. Theoretical considerations suggest that the market was fully segmented prior to 2001 and subsequently both investor groups have been granted partial access to the previously deprived market. The following section goes beyond the theoretical analysis by evaluating empirical findings.

The parallel listing of domestic A-shares and foreign B- and H-shares respectively provides a unique research opportunity, since segment specifics can be isolated by means of corresponding market prices. In addition to this, the structural break subsequent to the opening of the B-share segment brings with it interesting opportunities as well. The following two sections evaluate the current state of research by focusing on studies that exploit these opportunities.

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[671] This program, in which the Tianjin Branch of Bank of China is to be used, has been approved by the SAFE in 8/20/2007, SAFE, Pilot, 2007.

[672] Cf. CAIJING MAGAZINE, Revised, 2007.

[673] CAIJING (2008) reports that NYSE Euronext has been chosen to be the first foreign company to list A-shares, CAIJING MAGAZINE, Euronext, 2008.

6 Asset pricing and valuation models in China

As demonstrated in Chapter 4, assumptions of both equilibrium and intrinsic value models are directly affected by impediments on market integration. Chapter 5 has concluded from a theoretical examination of the institutional environment that the Chinese stock market can be considered to be imperfectly integrated with other developed countries' markets.

This chapter commences by supporting the theoretical conclusion of imperfect integration with empirical findings. Based on this result, the general environment for equilibrium and intrinsic value models with respect to empirical research is discussed. Subsequently, empirical research on equilibrium and intrinsic value models are discussed and arranged in relation to the characteristics of the Chinese stock market.

6.1 Relevant aspects of the Chinese stock market environment

6.1.1 Integration of the Chinese stock market in the world market

According to MA (1996) two kinds of capital controls are exercised in emerging markets. The first sort limits foreign investments from ownership in domestic securities, with the purpose of maintaining control. The second form restricts the international investments made by domestic investors, aiming to control foreign exchange.[674] As discussed in Chapter 5, in the PRC both kinds of controls are used intensively.

Macroeconomic research deals with measuring the level of globalization. For this purpose several indices are published. These indices evaluate a number of criteria, on which basis country rankings are made. A frequently quoted globalization index is the Kearney Foreign Policy Index of Globalization, published by A.T. Kearney and the Foreign Policy Magazine. Accordingly, in 2007 the PRC ranked 66th out of 72 countries.[675] The number of countries is limited due to data availability and data balanc-

[674] MA, Market, 1996, p. 220.
[675] Cf. FOREIGN POLICY MAGAZINE, Index, 2007.

ing.[676] However, this index is criticized for having weak robustness.[677] An alternative can be seen in the KOF Index of Globalization, published by the KOF Swiss Institute of Technology Zurich. It measures globalization in a political, economic, and social dimension. In 2009 the PRC was ranked 83 out of 208 countries with respect to economic globalization.[678]

While most developed countries allow individual foreign investors unrestricted access to their stock markets, there is almost no country where institutional investors are not subjected to constraints.[679] In the PRC pervasive restrictions are in place. The Wall Street Journal and the Heritage Foundation 2009 Index of Economic Freedom ranks the PRC (apart from Hong Kong and Macau) 132th out of 179 countries in the "least freedom" group. In the categories of investment, financial freedom and property rights the PRC is classified in the lowest category – repressed. While progress in the operating environment is acknowledged, weak rule of law, transparency, the complex approval process and the strong government regulation on foreign currency flows are stated as the main drawbacks.[680]

On a national level it is argued that the investor structure on both the SSE and the SZSE is largely regionally determined.[681] This perception is supported by empirical evidence collected by LI (2003b). The author investigates information transmission among the two stock exchanges and its A- and B-share segments on a pair-wise basis. For both stock exchanges, significant information transmission is only found within the A- and B-segments of each stock exchange but no or only weak spillover effects are observed between both exchanges.[682] Moreover, the author is not able to find a common long-term trend for the four market segments.[683] These findings regarding information flow are consistent with results by CHAKRAVARTY/SARKAR/WU (1998).[684] Contrary results are

[676] "At the same time, we have tried to balance the selection of small countries so no one region is overrepresented." FOREIGN POLICY MAGAZINE, Globalization, 2003, p. 1.
[677] Cf. LOCKWOOD, Index, 2004.
[678] KOF, Index, 2009. The methodology used is taken from DREHER, Index, 2006. The economic dimension comprises long distance flows of goods, capital and services as well as information and perceptions in respect to market exchanges. Another alternative index, suggested by KAMINSKY/SCHMUKLER (2003), does not cover the PRC, while Hong Kong and Taiwan are included. KAMINSKY/SCHMUKLER, Financial, 2003.
[679] Cf. BARTRAM/DUFEY, International, 2001, p. 120.
[680] WSJ/WHF, Index, 2009.
[681] Cf. SU, Chinese, 2003, p. 105.
[682] The direction of these effects is: SSEA⇒SZSEA and SSEB⇒SZSEB.
[683] LI, Efficiency, 2003b.
[684] CHAKRAVARTY/SARKAR/WU, Information, 1998.

obtained by CHUI/KWOK (1998) who examines cross-segment information movements both from the A- to the B-share segment and vice versa, with the latter relation being stronger.[685]

Most empirical research does not deal with the national level but examines the integration of the Chinese stock market with other international markets. The first available study performed by BAILEY (1994) examines the correlation between the Chinese A-share market and the Hang Seng Index, the S&P 500 and Europe Australia Far East indices for a sample from 1992 to 1993, and finds no evidence for integration. The author ascribes this to "severe barriers". With respect to the B-share segment the author finds little or no correlation with international stock returns. Correlation with stock indices is very weak and only significant for two securities at a 10% level. In respect to the factors that proxy for risk premiums results are more supportive. BAILEY (1994) concludes that global factors influence risk premiums in the B-share segment. The author further concludes that while not totally segmented from global financial markets, the B-share segments nevertheless offer substantial diversification opportunities.[686]

SU (2003) examines the association between world variables and volatility in the Chinese stock markets. Although some variables explain part of the variation he concludes that there is evidence that integration is rather weak.[687] The author further investigates the spillover effect of returns and volatility from the HKEx to the Chinese B-share segment. He only finds evidence for return spillover from HKEx to the domestic exchange and not vice versa. For volatility no spillover effect can be identified. When comparing the two domestic stock exchanges he finds superior evidence for the SSE.[688]

Taking all that into consideration it can be concluded that empirical results predominantly support the theoretical conclusion that the Chinese stock market is imperfectly integrated with other developed countries. This leads to the question of whether pricing in the Chinese stock markets is nevertheless consistent with the so-called irrelevance hypothesis.

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685 CHUI/KWOK, Market, 1998.

686 BAILEY, Evidence, 1994, pp. 252-258.

687 For instance he finds the weekly lagged HSI return variable to be correlated with the SSE B-share returns, the weekly lagged Morgan Stanley composite world index return variable significant for the SZSE A-share return and the weekly lagged NYSE return variable significant for both the SSE and SZSE A-share markets, SU, Chinese, 2003, pp. 102-105.

688 SU, Chinese, 2003. See also ZHANG/ZHAO, Country, 2004, p. 50. Contradicting evidence is obtained by FUNG/LEE/LEUNG, Segmentation, 2000.

6.1.2 Irrelevance hypothesis in the Chinese stock market

The irrelevance hypothesis states that investment decisions are made regardless of fundamental economic data. ELTON (1999) refers to the irrelevance hypothesis as "one of the fundamental issues in finance".[689] Rejecting the irrelevance hypothesis underpins the application of equilibrium and intrinsic value models on a fundamental level. It can straightforwardly be examined using factor models to find evidence that fundamental data is causing price changes.[690] While structurally identical to factor models based on the APT, discussed in the following section, tests of the irrelevance hypothesis differ with respect to the underlying theory. That is to say models based on APT hypothesize that factors exhaustively explain price changes, while the irrelevance theory claims that economic factors have no explanatory power.

This is typically examined in accordance with the two-factor model considered sufficient to explain stock returns in FAMA/FRENCH (1992).[691] Often additional factors considered relevant for the specific market environment are included.[692] The first factor in FAMA/FRENCH (1992) is based on the size-effect formulated by BANZ (1981). The reasoning is that investors are willing to pay less for small size firms, due to inferior transparency.[693] The second factor is book-to-market ratio. It is argued that firms with higher required returns will have higher ratios.[694] FAMA/FRENCH (1993) suggest including a third factor – an overall market factor, to account for market risk, in what has become known as the three-factor model.[695]

With respect to the two-factor model, results for the Chinese stock market unambiguously find evidence for relevance of fundamental data. EUN/HUANG (2007) find both the firm size and the book-to-market factor consistently associated with average stock returns.[696] Equivalent results are obtained by LI/HONG (2006), who explicitly test the two-factor model.[697] However, they also conclude that in contrast, both variables do not

[689] ELTON, Tests, 1999, p. 1199.
[690] However, it must be noted that associated variables do not necessarily equate to real risk factors but might merely correlate with them.
[691] FAMA/FRENCH, Cross-Section, 1992.
[692] For the PRC, a variable for state ownership is regarded relevant in XU/WANG, Governance, 1999.
[693] BANZ, Value, 1981, p. 17.
[694] Cf. FAMA/FRENCH, Size, 1995, pp. 134-136.
[695] FAMA/FRENCH, Factors, 1993.
[696] EUN/HUANG, China, 2007, p. 25 and WANG/IORIO, Returns, 2007.
[697] LI/HONG, China, 2006.

suffice in explaining cross-sectional return differences.[698] Empirical results on this three-factor model for the Chinese stock market are mixed. EUN/HUANG (2007) are unable to identify association with market beta. Instead they find significant negative correlation with firm-specific risk.[699] The finding that securities with high total risk have smaller returns contradicts the conventional economic relation of risk and return.[700] However, ANG ET AL. (2006A) observed an equivalent relation in the US-market and in a subsequent study for 23 developed markets around the world. Since the results are robust in controlling for other variables such as size or book-to-market, the authors conclude that this negative relation is a global phenomenon, without suggesting an explanation.[701] Opposing results in the PRC are obtained by LI/HONG (2006), who identify significant association with market beta.[702]

Several other factors are found to be associated with stock returns in the Chinese stock market. Examples are: bid-ask spreads as proxy for liquidity, dividend yield and P/E-ratio as proxy for profitability, binary variable of cross-listings as proxy for corporate governance.[703] A summary of recent empirical research on factor models in the PRC is provided in Tab. 5. Taking all these results into consideration, on a fundamental level it can be concluded that investment decisions in the PRC are made based on fundamental data.

698 LI/HONG, China, 2006, p. 6.
699 EUN/HUANG, China, 2007.
700 This is because of the possibility of diversifying unsystematic risk away, so that its correlation with stock returns should be approximately zero. However, if information is not readily available, expected return will increase with idiosyncratic risk, MERTON, Equilibrium, 1987, pp. 490-491.
701 ANG et al., Volatility, 2006a and ANG et al., Idiosyncratic, 2006b.
702 Because their tests are on portfolio rather than security levels, no evidence regarding systematic risk is obtained. LI/HONG, China, 2006.
703 Cf. EUN/HUANG, China, 2007, pp. 25-26, HAW/QI/WU, Earnings, 1999 and CHEN/FIRTH/KIM, Valuation, 2002. It is argued, that corporate governance improves, since oversee listings require stricter disclosure, making investments more transparent for the domestic shareholders also. EUN/HUANG, China, 2007, pp. 25-26.

Tab. 5 Recent empirical results from factor models for the A-share segment

Study	Factors
DREW/NAUGHTON/VEERARGHAVAN (2003) (SSE, 1993-2000)	Market beta, size and book-to-market ratio are all found to be significant
LI/HONG (2006) (SSE, 1997-2004)	Market beta, size, book-to-market ratio are all found to be significant
eun/huang (2007) (SSE & SZSE, 1994-2004)	Significant are: total risk, size, book-to-market ratio, P/E-ratio, dividend yield, leverage, liquidity and offshore counterparts. Non- significant are: market beta and the proportion of tradable shares[704]
wang/iorio (2007) (SSE & SZSE, 1994-2002)	Significant are: P/E-ratio, liquidity, dividend yield, book-to-market and size. Non-significant is: market beta

6.1.3 Equilibrium models in the Chinese stock market

As discussed in Section 2.2, the assumption underlying equilibrium models encompasses classical portfolio selection as well as perfect capital markets. With respect to the former, rational behavior and non-satiation can be regarded in a Boolean manner either true or false, while risk-aversion can be regarded continuous. Comparing the PRC with other developed countries, there it appears not to be substantiated to surmise differences regarding rational behavior, non-satiation and general risk-aversion.[705] However, as discussed in Section 4.2.2, different levels of risk aversion across investors from different countries can cause equilibrium prices to diverge. Assumptions of perfect capital markets, which include homogenous expectations, equal interest rates and no frictions, are subject to similar drawbacks as in other countries. Corresponding to risk aversion, heterogeneous expectations and different risk-free rates across countries can cause segment-specific prices, provided there is imperfect integration. Frictions in the form of transaction costs and taxes exist in the PRC as well as a spread

[704] In their frequently quoted preceding 2002 working paper, a significant positive relation was identified EUN/HUANG, Asset, 2002, p. 5.

[705] It can be argued that the institutions influenced by the government are not necessarily profit-maximizing, cf. ZHAO/MA/LIU, Valuation, 2005, p. 20. However, due to the large number of small investors, who follow attempts to obtain a profit from stock trading, it appears unlikely that the market is dominated in a way that prevents profit maximizing.

between credit- and debit-interest rates as anywhere else. However, it is argued that foreign and domestic investors might not share common expectations regarding future economic returns.[706]

Possibly discouraged by results in other countries, studies that specifically test the CAPM on the Chinese stock market are rare. Instead its implications are typically tested in combination with other factors. For instance, controlling for size and book-to-market by building portfolios, LI/HONG (2007) obtain an factor loading close to unity on the SSE. The authors interpret this as evidence in favor of the CAPM.[707] However, since size and book-to-market factors are also significant, this could alternatively be interpreted as evidence for the FAMA/FRENCH (1993) three-factor model.[708] LI/HONG (2007) also compare the CAPM to the three-factor model and find the latter to improve the fit and reduce the specification error.[709] Also DREW/NAUGHTON/VEERARGHAVAN (1999) are able to create zero-cost portfolios that earn abnormal returns based on the size effect. Consequently, the authors conclude that beta alone cannot suffice in explaining returns.[710]

Altogether, the elusiveness of the market portfolio and the risk-free rate impair tests of the CAPM in the Chinese stock market analogous to other countries. Therefore it is concluded that the applicability of the CAPM cannot be empirically supported. On the other hand, consistent with theoretical considerations discussed in Section 4.2.2, factor models based on APT, such as the two- or three-factor model, appear suitable for examining price differences. However, factor selection and sensitivity estimation rely on arbitrary choices.

6.1.4 Intrinsic value models in the Chinese stock market

In general, the intrinsic value models are based on no exogenous assumption. However, when the subject of empirical research, assumptions on terminal value, value-price

[706] Cf., MEI et al, Speculative, 2005, p. 5, BELTRATTI/CACCAVAIO, Chinese, 2007, p. 20, DARRAT/WU/ZHONG, Puzzle, p. 15, 2007 and GAO/TSE, Information, 2004, p. 3.
[707] LI/HONG, China, 2007, p. 6.
[708] This result is consistent with DREW/NAUGHTON/VEERARGHAVAN, Shanghai, 2003 and WANG/IORIO, Returns, 2007.
[709] LI/HONG, China, 2007, pp. 6-16.
[710] DREW/NAUGHTON/VEERARGHAVAN, Shanghai, 2003, pp. 135-136.

relation and capitalization object are required. With respect to the Chinese stock market, terminal value assumptions are equally arbitrary. With respect to a value-price relation, tests on the irrelevance hypothesis discussed in Section 6.1.2 can be concluded non-supportive for the Chinese stock market. However, the finding that prices are not attained independent of economic fundamentals cannot be considered sufficient for assuming a specific value-price relation. Therefore, the relation is further investigated by regarding informational efficiency.

The relation between value and price can be established by assuming efficient markets. Efficient markets in the sense of FAMA (1970) must be separated from allocational efficiency.[711] The former is concerned with price discovery and is based only on informational efficiency. The latter deals with directing capital to the most productive opportunities and requires both informational and operational efficiency.[712] In order to establish a value-price relation informational efficiency can be regarded as sufficient.[713]

Obviously, perfect informational efficiency is a restrictive assumption unlikely to be supported by empirical results. For this reason it has been subdivided into different levels of market efficiency: weak, semi-strong and strong. The weak form states that all past information about prices and returns are reflected in current stock prices. The semi-strong form theorizes that all publicly available information is internalized in the prices. Lastly, the strong form states that no agent has exclusive access to any relevant information.[714]

Most empirical research on informational efficiency deals with semi-strong form efficiency. Typically two methods are applied: time series analysis and event studies. For the former method, informational efficiency is tested by the random walk hypothesis. It states that stock-price changes are random.[715] In general, consensus exists that markets across the world are fairly efficient, while the level differs among nations depending on maturity.[716] SU (2003) rejects the random walk hypothesis for both SSE and SZSE for an

[711] FAMA, Efficient Markets, 1970.
[712] Operational efficiency requires that no internal organizational factors limit capital allocation, SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 47.
[713] Cf. CAMPBELL/LO/MACKINLAY, Econometrics, 1997, p. 20, LI, Efficiency, 2003b, p. 33 and COPELAND/WESTON/SHASTRI, Theory, 2005, pp. 353-355.
[714] Cf. FAMA, Efficient, 1991, p. 1575 and CAMPBELL/LO/MACKINLAY, Econometrics, 1997, pp. 21-22
[715] Cf. GODFREY/GRANGER/MORGENSTERN, Random-Walk, 1964.
[716] Cf. SOLNIK/MCLEAVEY, Investment, 2004, p. 94.

early sample period from 1992-1996.[717] Opposing results are obtained by LI (2003A), who evaluates a longer sample period from 1991-2001 for both SSE and SZSE. The author concludes that at least for the SZSE, weak-form efficiency was achieved at the end of the 90's. In a second study briefly afterwards, the author obtains evidence for the SSE also.[718] He investigates unpredictability as a sufficient condition for weak-form efficiency and finds that a time-varying autoregressive model and an asymmetric GARCH model lost their predictive ability in the recent end of the sample period.[719] LONG/PAYNE/FENG (1999) and LIMA/TABAK (2004) obtained mixed results.[720]

CAMPBELL/LO/MCKINLAY (1997) challenge time series analysis by pointing out that tests of the random walk hypothesis depend on the model that describes the normal security returns. Furthermore they emphasize that to some extent predictability of stock returns can be consistent with informational efficiency when taking trade-off between risk and return into account.[721] MALKIEL (2003) emphasizes that mathematical and economical significance should not be mixed. That is to say, while it is possible to mathematically predict stock returns, transaction cost might consume arbitrage opportunities.[722] Finally, URRRUTIA (1995) advises not to interpret autocorrelation as evidence against informational efficiency when dealing with emerging markets, because of unusually strong growth.[723]

Event studies as an alternative method of testing informational efficiency can be attributed to BALL/BROWN (1968).[724] These studies argue that in informational efficient markets it cannot be possible to systematically generate abnormal returns by trading on publicly available information. Event studies investigate price adjustments around the disclosure of economically significant information. According to weak-form efficiency, prices should rapidly adjust. In the case of semi-strong form efficiency, prices will be anticipated ahead of the announcement.

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[717] SU, Chinese, 2003, pp. 86-89. Equivalent results are obtained by LEE/CHEN/RUI, Volatility, 2001 and DARRAT/ZHONG, Random, 2000.
[718] LI, Efficiency, 2003b, p. 54.
[719] LI, Evidence, 2003a, pp. 341-347 and 357. However, the semi-strong form is rejected, LI, Efficiency, 2003b, pp. 54-55.
[720] LONG/PAYNE/FENG, Market, 1999 and LIMA/TABAK, Random, 2004.
[721] CAMPBELL/LO/MACKINLAY, Econometrics, 1997, pp. 24 and 30-31. See also SHARPE/ALEXANDER/BAILEY, Investments, 1999, p. 102.
[722] MALKIEL, Critics, 2003, pp. 61-62. It is argued that prices cannot perfectly reflect all information because there will always be information that is too costly to trade on, GROSSMAN/STIGLITZ, Impossibility, 1980, p. 405.
[723] URRUTIA, Emerging, 1995, p. 308.
[724] BALL/BROWN, Evaluation, 1968.

SU (2003) investigates price reactions to earnings announcements for firms that issue both A- and B-shares. The author obtains opposing results between the segments. While A-share investors react sluggishly, foreign investors correctly anticipate earnings changes, leaving little or no possibility for abnormal returns.[725] In contrast, opposing results for the A-share market are obtained by HAW/QI/WU (1999).[726] However, BALL (1992) states that due to research design bias, it is often not possible to conclude inefficiency from thus obtained results.[727] FAMA (1998) also points out that long-term anomalies can be considered chance results and are therefore not to be interpreted as reasons for abandoning informational efficiency.[728]

Tab. 6 summarizes empirical results on the informational efficiency at the Chinese stock market according to both time-series analysis and event studies. It reveals mixed results, with more recent studies indicating an increase in efficiency.

[725] SU, Chinese, 2003, pp. 322 et seq.
[726] HAW/QI/WU, Earnings, 1999.
[727] The author argues that interdependencies impair the ability to derive a true association between earnings information and abnormal earnings, BALL, Anomaly, 1992, pp. 341-342.
[728] FAMA, Efficiency, 1998, p. 304.

Tab. 6 Tests of weak-form informational efficiency [729]

Study	Method	Sample period	A-share segment	B-share segment
HAW/QI/WU (1999)	event study	(SSE & SZSE, 1994-1997)	no rejection	-
LONG/PAYNE/FENG (1999)	time-series	(SSE, 1992-1994)	rejection	no rejection
DARRAT/ZHONG (2000)	time-series	(SSE & SZSE, 1990-1998)	rejection	-
LEE/CHEN/RUI (2001)	time-series	(SSE & SZSE, 1990-1997)	rejection	rejection
SU (2003)	time-series	(SSE & SZSE, 1992-1996)	rejection	rejection
SU (2003)	event study	(SSE & SZSE, 1997-1998)	rejection	no rejection
LI (2003b)	time-series	(SSE & SZSE, 1991-2001)	no rejection	no rejection (SSE)
LIMA/TABAK (2004)	time-series	(SSE & SZSE, 1992-2000)	no rejection	rejection

The dilemma of consistently formulating testable hypotheses has caused empiricists to typically assume informational efficiency. Consequently, tests that deal with the pricing relation in the scope of intrinsic value models are therefore joint-tests of both the hypothesis at stake and implicitly informational efficiency.[730] This conclusion holds as well to the assumptions regarding terminal value and capitalization object.

Regarding the capitalization object, the Chinese stock market involves particular features. With respect to dividends it is argued that various forms of dividends exist, making it complicated to identify the adequate capitalization stream.[731] Moreover, a large proportion of companies have not distributed income.[732] If arbitrary dividend forecasts are to be avoided, a large proportion must be excluded from the sample.[733] Furthermore regarding accounting data, skepticism surrounds their value-relevance in the PRC.[734]

[729] Included are only studies that specifically test for informational efficiency, while a plethora of studies can be interpreted as implicit tests.

[730] A good example can be found in: CAMPBELL/LO/MACKINLAY, Econometrics, 1997, p. 25: "we do not take a stand on the market efficiency itself, but focus instead on the statistical methods that can be used to test the joint hypothesis of market efficiency and market equilibrium." See also BALL, Anomaly, 1992, p. 341.

[731] Besides cash and stock dividends, also mixed forms that involve rights exist, ECONOMIST, Pay, 2006. See also CHOW/FAN/HU, Model, 1999, p. 22.

[732] This is argued to be due to the history of most listed companies being SOE, ECONOMIST, Pay, 2006.

[733] Cf. LIU/HU, Dividend, 2005, p. 65.

[734] It is mostly argued that earnings management significantly impairs accounting data in the PRC. Cf. HAW/QI/WU, Management, 2005 and HUANG/LENK/SZCZESNY, Earnings, 2006.

While a discussion of the Chinese accounting system – referred to as PRC GAAP – lies beyond the scope of this thesis, generally speaking, a continuous convergence towards International Financial Reporting Standards (IFRS) can be observed.[735] However, it must be noted that the transformation is still in process and considerable differences remain.[736] Ample empirical research has examined value relevance of accounting information in the PRC. Corresponding research can be divided into short window event studies and long window association studies. As discussed above, event studies provide mixed results, while studies that examine the association between stock market returns and accounting information support their value relevance.

Empirical results on the relative usefulness can be structured according to the relevance of PRC GAAP and IFRS earnings or book value of equity to explain A- and B-shares prices. Tab. 7 provides a summary of empirical studies. It can be seen that PRC GAAP appears superior in explaining A-share prices. However, mixed results are obtained for B-share prices. While most studies deal with earnings and book value as accounting information, HAW/QI/WU (2001) find cash flows and accruals to be value relevant.[737] Furthermore, the DCF, RIV, OM and FOM require the CSR to hold. However, the CSR is regarded to be violated under PRC GAAP, particularly when capital increase is concerned.[738] Nevertheless, empirical research typically assumes non-violation.[739]

[735] For a detailed discussion cf. MA/LAU, Accounting, 2001 and XIAO/WEETMAN/SUN, Accounting, 2004. The starting point can be seen in the change from the former fund-based accounting system, adopted from the former Soviet Union, to a double-entry bookkeeping system under the Accounting Standard for Business Enterprises - Basic Standard in 1992.

[736] For discussion of the differences cf. DELOITTE, Standards, 2006.

[737] HAW/QI/WU, Accruals, 2001. CHEN/WANG (2004) find operating income and below-the-line items to be value relevant also, CHEN/WANG, Relevance, 2004.

[738] Cf. ZHAO/MA/LIU, China, 2005, pp. 15-16.

[739] Cf. HU, Usefulness, 2002 and BAO/CHOW, Usefulness, 1999.

Tab. 7 Relative usefulness of PRC GAAP vs. IFRS information for stock valuation

Study	A-share		B-share	
	Earnings	Book value	Earnings	Book value
BAO/CHOW (1999) (SSE & SZSE, 1992-1996)	-	-	IFRS > PRC GAAP	IFRS < PRC GAAP
ECCHER/HEALY (2000) (SSE & SZSE, 1993-1997)	IFRS < PRC GAAP	-	IFRS < PRC GAAP	-
CHEN/SUN/WANG (2002) (SSE & SZSE, 1994-1997)	IFRS < PRC GAAP	non-significant	IFRS > PRC GAAP	IFRS > PRC GAAP
HU (2002) (SSE, 1994-1999)	-	-	IFRS < PRC GAAP	IFRS = PRC GAAP
GAO/TSE (2004) (SSE & SZSE, 1995-2000)	IFRS < PRC GAAP	-	IFRS > PRC GAAP	-

x < y expresses a relatively higher usefulness of y

With respect to the Chinese stock market, it would seem that only five studies attempt to explicitly test intrinsic value models. These studies are CHOW/FAN/HU (1999), FERNALD/ROGERS (2002), ZHANG/ZHAO (2004), LIN/CHEN (2005) and ZHAO/MA/LIU (2005). Among these studies only the two actually apply intrinsic value models, while the others merely perform regression of input variables with stock prices. Tab. 8 summarizes samples, models and methods used.

CHOW/FAN/HU (1999) investigate whether stock prices at the SSE can be explained using the DDM.[740] The authors assume shares to be priced rationally and dividend expectations to be formed adaptively using past data. Examining correlation between dividends and their expected growth rates with stock prices, the authors find supporting evidence.[741] However, autocorrelation or collinearity is not addressed and tests of significance are only made for the complete model. Therefore it is not apparent whether explanatory power can be attributed to the dividend variables or the price variables.

FERNALD/ROGERS (2002) attempt to find evidence that it is generally promising to apply intrinsic value models to examine the price puzzle. Based on a perpetuity dividend

[740] Other studies also deal with dividends, either as factor within factor models or as discussed below as explanations for price differences between A- and B-shares.

[741] The null-hypothesis is rejected at an 18% level. CHOW/FAN/HU, Model, 1999, p. 560.

growth model with a long-run dividend forecasts proxied by an ex-post average, the authors obtain a 4% difference between foreign and domestic investors' intrinsic discount rate. Comparing real interest rates of long-term savings in China and US T-bonds, the authors find 3% spread and conclude that it explains much of the 4% difference.[742]

ZHANG/ZHAO (2004) examine the relation of price differences between A- and B-share prices as dependent variables and a number of proxies for risk-free rate and risk premium. The authors proxy country risk with the Euromoney country risk weighting, exchange risk with the 1-year change of USD/CNY exchange rate, and risk-free rate with the 5-year T-bonds yield and market risk premiums, for which no proxy is mentioned, although it appears to be the market risk premium derived from the A-share index. Overall, the authors' focus is on the country risk. Tests of significance support the hypothesis that political risk, risk-free rate and risk premium proxy are significant.[743]

LIN/CHEN (2005) explicitly attempt to test the relevance of accounting numbers for equity valuation in China. For this reason both prices and returns are observed. The relevant accounting variables, book value and earnings, are derived from the OM. The linear information dynamics are disregarded. Implicitly assuming CSR, the authors find both information to be value relevant in both A- and B-share segment. Furthermore, the authors also find IFRS information to add explanatory power to the model with respect to prices but not to returns.[744]

The study by ZHAO/MA/LIU (2005) applies the RIV with ten periods' abnormal earnings specification. The value estimates are obtained by using a panel data vector autoregression model. Subsequently, intrinsic value is computed by discounting with a risk-free rate proxied by the interest rate of 28-years of national debt for A-share investors and a 30-year US T-bond interest rate for the H-share investors. Comparison with market prices reveals that prices exceed fundamental value for most of the companies. The authors conclude that "at least for the mainland companies it is not suitable to assume that stock price equals its fundamental value computed according to DDM or RIV".[745] While the price differences between foreign and domestic investors appear consistent

[742] FERNALD/ROGERS, Puzzles, 2002.
[743] ZHANG/ZHAO, Country, 2004.
[744] LIN/CHEN, Relevance, 2005.
[745] ZHAO/MA/LIU, Valuation, 2005, p. 25.

with different risk-free rates, this is an inevitable consequence of the proxies used, since at the point in time used for this study the domestic risk-free rate was below the foreign risk-free rate. Furthermore, the conclusion that intrinsic value does not equal observable market prices is limited since the nominal interest rate of T-bonds with 30-year maturity is likely to differ from the risk-free rate perceived by the market. Furthermore, assuming terminal value to be zero beyond ten years is also likely to omit a value component.

Tab. 8 Empirical research on intrinsic value models

Study	Model
CHOW/FAN/HU (1999) (SSE, 1996-1998)	$p_t = \alpha + \beta_1 p_{t-1} + \beta_2 p_{t-2} + \beta_3 d_{t-1} + \beta_4 d_{t-2} + \beta_5 d_{t-3} + \varepsilon_t$ Underlying reasoning of DDM. Authors perform least-square analysis for model with lagged value of prices (p) and dividends (d) as explanatory variables.
FERNALD/ROGERS (2002) (SSE & SZSE, 1993-1998)	Underlying reasoning of DDM. Authors apply a perpetuity dividend growth model with a long-run dividend forecast, proxied by an ex-post average. Subsequently, comparison with real interest rates of long-term savings in China and US T-bonds are performed.
ZHANG/ZHAO (2004) (1992-2000, SSE)	Underlying reasoning of DDM. Authors perform least-square analysis of a linear multifactor regression model with several factors that are considered proxy for risk-free rate and risk premium. The authors apply foreign and domestic share price differences as the dependent variable.
LIN/CHEN (2005) (SSE & SZSE, 1995-2000)	$p_t = \alpha + \beta_1 b_t^{PRC} + \beta_2 e_t^{PRC} + \beta b_t^{IFRS-PRC} + \beta_4 e_t^{IFRS-PRC} + \varepsilon_t$ Underlying reasoning of OM. Book value of equity (b) and accounting earnings (e) are taken into account. Linear information dynamics are disregarded. Attempt to test value relevance of accounting numbers to equity valuation in China. The subscript PRC and IFRS refers to the relevant accounting standard, with IFRS-PRC being the difference between the IFRS accounting number and the corresponding PRC GAAP figure.
ZHAO/MA/LIU (2005) (SSE & HKEx, 1998-2003)	$\left(GB_t, ROE_t\right)' = \left(c_1, c_2\right)' + \sum_i \begin{pmatrix} a_{1i} & b_{1i} \\ a_{2i} & b_{2i} \end{pmatrix} \begin{pmatrix} GB_{t-i} \\ ROE_{t-i} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix}$ Underlying reasoning of RIV. Panel data Vector autoregression model is used to compute forecasts for future return on equity and book-value, according to industry portfolios. The models contain growth rate of equity (GB), return on equity (ROE), a constant term (c) and factor loading (a). Subsequently, values are used to compute present value using a risk-free rate and comparison with market prices is performed.

Therefore, it can be concluded that empirical research that examines the relevance of intrinsic value models at the Chinese stock market is limited. Among the five apparent

studies, only two apply an intrinsic value model while the others leave it with regression analysis of input variables and stock prices. The two studies that did apply an intrinsic value model only compared prices and intrinsic value at one point in time and did not perform hypotheses testing in order to gauge the statistical robustness of the results.

6.2 Concluding remarks

Empirical results predominantly support the theoretical conclusion that the Chinese stock market is imperfectly integrated with other developed countries. Nevertheless, on the fundamental level of the irrelevance hypothesis, empirical results strongly support the notion that investment decisions in the PRC are made based on fundamental data.

Altogether, the elusiveness of the market portfolio and the risk-free rate impair tests of the CAPM in the Chinese stock market analogous to other countries. Therefore it is concluded that the applicability of the CAPM cannot be empirically supported. On the other hand, consistent to theoretical considerations discussed in Section 4.2.2, factor models based on APT, such as the two- or three-factor model, appear suitable for examining price differences. However, factor selection and sensitivity estimation rely on arbitrary choices, thus impairing their application for objective valuation.

Therefore, with regard to the Chinese stock market, the applicability of intrinsic value models can be regarded a promising issue. On a general level, the value-price relation is gauged with respect to information efficiency. While event studies provide mixed results, studies that examine the association between stock market returns and accounting information support their value relevance. Actual empirical tests of intrinsic value models in the Chinese stock market are rare. While four studies examine the relation of input variables and stock prices, essentially only two studies apply an intrinsic value model empirically. Since results are not subjected to hypotheses testing but are merely interpreted qualitatively, it can be concluded that a need for continued research exists.

7 The Chinese discount puzzle

The seemingly puzzling relation between A-, B- and H-share prices, respectively, has drawn much interest from capital market researchers.[746] All shares are essentially equivalent regarding their economic characteristics.[747] Nevertheless, foreign shares are continuously traded at a significant discount to their domestic counterparts.[748] In reference to the law of one price, this could be considered a violation of fundamental economic theory.

The law of one price - attributed to JEVONS (1888) - states "that in the same open market, at any one moment, there cannot be two prices for the same kind of article."[749] This concept is based on the notion that arbitrage activity of simultaneously purchasing and selling will lead to equivalent goods having the same prices. However, the definition explicitly and implicitly entails conditions. Firstly, it is restricted to an open market. Secondly, it is not intertemporal. Thirdly, it is restricted to homogenous products. Lastly, it implicitly requires the absence of identifiable arbitrage opportunities.

While the first three conditions are essentially observable the last condition can be considered intricate. Therefore, the law of one price has been frequently challenged as being "no law at all".[750] Search frictions and information asymmetry are argued particularly to cause violation of the law of one price.[751]

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[746] Cf. BAILEY/CHUNG/KANG, Premiums, 1999 and CHAN/KWOK, Segmentation, 2005.

[747] The only qualitative difference is the fact that majority voting interest can only be obtained through A-shares. However, since overall only small fractions are traded over markets, majority voting interest premiums are typically paid when shares are sold through block trades outside of stock markets.

[748] Cf. KAROLYI/LI, Puzzle, 2003. It must be noted that in 1995, a few companies were traded at a premium, which negated into a discount over time, BERGSTRÖM/TANG, Differential, 2001, p. 412.

[749] The author refers to it as the "law of indifference", JEVONS, Theory, 1888, p. 66.

[750] VARIAN, Model, 1980, p. 651. See also STIEGLER, Information, 1961.

[751] Cf. BAYE/MORGAN, Price, 2004, p. 450 and BURDETT/JUDE, Dispersion, 1983. Accordingly, price differences in the PRC could be simply ascribed to inefficiency.

7.1 Characterization of the Chinese discount puzzle

7.1.1 The law of one price in the Chinese stock market

For the purpose of this thesis, the implicit condition can be neglected. This is because when empirically dealing with the asset pricing and valuation models discussed in this thesis, both perfect capital markets and arbitrage free markets assure the absence of arbitrary opportunities. Also the concept of informational efficient markets suffices in arbitraging deviations from the law of one price away. Therefore, empirical applications of CAPM, models based on APT and intrinsic value models already account for the implicit condition in their underlying assumptions.[752] Therefore, examining the law of one price in the Chinese stock market can be restricted to the explicit conditions.

With respect to equivalence of time, domestic and foreign shares can be interchanged at the same trading hours on SSE, SZSE and HKEx.[753] Consequently, comparing closing prices can be considered consistent with the law of one price.

The law of one price requires goods to be homogenous. Essentially, A-, B- and H-shares securitize equivalent residual rights, with equivalent voting and cash flow rights.[754] Nevertheless, while A- and B-shares are traded at equivalent exchanges with equivalent shareholder rights, H-shares can be considered distinct in their institutional environment. Consequently, deviation from A- and corresponding H-share prices could be attributed to different perceptions of institutional shareholder protection. However, with respect to B-shares such deviation cannot be attributed to heterogeneity.

Most importantly, the law of one price explicitly requires shares to be traded in one market. Although A- and B-shares obviously are traded in two different market segments, consistent with the discussion in Section 4.2 a common market could nevertheless be assumed provided those segments were perfectly integrated. However, since perfect integration has been rejected in Section 6.1.1, since shares are not interchangea-

[752] The CAPM relies on perfect capital markets, APT assumes arbitrary-free markets and empirical tests of intrinsic value models assume an informational efficient market, in order to construct a relation between value and price.

[753] Cf. SSE, Rules, 2006, Section 4, SZSE, Rules, 2006, Section 3 and HKEx, Rules, 2008, Section 501.

[754] Cf. CHUI/KWOK, Market, 1998, p. 336, EUN/HUANG, China, 2007, p. 458 and DELIOS/WU, Legal, 2005, p. 153. Dividends for B-shares are paid in foreign currency based on the same date exchange rate. The different kinds of domestic shares also have equivalent rights, BELTRATTI/CACCAVIO, Chinese, 2007 p. 5.

ble without impediments, arbitrage purchasing and selling cannot broadly take place, hence the law of one price is not applicable.

Market segmentation is common among equity markets in developing countries.[755] What makes the Chinese discount puzzle distinct is that findings contradict evidence from other countries. As BAILEY/CHUNG/KANG (1999) conclude from the observation of a variety of segmented markets, foreign shares usually trade at a premium. The premium could be justified by the diversification explanation attributed to EUN/JANEKIRMANAN (1986).[756] It is argued that international investors can diversify away specific country risk, and therefore require a lower rate of return.[757] As an example, the study by BAILEY/JAGITIANI (1994) examines price differences at the Stock Exchange of Thailand. In this market, securities that reach foreign ownership limits are traded in distinct segments with separated prices being published, they however remain identical in respect to dividends and voting rights. The authors identify a correlation between share prices and proxies for downward sloping demand, liquidity and information availability.[758]

Consequently, it can be concluded that the price differences could be in accordance with the law of one price, which given imperfect integration cannot be applied to the world market as a whole but only to segments that can be considered as one market in themselves.

7.1.2 Price differences between A-, B- and H-shares

The first to address the price differences at the Chinese stock market was BAILEY (1994). Equation (7.1) specifies the author's definition of the price differences. Accordingly, the foreign discount ξ_t for a specific stock at a specific point in time t is defined as the

[755] A current example is the 49.00% limit for foreign ownership in one company's stock traded on the Vietnamese exchanges.

[756] BAILEY/CHUNG/KANG, Premiums, 1999. See also CHAKRAVARTY/SARKAR/WU, Information, 1998, p. 348 and EUN/JANEKIRAMANAN, Model, 1987, p. 913.

[757] Cf. HIETALA, Segmented, 1989.

[758] Since the late 80's, the Stock Exchange of Thailand has published two listings for securities that have reached the foreign ownership limits: the "Main Board" and the "Alien Board", BAILEY/JAGTIANI, Thai, 1994. See also BEKAERT/HARVEY, Thailand, 2007.

price difference between foreign share p_{ft} and the corresponding domestic share relative to the price of the domestic share p_{dt}.[759]

$$\xi_t = \frac{p_{ft} - p_{dt}}{p_{dt}} \tag{7.1}$$

As an illustration Tab. 9 summarizes foreign share discounts as of May 2008. At first it can be seen that except for two companies, foreigners' prices are lower than domestic prices. For Anhui Conch Cement Co. Ltd. H-shares foreigners paid a premium of 8.16%. However, this premium is not persistent. On the SZSE for Konka Group Co. Ltd. B-shares foreigners paid a premium of 0.45%. The latter premium has been persistently paid since January 2003 with the exception of April 2007, however, it is not apparent what has caused this converse result. Altogether, discounts for foreign shares are similar throughout the different exchanges. With 49.27% the highest discounts are found at the SZSE. On the HKEx, H-shares trade at a discount of 41.18% compared to the corresponding A-shares. The highest observed discount of 76.25% was at the SSE but in general results are similar. Standard deviation is between 14.75% at the SZSE and 19.60% on the HKEx.

[759] BAILEY, Evidence, 1994, pp. 248 and 253-254. The reversal is performed by SU, Chinese, 2003, p. 129. CHEN/LEE/RUI (2001) suggest that the B-share discounts should be considered A-share premiums. The authors argue that B-share returns appear more related to market fundamentals than A-share returns, CHEN/LEE/RUI, Segmentation, 2001, pp. 150-152.

Tab. 9 Foreign share discount (May 2008)

	Total	SSE	SZSE	HKEx
Average	-44.59%	-47.42%	-49.27%	-41.18%
Standard deviation	18.08%	16.62%	14.75%	19.60%
Minimum	-76.25%	-76.25%	-66.67%	-75.80%
Maximum	8.16%	-8.78%	0.45%	8.16%
Number of observations	112	25	28	59

Source: THOMSON (2008)

The evolution of the foreign share discount is plotted in Fig. 9. It can be seen that the development across SSE, SZSE and HKEx is similar. For all exchanges, a decrease of the discount on foreign shares over time is apparent. The convergence is particularly strong in March 2001, following the opening of the B-share segment to domestic investors. The fact that this applied only to the SSE and the SZSE, while the HKEx was not directly affected by this reform, can also be seen since discounts between mainland and Hong Kong diverge and remain different essentially until January 2004. Subsequently, discounts converge again and since June 2007 appear synchronized again. This could be attributed to fading interest of domestic investors in B-shares due to perceived superior opportunities in the A-share segment. It can furthermore be seen that the effect of the opening was not abrupt but it took the prices time to adjust to it until a local maximum of 30.33% at the SZSE and 33.93% at the SSE was attained.

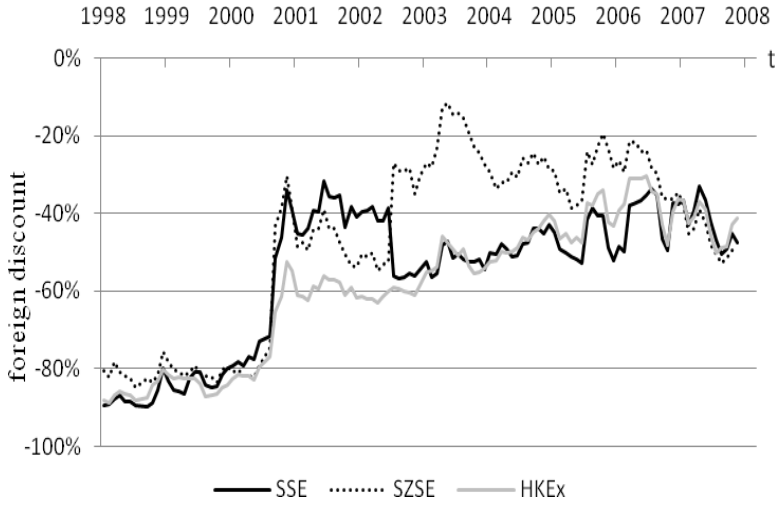

Fig. 9 Average foreign share discount [760]

7.2 Suggested explanations and empirical evidence

Currently, essentially five explanations for the Chinese discount puzzle are being discussed. In accordance with CHAN/MENKVELD/YANG (2006) they can be categorized into five competing hypotheses: speculation, information asymmetry, differential demand, differential risk and differential liquidity hypothesis.[761]

Being the most simplistic, the speculation hypothesis attributes the price differences to irrational behavior of domestic investors.[762] The information asymmetry hypothesis reasons violation of homogenous expectations due to asymmetric information distribution to be causing the price differences.[763] The differential demand hypothesis ascribes price differences to different price elasticity of demand.[764] The differential risk hypothesis relates the differences to unequal alternative investment opportunities or different risk tolerance.[765] The differential liquidity hypothesis argues that foreign investors

[760] Based on data by: Thomson (2008).
[761] CHAN/MENKVELD/YANG, Asymmetry, 2006, pp. 5-6. See also BERGSTRÖM/TANG, Differential, 2001, p. 411.
[762] Cf. MEI/SHEINKMAN/XIONG, Speculative, 2005, p. 1.
[763] A fifth hypothesis taken into account by CHEN/LEE/RUI (2001) is called the differential demand hypothesis. It is based on the notion that foreign and domestic investors have different demand functions. However, this hypothesis is particularly complicated to separate from the risk hypothesis in empirical tests. This impairs results by CHEN/LEE/RUI, Segmentation, 2001, pp. 138 and 146.
[764] Cf. DARRAT/WU/ZHONG, Puzzle, 2007 based on STULZ/WASSERFALLEN, Foreign, 1995.
[765] Cf. CHAN/MENKVELD/YANG, Asymmetry, 2006, pp. 5-6. This categorization is similar to BAILEY, Evidence, 1994, pp. 253-258.

require compensation for costly and time-consuming liquidation, by getting a premium.[766]

An overview of the competing hypotheses is provided in Fig. 10. Within these explanations, the speculation hypothesis takes a special position, since it contradicts the assumption of rational behavior. That is to say, provided the speculation dominates the pricing mechanism in the Chinese stock market, an essential assumption of equilibrium models would be violated. Correspondingly, the value-price relation required for empirical tests on intrinsic value models would be also disturbed.

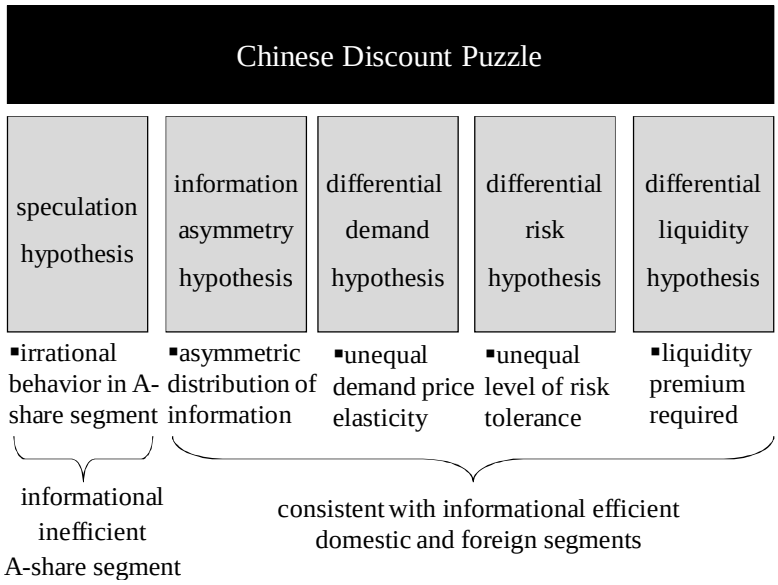

Fig. 10 Proposed explanations for the Chinese discount puzzle (own illustration)

Most empirical research that examines the foreign share discount proceeds by regressing hypothesized factors on the price differential. For this purpose time series, cross-section and panel data analysis are applied. In this manner BAILEY (1994) performed the first empirical study on the Chinese discount puzzle.[767] A few studies apply equilibrium models such as MA (1996) and SU (2003).[768] It seems that only two studies apply an intrinsic value model in order to examine the discount puzzle: FERNALD/ROGERS (2002) and ZHANG/ZHAO (2004).[769]

[766] See also BERGSTRÖM/TANG, Differential, 2001, p. 411.
[767] The author uses proxies for global interest rates and risk premiums and ascribes weak results to the short sample period, BAILEY, Evidence, 1994.
[768] MA, Market, 1996 and SU, Chinese, 2003, p. 105.
[769] FERNALD/ROGERS, Puzzles, 2002 and ZHANG/ZHAO, Country, 2004.

The following sections discuss the different hypotheses and review empirical research that deals with the Chinese discount puzzle. The relevant studies and their empirical results are summarized in Appendix: 2.

7.2.1 Speculation hypothesis

Some authors refer to the Chinese stock market as a casino.[770] They are referring to the notion that investment decisions are predominantly made regardless of fundamental data. Instead speculation, that is to say the endeavor to profit from price fluctuations, is argued to be the determining factor.[771] Since speculation cannot be directly observed, the reasoning is drawn from a variety of indicators, both institutional and quantitative. Institutional arguments buttress speculation with a lack of maturity in the institutional structure that includes investors, regulators and financial press. Quantitative arguments simply compare key indicators of the Chinese stock market to global benchmarks.

With respect to domestic investors, SU (2003) stresses that the "Chinese stock market is overwhelmed with individual investors, most with limited understanding of financial risk and investments, but is lack of long-term institutional investors".[772] The author further concludes: "domestic Chinese investors do not seem to completely understand the true nature of the equity market."[773] This assertion is based on the predominant role of individual investors. Because of the breakup into negotiable and non-negotiable market segments, active trading is primarily taking place in the former. However, it lacks a broad basis of institutional investors, typically regarded as balancing market fluctuations and positively influencing corporate governance.[774] Mutual fund companies were established in 1997. Thereupon the industry started to grow rapidly. As of December 2006, total assets held by mutual funds in PRC made up only 4.06% of GDP. The development of the mutual fund industry is illustrated in Fig. 11. However, on

[770] Cf. WONG, Market, 2006, pp. 409-419, GIRARDIN/ZHENYA, Casino, 2003, GREEN, Capital, 2003 and FERNALD/ROGERS, Puzzles, 2002, p. 425.

[771] The popularity of this statement is fed by the fact that it is as hard to prove as it is catchy. "It is widely believed that Chinese investors trade on rumors rather than fundamentals…share manipulation is widespread, and pushes prices away from the intrinsic value for a relatively long time period." CHAN/MENKVELD/YANG, Asymmetry, 2006, p. 28.

[772] SU, Chinese, 2003, p. 27. A popular picture is the retired senior, who performs stock trading as a form of gambling. However, while anecdotal information exists, people over 60 years of age amounted to only 6.93% at SSE in 2006, SSE; Fact, 2007, p. 95.

[773] SU, Chinese, 2003, p. 334.

[774] A positive effect of mutual fund companies on firms' earnings have been found empirically for the PRC also by YUAN/XIAO/ZOU, Mutual, 2008.

international comparison this figure is relatively small with a world average of 39.80%.[775] Regarding the regulatory body, corporate governance is frequently criticized as insufficient in the PRC.[776]

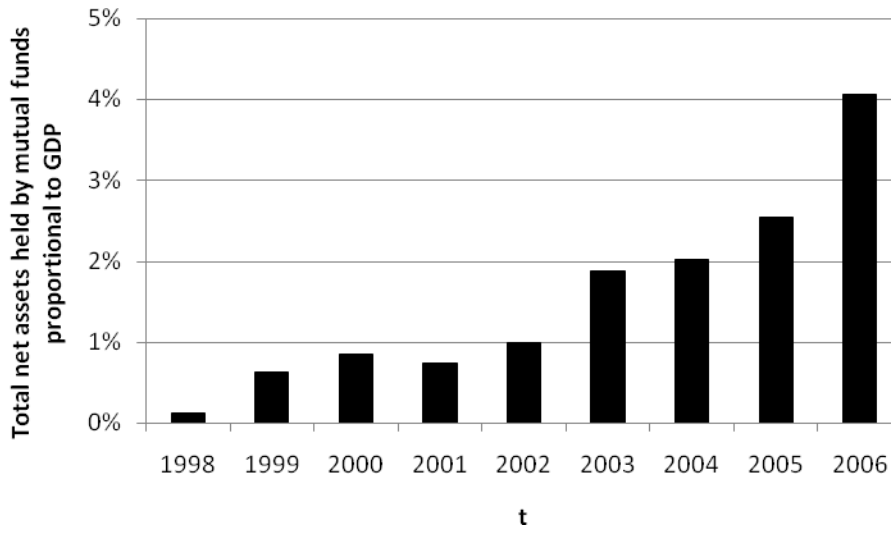

Fig. 11 Total assets held by mutual funds to GDP in the PRC [777]

The most frequently used quantitative indicators for speculation are volatility and trading activity.[778] Accordingly, high volatility and trading volume are considered indicators for a high level of speculation. From Tab. 10 it can be seen that annualized volatility in the Chinese stock market is comparably high. However, it must be noted that in emerging markets fundamentals can be considered more unsteady than in developed markets. For instance the monetary policy of the PBOC is not very predictable.[779] More generally speaking, the gradualism of economic reforms in the PRC, which follows the notion of making two steps forward and one step backwards, leads to constant changes in fundamentals.[780] Furthermore, data in Tab. 10 reveals throughout higher volatility in the B-share indices for both SSE and SZSE. This clearly contradicts the

[775] This figure is computed based on the 2007 year-end worldwide total net assets of mutual funds divided by the world GDP, ICI, Statistics, 2008 and CIA, Factbook, 2008. Data does not contain fund-of-funds and contains all sorts of mutual funds.
[776] Cf. CLARKE, Governance, 2003, CHI/YOUNG, Governance, 2007 and QIANG, Governance, 2003.
[777] Based on data by: SAC, Data, 2008.
[778] Volatility was previously mentioned as a result of dispersed shareholder structure. Since volatility can be due to other factors also, it is considered as one of the quantitative indicators.
[779] SU, Chinese, 2003, p. 29.
[780] As GREEN (2003) illustrates, the stamp tax on A-shares has been a popular tool to influence investors' sentiments. In May 1997 it was raised from 0.3% to 0.5%, in June 1998 it decreased to 0.4% and in November 2001 it was put back down to 0.2%, GREEN, Stock, 2003, p. 23.

simplistic notion that A-share prices differ from B-share prices due to high speculation among domestic investors.

Tab. 10 Annualized volatility [781]

Stock index	2005	2006	2007
CSI 300	17.58%	21.80%	36.07%
SSE A-shares	21.43%	20.99%	34.49%
SSE B-shares	27.65%	29.88%	47.75%
SZSE A-shares	23.62%	21.91%	36.46%
SZSE B-shares	25.64%	26.38%	38.45%
NASDAQ Composite	12.51%	14.16%	17.37%
FTSE 100	8.74%	12.54%	17.47%
Hang Seng Index	11.37%	14.29%	26.00%

Source: BLOOMBERG

With respect to turnover velocity as an indicator for speculation, high velocity has been acknowledged in Section 5.2.2. WONG (2006) argues that these extensive trading activities are unlikely to be fundamentally backed.[782] MEI/SHEINKMAN/XIONG (2005) examine the speculation hypothesis, and interpret a positive relation with turnover rate and idiosyncratic return volatility, and a negative relation with float of domestic shares, as evidence that speculative motives can help to explain price differences.[783]

However, it is not apparent how speculative behavior can be isolated from rational rearrangement within portfolios due to the continuous flow of information. Therefore, it should not be used to deal with the relation of price differences and speculation. Instead research should be constructed so as to falsify the hypothesis and, provided no significant evidence can be obtained, this can consistently be considered to be evidence in favor of the speculation hypothesis. Following this reasoning, because of the funda-

[781] Computation based on standard deviation of percentage variation of daily index closing prices.
[782] However, he also concludes that the Chinese stock market is "neither a casino nor an attractive investment venue", WONG, Market, 2006, pp. 412-415 and 420.
[783] MEI/SHEINKMAN/XIONG, Speculative, 2005. Similar results are obtained by CHAN/KWOK, Segmentation, 2005.

mental implication of the speculation hypothesis on the purpose of this thesis, it is examined empirically in Section 8.2.

As a general assessment on the speculation hypothesis it can be noted that, provided the assumed casino mentality, it is highly unlikely that domestic share prices would persistently exceed foreign share prices for such a long period of time.

7.2.2 Information asymmetry hypothesis

The information asymmetry hypothesis attributes share price differences to the superior information of domestic investors. Consequently, foreign investors require a premium for the higher level of uncertainty.[784] Empirical studies typically apply microstructure models. CHAN/MENKVELD/YANG (2006) argue that due to differences between regulatory environments, where accounting standards and disclosure requirements differ, it is more complicated for foreign investors to acquire information on Chinese companies. The authors hypothesize that uninformed investors could infer private information from the other segment's share price. Accordingly, they apply a microstructure model with information asymmetry proxies and investigate cross-sectional variation. Proxies used are: price impact and adverse selection component of the bid-ask spread and probability of informed trading. The authors find significant evidence for their information explanation. However, the method used does not allow conclusions on the level of price differences.[785]

An alternative empirical study has been performed by SU/FLEISHER (1999), who investigate difference in volatility between the A and B-share segments. The authors hypothesize that an underlying information flow causes the differences and proxy it with daily stock return and trading volume. Finding supporting evidence, they conclude that news arrives more rapidly to domestic investors. The authors ascribe this to the proximity to the information source of domestic investors. However, they note that their information proxy is homogenous and does not differentiate between gossip and truth.[786]

[784] Cf. CHAKRAVARTY/SARKAR/WU, Information, 1998. CHEN/GUL/SU, Comparison, 1999, p. 94, CHEN et al., Discounts, 2004, CHAN/MENKVELD/YANG, Asymmetry, 2006 and KAROLYI/LI, Puzzle, 2003, pp. 8-9. For financial news cf. CHUI/KWOK, Market, 1998, pp. 337-339. It has been termed information risk, DARRAT/WU/ZHONG, Puzzle, 2007, p. 8.

[785] CHAN/MENKVELD/YANG, Asymmetry, 2006.

[786] SU/FLEISHER, Volatility, 1999b and SU, China, 2003, pp. 169-213.

Correspondingly, CHAN/MENKVELD/YANG (2006) emphasize that the objective information variable might be affected by speculation rather than fundamentals.[787] Furthermore, BERGSTRÖM/TANG (2001) examine correlation between information proxies and price differences and find significant evidence for all of them.[788] Consistent results are found by CHAKRAVARTY/SARKAR/WU (1998).[789]

The information asymmetry hypothesis does not specifically define the reason for asymmetry. In this respect, the fact that Chinese companies are required to prepare financial reports, according to different standards for foreign and domestic investors, is drawn upon. A company that issues A-shares has to prepare a financial statement according to PRC GAAP. A company that issues B-shares is obliged to prepare financial reports according to IFRS or United States Generally Accepted Accounting Standards (US GAAP). Equally, a company that issues both A- and B-shares is therefore required to publish two sets of financial reports. Correspondingly, if the company issues H-shares it has to report according to the Hong Kong Statement of Standard Accounting Practice (HKSSAP).[790] In this context, the continuous convergence of PRC GAAP and IFRS mentioned in Section 6.1.4 can be considered consistent with the decreasing discount on foreign shares as discussed in Section 7.1.2. However, while capital controls can be considered quite effective, information controls cannot.[791] Hence, it is not intuitive that one group can sustainably be obstructed from information.

The asymmetric information hypothesis is also challenged by empirical studies finding bi-directional information flows. DARRAT/WU/ZHONG (2007) decompose forecasts' error variance and find no evidence for information asymmetry.[792] Consistent results are

[787] CHAN/MENKVELD/YANG, Asymmetry, 2006, p. 27

[788] The information proxies are: covariance between A- and B-shares, variance of B-shares and media coverage. BERGSTRÖM/TANG, Differential, 2001.

[789] The authors include a proxy for information asymmetry for coverage in English speaking news media, CHAKRAVARTY/SARKAR/WU, Information, 1998.

[790] For the period from 1994 to 1997 CHEN/GUL/SU (1999) and CHEN/SUN/WANG (2002) find an average difference of 20-30% between earnings reported according to PRC GAAP and IFRS, CHEN/GUL/SU, Comparison, 1999 and CHEN/SUN/WANG, Evidence, 2002.

[791] Domestic Chinese analysts have access to international databases. Annual reports according to IFRS, US GAAP and HKSSAP, provided on companies' web pages, can also be accessed from the PRC. Moreover, financial press publications such as the Wall Street Journal can be publicly purchased in the PRC. Independent financial press such as Caijing Magazine publishes detailed articles on their English web page. With respect to language barriers it must be noted that a large proportion of B-share investors are from Hong Kong and Taiwan, which share a common written language.

[792] DARRAT/WU/ZHONG, Puzzle, 2007.

obtained by CHUI/KWOK (1998) and YANG (2003).[793] CHEN/LEE/RUI (2001) apply Granger-causality tests in order to examine whether one class of investors lead price changes. For most stocks the authors are unable to find significant evidence for A-shares movements being informative for B-share movements and vice versa.[794] Consistent results are also obtained by WANG/WANG/LIU (2004).[795]

7.2.3 Differential demand hypothesis

The differential demand hypothesis is based on a theory by STULZ/WASSERFALLEN (1996). According to it, in segmented markets different price elasticity of demand can cause price differences.[796] That is to say the foreign share discount is attributed to higher price elasticity of foreign investors for Chinese stocks than domestic investors.[797] It is based on the fact that foreigners are argued to have broader investment alternatives since domestic investors are restricted to investments in the PRC.[798] Also after the introduction of QDII in 2006, discussed in Section 5.2.3, alternative investment opportunities remain limited.

The differential demand hypothesis essentially departs from the assumptions of perfect capital markets, which leave no room for heterogeneous elasticity.[799] The differential demand hypothesis does not specify which assumption of perfect capital markets is violated but simply allows the existence of heterogeneous elasticity. [800] STULZ/WASSERFALLEN (1996) argue that deadweight costs such as withholding tax, political risk, transactions and information acquisition costs could cause elasticity to differ.

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793 CHUI/KWOK, Market, 1998, YANG, Segmentation, 2003.
794 CHEN/LEE/RUI, Segmentation, 2001, pp. 140-146.
795 However, the authors identify Granger-causality in the variance-covariance structure. They interpret the result as evidence for B-shares containing more information regarding risk but not return. The missing linkage with return is argued to be due to the unequal investment horizon, leading to different investment objectives and not due to differences in the availability of information. WANG/WANG/LIU, Return, 2004, pp. 379-383.
796 STULZ/WASSERFALLEN, Foreign, 1995.
797 Cf. GORDON/LI, Market, 2003, pp. 284-285.
798 Cf. CHAN/KWOK, Market, 2005, p. 45, DARRAT/WU/ZHONG, Puzzle, 2007, p. 13, KAROLYI/LI, Puzzle, 2003 pp. 6-7 and CHEN/LEE/RUI, Segmentation, 2001, pp. 2-3.
799 Cf. BAGWELL, Heterogeneous, 1991, p. 218. When expectations are homogenous and no frictions exist, lending and borrowing at the same rate leads to markets where the demand for a specific share is perfectly price elastic, STULZ/WASSERFALLEN, Foreign, 1995, p. 1021.
800 Differences could be due to heterogeneous expectations regarding risk and return or different risk tolerance that all take effect in the absence of equal lending and borrowing interest rates.

CHAN/KWOK (2005) compare the relative supply of free-floating A- and B-shares and find significant negative correlation between foreign share discount and the supply of A-shares and positive correlation with the supply of B-shares.[801] As KAROLYI/LI (2003) point out, interpreting results is intricate, due to difficulties in distinguishing between supply and demand.[802] SUN/TONG (2000) interpret relatively more outstanding B-shares as putting downward pressure on B-share prices hence supporting the differential demand hypothesis. In contrast, CHEN/LEE/RUI (2001) interpret it conversely as evidence for larger foreign demand, thus contradicting the differential demand hypothesis.[803] Regardless of the specific interpretation, KAROLYI/LI (2003) find the relative number of shares outstanding non-significant in explaining foreign share discounts.[804] FERNALD/ROGERS (2002) do not test the differential demand hypothesis but simply conclude that it is plausible and a possible explanation for price differences.[805]

7.2.4 Differential risk hypotheses

The differential risk hypothesis is defined bivalent. Some researchers understand it as different risk tolerance of foreign and domestic investors.[806] Others argue that alternative investment opportunities cause different perceptions of risk. The commonness and difference can be explained in the following way: in a perfect capital market the optimal portfolio and the prices of securities that constitute it do not depend on individual risk preferences but on the market average. If two such markets coexist that are imperfectly integrated, differences in risk tolerance and alternative investment opportunities will lead to differences in prices. Under this scenario, the differential risk hypothesis has the following implications. For the former of the two definitions, domestic investors are assumed to have lower average risk aversion thus requiring less compensation for assumed risk. For the latter the unequal investment horizon leads to different market portfolios and correlation of individual stocks in the two segments. Provided there is homogenous average risk tolerance, the differential risk hypothesis is ceteris paribus

[801] CHAN/KWOK, Segmentation, 2005. Consistent results are obtained by DARRAT/WU/ZHONG, Puzzle, 2007.
[802] KAROLYI/LI, Puzzle, 2003, pp. 18 and 7.
[803] SUN/TONG, Segmentation, 2000, CHEN/LEE/RUI, Segmentation, 2001.
[804] KAROLYI/LI, Puzzle, 2003.
[805] FERNALD/ROGERS, Puzzles, 2002, p. 419.
[806] Cf. CHEN/LEE/RUI, Segmentation, 2001 and CHAN/KWOK, Segmentation, 2005.

consistent with the foreign share discount in two cases: either lower risk-free rate or lower market risk premium in the domestic segment.

On the one hand comparing the difference between interest rates in the PRC with other countries, as illustrated in Section 8.1, the observed reversion contradicts the continuously positive discount for foreign shares presented in Fig. 9. On the other hand since foreign investors are reasoned to have broader investment opportunities, the fact that systematic risk can be diversified more effectively contradicts a lower market risk premium for domestic investors. For this reason, in order to prevent contradiction with classical portfolio selection theory, it is necessary to allow for different average risk tolerance between foreign and domestic investors. Consequently, both hypotheses can be reconciled by arguing that total risk causes differences among foreign and domestic prices since domestic investors are less risk averse.

CHAN/KWOK (2005) find a significant relation between price differentials and volatility as risk proxy.[807] Consistent results are found by MA (1996), CHEN ET AL. (2004) and DARRAT/WU/ZHONG (2007).[808] However, opposing results are obtained by CHEN/LEE/RUI (2001).[809] Moreover, mixed results are obtained from studies that examine the relation of market beta and price differentials.[810]

7.2.5 Differential liquidity hypotheses

The differential liquidity hypothesis ascribes price discounts to lower liquidity in the foreign share segment.[811] It is based on differences in trading activity between the share segments. This becomes obvious when comparing the stock turnover rate.[812] From Fig. **12**, where the turnover rate in the A- and B-shares segment of the SZSE is plotted, it can be seen that turnover in the A-share segment was greater than in the corresponding B-share segment with only one exception. In the year of the opening of the B-share

[807] CHAN/KWOK, Segmentation, 2005
[808] MA, Market, 1996, CHEN et al., Discounts, 2004 and DARRAT/WU/ZHONG, Puzzle, 2007.
[809] CHEN/LEE/RUI, Segmentation, 2001.
[810] Supporting evidence is obtained by: MA, Market, 1996, SU, Discount, 1999, BERGSTRÖM/TANG, Differential, 2001. Rejecting evidence is obtained by: FERNALD/ROGERS, Puzzles, 2002 and ZHANG/ZHAO, Country, 2004.
[811] For a discussion of liquidity premiums cf. AMIHUD/MENDELSON, Returns, 1989.
[812] Stock turnover rate is computed as a hundred times the transaction volume, divided by the number of tradable shares.

segment to domestic investors, trading activity in the foreign segment exceeded activity in the domestic segment.

Empirical research on the differential liquidity hypothesis typically applies bid-ask spread or relative trading volume of turnover ratio as proxy for liquidity. CHAN/KWOK (2005) find supporting evidence for a positive relation between A- and B-share price differences and relative trading volume.[813] Consistent results for trading volume and turnover are obtained by DARRAT/WU/ZHONG (2007), for trading volume and bid-ask spread by BERGSTRÖM/TANG (2001) and CHEN/LEE/RUI (2001) and for turnover and bid-ask spread by CHEN ET AL. (2004).[814] Opposing results are obtained by KAROLYI/LI (2001) and MA (1996).[815]

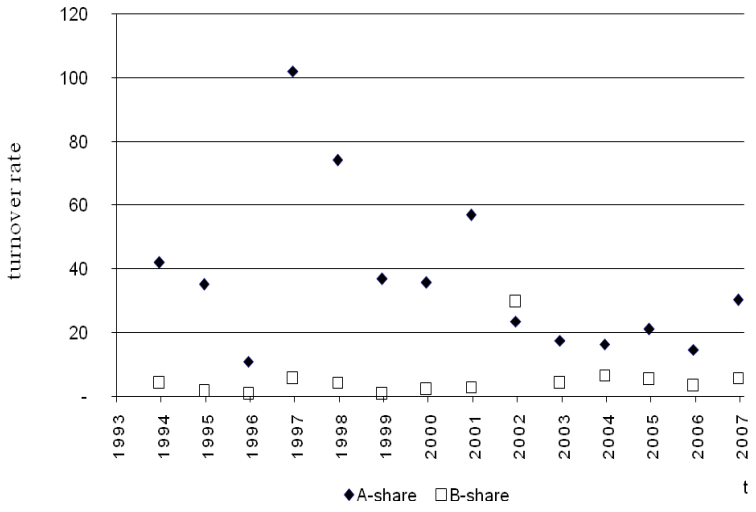

Fig. 12 A- and B-share turnover rates at SZSE [816]

While supportive evidence for the liquidity hypothesis is various, it also appears unlikely that it is able to solely explain the price discounts. This becomes apparent when taking into account empirical results that include the HKEx. FONG/WONG/YONG (2007) find much greater liquidity in the HKEx, but argue that relative liquidity is nevertheless significantly related to price differences.[817]

[813] CHAN/KWOK, Segmentation, 2005.
[814] DARRAT/WU/ZHONG, Puzzle, 2007, CHEN/LEE/RUI, Segmentation, 2001, BERGSTRÖM/TANG, Differential, 2001 and CHEN et al., Discounts, 2004.
[815] KAROLYI/LI, Puzzle, 2003 and MA, Markets, 1996.
[816] Based on data by: SZSE, Fact, 1998, SZSE, Fact, 2004 and SZSE, Market, 2008.
[817] FONG/WONG/YONG, Disparity, 2007, p. 13.

7.3 Concluding remarks

Contradicting findings from other countries, foreign investors in the PRC require considerable discounts. This phenomenon has become known as the Chinese discount puzzle. Prior research has suggested essentially five explanations expressed in five hypotheses.

The speculation hypothesis takes a special place since its falsification can be regarded essential for the application of both equilibrium and intrinsic value models in empirical research. Predominant evidence for rational investment can be considered evidence against the hypothesis.

The explanation that unequal access to information between foreign and domestic investors causes price differences, formulated in the information asymmetry hypothesis, is debatable. While investors cannot be regarded as mutually excluded from each other's information, nevertheless differences in perception could induce investors to exploit information asymmetrically.

The differential demand hypothesis states that different price elasticity between foreign and domestic investors causes price differences. However, empirical results are mixed due to problems with interpreting demand and supply proxies.

The differential risk hypothesis attributes foreign discounts to less risk aversion on the part of domestic investors. Empirical evidence with respect to several risk proxies is also mixed.

The differential liquidity hypothesis, which states that foreigners require compensation for costly and time-consuming liquidation, can only partly be related to the price differences.

Overall ambiguity of empirical results provides little clarity on the cause of the price differences. However, when accepting simultaneous relevance of more than only one explanation it can be concluded that several factors appear to interact.

8 Empirical analysis

In this chapter the theoretical considerations regarding intrinsic value models discussed above are conveyed through to an empirical context. The objective is to examine whether results from actual data support the application of intrinsic value models despite the segmentation of the Chinese stock market. The analysis is structured on four consecutive levels, with each being based on its predecessors. Consequently, a logical structure is followed that begins with a broad perspective and then becomes increasingly more specific.

On the most elementary level, it is examined whether domestic investors make investment decisions rationally. That is to say, following LEE/MYERS/SWAMINATHAN (1999), tests are performed for a long-term relationship between prices in both segments that can be considered to be necessary condition, if prices in both segments are said to be based on fundamental economic data.[818] In this respect the speculation hypothesis, discussed in Section 7.2.1, which claimed A-share prices to be determined by speculation, is revised. In this respect, it is argued that rationality can be found to exist, if foreign and domestic investors base decisions on equivalent considerations. Therefore, empirical data is tested for an equilibrium relationship of A-, B- and H-shares respectively. While irrational behavior has no effect on intrinsic values in general, it prevents prices from reflecting value. Therefore, empirical research that requires a value-price relation is constrained. Furthermore, for practitioners the usefulness of intrinsic value models also depends on the ability to benefit from identifying mispricing. However, if speculation dominates the pricing mechanism and thus stops mispricing being corrected, knowledge of intrinsic value can be regarded as useless.

Based on a fundamentally common relation, on the second level the association of prices and fundamental data is examined. Following LI/CHEN (2005), it is argued that if prices can be found to be related to input variables for intrinsic value models, this would substantiate their applicability.[819] Accordingly, it is examined whether the relation of foreign and domestic share prices to intrinsic value input variables can be found consistent with economic theory. As opposed to previous studies, this thesis applies an

[818] LEE/MYERS/SWAMINATHAN, Dow, 1999, pp. 1693-1694.
[819] LIN/CHEN, Relevance, 2005, p. 79.

ex-ante perspective for investor expectations, which is predominantly recommended by researchers as discussed in detail in Section 3.2.4.

As a result of the theoretical discussion of intrinsic value models in imperfectly integrated markets outlined in Section 4.2.3, on the third level it is examined, whether differences between stock prices can be found to be related to different environmental conditions. Following ZHANG/ZHAO (2004), while foreign and domestic investors capitalize an identical object, segment-specific differences cause both groups to apply different discount factors for valuation.[820] Provided a value-price relation exists, these segment-specific differences are theorized to have explanatory power for the price differences.

Following FERNALD/ROGERS (2002), on the last level different specifications of intrinsic value models are applied to empirical data in order to compute implied discount rates.[821] Proceeding from prior research, alongside qualitative evaluation statistical tests are performed in order to examine the relationship between values from intrinsic value models and price differences. Thus, this step goes beyond the general applicability of intrinsic value models and deals with their concrete application. It is examined whether results from intrinsic value models are consistent with price differences and can therefore be recommended for international asset valuation where imperfect integration is concerned.

8.1 Data

Data used for the empirical analysis are publicly available. The major sources are Worldscope, Datastream, I/B/E/S History and Bloomberg Professional databases. Additional data is obtained from online sources provided by governmental institutions and private organizations. Data availability ranges from daily to yearly. An overview of the 122 sample companies is presented in Appendix: 3.

The most fundamental variable used on all four levels of the empirical analysis is stock price. Consequently, maximum sample size and minimal sample intervals are confined by data availability. Meeting the condition of time-equivalence required by the law of one price, daily closing prices for the SSE, SZSE and HKEx are collected from Data-

[820] ZHANG/ZHAO, Country, 2004, pp. 46-47.
[821] FERNALD/ROGERS, Puzzles, 2002, pp. 421-422.

stream. For conversion to a uniform currency base, daily historical exchange rates obtained from Oanda Corporation's website are used.[822] Datastream provides historical Chinese stock prices starting from June 15, 1998. The cut-off date is June 2, 2008, leading to an observation period of nearly ten years. According to the categorization of the Chinese stock market by DENG (2002), this largely corresponds to the third phase of development – intensification.[823] Daily closing prices are used to compute relative prices paid by foreigners, as the quotient of foreign and domestic share closing prices.[824]

Since, as discussed in Section 3.1, a true risk-free rate cannot be observed, empirical research requires using a proxy. In order to account for counterparty, inflation, exchange rate and reinvestment risk, typically government bonds with equivalent maturity are used. As a result of the transformation in the financial system, T-bonds were reintroduced in 1981.[825] In April 1988 T-bonds became tradable for the first time and are now publicly tradable on both the SSE and the SZSE. Currently, all debt issued by the government is long-term and foreign investors are not allowed into the domestic bond market.[826] With respect to the PRC, data for T-bonds is not readily available. Bloomberg Professional provides continuous data starting April 2006.[827] Therefore it is

[822] Historical exchange rates are obtained from www.oanda.com.

[823] Accordingly, the development of the Chinese stock market is divided into three phases: experimental or launching period (1980-1990), comprehensive deployment (1990-1999) and intensification (1999-…), DENG, Market, 2002, pp. 69-88.

[824] Relative prices are chosen instead of absolute price differences in order to standardize and obtain cross-company comparability. This approach is consistent with FERNALD/ROGERS, Puzzles, 2002, p. 422 and KAROLYI/LI, Puzzle, 2001, p. 9. Logarithms of the quotient are used by ZHANG/ZHAO, Country, 2004, p. 57. Alternatively, differences are applied by BERGSTRÖM/TANG, Differential, 2001, p. 410.

[825] In the financial system prior to the reform and opening-up the MOF was able to directly dispose of the funds administered by the PBOC. The issuance of T-bonds was terminated in 1958. Since the concept was new to most investors it was considered a patriotic contribution to purchase T-bonds, CHINA DAILY, Bond, 2008, p. 1 and SU, Chinese, 2003, p. 4. The first T-bonds with five to ten years of maturity where issued in a batch of CNY 4 bn. Half of the first batch was purchased by SOE and institutions, with the other half purchased by individuals through so-called "certificate T-bonds". This certificate securities state deposit debt was sold via banks on behalf of the MOF, with investors receiving a "certificate of T-bond fund receipt". In the initial phase trading T-bonds over secondary markets was not permitted and certificates T-bonds still have to be held until maturity. Early redemption is possible, although subject to a fee. However, since February 2002 individuals have no longer been restricted to certificate T-bonds, GREEN, Stock, 2003, p. 37.

[826] The trading was permitted starting on 4/21/1988 in an experiment in seven selected cities (Shenyang, Shanghai, Guangzhou, Wuhan, Chongqing, Shenzhen and Harbin) before extending it to another 54. Trading required actual physical presence. In 1991 trading was extended to all cities of prefecture level, CHINA DAILY, Bond, 2008. As of end 2007, the total transaction volume of T-bonds accounted for CNY 19 trillion (76.14% of GDP).

[827] Bloomberg provides T-bond yields since 07/2005, although there is missing data between 09/2005 and 04/2006. Other sources such as SSE, SZSE and PBOC provide no historical data.

worthwhile to consider bank deposit interest rates as an alternative.[828] While substantial fluctuations across banks impair this proxy for other countries, rates for commercial banks in the PRC are fixed by the central bank. Therefore, these rates can be regarded universal without incorporating individual risk. Despite decentralization and transformation of the banking system, interest rates for saving deposits are stipulated by the PBOC. Rates are fixed for call money for several maturities; with a continuously upward sloping yield curve structure with diminishing marginal growth. With the longest deposit time of five years, the ability to approximate maturity matching is inferior to that of T-bonds. However, since the statistical tests applied are merely concerned with changes instead of levels, the effect can be neglected. Fig. 13 plots the 10-year PRC T-bond yield and the 1-year bank deposit rate from April 2006 to June 2008. While both appear to be sharing a common trend, the intersecting in the late period indicates that they cannot be considered equivalent appropriate substitutes. Moreover, a further difference can be seen in the fact that market factors cause T-bond yield changes, while deposit rates are fixed without deviation in-between adjustments by the PBOC. As a consequence, for the empirical analysis both proxies are applied. In order to have continuous data for the entire sample period, the 1-year bank deposit rate is applied instead of the 5-year rate, which is consistent with the focus on changes instead of levels and the fact that both lines are parallel. Data is obtained from the website of the National Bureau of Statistics of China.[829]

[828] This surrogate has also been suggested by LI/YAN/GRECO, Segmentation, 2006, p. 235.
[829] NBSC, Data, 2008.

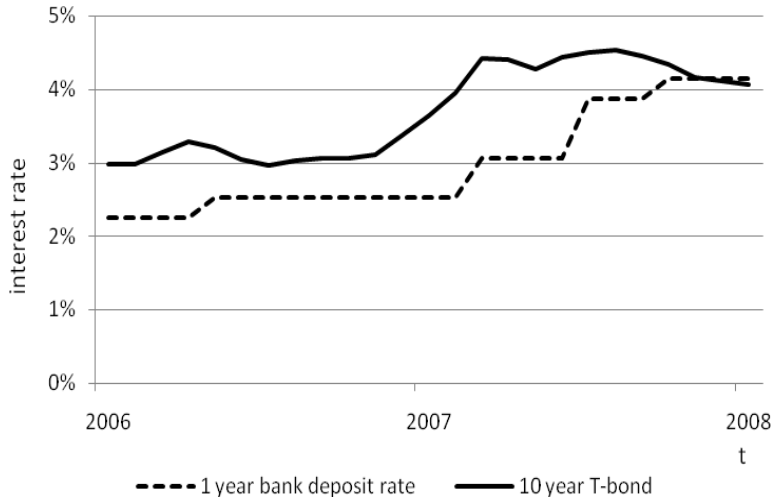

Fig. 13 PRC 10-year T-bonds yield vs. 1-year bank deposit rate [830]

A comparison between risk-free rate proxy for foreign and domestic investor is illustrated in Fig. 14. In order to compare equivalent maturities, it shows the 1-year deposit rate and the 1-year US T-bond yield. The area below the line graph represents the spread between both rates. Comparison reveals multiple intersections. Since foreign share discounts have been found for the entire sample period, as presented in Section 7.1.2, the risk-free rate difference can be considered insufficient as an explanation.

[830] Based on data by: BLOOMBERG, 2008 and NBSC, 2008.

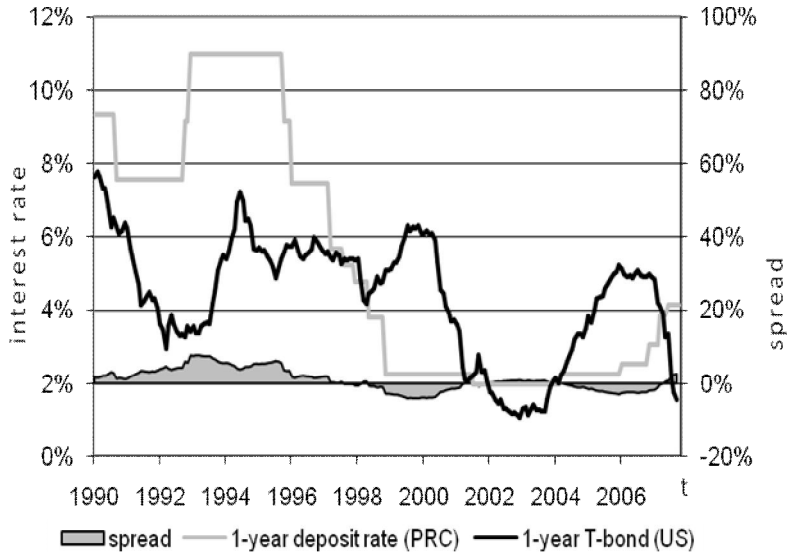

Fig. 14 US 1-year T-bond yield and PRC 1-year bank deposit rate [831]

The risk-free rate for foreign investors is proxied by the maturity equivalent US T-bond yield collected from the Federal Reserve Bank's website.[832] Consequently, it is assumed that investors in Hong Kong regard the US T-bond rate as the risk-free rate equivalent.[833] Under the long lasting exchange rate peg between CNY and USD it could be argued that interest rates in both countries follow a close process. If this was the case it should be theorized that the interest rate differential could not be able to provide any explanatory power in price differences. CHEUNG/TAM/YIU (2006) examine the relation and find US interest rates only weakly influence Chinese rates. The authors conclude that despite the de facto peg the Chinese have retained policy independence of their interest rate.[834]

As one of the first studies, if not the first, expected earnings are proxied by consensus analysts' forecasts. ANG/MA (1999) have compared forecast errors to those from Hong Kong and find them about twice as high in number.[835] However, quality is likely to have improved over time. Furthermore, for the purpose of this study only companies with foreign secondary market investment are considered. FAN/LUI/SO (2005) compare analysts' forecasts and conclude forecasts for shares that report both according to do-

831 FED, Statistical, 2008 and NBSC, Data, 2008.
832 FED, Statistical, 2008.
833 This is consistent with ZHAO/MA/LIU (2005), who refer to Hong Kong's status as an international financal center, ZHAO/MA/LIU, Valuation, 2005, p. 16.
834 CHEUNG/TAM/YIU, Interest, 2006.
835 ANG/MA, Analysts, 1999.

mestic and to international accounting standards to be superior to those that report only according to one standard.[836] In general, applying the same forecast data to represent expectations of foreign and domestic investors implicitly assumes that both share a common perception. Whether this assumption holds in reality is questionable, so that remaining unexplainably might be attributed to this.

As proxy for expected earnings, analysts' consensus earnings forecasts are obtained from I/B/E/S. Since updates are performed on a monthly basis, mean forecasts data is used for the next three forecast years' earnings forecasts and the long-term growth rate subsequently. The long-term growth rate represents the expected annual increase in operating earnings over typically three to five years. Both sets of data are not calculated by I/B/E/S but received directly from contributing analysts. Forecast data for the Chinese market is limited and with often a small number of analysts covering a certain stock. However, companies with only one analyst covering stock are also included on the one hand in order not to further decrease the sample and on the other hand in order to avoid sample truncation bias, since lesser known firms with no or weak analyst coverage would otherwise be screened out.[837] As of June 1998 the average number of analysts covering a specific stock was 5.9 with a maximum of 27 and a minimum of 1. As of May 2008 the average number rose to 8.4 with a maximum of 28 and a minimum of 1. With respect to Chinese earnings forecasts, an important deficiency with data provided by I/B/E/S is the fact that it is unclear if the forecasts refer to IFRS or PRC GAAP. Inquiry with the data provider revealed that while IFRS is prioritized, data is in fact a mixture that cannot be separated. This could be of no relevance, provided both foreign and domestic investors equally evaluate information available. However, if investors discriminated between both data, the effect of this lack of clarity on empirical results would remain unclear. Moreover, a second problem arises from this. Since the database does not feature information on whether IFRS or PRC GAAP data are being reported, it could be possible that earnings and book-value per share are not reconcilable. Since this inconsistency cannot be precluded it must be noted that results could be biased if in fact mixed data is included in the sample. In the absence of a better solution it is subsequently concluded that data should be assumed to be consistent. In this respect the argumentation by BEKAERT/HARVEY (2002) is followed, who state with respect

[836] FAN/LUI/SO, Forecasts, 2005, pp. 36-55.
[837] Cf. HAIL/LEUZ, International, 2006, p. 525.

to emerging markets: “it is better for the empiricist to use what is available than to use nothing”.[838]

For the computation of residual earnings two additional variables are necessary: book value of equity and dividends paid. The former variable is obtained from Worldscope on a per share basis. It is computed as common equity divided by the number of outstanding shares at the company’s fiscal year end and updated on an annual basis. Since I/B/E/S supplies only earnings forecasts, expected book value is computed by applying historical dividend payout ratios to earnings forecast and assuming clean surplus accounting.[839] For this purpose the indicated annual dividend is obtained by Datastream, and is reported on a per share basis. This variable comprises all dividends paid in the last financial year. For the computation of residual earnings this figure is assumed to be constant. Since residual earnings are computed on a monthly basis, a trade-off exists between increasing the number of observations and including the actual book value of equity. Due to the fact that the available data is already limited the monthly perspective is taken despite reservations.

8.2 Relationship between foreign and domestic shares

8.2.1 Research Environment

Fig. 15 plots the capitalization weighted A- and B-share index for both SSE and SZSE, all of which were developed with a base value of 100. Moreover, the HSCE is plotted, a capitalization weighted index published by the HKEx comprised of H-shares, which has been developed with a base value of 2000. In the sample period four remarkable events are visible. The Asian financial crisis that started in July 1997 and lasted until 1999 is particularly apparent in the B- and H-share segment. The consequences of the severe acute respiratory syndrome (SARS) epidemic between November 2002 and July 2003 are visible in all segments. The dot-com rally and the associated market slump following September 11, 2001 as well as the stock bubble that burst in October 2007, triggered by the subprime mortgage crisis, are equally evident in all graphs. Since the sample period covers the opening of the B-share segment to domestic investors, which

[838] BEKAERT/HARVEY, Research, 2002, p. 444.
[839] This is consistent with CORTEAU et al., IBES, 2007, p. 8.

was announced on February 19, 2001, this provides the opportunity to examine its effect on cross-segment price relationships also. However, based on graphical inspection it cannot be isolated from the dot-com rally.

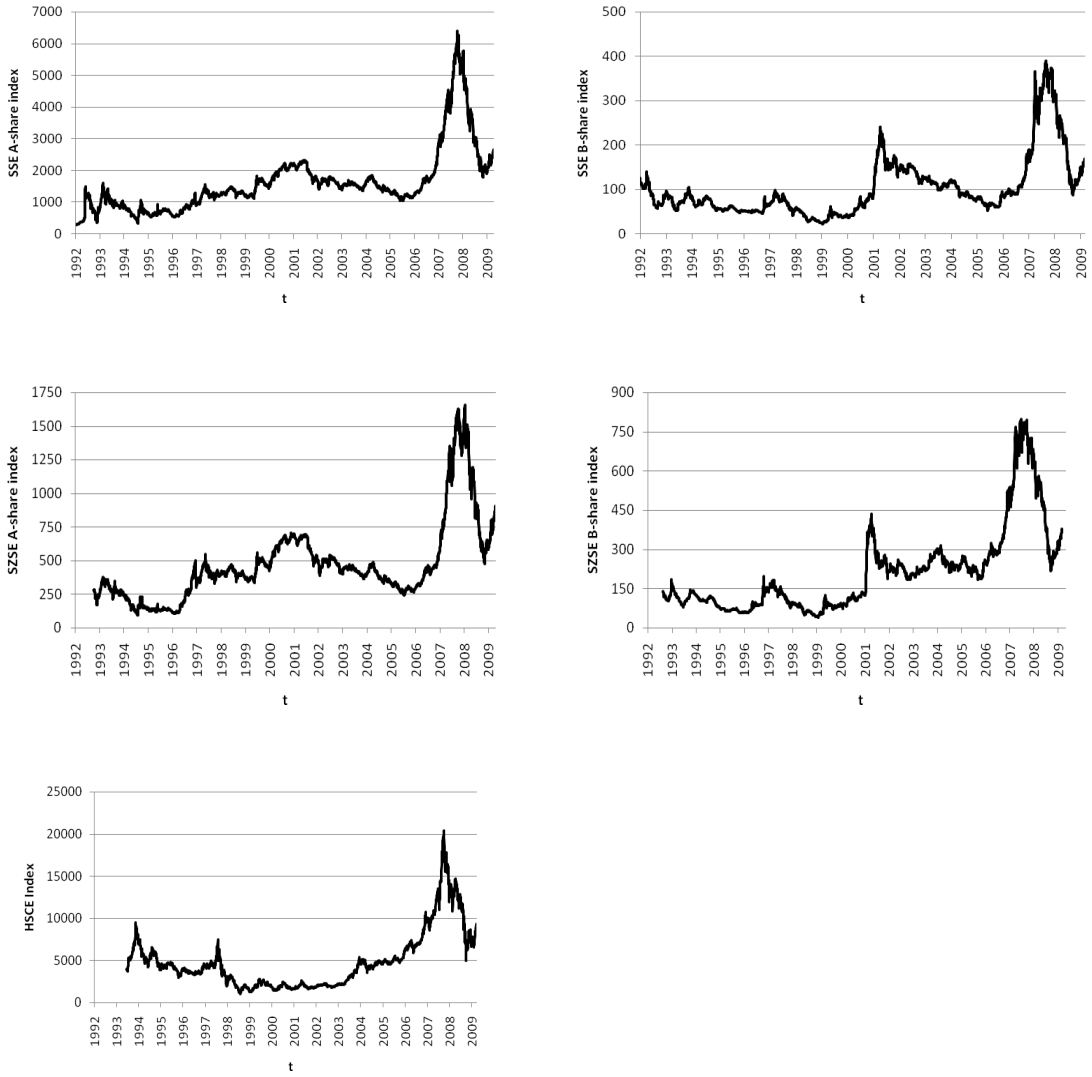

Fig. 15 Chinese stock market indices [840]

These events indicate possible structural breaks that have to be accounted for. However, as graphical analysis suggests, only the Asian financial crisis and possibly the opening of the B-share segment appear to be segment-specific. The other events can be theorized to be common reversals of trends. Since the Asian financial crisis lies mostly outside and only shortly in the initial phase of the sample period, it is not separately analyzed. However, the opening of the B-share segment that appears predominantly to

[840] Based on data by: Bloomberg.

affect the B-share segments is examined in greater detail by subdivision of the sample in the following section.

8.2.2 Cointegration test structure and previous empirical results

The relationship between two time series can be studied by examining linear combinations of them. However, in the case of integrated series, residuals will be non-stationary and observed correlation might be spurious.[841] This problem can be circumvented if a stationary linear combination of two non-stationary time series can be identified. In this case the time series are said to be cointegrated.[842] Cointegration tests deal with the question of whether a stationary linear combination exists.

GREENE (2008) groups tests for cointegration according to two approaches. Firstly, the approach suggested by ENGLE/GRANGER (1987) that suggests regressing the non-stationary variables in a single equation and testing obtained residuals for stationary. If the residuals of the linear combination are stationary, both variables can be assumed to be cointegrated.[843] Secondly, the test attributed to JOHANSEN (1991), based on vector autoregression, examines the evolution of relations between multiple time series.[844] The advantage of the latter so-called Johansen Cointegration test is that it allows for more than one cointegration relation.[845] Since in the scope of this thesis it is to be examined whether at least one equilibrium relationship between A- and B- and H-share prices respectively can be identified, the first approach - subsequently referred to as Engle Granger Cointegration test (EGC) - can be considered to be sufficient.

Previously, other empirical studies have examined the relationship between A-, B- and H-shares respectively. For an early sample period from 1993 to 1995 CHAN/CHENG/FUNG (2001) performed cointegration tests for currency-adjusted A- and B-share prices at both SSE and SZSE. At a 5% level, at the SSE the authors find evidence

[841] That is to say, evidence suggests the relation to be causal, when it is in fact only contemporaneous, HARRIS/SOLLIS, Time Series, 2003, pp. 26 and 32-34, GREENE, Econometric, 2008, p. 756 and GRANGER/NEWBOLD, Spurious, 1974, pp. 111-120. While OLS estimators remain unbiased they would no longer be efficient.

[842] This approach appears preferable to trying to remove stochastic trends since this relies on the ability to achieve an appropriate modeling, GUJARATI, Econometrics, 2003, pp. 822-830 and BALTAGI, Theoretical, 2003, p. 634.

[843] ENGLE/GRANGER, Co-integration, 1987.

[844] Cf. GREENE, Econometric, 2008, pp. 761-767 and JOHANSEN, Cointegration, 1991.

[845] For a discussion of advantages cf. BALTAGI, Theoretical, 2003, pp. 643-646.

for a long-run equilibrium relationship for 34.62% and at the SZSE for 31.58% of the sample companies, concluding that A- and B-shares predominantly have their own price dynamics.[846] FERNALD/ROGERS (2002) evaluate data between 1993 and 1997 from SSE, SZSE and HKEx and find 12.28% affirmative evidence at a 5% level.[847] Supportive evidence is obtained by SJÖÖ/ZHANG (2000), who examine data from SSE and SZSE for a period from 1993 to 1997. The authors find evidence for 58.50% cointegrated relationships at a 5% level.[848]

As far as is apparent, only two studies have dealt with cointegration after the opening of the B-share segment. CHAN/MENKVELD/YANG (2007) find only 13.16% cointegrated relationships previously and 72.37% subsequently, at a 5% level. The authors conclude that the market was perfectly segmented prior to the opening.[849] DARRAT/WU/ZHONG (2007) find 46.97% cointegrated prior to 2001 and 72.41% after the opening at a 10% level.[850] While differences are likely to be due to sensitivity to the definition of the specific sample period and the different confidence levels, both studies cover only a brief period following the opening.[851] Hence, this thesis is the first to expand the analysis of cointegration by including the long-term effect of the opening.

Before implementing the cointegration test a brief preliminary analysis of the graphical illustration is presented. As an illustration, Fig. 16 plots the prices for A- and B-shares of Huangshan Tourism Development Co. Ltd.[852] While in the early stage from 1998 to the beginning of 2001 the spread between both prices is relatively constant, subsequently the prices converge until 2006, when comparable rapid price increases disrupt the relation. Generally the plot indicates a close relationship. Moreover, the convergence appears to be synchronized with the opening of the B-share segment. The subsequent

[846] The authors conducted the test for all combinations of intercept and trend, CHAN/CHENG/FUNG, China, 2001, pp. 36-45.
[847] FERNALD/ROGERS, Puzzles, 2002, p. 421.
[848] SJÖÖ/ZHANG, Segmentation, 2000, p. 435. YANG (2003) examines cointegration among A-, B- and H-share stock indices. The author is unable to find a long-term relationship. However, the different composition of these indices significantly impairs the derived conclusions, YANG, Segmentation, 2003.
[849] CHAN/MENKVELD/YANG, Informativeness, 2007, pp. 408-411. However, it must be noted that with a period from 1/10/2000 to 11/8/2001 the sample size applied is relatively short and, with 310 observations prior and 167 subsequent to the opening, also uneven.
[850] DARRAT/WU/ZHONG, Puzzle, 2007, pp. 6-8.
[851] CHAN/MENKVELD/YANG, Informativeness, 2007, pp. 391-415 and DARRAT/WU/ZHONG, Puzzle, 2007, pp. 1-36.
[852] The example is chosen since it was the first company in the SSE sample. 600054 (A-share) 900942 (B-shares). The d-value of 0.0398 suggests strong positive autocorrelation in the data, cf. GREENE, Econometric, 2008, p. 645.

divergence corresponds to the inflating of the asset bubble, which appears to be more excessive for the A-share.

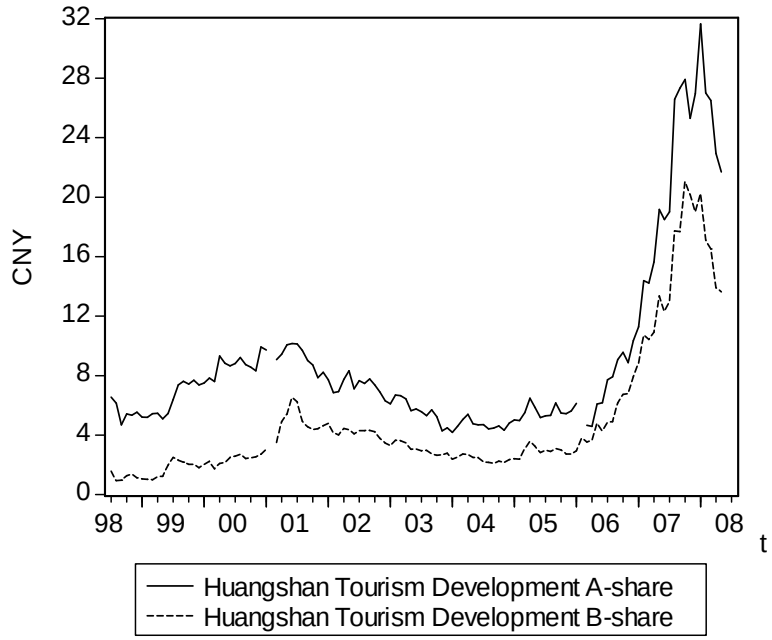

Fig. 16 A- and B-share prices of Huangshan Tourism Development Co. Ltd.

For the cointegration analysis the EGC is implemented in the following way.[853] On the first level, it is tested whether a particular set of A- and B- and H-share prices respectively are integrated of the same order. For this purpose the Augmented Dickey Fuller Test (ADF) is applied to test the hypothesis that both variables are having unit-root, that is to say are integrated to the order one.[854] In order to construct the regression model the issue of intercept and trend variable is examined based on the Akaike information criterion.[855] Equation (8.1) presents the stochastic process with A-share price time series (y_{dt}), B-share price time series (y_{ft}), constant term (c), trend variable (δ) and disturbance term (z_t). In accordance with HANSEN (1992), who suggests excluding the deterministic trend from the model for efficiency, δ is assumed to be zero.[856]

[853] The test is constructed according to HARRIS/SOLLIS, Time Series, 2003, pp. 79-84.
[854] Unlike the Dickey Fuller test, the Augmented Dickey Fuller test allows for the disturbance to be correlated, cf. GREENE, Econometric, 2008, p. 751. It is argued that because in finite samples non-stationary and stationary processes are nearly equivalent, the ADF is not sufficient to base definite statements regarding stationarity on thus obtained results. However, it is possible to make a statement on whether the sample data exhibits stationary attributes, cf. HAMILTON, Time Series, 1994, pp. 444-447 and HARRIS/SOLLIS, Time Series, 2003, p. 57.
[855] For a brief presentation of the AIC, cf. GREENE, Econometric, 2008, pp. 142-143.
[856] HANSEN, Cointegrating, 1992.

Equation (8.2) represents the second level with estimated parameters, denoted with a head, resulting from OLS estimation of (8.1).[857] Finally, Equation (8.3) corresponds to the ADF with the null-hypothesis of unit root.[858] In order to account for possible autocorrelation in the residuals, lagged differences of the dependant variable ($\hat{z}$) are examined. The number of lag factors N is chosen according to the Bayesian information criterion, with a maximum of 24.[859] The factor loadings for the lag variables are connoted with ζ and the disturbance term ε is assumed to be iid. Due to the stepwise regression the ordinary critical values of the ADF are not applicable, instead critical values are taken from MACKINNON (1991).[860]

$$y_{dt} = c + \beta y_{ft} + \delta t + z_t \tag{8.1}$$

$$\hat{z}_t = y_{dt} - \hat{c} - \hat{\beta} y_{ft} \tag{8.2}$$

$$\Delta \hat{z}_t = \rho \hat{z}_{t-1} + \sum_{i=1}^{N-1} \zeta_i \Delta \hat{z}_{t-i} + \varepsilon_t, \qquad \varepsilon_t \sim iid(0, \sigma^2), \qquad H_0: \rho = 0 \tag{8.3}$$

8.2.3 Cointegration at the Shanghai stock exchange

After deleting observations with missing values, corresponding A- and B-share prices for 22 companies are collected. With respect to the early sample period two companies have to be disregarded, because they did not start issuing A-shares until March 2001. Results from the Akaike information criterion suggest including an intercept term for all sample companies and all of them contain a unit-root, thus making the EGC applicable.

Tab. 11 summarizes the results of the EGC for the SSE. The upper part reports the t-values. The lower part presents the proportion of companies for which A- and B-shares can be assumed to be cointegrated at different confidence levels. The table is subdi-

[857] Inconsistency because of subsequent regressions is not a problem since the estimator can be considered to be superconsistent, GREENE, Econometric, 2008, p. 762.

[858] The ADF does not contain an intercept term since it examines the residuals derived from the original equation, which already contained a constant term, cf. HARRIS/SOLLIS, Time Series, 2003, p. 80.

[859] The procedure is illustrated according to BALTAGI, Theoretical, 2003, pp. 639-642.

[860] MACKINNON, Critical, 1991. Note that the automatically generated values by EViews are not applicable.

vided into three phases: the early sample period from June 1998 to January 2001 prior to the opening of the B-share segment to domestic investors, the entire sample period and the late period subsequent to the opening until the end of the total sample period. At a 5% level with 65.00% the majority of stock prices cannot be considered to be cointegrated for the early sample period. As expected, following the opening of the B-share segment a significant shift towards cointegration can be observed in the second phase. At a 5% level 86.36% of A- and B-shares can be considered to be cointegrated, which persists even at a 1% level. When regarding the entire sample, results clearly reject the hypothesis of a stable long-term equilibrium relationship. At a 10% level only for one element can cointegration of A- and B-shares be found to be significant, which amounts to 5% of the sample companies. When narrowing the level to 5%, no significant relationship can be identified. Detailed results are presented in Appendix: 4.

Results for the second phase predominantly support the hypothesis that foreign and domestic investors on the SSE make investment decisions on common factors. However, for the first phase this is only the case for eight companies. Consistent with theoretical considerations, the fact that over the entire sample period almost no evidence for a stable long-term relationship can be identified supports the perception of a structural break. Results overall support the notion that the opening of the B-share segment had a supportive effect on the integration of the two market segments, since it triggered a significant shift in the relationship of A- and B-shares.

Tab. 11 Proportion of significant cointegrated relations at SSE

	Phase 1 6/1998-1/2001	Whole sample 6/1998-6/2008	Phase 2 3/2001-6/2008
Level			
1%	15.00%	0.00%	86.36%
5%	35.00%	0.00%	86.36%
10%	40.00%	5.00%	90.91%

Results of Engle-Granger test of cointegration based on daily observations from June 15, 1998 to June 2, 2008 of A- and B-share prices. Results represent the outcome of stationarity-tests on the residuals obtained from single-equation regression of A- and B-shares with the null-hypothesis being nonstationarity. The single-equation regression is structured as follows, with y as the stock price of A-share (subscript d) and B-shares (subscript f), β being its factor loading, c being a constant term, z representing the residual and subscript t being the specific date: $y_{dt} = c + \beta y_{ft} + z_t$

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.04678 (10%), -3.3400 (5%) and -3.9041 (1%).

In order to further analyze the effect of opening the B-share segment, the sample is subdivided into periods of equivalent length. Aligned to the period before the opening, five subperiods of 31 months are constructed. Results are reported in Tab. 12. When regarding the subperiod overlapping the opening from January 2000 to June 2002, apparently all relationships between A- and B-shares experience a break. In the period directly following the opening from March 2001 to September 2003, cointegrated relationships peak with 90.91% at a 5% level. This result is broadly consistent with DARRAT/WU/ZHONG (2007) and CHAN/MENKVELD/YANG (2007).[861] In the subsequent two periods from June 2003 to January 2006 and from January 2006 to June 2008 this high proportion of cointegrated relationships recedes. Nevertheless, with 50.00% and 40.91%, at a 5% level, it remains above the level prior to the opening. Detailed results are presented in Appendix: 5.

[861] DARRAT/WU/ZHONG, Puzzle, 2007 and CHAN/MENKVELD/YANG, Informativeness, 2007.

Tab. 12 Proportion of significant cointegrated relations at SSE for 31-month intervals

	06/1998-01/2001	01/2000-06/2002	3/2001-9/2003	6/2003-1/2006	1/2006-6/2008
Level:					
1%	15.00%	0.00%	86.36%	31.82%	22.73%
5%	35.00%	0.00%	90.91%	50.00%	40.91%
10%	40.00%	0.00%	95.45%	59.09%	50.00%

Specification see Tab. 11

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.0506 (10%), -3.3441 (5%) and -3.9912 (1%).

It is conceivable to ascribe the tight relation following the opening of the B-share segment to a leading role of A-share investors entering the B-share segment, a phenomenon which subsequently ebbed. Particularly the effects of the inflation of the asset bubble that burst in 2007 appear to be more excessive in the A-share segment. The finding that the introduction of the QFII-program on May 22, 2003, which grants foreign institutional investors restricted access to the A-share market, cannot be found to have significant influence, can be attributed to the very limited proportion of the quota, as theorized in Section 5.2.3.[862]

When further breaking down the subsamples, substantial sensitivity regarding marginal changes becomes apparent in the test statistics. That is to say shifting or truncating the time series by one day leads to significantly different implications on cointegration in several cases. This is a result of the power and size of the unit-root test in finite sample periods. The low power in short sample periods leads to the over-rejection of cointegration, and depends more on the span of the data than on the size of the sample, while the size has a converse effect.[863] Therefore, it does not appear constructive to narrow the subsample below the 646 observations of the 31 month subperiod.

[862] DARRAT/WU/ZHONG (2007) explicitly do not include data after 2003 in their sample in order to isolate the effect of the opening of the B-share segment, DARRAT/WU/ZHONG, Puzzle, 2007, p. 3.
[863] Cf. GUJARATI, Econometrics, 2003, pp. 818-820.

8.2.4 Cointegration at the Shenzhen stock exchange

After deleting observations with missing values from the sample, A- and B-share prices for 17 companies listed on the SZSE are selected. Of these, three notably did not begin issuing A-shares prior to the opening of the B-share segment, so that these companies are disregarded from the early sample period. Again, all are found to have unit root, so that the EGC can be applied.

Tab. 13 reports the results from the EGC for the SZSE. Overall, findings widely correspond to those from the SSE. In the early period from June 1998 to January 2001 cointegrated relationships for 50.00% of the sample companies can be identified at a 5% level. When regarding the period after the opening of the B-share segment, the majority of 76.47% of A- and corresponding B-shares are found cointegrated at a 5% level. With respect to the entire sample period, the structural break, detected at the SSE, is equally obvious for data from the SZSE. Only for one company is a long term relationship found significant at a 10% level. When narrowing the level to 5%, no significant relationship can be identified. Detailed results are presented in Appendix: 6.

Tab. 13 Proportion of significant cointegrated relations at SZSE

	Phase 1 6/1998-1/2001	Whole sample 6/1998-6/2008	Phase 2 3/2001-6/2008
Level:			
1%	14.29%	0.00%	58.82%
5%	50.00%	0.00%	76.47%
10%	71.43%	14.29%	82.35%

Specification see Tab. 11

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.04678 (10%), -3.3400 (5%) and -3.9041 (1%).

Analogous to the analysis of the SSE in the previous section, subsamples of 31 months are constructed. Results are reported in Tab. 14. Again, findings are essentially equivalent to those from the SSE. Most importantly, no durable cointegration relationship can be identified over the opening of the B-share segment. Moreover while not equally

distinctive, the proportion of cointegrated relationships peaks subsequent to the opening and accounts for 75.00% in the period from March 2001 to September 2003 at a 5% level. The major distinction from the SSE can be seen when comparing prior to post opening. Apparently, before the opening, half of A- and B-shares were cointegrated. However, after the immediate merger effect abated in the period from June 2003 to January 2006, only 17.65% can be considered cointegrated at a 5% level, and from January 2006 to June 2008 merely 11.76%. Consequently, it must be concluded that the effect of the opening appears only temporary for the majority of companies listing A- and B-shares on the SZSE. In addition, it is puzzling that cointegrated relationships are found even less than prior to the opening. Detailed results are presented in Appendix: 7.

Tab. 14 Proportion of significant cointegrated relations at SZSE for 31-month intervals

	06/1998-01/2001	01/2000-06/2002	3/2001-9/2003	6/2003-1/2006	1/2006-6/2008
Level:					
1%	14.29%	0.00%	58.82%	0.00%	5.88%
5%	50.00%	0.00%	82.35%	17.65%	11.76%
10%	71.43%	0.00%	88.24%	35.29%	23.53%

Specification see Tab. 11

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.0506 (10%), -3.3441 (5%) and -3.9912 (1%).

8.2.5 Cointegration at the Hong Kong stock exchange

After excluding series with missing values and those without unit-root from the data, 19 companies are obtained that issue both A- and H-shares. However, six companies (31.58%) did not do so prior to the opening of the B-share segment. Results below are only presented for those remaining 13 companies that continuously offered both share classes throughout the entire sample period.

Results reported in Tab. 15 reveal an important feature of the HKEx as opposed to the two mainland markets. When regarding the entire sample period, the structural break visible on both mainland stock exchanges is not evident in Hong Kong. For the entire sample period 25.00% of A- and corresponding H-shares are assumed to be cointe-

grated at a 5% confidence level. Overall the proportion increases from 16.67% prior to 33.33% subsequent to the opening. Detailed results are reported in Appendix: 8.

Tab. 15 Proportion of significant cointegrated relations at HKEx

	Phase 1 6/1998-1/2001	Whole sample 6/1998-6/2008	Phase 2 3/2001-6/2008
Level:			
1%	8.33%	16.67%	16.67%
5%	16.67%	25.00%	33.33%
10%	25.00%	25.00%	41.67%

Specification see Tab. 11

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.04678 (10%), -3.3400 (5%) and -3.9041 (1%).

When subdividing the sample into periods of equivalent length, this feature becomes even more apparent as can be seen in Tab. 16. As a matter of fact the proportion of cointegration peaks in the period of the opening of the B-share segment based on the 10% level. Moreover, it becomes obvious that the level of cointegration remains relatively stable throughout all subsamples. This finding is consistent with the notion that the opening of the B-share segment primarily affects the B-share segment, while the effect on the A- and H-share segment is theorized to be only small.[864] However, data suggests cointegration to be generally less significant on the HKEx. In no subsample can the majority of stock price series be considered cointegrated. The finding that A- and B-shares appear to be closely linked, while A- and H-shares are largely decoupled, could be attributed to the fact that while A- and B-shares are traded under the same legal and regulatory framework, the HKEx offers a very different investment environment. Detailed results are reported in Appendix: 9.

[864] As far as is apparent, this finding is novel as neither DARRAT/WU/ZHONG (2007), nor CHAN/MENKVELD/YANG (2007) have included data from the HKEx in their analysis.

Tab. 16 Proportion of significant cointegrated relations at HKEx for 31-month intervals

	06/1998-01/2001	01/2000-06/2002	3/2001-9/2003	6/2003-1/2006	1/2006-6/2008
Level:					
1%	8.33%	16.67%	33.33%	8.33%	16.67%
5%	16.67%	33.33%	33.33%	33.33%	16.67%
10%	25.00%	50.00%	41.67%	33.33%	33.33%

Specification see Tab. 11

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.0506 (10%), -3.3441 (5%) and -3.9912 (1%).

8.2.6 Concluding remarks on cointegration

Foreign and domestic investors appear to make investment decisions that are interrelated for a large proportion of the sample companies. This applies particularly after the opening of the B-share segment, where evidence for a common relationship for the majority of A- and corresponding B-shares has been obtained. Consequently, the hypothesis that domestic investors base decisions merely on speculation while foreign investors trade rationally appears not to be supported by empirical data.

Furthermore, the effect of opening the B-share segment to domestic investors can be clearly detected in the data, which simultaneously indicates a structural break. However, results suggest that this effect has only to some extent been sustainable. This is presumed to be due to a leading role of A-share investors in the B-segment subsequent to the opening, which decreased afterwards. Moreover, the increased deviation of A- and B-share prices in the late subperiod is ascribed to a more excessive inflation of the asset bubble in the A-share segment.

Results on the HKEx are distinctive. The long-term relationship between A- and corresponding H-shares is found to be more stable over the entire sample period but below the levels of both SSE and SZSE. The stability is regarded to be consistent with the fact that the opening of the B-share segment had no direct implications on the H-share segment, which remains legally inaccessible to domestic investors. The discovery of a lower proportion of cointegrated relationships is attributed to its different legal and regulatory environment compared with the domestic stock markets SSE and SZSE.

Consequently, it can be concluded that cointegration tests are useful to a limited extent for drawing conclusions on rationality on the HKEx.

8.3 Intrinsic value model input variables and stock prices

Empirical results from the previous section can be interpreted as evidence for rational investment decisions across the share segments. Since rationality is a necessary condition for an efficient pricing mechanism that reflects fundamental value, this does not suffice to draw conclusions on a value-price relation. For this purpose the association of prices and fundamental data is examined. Because the value-price relation is based on rationality, inferences on rationality can be made.

Therefore, subsequently the relation of foreign and domestic share prices with intrinsic value input variables is examined for the three stock exchanges separately using ordinary least square analysis (OLS).

8.3.1 Analysis of input variables

The three variables being examined are: expected earnings, book value of equity and risk-free rate. Since updates are performed on a monthly basis this chapter applies monthly instead of daily observations.

Since expected earnings are not observable, analysts' forecasts are used as a proxy. Consequently, statistical tests depend on how well forecasts proxy actual expectations, making it a joint test. Depending on the specification, intrinsic value models include several years of forecasts. However, since it is theorized that their influence decreases over time and that collinearity is likely, this section focuses on the relation with 1-year forecasts only. It is argued that if 1-year forecasts are not priced by markets, a value-price relation can be rejected with respect to this variable. Corresponding data is collected on a per share basis. Being the least available variable, earnings forecasts confine the maximum number of sample elements.

While some specifications of intrinsic value models such as the DDM and the OJM do not include book value of equity, it is used in the RIV and therefore relevant for Sec-

tion 8.5. Consistently to the earnings variable, book value of equity is collected on a per share basis.

For the foreign investor in the B- and H-share segment, the 1-year US T-bond yield is used as proxy for the risk-free rate. As suggested in Section 8.1, the 1-year PRC bank deposit rate is used for domestic investors in the A-share segment. Subsequently, the regression is repeated with the 10-year PRC T-bond yield for A-shares only.

Equation (8.4) illustrates the regression equation, with stock price (p) as explained and book value of equity (b), expected earnings (e) and risk-free rate (r) as explanatory variables. An intercept term is included in order to absorb the effect related to regression through the origin.[865] The net effect of the omitted factors is captured in the disturbance.[866] Omitted random variables are assumed to be independent and identically distributed, so that the distribution of their sums, which surfaces in the disturbance, is likely to be iid. In order to preclude spurious regression the Augmented Dickey-Fuller Test is performed to test for a unit-root. Results clearly support stationarity of the time series. Elementary data analysis suggests heteroscedasticity and autocorrelation characteristics, so that regression analysis applies heteroscedasticity and autocorrelation consistent covariances as discussed in the previous section.

The null-hypotheses are constructed so that one-sided tests of significance are performed. Due to their positive effect on the value of a company, book value of equity and expected earnings are suggested to have a positive coefficient. Opposingly, the discount effect of cash flows assumes a negative relation with the risk-free rate so that the coefficient is theorized to be negative. Therefore, tests of significance are based on one-sided critical values, which are computed using the t test.[867]

[865] Cf. GUJARATI, Econometrics, 2003, pp. 164-168.
[866] Cf. GREENE, Econometric, 2008, p. 9.
[867] Cf. GUJARATI, Econometrics, 2003, pp. 129-133.

$$p_t = \alpha + \gamma_1 b_t + \gamma_2 e_t + \gamma_{31} r_t + \varepsilon_t, \text{ where } \varepsilon \sim iid(0, \sigma^2) \quad (8.4)$$

$$H_0 : \gamma_i \leq 0, \text{ where } i = (1,2) \text{ and } H_0 : \gamma_3 \geq 0$$

Results are summarized in Tab. 17. The average adjusted R^2 is similar for B- and H-shares, and only a little lower for A-shares, suggesting the included variables to explain more than half of the share prices. This is consistent with the fact that only single-period earnings forecasts are included. The Jarque-Berra Test of Normality on residuals essentially supports the assumption of iid.[868]

Overall, results strongly support the value relevance of all three variables. However, for a large proportion of the sample companies not all three variables are found significant. While data quality can be regarded one explanation, this could also be interpreted as evidence against the application of intrinsic value models. Results at the HKEx are most supportive, while results from the A-share segment are least supportive.

Detailed results are reported in Appendix: 10 and Appendix: 11 for the A-shares, Appendix: 12 for B-shares and Appendix: 13 for H-shares.

Tab. 17 Multivariate regression using PRC deposit rate

	Number of companies	Median number of observations	Average adjusted R^2	BPS positive significant relations at 5% level	EPS positive significant relations at 5% level	Risk-free rate negative significant relations at 5% level
A-shares	52	47	0.5062	48.08%	34.62%	38.46%
B-shares	52	47	0.6106	42.30%	48.08%	50.00%
H-shares	24	76	0.6136	70.83%	58.33%	62.50%

Results of multivariate regression show the relation between stock prices, book-value of equity, expected earnings proxy and risk-free rate proxy based on OLS-regression. The sample contains monthly observations between June 1998 and May 2008. Tests are performed on an individual company basis. The regression equation is structured as follows, with p being the company's A-share price, α being the constant term, b as the current book-value of equity per share, e as one-year analysts' earnings forecast per share, r as 1-year PRC bank deposit rate with γ being the corresponding factor loadings, u the disturbance term and t the specific date:

$p_t = \alpha + \gamma_1 b_t + \gamma_2 e_t + \gamma_3 r_t + u_t$, *with* $H_0 : \gamma_i < 0$, *where* $i = (1,2)$ *and* $H_0 : \gamma_3 \geq 0$

[868] Cf. GUJARATI, Econometrics, 2003, pp. 109 and 148-149.

The regression is performed using heteroscedasticity and autocorrelation consistent covariances according to NEWEY/WEST (1987).

When repeating the analysis for the A-share segment using the 10-year PRC T-bond yield as proxy for the domestic risk-free rate results for the book value of equity and expected earnings improve considerably, whereas the risk-free rate proxy appears unrelated for most cases. However, it must be noted that the differences to results reported in Tab. 17 can also be attributed to the unequal sample period and possible small sample bias related to the relatively small number of observations. The coefficient for the risk-free rate is positive in all but one case. Detailed results are reported in Appendix: 11.

Tab. 18 Multivariate regression using PRC T-bond

	Number of companies	Median number of observations	Average adjusted R^2	BPS positive significant relations at 5% level	EPS positive significant relations at 5% level	Risk-free rate negative significant relations at 5% level
A-shares	20	26	0.8256	85.00%	45.00%	5.00%

Specification see Tab. 17

This result suggests that the 10-year PRC T-bond yield is a more relevant proxy than the 1-year PRC bank deposit rate for the A-share investor. However, the positive relation contradicts economic theory, which finds that investors' willingness to purchase a risky asset decreases when risk-free return increases. As far as is apparent, this puzzling result has not afore been recognized, since other studies have not examined the relation of A-share prices to risk-free rate proxies separately, but only cumulative with a foreign risk-free rate in relation to price differences.[869] Because of the clear contradiction of fundamental economic theory it is conceivable that linearity with an unknown value-relevant variable causes the significant relation. Generally speaking, because of their interdependence with a multitude of economic relationships, the interest rate's central role makes it a priori intricate to isolate a single effect. It is conceivable that monetary policy actively controls stock price movements. In the PRC it is broadly acknowledged

[869] Cf. ZHANG/ZHAO, Country, 2004 and LI/YAN/GRECO, Segmentation, 2004.

that besides inflation, monetary policy focuses largely on economic growth and asset price misalignments.[870] Alternatively, interest rates can also be considered related to expected inflation so that changes affect stock prices depending on their perceived role as inflation hedge, being greatly controversial.[871]

8.3.2 Concluding remarks on input variables

Summarizing the aforementioned empirical evidence, the input variable appear largely related to stock prices throughout all segments for the majority of companies. The fact that a number of stocks appear nevertheless unrelated to all three input variables is ascribed to data quality and occasional inadequacy of earnings forecasts as a proxy for expectations. While for foreign investors the negative effect of the risk-free rate proxy is found largely relevant, this effect is somewhat smaller with the domestic segment. When looking at the 10-year PRC T-bond yield as proxy, results clearly contradict the negative-relation proposition of intrinsic value models. Pointing out the central role of interest rates in economic transactions, it is argued that this is due to unison with another unknown value-relevant factor.

8.4 Segment-specific variables and stock price differences

The two previous sections have provided evidence for the rationality of investment decisions of both foreign and domestic investors and the relevance of input variables for intrinsic value models. This section departs from the common factors by focusing on the distinctions. In this respect it attempts to find evidence to explain price differences by segment specific variables. According to the theoretical framework of intrinsic value models the only distinctive input variable is the discount rate. This is because all other variables are company and not investor specific. It could be argued that due to unequal perception of the relevance of PRC GAAP and IFRS accounting data, earnings expectations, book value of equity and future dividends could also be investor specific. However, as discussed in Section 7.2.2, being accessible to both groups of investors alike, different perception could be argued to be rather psychological. Therefore these

[870] Cf. LARDY, Policy, 2005. The official objective of the PBOC is „to maintain the stability of the value of the currency and thereby promote economic growth.“ PBOC, Objective, 2004.
[871] Cf. FAMA/SCHWERT, Inflation, 1977, BODIE, Inflation, 1976 and SOLNIK, Expectations, 1983a.

variables are considered independent from the share segment.[872] Consequently, results in this section rely on identical perception of available data making subsequent examination joint-tests.

As discussed in Section 4.2.3, the discount rate can be considered to encompass all relevant differences between foreign and domestic investors regarding risk aversion, liquidity or asymmetric information other than those used as input variables. Therefore, these unspecified effects are isolated by decomposing the discount rate into risk-free rate and risk premium. The theory states that these differences suffice in explaining price differences. Most fundamentally, the risk-free rate can be reasonably proxied by observable data. Therefore, the relation between prices and risk-free rates is examined, arguing that if no relation can be identified, it cannot be concluded that intrinsic value models cannot consistently be applied in segmented markets.

8.4.1 Stock price and risk-free rate quotients

The regression model is presented in Equation (8.5). As dependent variables the quotient of foreign and domestic share price (p_f/p_d) is used.[873] The explanatory variable is computed as the quotient of foreign and domestic risk-free rate (r_f/r_d). Since an increase in the risk-free rate for the foreign investor is theorized to be negatively related to foreign share price changes and vice versa, this suggests a one-sided test. Therefore the test is set up with the null-hypothesis of a positive relationship between price and risk-free rate quotients. In order to preclude spurious regression the Augmented Dickey-Fuller Tests is performed to test for a unit-root. Results clearly support stationarity of the time series. Elementary data analysis suggests heteroscedasticity and autocorrelation in the majority of relationships.[874] Consequently, as applied above, tests are performed with heteroscedasticity and autocorrelation consistent covariances as suggested by NEWEY/WEST (1987).[875]

[872] This is consistent with ZHAO/MA/LIU (2005) who regard capital costs as the only fundamental value different in the segments, ZHAO/MA/LIU, Valuation, 2005, p. 17.

[873] Note that the assumption for the classical regression model merely requires linearity in the parameters, while the regressor and regressand may be non-linear. This dependant variable is consistent with FERNALD/ROGERS, Puzzles, 2002, p. 422.

[874] White Heteroscedasticity is significant in 52.14% at a 10% level and the d-statistic is less than 0.5 in 76.07% for the 117 companies.

[875] NEWEY/WEST, Covariance, 1987.

$$\frac{p_{i,ft}}{p_{i,dt}} = \alpha + \gamma \frac{r_{ft}}{r_{dt}} + \varepsilon_t \tag{8.5}$$

$$H_0 : \gamma \geq 0$$

Results from the test specified in Equation (8.5) are reported for the three stock exchanges separately in Tab. 19. While almost two thirds of the relationships are found negative for the SSE supporting the theoretical consideration, overall exchanges this holds only for around half of the sample companies. Particularly when regarding the HKEx only around one third of the coefficients are found to be negative. For all companies slightly less than one third shows a significant negative relation at a 5% level, which is highest at the SSE with almost half and lowest for the HKEx, where less than 10% of negative relationships are found significant. Detailed results are reported in Appendix: 14.

Tab. 19 Empirical results using PRC deposit rate

Stock exchange	Number of companies	Negative coefficient		negative coefficient and significant at 5% level		Median R^2	Median number of observations per company
SSE	43	27	62.97%	21	48.84%	0.1925	85
SZSE	37	16	43.24%	11	29.73%	0.2437	69
HKEx	37	14	37.84%	3	8.11%	0.2412	55
	117	57	48.72%	35	29.91%	-	-

Results of univariate OLS regression of foreign and domestic share price and risk-free rate proxy quotients. The sample contains monthly observations between June 1998 and May 2008. Tests are performed on an individual company basis. The regression equation is structured as follows, with p being the company's price of A-shares (subscript d) and B-/ H-shares (subscript f), α being the constant term, r^f as 1-year US T-bond yield, r^d as the 1-year PRC deposit rate with γ being its factor loading, u the disturbance term and t the specific date:

$$\frac{p_t^B}{p_t^A} = \alpha + \gamma \frac{r_t^f}{r_t^d} + u_t, \quad where \quad H_0 : \gamma \geq 0$$

The regression is performed using heteroscedasticity and autocorrelation consistent covariances according to NEWEY/WEST (1987).

In order to examine whether this effect can be attributed to the weakness of the 1-year deposit rate as a proxy for the alternative risk-free investment for the domestic investor, the quotient of 10-year US and PRC T-bonds yields is tested instead. Due to data availability, discussed in Section 8.1, only the period from July 2005 to January 2008 evaluated with.

The test structure is analogous to Equation (8.5). Separated into the three exchanges, Tab. 20 reports the results. Results appear less supportive than in the previous analysis. Overall only around one third of the relationships are found negative, while differences are greater across the stock exchanges. Altogether, results tend to support a positive relationship, however, no clear conclusion can be derived. The relatively low proportion of theoretical-consistent relations for the HKEx could be explained by the fact that while the proxy was found to be contradictory regarding A-share prices, the US T-bond yield proxy was found to be of little relevance to H-share prices in Section 8.3.1. Detailed results are reported in Appendix: 15.

Tab. 20 Empirical results using PRC T-bond yields

Stock exchange	Number of companies	Negative coefficient		negative coefficient and significant at 5% level		Median R^2	Median number of observations per company
SSE	43	26	60.47%	12	27.91%	0.1430	26
SZSE	34	3	8.11%	1	2,70%	0.4822	24
HKEx	37	7	18.92%	2	5.41%	0.4102	201
	117	36	30.77%	15	12.82%	-	-

Results of univariate OLS regression of foreign and domestic share price and risk-free rate proxy quotients. The sample contains monthly observations between June 1998 and May 2008. Tests are performed on an individual company basis. The regression equation is structured as follows, with p being the company's price of A-shares (subscript d) and B-/ H-shares (subscript f), α being the constant term, r^f as 10-year US T-bond yield, r^d as the 10-year PRC T-bond yield with γ being its factor loading, u the disturbance term and t the specific date:

$$\frac{p_t^B}{p_t^A} = \alpha + \gamma \frac{r_t^f}{r_t^d} + u_t, \quad where \quad H_0 : \gamma \geq 0$$

The regression is performed using heteroscedasticity and autocorrelation consistent covariances according to NEWEY/WEST (1987).

8.4.2 Concluding remarks on stock price and risk-free rate quotients

Regarding the question, whether alternative risk-free investment opportunities between foreign and domestic risk-free rates are suitable to explain corresponding stock price differences in the Chinese stock market, empirical results are mixed. While a negative relation is found for nearly half of the company's stock prices, test of significance a less supportive. Taking into account the results from Section 8.3, this might be attributable to the fact that the risk-free rate proxy for domestic investors is not regarded as alternative investment in the way intrinsic value models suggest, and the proxy for H-shares is found to be essential of little relevance. Nevertheless, empirical evidence for the SSE can be regarded promising.

8.5 Implicit discount rates

On the final level consistency between empirical results from applying intrinsic value models and their theoretical implications are examined. That is to say, by inputting empirical data from the Chinese stock market in intrinsic value models, it is analyzed how results concur with what the underlying theory suggests.

As illustrated in Section 2.3, equations for intrinsic value models are commonly stated with value as dependent variable. However, since value is proxied by using observable stock prices the original equation is solved for the discount rate as dependent variable. Since the value-price relation implies that the equation comprehensively includes all relevant factors, thus obtained implicit discount rates are argued to also encompass the essential differences between foreign and domestic investors becoming observable through different prices. Alternatively, it could be decided to set value as an unknown variable and surrogate the discount rate. However, while proxying the risk-free component is common in empirical research, a proxy for the risk premium requires restrictive additional assumptions. As discussed in Section 3.2, applying CAPM β-factors requires the assumptions of neoclassical perfect capital markets, where equivalence of value and price is an implicit part. Consequently, assuming only a value-price relation is considered less restrictive.[876] Furthermore, while being merely an algebraic rearrangement, this procedure allows for the attainment of implicit discount rates, which are standardized and comparable across companies and countries.

Subsequently, it is examined whether implied discount rate differences between foreign and domestic share prices are found to be consistent with differences between risk-free rates. Besides qualitative comparison, hypothesis testing is performed. It is argued that if supportive results are obtained, the remainder is a reasonable estimate for the risk premium, which may remain unobservable. By the same token, this is considered to be supportive evidence for intrinsic value models to be applicable despite market segmentation.

Following the results of the discussion in Section 2.3, different specifications of intrinsic value models are used to compute implicit discount rates. This is because although from a theoretical perspective all models are fundamentally equivalent, dealing with the terminal value conundrum requires additional assumptions that cause results to differ nevertheless. Furthermore, the necessity to surrogate when empirical data is involved further leads to practical differences between models with dissimilar input variables. Altogether three specifications are applied, which are specified in Appendix: 16. These include the model according to GEBHARDT/LEE/SWAMINATHAN (2001) (GM), a modifica-

[876] This approach is common since the appropriateness of risk premiums can subsequently be measured with their relation to conceived risk factors, cf. GODE/MOHANRAM, Ohlson-Juettner, 2003 and BOTOSAN/PLUMLEE, Alternative, 2005.

tion of this model suggested by the same authors (MGM) and the model suggested by OHLSON/JUETTNER (2003) (OJM) discussed above. The models have been chosen due to results of previous studies.[877] Due to a lack of clarity regarding the kind of dividends to apply as discussed in 6.1.4, no specification of the DDM is chosen.

8.5.1 Descriptive statistics on implicit discount rates

Implicit discount rates are computed for periods when data for all relevant input variables was available based on monthly observations as specified in Section 8.1. In a few cases parameter constellation was extreme, yielding exaggeratedly high values. In order to refrain from distortion, computed rates above 1000% are considered outliers and excluded from the sample.[878] According to common practice, sample elements that yielded negative implicit discount rates for either foreign, or domestic share prices have also been excluded from the analysis, due to a lack of economic interpretation.

Descriptive statistics for all three models for the sample period from July 1998 to May 2008 are reported in Tab. 21. For the GM and the MGM over one thousand observations are available. Due to more constrictive data requirements, for the OJM the number of observations available is considerably smaller. When jointly regarding all three specifications, average differences between the discount rates for foreign and domestic investors lie between 2.37% and 2.80%. This finding is consistent with FERNALD/ROGERS (2002), who identify a 3% difference.[879] When regarding the risk-free rate differences for both proxies, foreigners are found to require a higher risk premium. On average, the difference between a 1-year US T-bond yield and a 1-year PRC bank deposit rate is 1.10% and the difference between a 10-year US and a 10-year PRC T-bond yield is 0.60%. As a result, investors appear to weight the disadvantage of country risk higher than the advantage of international diversification. The bandwidth lies between a minimum rate of –6.92% and 15.50%.[880] Extreme values are particularly common in the early sample period. Compared with an average difference between 1-year T-bond yield and 1-year bank deposit rate of 1.11% and between 10 year US and

[877] Cf. HAIL/LEUZ, International, 2006 and CLAUS/THOMAS, Empirical, 2001.
[878] While the 1000% borderline is arbitrary, it can be considered reasonable as the next highest value for a single individual was 79.77%.
[879] FERNALD/ROGERS, Puzzles, 2002, p. 420. The authors only compute price differences but do not examine their relationship with other variables.
[880] Negative values stem from observations where B-share prices lie above A-share prices.

PRC T-bond yield of 0.60%, this also suggests a higher risk premium for foreign investors. Detailed results are reported in Appendix: 17 to Appendix: 19.

Tab. 21 Descriptive statistics of intrinsic discount differences

	GM	MGM	OJM
total observations	1.562	3.335	678
cross-sections (companies)	65	99	65
average number per cross-section	24	34	9
maximum	14.51%	15.50%	13.69%
minimum	-3.63%	-6.92%	-3.01%
arithmetic mean	2.58%	2.8%	2.37%
standard deviation	0.0260	0.0293	0.0274

Fig. 17 plots the arithmetic mean of spreads between foreign and domestic implicit discount rates according to the three models. The arithmetic mean is positive for all models throughout the entire sample period. Among the individual observations, over 90% are greater than zero. Overall it can be seen that prior to the opening of the B-share segment no clear trend is apparent. However, subsequently a general convergence throughout the models is noticeable. Furthermore divergence from the mean is considerable, with the GM and the OJM being least variant. When regarding the entire sample, the standard deviation for the GM is 2.60%, while the mean is 2.58%. The fact that data points are not clustered closely around the mean suggests that risk premiums are firm specific. On the other hand dispersion could be due to deficiency of intrinsic value models, as omitted variables or other forms of misspecification will affect the implied discount rates, or could be due to the proxies applied.

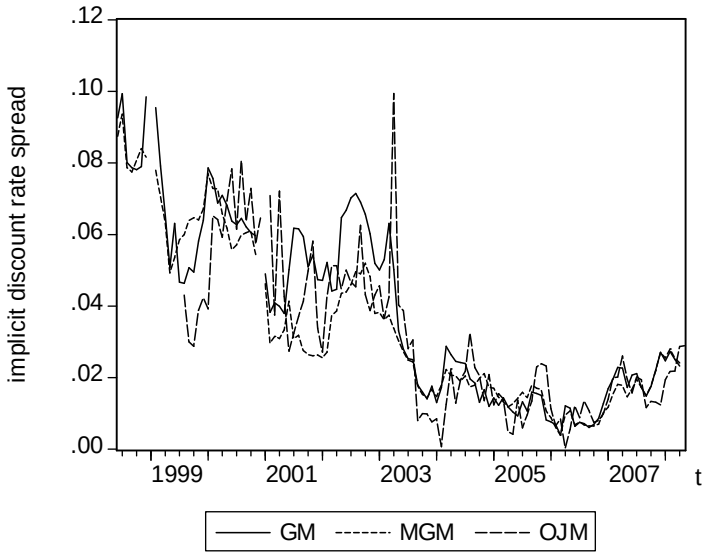

Fig. 17 Average implicit discount rate spreads

8.5.2 Analysis of implied discount and risk-free rates

As discussed in detail in Chapter 3, the discount rate can be decomposed into risk-free rate and risk premium. While the risk-free rate represents the universal alternative investment, the risk premium might be universal or firm-specific. Provided there is the correct model specification and the proxies used are relevant, the risk-free rate is theorized to be directly and positively associated with the implied discount rate. Consequently, differences between risk-free rates for foreign and domestic investors are believed to drive differences between corresponding implied discount rates. Assertions on the risk premium, as second component, are less straightforward. Besides the possibility of time-variance and idiosyncrasy, identifying a fitting proxy is intricate.[881] For this reason this thesis restricts itself to the risk-free rate. After all it can be argued that if no evidence for the risk-free component can be obtained, the applicability of intrinsic value models can be generally rejected.

[881] Contradicting results are obtained by ZHANG/ZHAO, Country, 2004. The authors obtained empirical results of price differences and risk premium proxies are not significant for the vast majority of companies, so that it is not persued and not reported in this thesis. Proxies for the risk premium are examined for country, foreign exchange and liquidity risk. Country risk is proxied by S&P long-term sovereign credit risk ratings obtained from the S&P web-site: www2.standardandpoors.com. Foreign exchange risk is proxied by annualized volatility in the cross-rates between USD/HKD and CNY computed on a monthly basis with daily observations, obtained from www.oanda.com. Liquidity risk is proxied by the relative bid-ask spread of foreign and domestic share prices obtained from Thomson Financial database. Turnover rate has not been used as proxy due to persistence problems as discussed in MEI/SHEINKMAN/XIONG, Speculative, 2005, p. 16.

The sample interval is constrained by the fact that analysts' earnings forecasts are updated monthly, so that intrinsic values are computed on a monthly basis. Since, furthermore, input variables are not fully available throughout, the sample objects are limited to observations where all relevant variables were available. In order not to further decrease the sample, analysis is performed on a consolidated basis. That is to say average implicit discount rates are computed using monthly data according to the three model specifications. Subsequently, regression analysis is performed in order to examine the relationship between the quotient of foreign and domestic implicit discount rates and the quotient of foreign and domestic discount rates. The test is based on the regression Equation (8.6). The dependent variable is the quotient of the implicit discount rate based on foreign (x_f) and domestic share prices (x_d). The independent variable is computed as the quotient of foreign (r_f) and domestic risk-free rate (r_d). Although implicit discount rates are theorized to be positively related to the risk-free rate, a two-sided test is performed in order to account for findings regarding a reverse relation in Section 8.4.

$$\frac{x_{ft}}{x_{dt}} = \alpha + \gamma \frac{r_{ft}}{r_{dt}} + \varepsilon_t \tag{8.6}$$

$$H_0 : \gamma = 0$$

Results summarized in Tab. 22 show a mixed picture. Using the quotient of 1-year US T-bond yield and 1-year PRC deposit rate as independent variable, coefficients are found to be positive for all models. However, only for the MGM and the OJM is the relation found to be significant on a 5% level. When using the quotient of 10-year US and PRC T-bond yield as regressor, relationships are found to be negative for all models. Results obtained using the MGM are again found significant on a 5% level. As opposed to the first proxy, the OJM yields only non-significant results, while the results obtained from the GM are found significant on a 5% level.

While results for the 1-year T-bond yield and the 1-year deposit rate combination can be regarded supportive, the main weakness of this analysis can be seen in the way individual data is being pooled as a result of a lack of continuous data for companies. This is because since averages are not based on a constant set of companies, changes in

implicit discount rates could be due to in- and exclusion of different companies. Consequently, this test procedure relies on risk premiums being universal and not firm-specific. Hence, inconsistency among the results could be attributed to firm-specific risk premiums. Detailed results are reported in Appendix: 20 and Appendix: 21.

Tab. 22 Relationship between cumulative implied discount rates and risk-free rates

	1-year PRC deposit and 1-year US T-bond			10-year US and 10-year PRC T-bond yields		
	observations	γ	Significant at 5%/10% level with heteroscedasticity and autocorrelation consistent covariances	observations	γ	Significant at 5%/10% level with heteroscedasticity and autocorrelation consistent covariances
GM	114	positive	0/0	25	negative	+/+
MGM	116	positive	+/+	25	negative	+/+
OJM	105	positive	+/+	25	negative	0/0

Results of univariate OLS regression of cumulative implied discount rate quotients and risk-free rate proxy quotients. Sample contains monthly observations between June 1998 and May 2008. Quotients are obtained as follows, where x_{it} is the implied risk-free rate for company i at time t from domestic market prices (index d) and foreign market prices (index f), N the number of companies, α the intercept, r^f the 1-year US T-bond yield, r^d the 1-year PRC bank deposit rate with γ being its factor loading and u as disturbance term.

$$\frac{x_t^f}{x_t^d} = \alpha + \gamma \frac{r_t^f}{r_t^d} + u_t, \quad where \quad \frac{x_t^f}{x_t^d} = \frac{\frac{x_{1t}^f}{x_{1t}^d} + \frac{x_{2t}^f}{x_{12}^d} + \ldots + \frac{x_{Nt}^f}{x_{Nt}^d}}{N} \quad and \quad H_0 : \gamma = 0$$

The regression is performed using heteroscedasticity and autocorrelation consistent covariances according to NEWEY/WEST (1987). ** and * is statistically significant at 5% and 10% level, respectively.

In order to deal with the shortcomings of time series and cross-sectional analysis related to missing values both regarding time intervals and across companies, data is pooled and relationships are examined using panel data. When evaluating panel data, assumptions regarding slope coefficient, intercept and error term have to be made.[882] Previous results suggest an individual effect yielding heterogeneity. Since this effect is unobservable this leads to an omitted variable problem, which causes bias and inconsistency of the γ-estimator.[883] Therefore, firm-specific risk premiums across units are implemented by allowing the intercept to differ among individuals using a fixed effect

[882] Cf. GUJARATI, Econometrics, 2003, p. 640.
[883] Cf. GREENE, Econometric, 2008, p. 183.

model.[884] In order for OLS estimators to remain efficient, the disturbance must be independent from the regressor in every period. Moreover, residuals must be free of heteroscedasticity and uncorrelated.[885] Therefore, unit-root tests for stationarity are performed. Furthermore, the fixed effects model suffers from a large loss of degrees of freedom since it requires a large number of dummy variables because of various cross-sectional units, and thus impairs the power of statistical tests.[886] This problem is inherent in the fixed effects model and represents a clear drawback.

GREENE (2008) emphasized the major shortcoming of the fixed effects model to be its lack of identification of time-invariant variables.[887] Since besides the intercept the only other regressor is the time-variant risk-free rate, this shortcoming can be disregarded for the purpose of the procedure that follows.

The fixed effects model is specified in (8.7), which differs from the model shown in (8.6) by having double subscript on the variables, with conventional notation of i for the cross-section and t for the time series dimension. In order to allow the omitted effects to vary across companies, the intercept term α is also firm-specific.[888]

$$\frac{x_{fit}}{x_{dit}} = \alpha_i + \gamma_i \frac{r_{ft}}{r_{dt}} + \varepsilon_{it} \tag{8.7}$$

$$H_0 : \gamma_i \leq 0$$

The coefficient of the constant term represents the overall mean of the fixed effects. Since the R^2 and F-statistics are based on differences between the estimation and a specification with only a single constant, they relate to the explanatory power of the complete model.[889] The varying number of observations across individuals makes the panel unbalanced. Because of the data-processing method, values are assumed to be missing randomly. The regression is performed allowing for covariance across cross-sections by using White cross-section standard errors.

[884] Cf. BALTAGI, Panel, 2008, pp. 14-17.
[885] Cf. GREENE, Econometric, 2008, pp. 182-185 and BALTAGI, Panel, 2008, p. 14.
[886] Cf. BALTAGI, Panel, 2008, p. 15 and GUJARATI, Econometrics, 2003, p. 646.
[887] GREENE, Econometric, 2008, p. 194.
[888] The specification follows GREENE, Econometric, 2008, pp. 193-194 and BALTAGI, Panel, 2008, pp. 13-17.
[889] Cf. EVIEWS, Guide, 2004, p. 838.

Results for all three model specifications are summarized in Tab. 23. Results for both MGM and OJM theory-consistently corresponding to the previous analysis, with the exception that the positive relationship according to the OJM is only significant on a 10% level. With respect to 10-year US and PRC T-bond yields, consistent to the cumulative analysis, the panel results are also negative for all models, however overall significant on a 5% level. Different to the cumulative analysis are results for the GM, which are found negative and significant, instead of positive and non-significant. Overall, with the exception of the OJM, results suggest a relatively high level of significance in all cases. This could be due to the small number of observations, making results less powerful. While it could be that time also has a significant effect, that is to say that the functional relationship with the risk-free rate shifts over time, the number of observations is not sufficient to test for it. Consequently, while this model ascribes idiosyncrasy to the companies, the effect of firm-specific risk premiums is nevertheless assumed to be time-invariant. The slope coefficient is assumed to be constant, so that differences among risk-free rates have a proportional effect on price differences across companies. This implies that the constant term effectively captures differences across groups.[890] Detailed results are reported in Appendix: 22 to Appendix: 24.

[890] Cf. GREENE, Econometric, 2008, p. 194.

Tab. 23 Relationship between implied discount rates and risk-free rates using fixed effects

	1y US T-bond and 1y PRC deposit rate			10y US and PRC T-bond yields		
	included observations after adjustments	γ	Significant at 5%/10% level with heteroscedasticity and autocorrelation consistent covariances	included observations after adjustments	γ	Significant at 5%/10% level with heteroscedasticity and autocorrelation consistent covariances
GM	114	negative	+/+	25	negative	+/+
MGM	116	positive	+/+	25	negative	+/+
OJM	105	positive	0/+	25	negative	+/+

Results of a fixed effects panel analysis of foreign and domestic share price and risk-free rate proxy quotients using fixed effects model. The sample contains monthly observations between June 1998 and May 2008. Tests are performed on an individual company basis. The regression equation is structured as follows, with x being the company's implicit discount rate of A-shares (subscript d for domestic) and B-/H-shares (subscript f for foreign), α being the constant term, r_f as 1- or 10-year US T-bond yield, r_d as the 1-year bank deposit rate and the 10-year PRC T-bond yield respectively, with γ being its factor loading, u the disturbance term and t the specific date:

$$\frac{x_{fit}}{x_{dit}} = \alpha_i + \gamma_i \frac{r_{ft}}{r_{dt}} + u_{it} \text{ , with } H_0 : \gamma_i \leq 0$$

In order to test for stationarity, several unit root tests are applied to the panel data, which are essentially multiple-series unit root tests. The tests include Breitung's test and then the Levin, Lin and Chu Test.[891] Since no superiority of one test over the other is apparent, results are regarded jointly.[892] Data are tested for both a common and an individual unit root process on levels with individual intercept term with an automatic selection of lags according to SIC. Results are summarized in Tab. 24. Around two thirds of tests suggest stationarity, so the estimators are considered to be efficient.[893]

[891] Tests have been chosen due to availability in Eviews. For a discussion cf. BALTAGI, Panel, 2008, pp. 275-280.

[892] Consistent with the conclusion by BALTAGI, Panel, 2008, p. 284.

[893] The reversed hypothesis test by Hadari (Hadari Z-stat) reported in the Appendix is disregarded following the argument of its poor performance in monte carlo tests performed by HLOUSKOVA/WAGNER, Panel, 2006.

Tab. 24 Unit-root tests

	Null: Unit root (assumes common unit root process) at 5% level		Null: Unit root (assumes individual unit root process) at 5% level		
	Levin, Lin & Chu t-stat	Breitung t-stat	Im, Pesaran and Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square
GM	reject	not-reject	reject	reject	reject
MGM	reject	reject	reject	reject	reject
OJM	reject	not-reject	not-reject	reject	reject

8.5.3 Concluding remarks on implicit discount rates

Examining the relation between differences of foreign and domestic shares and differences in the risk-free rates, this relation is found to be firm-specific. With respect to the 1-year US T-bond yield and the time-equivalent PRC deposit rate, results are mixed and not consistently in accordance with the theory of intrinsic value models.

Moreover, due to the large number of variables, the power of the test is limited and results should be interpreted with caution, particularly with respect to the OJM with the fewest number of observations.

When applying the 10-year US and PRC T-bond yield, relationships are found negative - without exception - and in most cases significant also. Contradicting the economic theory of intrinsic value models, this could be ascribed to the strong relation of the PRC T-bond yield with unknown possibly macroeconomic factors, that obscure the function as risk-free rate proxy.

Overall, the evidence is not convincingly consistent with the hypothesis of a positive relationship between risk-free rate and implied discount rate.

8.6 Concluding remarks

The empirical results in this chapter do not provide unambiguous support for the application of intrinsic value models in the segmented Chinese stock market.

Results from cointegration analysis have suggested differences across companies and time. That is to say, for a great number of companies evidence for a relation between

foreign and domestic share prices supports the notion of an equivalent rationale of foreign and domestic investors. However, results vary in time and no trend towards a closer relationship could be identified since, despite temporary improvement following the opening of the B-share segment, the relation deteriorates in more recent subsamples. It can be noted that the relation between A- and H-shares appears less linked, which is attributed to a different regulatory environment on the HKEx.

Empirical evidence on the relation between stock prices and intrinsic value model input variables is also mixed. With respect to book value of equity and forecasted earnings explanatory power could be identified throughout all segments for the majority of companies. With regard to the risk-free rate proxy, this holds also for the B-share segment. However, results from the A-share segment are surprisingly little supportive, indicating serious shortcomings of the proxy. Applying the 10-year PRC T-bond yield as alternative proxy yields results clearly contradicting economic theory. This is ascribed to collinearity with unknown, possibly fundamental economic factors, not included in the regression. Also results for the H-share risk-free rate proxy show little explanatory power, thus buttressing the fundamental difference between the mainland markets and the market in Hong Kong.

When observing the relation between the price differences of foreign and domestic investors and differences between corresponding risk-free rates, results provide little clear conclusion. This is reasoned to be due to the weakness of the proxy for the domestic as well as the Hong Kong risk-free rate.

Lastly, in comparison with results from other countries, computed implicit discount rates appear sound. The analysis of their relation with price differences on a cumulative basis indicates firm-specific variables to have an influence. Accounting for idiosyncrasy by allowing for firm-specific risk premiums, results support the influence of a firm-specific effect. However, results from analyzing the relation between quotients of foreign and domestic implied discount rates and stock prices do not consistently supporting the application of intrinsic value models.

When looking at the results from the four levels jointly, it is apparent that the results lack coherence. Tab. 25 provides an overview of stocks that showed predominantly supportive evidence for a cointegrated relationship and supportive evidence in the

regression analysis of Section 8.3 to Section 8.5.[894] Only for one company results are persistently non-supportive, whereas for seven companies results are consistently supportive. It could be argued that value investment does not broadly encompass the entire market but is restricted to a small number of stocks. Since common traits of these companies are not apparent, it is argued that results are incidental rather than systematic. Furthermore, the exchange where the company is listed does not appear to have an effect as all exchanges are represented among the consistent stocks. In this respect it appears far-fetched to argue that value investment takes place only for a small number of stocks.

[894] The table summarizes the results of Section 8.2 to 8.5 by including all stocks that meet the following criteria: Positive evidence: cointegrated relationship on most occasions, statistical significant relationship to risk-free rate, earnings per share, book value per share and significant relationship of foreign and domestic share price quotient with risk-free rate, all at a 5% level. Negative evidence: no cointegrated relationship for most occasions, non-significant relationships to risk-free rate, earnings per share, book value per share and non-significant relationship of foreign and domestic share price quotient with risk-free rate quotient, all at a 10% level. Moreover, it must be noted that due to data availability, the number of tests undergone varies. Consequently, Tab. 25 displays a company such as SVAElectron that has been tested on seven occasions, with Shenzhen Nanshan that underwent only two tests. In order to limit this bias, stocks that were tested only once have been excluded from the table.

Tab. 25 Companies with consistent results

Company	Industry	Exchanges listed	Results	number of Tests
Air China	transportation	SSE/HKEx	supportive	5
Bank of China	banking	SSE/HKEx	supportive	3
Changchai	manufacturing	SZSE	supportive	5
China Fangda Group	manufacturing	SZSE	supportive	4
China Merchants Bank	banking	SSE/HKEx	supportive	3
China Shenhua Energy	energy	SSE/HKEx	supportive	2
Huaxin Cement	manufacturing	SSE	supportive	3
ICBC	banking	SSE/HKEx	supportive	3
Jiangsu Expressway	transportation	SSE/HKEx	supportive	4
Jiangxi Copper	manufacturing	SSE/HKEx	supportive	3
Shanghai Lujiazui	finance	SSE	supportive	3
Shenzhen Nanshan	utility	SZSE	supportive	2
SVAElectron	manufacturing	SSE	supportive	7
Anhui Gujing Distillery	manufacturing	SZSE/SZSE	not supportive	2

Taking all that into consideration it can be concluded that evidence for value investment in general could be found for the Chinese stock market. However, the lack of consistently supportive evidence for intrinsic value models leads to the conclusion that straightforward linear factor models with value variables can be regarded tantamount. However, it must be noted, that results could be attributed to data inferiority, violation of underlying assumptions or procedural flaws.

9 Conclusion

The objective of this thesis is to examine, both theoretically and empirically, the applicability of intrinsic value models at the Chinese stock market. Intrinsic value models are used as a collective term for models based on the capitalization of income method, which defines the value of a specific stock to equal the present value of all its future income streams. Thus it contributes to the field of international portfolio investment that can be considered to be a subset of Finance dealing particularly with the augmentation towards an international environment.

The comparison of intrinsic value models with equilibrium models excerpts central differences. The fundamental distinction can be seen in the theoretical framework. While equilibrium models are based on neoclassical theory, the foundation for intrinsic value models is merely an algebraic statement based on the non-restrictive capitalization of income method. Therefore equilibrium models are based on assumptions such as rational behavior, risk aversion and non-satiation, in addition to the model specific assumptions such as those required by perfect capital markets for the CAPM and matching expectations for the APT. On the other hand, intrinsic value models in their generic form require no such restraining assumptions.

However, when practical or empirical objectives are involved, this seeming lack of restriction diminishes, since intrinsic value models require specification involving additional assumptions in order to be applicable. Consequently, for comprehensive comparison, limitations with respect to application are to be accounted for as well.

Empirical application is also accompanied with problems when equilibrium models are concerned. The main drawback of the CAPM can be seen in the elusiveness of defining risk aversion, risk-free rate and market portfolio. The APT provides no guidelines on how to exhaustively identify risk factors and assumes agents to share expectations on factor loadings.

Intrinsic value models share with equilibrium models the quandary of an elusive risk-free rate. Furthermore, in order to account for the going concern assumption of equity valuation, the terminal value conundrum has to be embraced. Solutions vary from arbitrary truncation to disputable assumptions on stochastic processes. In addition, if

the model is to account for investors' risk aversion, a model-exogenous risk premium is required. Specifications that apply residual income as capitalization object rely furthermore on the clean surplus relation.

A further structural difference results from the models' center of reference. While equilibrium models are arranged in order to explain prices, intrinsic value models describe value. Hence, establishing a common basis for comparison involves constituting a relation between value and price. With respect to equilibrium models, assumptions of homogeneous expectations and rational behavior directly lead to value-price equivalence since arbitrage opportunities are exploited. However, the general unobservability of value makes this basis inapplicable. Conversely, in their generic form intrinsic value models make no assertions on how prices are attained. Consequently, empirical research that relies on a value-price relation is bound to corresponding exogenous assumptions.

Because of the elusiveness of risk-free rate and risk premiums, in order to limit leeway intrinsic value models can be applied adhering to conventional best practice. In this respect the risk-free rate is typically surrogated by the yield of a risk-minimizing alternative investment with equivalent maturity. Methods of obtaining risk premiums directly, such as survey premiums, do not appear promising. Instead it appears constructive to deduce market premiums from observable data. This can be operationalized by regarding investors' willingness to pay reflected in market prices and their expected return using analysts' forecasts as an ex-ante approach. This is because an unexpected component separates realizations from expectations and it appears unreasonable to assume that risk premiums are time-invariant. Consequently, computing implied discount rates and subsequently decomposing them into risk-free and risk premium components is suggested to yield consensus market-based values. Regarding the terminal value conundrum, no best practice has been established. As a result, concurrent application of more than one specification is common.

While in a single-market environment equilibrium models could be preferable, intricacy increases when extending the scope to an international perspective. This is due to the fact that international market integration can be considered to be underdeveloped. Consequently, valuation models cannot be applied without augmentation. It is concluded that, as opposed to the CAPM, intrinsic value models can straightforwardly

account for market segmentation, without requiring complex modifications. Consequently, it is suggested that where segmented markets are concerned, it is worthwhile to consider the application of intrinsic value models. However, difficulties with disentangling selective factors and leeway with respect to the models' specification conflict with these advantages.

For this purpose, the Chinese stock market offers a unique research opportunity, since it is segmented into foreign and domestic investors and simultaneously offers the chance to examine differences because both groups have access to segment-specific stocks that are essentially equivalent. Consequently, it is possible to isolate group-specific differences since they are not obscured by differences across companies. In both market segments considerably different prices are attained. Although these differences are widely recognized among practitioners and academics, empirical analysis failed to provide unambiguous explanations. While one-sided irrational behavior is broadly rejected, unequal appreciation of available information, different risk tolerance and investment alternatives, as well as unequal market liquidity and potential unequal price elasticity appear relevant. However, as long as the actual cause is unknown it is not conceivable how equilibrium models are to be augmented in order to account for it. On another level, since intrinsic value models do not rely on assumptions affected by these factors, applicability remains generally unaltered despite uncertainty regarding the cause.

The empirical analysis in this thesis is structured in order to obtain supportive evidence for the underlying concept or intrinsic value models as well as their concrete applicability. In order to do so, tests are performed regarding consistency with the concept of intrinsic value models, particularly with respect to the value-price relation. Furthermore, intrinsic value models are applied and subsequently results are tested for consistency with model implications. Since not all variables are observable, proxies are used instead. As far as is apparent, this thesis is the first empirical study in the Chinese stock market that proxies expected earnings by using analysts' forecasts. The risk-free rate is proxied using US T-bond yields for foreign investors and PRC T-bond yields and bank deposit rates respectively for the domestic investors. Due to general perception of data quality in emerging markets, the empirical results are obtained successively on a four-level structure.

On the first level it is examined whether in both market segments prices are based on common rationale. Hence it is possible to shed light on the assertions that while foreigners perform value investment, the domestic segment is dominated by pure speculation. Therefore, it is tested whether a general relation between prices in the foreign and domestic share segment exists. Empirical results reveal a long-term equilibrium relation for a large proportion of companies, particularly in the later sample period. However, at the HKEx cointegrated relationships are considerably less frequent. This is attributed to regulatory differences that impair comparability between the stocks.

On the second level the relevance of input variables for intrinsic value models and stock prices is examined on foreign and domestic segments individually. By doing so, a general value-price relation is examined. Therefore, it is tested for a relation of prices with risk-free rates, expected earnings and book value of equity. Both book value of equity and earnings forecasts support their relevance for around two thirds of the sample companies throughout all exchanges and market segments. Regarding the risk-free rate, results are mixed. While a significant relation with most stocks could be identified in the B-share segments, results for A- and H-shares are predominantly non-supportive. This is attributed to the weakness of the domestic bank deposit rate as proxy, which appears not to relate to the perceived risk-free rate. However, applying the 10-year PRC T-bond yield as alternative proxy, results clearly contradict theoretic implications of intrinsic value models. This is ascribed to a linear relation with another unknown value-relevant variable. The fact that the effect through the discount factor is obscured is in line with the central role of interest rates in economic relations that constitute a multitude of interdependent associations. Results from the HKEx buttress the fundamental difference between the mainland and the Hong Kong stock market.

On the third level it is examined whether attributes for intrinsic value models that are segment specific are related to price differences. It is argued that changes in relative prices are related to changes in the relative risk-free rate of foreign and domestic investors. While on the SSE results for around half of the sample companies are supportive, results on the other two exchanges are not consistent with theoretical considerations. Negative and positive relations are mixed and tests of significance provide no clear direction. Therefore it is concluded that differences between risk-free rates are not qualified to explain price differences. It is concluded that the problem lies in the irrelevance of the domestic as well as the Hong Kong risk-free rate. Since the positive

relation of the PRC T-bond yield and domestic stock prices has not been recognized in prior research, similar tests that relate price differences to the difference between foreign and domestic risk-free rates are likely to be due to a predominant effect of the foreign risk-free rate in the specific sample period. The similarity of results from the SZSE and the HKEx could be interpreted when considering that on these exchanges investors from Hong Kong predominantly constitute the demand side.

On the last level intrinsic value models are applied to data from the Chinese stock market. Therefore three specifications are used: two aspects suggested in GEBHARDT/LEE/SWAMINATHAN (2001) and one based on OHLSON/JUETTNER (2003). Assuming price to be a stochastic process, with expected value equal to intrinsic value and solving the equation for the discount rate, leads to mean implied discount rates between 2.4% and 2.8%. When regarding the difference between the risk-free rate proxies with the deposit rate proxy on an average of 1.1%, and with the T-bond proxy of 0.6%. This suggests for both cases that foreign investors weight country risk heavier than the advantage of international diversification.

Subsequently, it is examined whether a relationship between the computed implied discount rates and the relative risk-free rate exists. Regression analysis of average implied discount rates with risk-free rate quotients leads to supportive results by all three models, however, significance is only found for the MGM and the OJM on a 5% level. In order to allow for an individual influence, panel analysis is performed using a fixed effects model. While results clearly support the assertion that the effect is firm-specific, relations are found to be mixed. However, it can be emphasized that the two models that were found significant from the cumulative analysis are again theory consistent and significant, at least on a 10% level. However, Overall, the evidence is not convincingly consistent with the hypothesis, which claims a positive relationship between risk-free rate and implied discount rate.

When pooling results from all four levels it is conspicuous that only for a small number of companies findings are consistently supportive for value investment on all levels. While it could be due to the relatively immature stage of the Chinese stock market, it might as well be incidental. This is because shortcomings of data quality discussed in Section 8.1 are likely to have a considerable effect on results. If it is assumed that data

quality will improve as market maturation progresses, it can be argued that applicability of intrinsic value models will improve likewise.

Hence, for both academic and practitioner the relevance of market segmentation for stock prices can be concluded. Regarding the Chinese stock market in particular, present evidence against the speculation hypothesis can be considered sufficient for rejecting the notion of domestic investors' irrational casino mentality. The cointegration analysis has illustrated to policymakers that the one-way opening of the B-share segment to domestic investors did not lead to continuous price-convergence. This finding should be taken into account with respect to the long awaited merger of A- and B-share segment as well as the intended opening of the HKEx to domestic investors.

Taking all that into consideration, it can be said that empirical results can essentially be regarded supportive for value investment. However, the poor results with regard to the domestic and Hong Kong risk-free rate proxy do not convincingly support the application of intrinsic value models. Therefore, it can be concluded that straightforward linear factor models with value variables can be regarded tantamount.

Appendices

Appendix: 1 World stock markets as of January 2008

Stock exchange	Number of listed companies			Market capitalization (million USD)	Share turnover velocity
	total	domestic	foreign		
Americas					
Buenos Aires SE	111	106	5	54,144.5	9.1%
Mexican Exchange	369	125	244	389,839.1	30.0%
NASDAQ	3.064	2.713	351	3,703,024.5	314.5%
NYSE Group	2.296	1.878	418	14,611,421.1	176.5%
Santiago SE	240	237	3	210,978.4	24.0%
Sao Paulo SE	402	393	9	1,282,801.7	58.6%
Asia - Pacific					
Australian SE	2.002	1.919	83	1,158,800.6	106.0%
Bombay SE	4.895	4.895	0	1,472,768.0	30.3%
Bursa Malaysia	989	986	3	317,996.1	56.9%
Hong Kong Exchanges	1.240	1.231	9	2,208,643.5	97.5%
Indonesia SE	385	385	0	208,800.7	68.1%
Jasdaq	974	974	0	109,585.7	53.8%
Korea Exchange	1.761	1.758	3	957,388.9	196.8%
National Stock Exchange India	1.339	1.339	0	1,345,543.5	71.3%
Osaka SE	477	476	1	189,661.5	132.7%
Shanghai SE	860	860	0	3,134,719.3	204.2%
Shenzhen SE	677	677	0	730,280.2	380.4%
Singapore Exchange	765	473	292	468,790.4	78.9%
Taiwan SE Corp.	710	705	5	596,161.2	155.4%
The Stock Exchange of Thailand	523	523	0	185,354.9	67.8%
Tokyo SE	2.415	2.390	25	4,128,950.5	141.6%
Europe - Africa - Middle East					
BME Spanish Exchanges	3.540	3.501	39	1,638,713.3	195.6%
Borsa Italiana	306	300	6	959,096.7	208.7%
Deutsche Börse	868	763	105	1,858,305.9	217.9%
Egyptian Exchange	430	430	0	149,848.0	63.1%
Euronext	1.039	1.039	0	3,728,153.3	141.7%
JSE	408	371	37	719,086.1	54.1%
London SE	3.300	2.584	716	3,449,909.6	157.8%
OMX Nordic Exchange	848	822	26	1,118,119.7	139.2%
Swiss Exchange	340	257	83	1,210,238.3	139.5%

Source: WFE, Focus, 2008.

Appendix: 2 Empirical results on the Chinese discount puzzle

Author(s)	Sample	Hypothesis	Economic model	Explanatory variables	Results
CHEN/LEE/RUI (2001)	1992-1997 SSE & SZSE	IAH, DLH, DRH, DDH	Factor Model	Market risk premium, US mutual fund investment volume, dummy variable for ADR, close-end fund premium, media coverage, market capitalization, Institutional Investor credit rating, restricted/unrestricted share ratio	DLH (+), IAH (-), DDH (-), DRH(-)
MA (1996)	1992-1994 SSE & SZSE	DLH, DRH	EJM[895], CAPM	CAPM-β, outstanding shares, trading volume	DLH (-), DRH^{β} (+)
WANG/WANG/LIU (2004)	1993-2000 SSE & SZSE	IAH	-	Return and return volatility	IAH (+)
CHAN/KWOK (2005)	1991-2000 SSE & SZSE	SH, DLH, DDH, IAH, DRH	-	Trading volume, free float, return volatility, market capitalization	DLH (+), SH (+), DDH (+), DRH (+), IAH (-)
BAILEY (1994)	1992-1993 SSE & SZSE	RPH(-)	Factor Model	Return and volatility of indices	RPH(-)
CHAKRAVARTY/ SARKAR/WU (1998)	1994-1996 SSE & SZSE	IAH	Factor Model	Return, media coverage,	IAH (+)
SUN/TONG (2000)	1994-1998 SSE & SZSE	DDH	Factor Model	Market capitalization, trading volume, firm size, bond supply, return volatility, inflation, changes in foreign reserves	DDH (+)
FERNALD/ROGERS (2002)	1993-1998 SSH & SZSE	DRH, RPH	DDM	CAPM-β, dividend payout ratio, turnover, state ownership, sales growth, export-orientation dummy	DRH(-), RPH(+)
SU (1999)	1994-1996 SSE & SZSE	DRH	CAPM	Trading volume, dividend return, return volatility	DRH(+)

[895] Model according to EUN/JANAKIRAMANAN (1986).

Author(s)	Sample	Hypothesis	Economic model	Explanatory variables	Results
BERGSTRÖM/TANG (2001)	1995-1999 SSH & SZSE	IAH, DRH, DLH	Factor Model	Media coverage, return variance, bid-ask spread, trading volume, CAPM-β, firm size, free float,	IAH(+), DRH(+), DLH(+)
KAROLYI/LI (2001)	1999-2001 SSE & SZSE	DLH, DDH, IAH, DRH	Factor Model	Trading volume, outstanding shares, firm size, return volatility, CAPM-β	DLH(-), DDH(-), DRH(+), IAH(+)
CHEN et al. (2004)	1999-2001 N.A.	IAH, DRH, DLH, DDH	-	Free float, trading volume, bid-ask spread, book-to market price ratio, state ownership, return volatility	DLH(+), DRH(+), IAH(+), DDH(+)
ZHANG/ZHAO (2004)	1992-2000 SSE	-	DDM	Euromoney country risk weighting, exchange rate changes, T-bond yields, CAPM-β	RPH(+)
MEI/SHEINKMAN/XIONG (2005)	1993-2001 SSE & SZSE	SH	DDM	Turnover, interest rates changes	SH(+)
CHAN/MENKVELD/ YANG (2006)	2000-2001 SSE & SZSE	IAH		Specific asymmetric information variables: price impact measure, adverse selection component, spread decomposition, probability of informed trading	IAH(+)
LI/YAN/GRECO (2006)	1997-2002 HKEx	DRH	CAPM	Market risk premiums, Savings rate	DRH (+)
DARRAT/WU/ZHONG (2007)	1998-2003 SSE & SZSE	IAH, DRH, DLH, DDH	--	Trading volume, floating-ratio	IAH(-), DLH(+), DDH(+), DRH(+)
FONG/WONG/YONG (2007)	2000-2007 SSE, SZSE & HKEx	LH, DRH, DDH, IAH	Factor Model	Relative liquidity, price volatility, tradable shares, firm size	LH(+), DRH(+), DDH(+), IAH(-)

Because of the abundance of capital market research for the PRC, despite the fact that other empirical research allows conclusions regarding the hypotheses, only studies are included that explicitly address the price difference. The hypotheses are defined as: different demand hypothesis (DDH), different liquidity hypothesis (DLH), Different risk hypothesis (DRH) in the sense of absolute return volatility or correlation with market portfolio, risk premium hypothesis (RPH) in the sense of all risk-related factors, speculation hypothesis (SH) and information asymmetry hypothesis (IAH).

Appendix: 3 Sample companies

Company name	Venue for trading of domestic shares	Venue for trading of foreign shares	A-share code	B-/ H-share code	Thomson Financial general industry classification
Air China Ltd.	SSE	HKEx	601111	000753	Transportation
Aluminum Corporation of China Ltd.	SSE	HKEx	601600	002600	Industry
Angang Steel Co. Ltd.	SZSE	HKEx	000898	000347	Industry
Anhui Conch Cement Co. Ltd.	SSE	HKEx	600585	000914	Industry
Anhui Expressway Co. Ltd.	SSE	HKEx	600012	000995	Industry
Anhui Gujing Distillery Co. Ltd.	SZSE	SZSE	000596	200596	Industry
Bank of China Ltd.	SSE	HKEx	601988	003988	Bank
Beiren Printing Machinery Holdings Ltd.	SSE	HKEx	600860	000187	Industry
Bengang Steel Plates Co. Ltd.	SZSE	SZSE	000761	200761	Industry
BOE Technology Group Co. Ltd.	SZSE	SZSE	000725	200725	Industry
Changchai Co. Ltd.	SZSE	SZSE	000570	200570	Industry
China CITIC Bank Co. Ltd.	SSE	HKEx	601998	000998	Bank
China Construction Bank Corp.	SSE	HKEx	601939	000939	Bank
China Eastern Airlines Co. Ltd.	SSE	HKEx	600115	000670	Transportation
China Fangda Group Co. Ltd.	SZSE	SZSE	000055	200055	Industry
China First Pencil Co. Ltd.	SSE	SSE	600612	900905	Industry
China International Marine Co. Ltd.	SZSE	SZSE	000039	200039	Industry
China Life Insurance Co. Ltd.	SSE	HKEx	601628	002628	Insurance
China Merchants Bank Co. Ltd.	SSE	HKEx	600036	003968	Bank
China Railway Group Ltd.	SSE	HKEx	601390	000390	Industry
China Shenhua Energy Co. Ltd.	SSE	HKEx	601088	001088	Industry
China Shipping Development Co. Ltd.	SSE	HKEx	600026	001138	Transportation
China Southern Airlines Co. Ltd.	SSE	HKEx	600029	001055	Transportation
China Textile Machinery Stock Ltd.	SSE	SSE	600610	900906	Industry
China Vanke Co. Ltd.	SSE	SZSE	000002	200002	Industry
Chongqing Changan Automobile Co. Ltd.	SZSE	SZSE	000625	200625	Industry
Chongqing Iron & Steel Co. Ltd.	SSE	HKEx	601005	001053	Industry
Dalian Refrigeration Co. Ltd.	SZSE	SZSE	000530	200530	Industry
Danhua Chemical Technology Co. Ltd.	SSE	SSE	600844	900921	Industry
Datang International Power Generation Co. Ltd.	SSE	HKEx	601991	000991	Utility
Dazhong Transportation Group Co. Ltd.	SSE	SSE	600611	900903	Transportation
Dongfang Electric Co. Ltd.	SSE	HKEx	600875	001072	Industry
Double Coin Holdings Ltd.	SSE	SSE	600623	900909	Industry
Eastern Communications Co. Ltd.	SSE	SSE	600776	900941	Industry
Foshan Electrical and Lightning Co. Ltd.	SZSE	SZSE	000541	200541	Industry
Guangdong Electric Power Development Co. Ltd.	SZSE	SZSE	000539	200539	Utility
Guangdong Provincial Expressway Development Co. Ltd.	SZSE	SZSE	000429	200429	Industry
Guangdong Sunrise Holdings Co. Ltd.	SZSE	SZSE	000030	200030	Industry

Company name	Venue for trading of domestic shares	Venue for trading of foreign shares	A-share code	B-/ H-share code	Thomson Financial general industry classification
Guangzhou Pharmaceutical Co. Ltd.	SSE	HKEx	600332	000874	Industry
Guangzhou Shipyard International Co. Ltd.	SSE	HKEx	600685	000317	Industry
Hainan Airlines Co. Ltd.	SSE	SSE	600221	900945	Transportation
Hainan Dadonghai Tourism Center Holding Ltd.	SZSE	SZSE	000613	200613	Industry
Hainan Pearl River Holdings Co. Ltd.	SZSE	SZSE	000505	200505	Industry
Hefei Meiling Co. Ltd.	SZSE	SZSE	000521	200521	Industry
Huadian Energy Co. Ltd.	SSE	SSE	600726	900937	Utility
Huadian Power International Co. Ltd.	SSE	HKEx	600027	001071	Utility
Huaneng Power International Inc.	SSE	HKEx	600011	000902	Utility
Huangshan Tourism Development Co. Ltd.	SSE	SSE	600054	900942	Industry
Huaxin Cement Co. Ltd.	SSE	SSE	600801	900933	Industry
Hubei Sanonda Co. Ltd.	SZSE	SZSE	000553	200553	Industry
Industrial and Commercial Bank of China Ltd.	SSE	HKEx	601398	001398	Bank
Inner Mongolia Eerduosi Cashmere Products Co. Ltd.	SSE	SSE	600295	900936	Industry
Jiangling Motors Co. Ltd.	SZSE	SZSE	000550	200550	Industry
Jiangsu Expressway Co. Ltd.	SSE	HKEx	600377	000177	Industry
Jiangxi Copper Co. Ltd.	SSE	HKEx	600362	000358	Industry
Jinan Qingqi Motorcycle Co. Ltd.	SSE	SSE	600698	900946	Industry
Jingwei Textile Machinery Co. Ltd.	SZSE	HKEx	000666	000350	Industry
Jinshan Development & Construction Co. Ltd.	SSE	SSE	600679	900916	Industry
Jinzhou Port Co. Ltd.	SSE	SSE	600190	900952	Industry
Konka Group Co. Ltd.	SZSE	SZSE	000016	200016	Industry
Livzon Pharmaceutical Group Co. Ltd.	SZSE	SZSE	000513	200513	Industry
LU Thai Textile Co. Ltd.	SZSE	SZSE	000726	200726	Industry
Maanshan Iron & Steel Co. Ltd.	SSE	HKEx	600808	000323	Industry
PetroChina Co. Ltd.	SSE	HKEx	601857	000857	Industry
SGSB Group Co. Ltd.	SSE	SSE	600843	900924	Industry
Shandong Chenming Paper Holdings Co. Ltd.	SZSE	SZSE	000488	200488	Industry
Shandong Xinhua Pharmaceutical Co. Ltd.	SZSE	HKEx	000756	000719	Industry
Shanghai Automation Instrumentation Co. Ltd.	SSE	SSE	600848	900928	Industry
Shanghai Baosight Software Co. Ltd.	SSE	SSE	600845	900926	Industry
Shanghai Chlor-Alkali Chemical Co. Ltd.	SSE	SSE	600618	900908	Industry
Shanghai Dajiang Group Stock Co. Ltd.	SSE	SSE	600695	900919	Industry
Shanghai Diesel Engine Co. Ltd.	SSE	SSE	600841	900920	Industry
Shanghai Dingli Technology Development Group Co. Ltd.	SSE	SSE	600614	900907	Industry
Shanghai Erfangji Co. Ltd.	SSE	SSE	600604	900902	Industry

Company name	Venue for trading of domestic shares	Venue for trading of foreign shares	A-share code	B-/ H-share code	Thomson Financial general industry classification
Shanghai Friendship Group Inc. Co.	SSE	SSE	600827	900923	Industry
Shanghai Haixin Group Co. Ltd.	SSE	SSE	600851	900917	Industry
Shanghai Highly Group Co. Ltd.	SSE	SSE	600619	900910	Industry
Shanghai Jinjiang International Hotels Development Co. Ltd.	SSE	SSE	600754	900934	Industry
Shanghai Jinqiao Export Processing Zone Co. Ltd.	SSE	SSE	006491	900911	Industry
Shanghai Kai Kai Industrial Co. Ltd.	SSE	SSE	600272	900943	Industry
Shanghai Lian Hua Fibre Co.	SSE	SSE	600617	900913	Industry
Shanghai Lujiazui Finance & Trade Zone Development Co. Ltd.	SSE	SSE	600663	900932	Industry
Shanghai Material Trading Co. Ltd.	SSE	SSE	600822	900927	Industry
Shanghai Mechanical & Electrical Industry Co. Ltd.	SSE	SSE	600835	900925	Industry
Shanghai Nine Dragon Co. Ltd.	SSE	SSE	600555	900955	Industry
Shanghai Potevio Co. Ltd.	SSE	SSE	600680	900930	Industry
Shanghai Sanmao Enterprise Group Co. Ltd.	SSE	SSE	600689	900922	Industry
Shenzhen Shenbao Industrial Co. Ltd.	SZSE	SZSE	000019	200019	Industry
Shenzhen Special Economic Zone Real Estate Co. Ltd.	SZSE	SZSE	000029	200029	Industry
Shanghai Wai Gaoqiao Free Trade Zone Development Co. Ltd.	SSE	SSE	600648	900912	Industry
Shanghai Wingsung Co. Ltd.	SSE	SSE	600613	900904	Industry
Shanghai Worldbest Co. Ltd.	SSE	SSE	600094	900940	Industry
Shanghai Yaohua Pilkington Glass Co. Ltd.	SSE	SSE	600819	900918	Industry
Shanghai Zhenhua Port Machinery Co. Ltd.	SSE	SSE	600320	900947	Industry
Shenji Group Kunming Machine Tool C. Ltd.	SSE	HKEx	600806	000300	Industry
Shenzhen Accord Pharmaceutical Co. Ltd.	SZSE	SZSE	000028	200028	Industry
Shenzhen China Bicycle Co.	SZSE	SZSE	000017	200017	Industry
Shenzhen Chiwan Wharf Holdings Co. Ltd.	SZSE	SZSE	000022	200022	Industry
Shenzhen Expressway Co. Ltd.	SSE	HKEx	600548	000548	Industry
Shenzhen Fiyta Holdings Ltd.	SZSE	SZSE	000026	200026	Industry
Shenzhen International Enterprise Co. Ltd.	SZSE	SZSE	000056	200056	Industry
Shenzhen Nanshan Power Station Co. Ltd.	SZSE	SZSE	000037	200037	Utility
Shenzhen SEG Co. Ltd.	SZSE	SZSE	000058	200058	Industry
Shenzhen Tellus Holding Co. Ltd.	SZSE	SZSE	000025	200025	Industry
Shenzhen Textile Holdings Co. Ltd.	SZSE	SZSE	000045	200045	Industry
Shenzhen Victor Onward Textile Industry Co. Ltd.	SZSE	SZSE	000018	200018	Industry
Shijiazhuang Baoshi Electronic Glass Co. Ltd.	SZSE	SZSE	000413	200413	Industry
Sinopec Shanghai Petrochemical Co.	SSE	HKEx	600688	000338	Industry

Company name	Venue for trading of domestic shares	Venue for trading of foreign shares	A-share code	B-/ H-share code	Thomson Financial general industry classification
Ltd.					
Sinopec Yizheng Chemical Fibre Co. Ltd.	SSE	HKEx	600871	001033	Industry
SVAElectron Co. Ltd.	SSE	SSE	600602	900901	Industry
Tianjin Capital Environment Protection Group Co. Ltd.	SSE	HKEx	600874	001065	Utility
Tianjin Marine Shipping Co. Ltd.	SSE	SSE	600751	900938	Transportation
Weifu High-Technology Co. Ltd.	SZSE	SZSE	000581	200581	Industry
Wuxi Little Swan Co. Ltd.	SZSE	SZSE	000418	200418	Industry
Yantai Changyu Pioneer Wine Co. Ltd.	SZSE	SZSE	000869	200869	Industry
Yanzhou Coal Mining Co. Ltd.	SSE	HKEx	600188	001171	Industry
Zhonglu Co. Ltd.	SSE	SSE	600818	900915	Industry
ZTE Co.	SZSE	HKEx	000063	000763	Industry

Appendix: 4 Cointegration at the SSE

Company name	t-statistic 6/1998-1/2001	t-statistic 6/1998-6/2008	t-statistic 3/2001-6/2008
China First Pencil	-2.6240	-2.6558	-4.3015***
China Textile Machinery	-4.1486***	-2.8497	-4.3037***
Double Coin Holdings	-2.7551	-2.8065	-3.9260***
Hainan Airlines	-1.8120	-2.3882	-6.6535***
Huadian Energy	-2.8265	-2.0657	-7.3519***
Huangshan Tourism Development	-3.2030*	-2.9829	-5.4711***
Jinan Qingqi Motorcycles	-1.5296	-1.6941	-1.4028
Jinzhou Port	-3.7560**	-2.2840	-6.1827***
SGSB Group	-2.7332	-2.6792	-4.9017***
Shanghai Automation	-3.7243**	-2.2687	-6.7053***
Shanghai Chlor Alkali	-2.4894	-2.5437	-3.3089*
Shanghai Dajiang Group	-2.6190	-2.1877	-5.4939***
Shanghai Dingli	-2.9846	-2.2001	-7.4128***
Shanghai Erfangji	-4.2109***	-2.3678	-5.8101***
Shanghai Jin Jiang	-2.9093	-3.2435*	-6.7106***
Shanghai Kaikai	n.a.	n.a.	-8.8957***
Shanghai Nine Dragon	n.a.	n.a.	-4.6282***
Shanghai Potevio	-4.1953***	-2.0769	-5.3734***
Shanghai Sanmao	-2.5137	-2.2329	-7.0975***
Shanghai Wai Gaoqiao	-3.8881**	-2.0912	-4.4681***
Shanghai Worldbest	-1.8819	-1.8385	-3.9063***
Tianjin Marine Shipping	-3.8607**	-1.7300	-2.9372

Results of Engle-Granger test of cointegration based on daily observations from June 15, 1998 to June 2, 2008 of A- and B-share prices. Results represent the outcome of stationarity-tests on the residuals obtained from single-equation regression of A- and B-shares with the null-hypothesis being non-stationarity. The single-equation regression is structured as follows, with y as the stock price of A-share (subscript d) and B-shares (subscript f), β being its factor loading, c being a constant term, z representing the residual and subscript t being the specific date: $y_{dt} = c + \beta y_{ft} + z_t$.

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.04678 (10%), -3.3400 (5%) and -3.9041 (1%). ***, ** and * is statistically significant at 1%, 5% and 10% level, respectively.

Appendix: 5 Cointegration at SSE for 31 month intervals

Company name	t-statistic 06/1998-01/2001	t-statistic 01/2000-06/2002	t-statistic 3/2001-9/2003	t-statistic 6/2003-1/2006	t-statistic 1/2006-6/2008
China First Pencil	-2.6254	-1.7220	-4.9408***	-4.2297***	-2.3301
China Textile Machinery	-4.1465***	-2.3223	-3.9810***	-3.2055*	-2.2393
Double Coin Holdings	-2.7525	-2.2070	-4.2407***	-2.1200	-4.6645***
Hainan Airlines	-1.8147	-2.1251	-5.6343***	-4.4771***	-3.3418**
Huadian Energy	-2.8290	-1.2635	-5.5820***	-2.4983	-3.5352**
Huangshan Tourism	-3.2009*	-1.7555	-5.3061***	-3.0406	-3.2937*
Jinan Qingqi Motorcycles	-1.5343	-1.4353	-3.9040**	-4.1180***	-2.4753
Jinzhou Port	-3.7525**	-1.2623	-4.6490***	-2.8153	-2.8946
SGSB Group	-2.7337	-2.1108	-4.1779***	-2.8358	-3.5590**
Shanghai Automation	-3.7311**	-1.6670	-4.7222***	-2.8383	-3.2196*
Shanghai Chlor Alkali	-2.4872	-2.7631	-5.1393***	-2.6775	-2.7474
Shanghai Dajiang Group	-2.6169	-2.2091	-4.3424***	-2.9762	-2.0627
Shanghai Dingli	-2.9665	-1.5195	-8.6640***	-3.4552**	-2.4228
Shanghai Erfangji	-4.2186***	-2.3008	-4.4169***	-3.4481**	-2.9843
Shanghai Jin Jiang	-2.9088	-2.2809	-3.3176*	-4.0629***	-4.3625***
Shanghai Kaikai	n.a.	n.a.	-6.1570***	-3.5210**	-6.0681***
Shanghai Nine Dragon	n.a.	n.a.	-2.9303	-4.2580***	-3.3491**
Shanghai Potevio	-4.1903***	-2.2324	-6.6232***	-2.7153	-2.3705
Shanghai Sanmao	-2.5015	-2.4039	-4.9244***	-4.6877***	-4.2505***
Shanghai Wai Gaoqiao	-3.8862**	-1.8140	-4.2904***	-3.4719**	-4.3128***
Shanghai Worldbest	-1.8793	-1.7485	-3.9777***	-3.1685*	-2.4769
Tianjin Marine Shipping	-3.8695**	-0.9783	-4.6994***	-4.3911***	-2.7247

See specification Appendix: 4

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.0506 (10%), -3.3441 (5%) and -3.9912 (1%). ***, ** and * is statistically significant at 1%, 5% and 10% level, respectively.

Appendix: 6 Cointegration at the SZSE

Company name	t- statistic 6/1998-1/2001	t- statistic 6/1998-6/2008	t- statistic 3/2001-6/2008
Bengang Steel Plates	-3.1519*	-3.1276*	-4.6882***
BOE Technology	n.a.	n.a.	-2.6155
China Fangda Group	-2.9975	-1.9103	-4.4066***
Chongqing Changan Automobile	-3.2093*	-3.1067*	-3.4222**
Dalian Refrigeration	-3.4749**	-2.8824	-5.0584***
Guangdong Provincial Expressway Development	-3.1572*	-1.8748	-7.2320***
Hainan Dadonghai Tourism	-2.9291	-1.6694	-5.0039***
Hainan Pearl River	-3.9339***	-0.1129	-0.7361
Hubei Sanonda	-2.7200	-2.5298	-3.5728**
LU Thai Textile	n.a.	n.a.	-4.4019***
Shandong Chenming Paper	n.a.	n.a.	-2.5658
Shenzhen Accord Pharmaceutical	-2.7562	-1.7236	-6.2665***
Shenzhen China Bicycle	-3.4798**	-1.4626	-6.4901***
Shenzhen International Enterprise	-4.5751***	-2.3404	-4.0395***
Shenzhen SEG	-3.4725**	-1.6067	-5.1319***
Shijiazhuang Baoshi Electronic Glass	-3.4323**	-2.0902	-3.7877**
Weifu High-Technology	-3.6475**	-2.2142	-3.1790*

See specification Appendix: 4

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.04678 (10%), -3.3400 (5%) and -3.9041 (1%). ***, ** and * is statistically significant at 1%, 5% and 10% level, respectively.

Appendix: 7 Cointegration at SZSE for 31 month intervals

Company name	t- statistic 06/1998-01/2001	t- statistic 01/2000-06/2002	t- statistic 3/2001-9/2003	t- statistic 6/2003-1/2006	t- statistic 1/2006-6/2008
Bengang Steel Plates	-3.1519*	-1.6673	-6.4442***	-2.8698	-2.4787
BOE Technology Group	n.a.	n.a.	-6.0773***	-2.1959	-1.9596
China Fangda Group	-2.9975	-0.8901	-6.0314***	-2.5463	-3.0595*
Chongqing Changan Auto	-3.2093*	-1.8801	-2.7319	-3.4884**	-3.0925*
Dalian Refrigeration	-3.4749**	-2.2643	-4.9582***	-2.8373	-3.6540**
Guangdong Provincial	-3.1572*	-1.7290	-6.2496***	-2.9245	-4.2166***
Hainan Dadonghai Tourism	-2.9291	-1.0573	-4.5417***	-3.1179*	-1.8092
Hainan Pearl River	-3.9339***	-1.5250	-4.8186***	-3.7698**	-0.3780
Hubei Sanonda	-2.7200	-1.7952	-3.4698**	-3.1923*	-2.3095
LU Thai Textile	n.a.	n.a.	-3.1098*	-1.9190	-2.5987
Shandong Chenming Paper	n.a.	n.a.	-2.3953	-1.6448	-2.3913
Shenzhen Accord Pharma	-2.7562	-1.7118	-5.7955***	-3.5218**	-2.0277
Shenzhen China Bicycle	-3.4798**	-1.5169	-4.1452***	-2.3156	-2.6632
Shenzhen International	-4.5751***	-2.5631	-3.6670**	-2.5789	-1.6354
Shenzhen SEG	-3.4725**	-1.7537	-3.6585**	-3.2610*	-2.4113
Shijiazhuang Baoshi Electro	-3.4323**	-1.9089	-4.6673***	-2.7633	-1.9276
Weifu High-Technology	-3.6475**	-1.8584	-3.8711**	-2.3652	-1.7300

See specification Appendix: 4

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.0506 (10%), -3.3441 (5%) and -3.9912 (1%). ***, ** and * is statistically significant at 1%, 5% and 10% level, respectively.

Appendix: 8 Cointegration at HKEx

Company name	t- statistic 6/1998-1/2001	t- statistic 6/1998-6/2008	t- statistic 3/2001-6/2008
China Life Insurance	-2.6734	-2.8857	-3.0417
China Southern Airlines	-1.9211	-1.4545	-1.9257
Datang International Power	-2.5611	-2.2769	-1.9209
Dongfang Electric	-3.5565**	-3.7314**	-2.9059
Guangzhou Shipyard Int.	-1.7033	-5.029***	-4.3146***
Petro China	-1.3376	-2.6554	-2.3405
Shandong Xinhua Pharmaceutical	-2.1733	-2.2538	-3.1603*
Shenji Group Kunming Machine	-6.0626***	-2.8846	-3.5682**
Shenzhen Expressway	-2.8307	-4.1766***	-3.5305**
Sinopec Shanghai Petro	-1.6687	-0.7527	-0.8314
Tianjin Capital Environment	-3.2803*	-1.3282	-1.2836
Yanzhou Coal Mining	-2.2299	-2.8675	-4.2504***

See specification Appendix: 4

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.04678 (10%), -3.3400 (5%) and -3.9041 (1%). ***, ** and * is statistically significant at 1%, 5% and 10% level, respectively.

Appendix: 9 Cointegration at HKEx for 31 month intervals

Company name	t- statistic 06/1998-01/2001	t- statistic 01/2000-06/2002	t- statistic 3/2001-9/2003	t- statistic 6/2003-1/2006	t- statistic 1/2006-6/2008
China Life Insurance	-2.6734	-1.2938	-1.6124	-3.5845**	-2.1035
China Southern Airlines	-1.9211	-1.5107	-4.3724***	-4.3404***	-2.0827
Datang International Power	-2.5611	-3.2126*	-3.9443***	-3.6991**	-1.2408
Dongfang Electric	-3.5565**	-3.1711*	-1.4424	-0.9139	-2.3783
Guangzhou Shipyard Int.	-1.7033	-2.9410	-2.6290	-2.0544	-2.9994
Petro China	-1.3376	-2.0304	-2.3712	-3.7680**	-2.3380
Shandong Xinhua Pharma	-2.1733	-1.9563	-2.0541	-2.5862	-3.0672*
Shenji Group Kunming	-6.0626***	-3.7013**	-2.6505	-0.9777	-4.4096***
Shenzhen Expressway	-2.8307	-4.2975***	-3.1197*	-2.7870	-4.4601***
Sinopec Shanghai Petro	-1.6687	-3.5035**	-2.3503	-2.7789	-1.3948
Tianjin Capital Environment	-3.2803*	-4.5798***	-3.9848***	-2.9776	-2.3991
Yanzhou Coal Mining	-2.2299	-2.9784	-4.1414***	-2.2218	-3.1585*

See specification Appendix: 4

Tests are performed on an individual company basis with significance being gauged by critical values according to MACKINNON (1991): -3.0506 (10%), -3.3441 (5%) and -3.9912 (1%). ***, ** and * is statistically significant at 1%, 5% and 10% level, respectively.

Appendix: 10 Regression analysis for A-shares (PRC bank deposit rate)

Company name	Adj. R^2	monthly obser-vations	Coefficients			
			γ_1 (BPS)	γ_2 (EPS)	γ_3 (risk-free rate)	α (inter-cept)
Bengang Steel Plastes	0.43	77	1.84**	-1.53	0.29**	0.52
BOE Technology	0.72	63	0.56	4.77**	-0.35**	-0.85
Changchai	0.43	40	0.58	8.68**	3.06**	7.19**
China Fangda	0.45	51	5.15**	-3.83	-0.82**	-4.15
China First Pencil	0.72	43	-11.53**	56.02**	3.06**	34.28**
China Textile	0.23	12	1.07**	-12.38**	5.15**	4.76**
Chongqing Changan	0.44	117	1.41**	3.96*	-0.77**	-1.89
Dalian Refrigeration	0.74	62	-1.64**	-27.70**	6.25**	18.59**
Dazhong Transportation	0.19	77	0.04	-2.81**	2.89**	0.53**
Double Coin	0.28	49	-3.65**	-6.34	2.47**	10.51**
Guangdong Electric Power	0.17	117	-0.53	14.12**	0.81**	3.67
Guangdong Provincial Express	0.08	99	2.90**	-3.78	-0.50**	-2.00
Hainan Airlines	0.41	65	0.90**	9.37**	1.42**	6.76*
Hefei Meiling	0.30	14	-5.61*	15.27**	1.96**	24.45**
Huadian Energy	0.25	96	-2.65**	9.86**	3.79**	13.72**
Huangshan Tourism	0.78	96	10.38**	29.68**	-2.03**	-15.27**
Hubei Sanonda	0.50	57	10.27**	34.57**	-2.86**	-9.68**
Inner Mongolia Eerduo	0.80	55	0.28**	-0.21	-7.80**	-1.15**
Jiangling Motors	0.53	83	-0.97	16.02**	-0.10**	-0.41
Jinan Qingqi Motorcycle	0.47	41	0.22**	0.70	6.04**	4.64**
Jinshan Development	0.48	43	-3.16**	-8.76**	3.28**	6.31**
Jinzhou Port	0.07	40	0.35	-4.56	4.20**	7.50**
SGSB	0.75	27	-14.87	38.33*	0.84**	33.63
Shandong Chenming	0.82	62	0.93*	-5.36**	-7.00**	-6.28**
Shanghai Automation	0.43	12	2.14**	5.21	1.41**	5.44*
Shanghai Chlor-Alkali	0.20	51	-15.21	22.01**	1.44**	44.94*
Shanghai Dajiang	0.54	16	19.39**	-51.77**	-1.24**	-7.96
Shanghai Diesel Engine	0.60	53	0.64	-4.66**	-0.34**	-0.60
Shanghai Dingli Technology	0.54	26	6.55**	18.91	2.61**	13.07**
Shanghai Erfangji	0.35	12	1.45*	6.61**	7.61**	7.12**
Shanghai Friendship Group	0.88	64	0.07**	2.13**	-0.49	-0.07
Shanghai Highly	0.86	53	0.67**	-1.03**	-4.57**	-0.92**
Shanghai Jinjiang Int.	0.67	43	0.18	21.84**	1.65**	13.97*
Shanghai Jinqiao	0.53	51	6.89**	-0.25	-1.14**	-8.44
Shanghai Lian Hua Fibre	0.63	10	-1.88*	0.07	1.55**	3.46*
Shanghai Material	0.94	10	0.74	5.48	-5.96**	-2.13**
Shanghai Mechanical	0.75	67	0.22**	1.92**	-2.32**	-1.46**
Shanghai Nine Dragon	0.85	20	13.37**	7.82	-2.57**	-75.42**
Shanghai Potevio	0.76	42	26.23**	-22.93**	-2.82**	-21.34**
Shanghai Sanmao	0.14	10	-3.90**	-2.92	3.19**	14.85**
Shanghai Wai Gaoqiao	0.48	34	8.64	16.29	0.23**	5.76
Shanghai Worldbest	0.75	45	3.86**	2.17	0.21**	0.55
Shanghai Yaohua Pilkin	0.46	73	0.01	1.29**	0.59**	0.29
Shanghai Zhenhua Port	0.90	109	0.43**	0.79**	-2.23**	-0.69**
Shenzhen China Bicycle	0.61	12	4.76**	-3.67*	1.45**	0.85*
Shenzhen Tellus	0.03	12	2.58**	6.42	2.75**	6.48**
Shenzhen Textile	0.19	12	-2.35	-30.24**	2.36**	10.87**
SVAElectron	0.26	94	0.36*	0.88**	-0.97**	-0.83

Company name	Adj. R^2	monthly observations	Coefficients			
			γ_1 (BPS)	γ_2 (EPS)	γ_3 (risk-free rate)	α (intercept)
Tianjin Marine Shipping	0.91	16	-0.01**	14.23*	11.07**	11.37**
Weifu High Technology	0.47	109	5.17**	-13.05**	-2.48**	-11.47**
Yanzhou Coal Mining	0.91	16	-0.01**	14.23*	11.07**	11.37**
Zhonglu	0.16	12	0.02**	-0.01	4.46	0.11**

Results of multivariate regression show the relation between stock prices, book-value of equity, expected earnings proxy and risk-free rate proxy based on OLS-regression. The sample contains monthly observations between June 1998 and May 2008. Tests are performed on an individual company basis. The regression equation is structured as follows, with p being the company's A-share price, α being the constant term, b as the current book-value of equity per share, e as one-year analysts' earnings forecast per share, r as 1-year PRC bank deposit rate with γ being the corresponding factor loadings, u the disturbance term and t the specific date:

$$p_t = \alpha + \gamma_1 b_t + \gamma_2 e_t + \gamma_3 r_t + u_t, \ with \ H_0 : \gamma_i \leq 0, where \ i = (1,2) \ and \ H_0 : \gamma_3 \geq 0$$

The regression is performed using heteroscedasticity and autocorrelation consistent covariances according to NEWEY/WEST (1987). ** and * is statistically significant at 5% and 10% level, respectively.

Appendix: 11 Regression analysis for A-shares (PRC T-bond)

Company name	Adj. R^2	monthly obser-vations	Coefficients			
			γ_1 (BSP)	γ_2 (ESP)	γ_3 (risk-free rate)	α (inter-cept)
Changchai	0.44	12	0.34**	0.42**	-0.04**	-0.28**
China First Pencil	0.80	26	-1.31**	-0.80**	2.18**	0.56**
China Textile	0.87	27	10.67**	18.90**	8.37**	-41.60**
Chongqing Changan	0.94	9	4.72**	-0.55**	0.26**	-15.29**
Hubei Sanonda	0.95	17	0.18**	1.08**	0.48**	-2.15**
Inner Mongolia Eerduosi	0.95	19	0.54**	-0.56**	0.17**	-1.47**
Jinzhou Port	0.96	15	1.28**	-0.79**	1.38**	-9.15**
Shanghai Dingli Technology	0.62	17	0.40**	-0.31**	0.22**	-1.39**
Shanghai Erfangji	0.74	28	0.26**	1.17**	0.60**	-1.98**
Shanghai Friendship Group	0.89	22	13.12**	-7.55**	7.78**	-54.96**
Shanghai Highly	0.89	25	-1.06**	-0.35**	0.30**	1.90**
Shanghai Potevio	0.93	28	4.23**	2.20**	3.08**	-18.48**
Shanghai Sanmao	0.76	28	2.01**	-10.90**	5.43**	-14.92**
Shanghai Worldbest	0.49	12	6.88**	-43.83**	1.79**	-14.59**
Shanghai Yaohua Pilkin	0.85	28	15.47**	28.58**	3.92**	-67.82**
Shanghai Zhenhua Port	0.84	28	5.99**	11.40**	5.33**	-37.71**
Shenzhen Textile	0.83	27	6.46**	-13.29**	8.15**	-39.73**
Tianjin Marine Shipping	0.85	27	8.90**	-9.75**	5.75**	-42.11**
Weifu High Technology	0.77	28	-4.11**	4.18**	3.52**	0.20**
Yanzhou Coal Mining	0.76	13	4.59**	1.00**	0.75**	-15.57**

Specification see Appendix: 10

Appendix: 12 Regression analysis for B-shares

Company name	Adj. R^2	monthly obser-vations	Coefficients			
			γ_1 (BSP)	γ_2 (ESP)	γ_3 (risk-free rate)	α (inter-cept)
Bengang Steel Plates	0.71	77	1.46**	1.54	-9.58**	-1.46
BOE Technology Group	0.38	87	0.50	1.11**	-31.90**	2.80**
China Fangda Group	0.32	51	1.74	-1.53	-58.58**	2.60
China First Pencil	0.85	44	4.37*	30.36**	3.21**	-7.74*
China Textile Machinery	0.11	12	0.06	4.68	-30.10**	2.21
Chongqing Changan Auto	0.68	118	1.16**	1.73*	-14.80**	-0.04
Dalian Refrigeration	0.42	63	1.28**	-14.23**	-80.97**	6.36**
Dazhong Transportation	0.39	78	0.18	-17.40**	-27.15**	4.64**
Double Coin	0.64	50	-2.3**	-0.65	-71.46**	9.54**
Eastern Communication	0.74	61	0.24**	1.63**	-3.83**	-0.14**
Guangdong Provincial Express	0.67	101	1.73**	6.37**	-27.10**	-1.49
Hainan Airlines	0.56	83	1.07**	5.61**	-84.97**	3.22**
Hainan Dadonghai Tourism	0.78	11	0.90	12.02**	-34.70**	0.52
Huadian Energy	0.45	99	0.37	10.61**	-44.63**	2.27
Huangshan Tourism	0.87	98	9.88**	23.67**	-65.31**	-12.91**
Huaxin Cement	0.75	48	0.23	2.14**	5.34**	-0.84
Hubei Sanonda	0.15	57	2.44	9.82	-37.66**	-1.10
Inner Mongolia Eerduosi	0.54	56	1.49	12.22**	-6.73**	-2.09
Jinan Qingqi Motorcycle	0.63	42	0.30**	-3.00**	-74.50**	5.51**
Jinshan Development	0.63	45	31.29**	3.87	-197.80**	-34.86**
Jinzhou Port	0.59	47	4.82*	20.75**	-162.22**	2.59
SGSB Group	0.76	28	-9.90	29.82**	-75.11**	20.23
Shandong Chenming Paper	0.85	87	1.59**	-1.15	-21.33**	-0.30
Shanghai Automation	0.25	12	0.41**	3.51	11.72**	-0.77
Shanghai Baosight	1.00	12	-0.04*	2.31**	-5.05**	0.30**
Shanghai Chlor-Alkali	0.73	52	-6.37*	11.23**	-96.80**	22.39**
Shanghai Dajiang Group	0.77	16	0.47	-10.34**	61.81**	-2.48*
Shanghai Diesel Engine	0.64	56	-9.03**	-16.68**	-118.01**	41.20**
Shanghai Dingli Technology	0.75	27	-1.31	290.50**	-16.85**	-0.74
Shanghai Erfangji	0.30	12	-0.11	1.68**	-5.69**	1.30**
Shanghai Friendship Group	0.85	65	0.55*	14.73**	3.85**	-0.33
Shanghai Haixin	0.53	46	0.10**	-0.39	-6.48**	0.37**
Shanghai Highly Group	0.83	54	4.67**	-5.41**	19.78**	-8.45**
Shanghai Jinjiang Int	0.65	44	-4.62**	12.17**	-142.06**	20.64**
Shanghai Jinqiao Export	0.83	52	6.69**	-0.06	-4.08**	-12.87**
Shanghai Kaikai	0.69	40	2.13	27.85	-36.98**	-3.86
Shanghai Lian Hua Fibre	0.02	12	5.11	6.44**	32.09**	-10.16
Shanghai Lujiazui	0.72	94	1.16**	-3.61**	-9.36**	-1.57**
Shanghai Material Trading	0.93	10	6.74**	16.98*	-9.82**	-9.57**
Shanghai Mechanical	0.65	68	1.07	14.11**	-9.43**	-3.47
ShanghaiNineDragon	0.75	32	-0.77	45.19**	-251.38**	0.74
Shanghai Potevio	0.77	43	19.03**	3.75	-51.42**	-27.88**
Shanghai Sanmao	0.07	12	1.30	5.74*	-72.79**	1.06
Shanghai Wai Gaoqiao	0.52	35	3.05	-73.04**	-180.78**	14.39
Shanghai Wingsung	0.12	12	0.04	-2.92	3.07**	-0.07**
Shanghai Worldbest	0.79	46	2.11**	17.24**	-72.17**	-0.31
Shanghai Yaohua Pilkin Glass	0.53	74	0.98	6.69**	-55.83**	1.90

Company name	Adj. R^2	monthly obser-vations	Coefficients			
			γ_1 (BSP)	γ_2 (ESP)	γ_3 (risk-free rate)	α (inter-cept)
Shanghai Zhenhua Port	0.89	110	2.80**	9.38**	-5.11**	-1.23*
Shenzhen China Bicycle	0.63	12	1.06**	-0.04	12.88**	-0.54
SVAElectron	0.34	99	1.06**	6.39**	-34.67**	0.95
Tianjin Marine Shipping	0.83	16	-0.00**	3.92	31.20**	0.16
Weifu High-Technology	0.68	113	3.99**	-4.25**	4.34**	-7.33**

Specification see Appendix: 10

Appendix: 13 Regression analysis for H-shares

Company name	Adj. R^2	monthly obser-vations	Coefficients			
			γ_1 (BSP)	γ_2 (ESP)	γ_3 (risk-free rate)	α (inter-cept)
Angang Steel	0.76	112	0.00**	3.96*	-22.74**	1.05
Anhui Conch	0.86	47	0.01**	17.47**	-50.72**	-22.51**
Anhui Expressway	0.42	61	0.00	14.51**	-54.23**	1.61*
Beiren Printing	0.33	78	-0.01**	-13.61**	-76.22**	18.41**
China Eastern Airlines	0.68	53	0.00**	19.78**	-141.95**	-5.41**
China Shipping Develop	0.77	72	0.01**	12.94**	-286.80**	-15.28*
China Southern Airline	0.56	55	0.00	32.34**	107.76**	-9.21**
Chongqing Iron Steel	0.87	112	0.00**	5.56**	4.47**	-0.64**
Datang International Power	0.88	114	0.00	19.29**	-8.12**	0.09
Dongfang Electric	0.79	25	0.00**	34.70**	753.09**	-80.61**
Guangzhou Pharma	0.58	25	0.01**	8.53	-23.59**	-19.40*
Guangzhou Shipyard Int.	0.82	24	-0.00	45.23**	1924.58**	-110.62**
Huadian Power Int.	0.34	105	0.00**	1.90	-38.46**	0.68
Huaneng Power Int.	0.54	76	0.00**	6.69**	-143.23**	3.61**
Jiangsu Expressway	0.72	25	0.00**	30.67**	81.54**	-13.40**
Jiangxi Copper	0.72	76	0.00**	8.24*	-497.14**	6.37**
Jingwei Textile	0.47	98	-0.00**	13.52**	50.54**	9.43**
Maanshan Iron & Steel	0.51	111	0.00**	-1.59	-13.29**	2.39**
Shandong Xinhua Pharma	0.61	67	0.01**	15.87	234.42**	-11.29*
Shenzhen Expressway	0.42	75	0.00	23.94**	-109.88**	3.38
Sinopec Shanghai	0.44	113	0.00**	0.98	48.84**	-17.54**
Sinopec Yizheng	0.39	113	0.00**	17.18**	-81.92**	-4.13**
Yanzhou Coal Mining	0.41	108	0.00**	-22.94**	-138.99**	9.73**
ZTE	0.84	113	0.00**	14.68*	118.75**	-1.17

Specification see Appendix: 10

Appendix: 14 Stock price quotient and 1y US T-bond yield and PRC deposit rate quotient

Company name	Stock exchange	Coefficent	t-statistic	R^2	monthly observations
Air China	HKEx	0.14	6.6206**	0.71	13
Aluminum Corporation of China	HKEx	-0.02	-0.4154	0.02	13
Angang Steel	HKEx	0.22	3.2703**	0.55	13
Anhui Conch Cement	HKEx	0.17	2.1110**	0.14	39
Anhui Expressway	HKEx	-0.03	-1.0837	0.14	8
Anhui Gujing Distillery	SZSE	0.02	1.0542	0.08	10
Bank of China	HKEx	0.17	2.5997**	0.49	14
Beiren Printing Machinery	HKEx	0.08	2.3682**	0.20	50
Bengang Steel Plates	SZSE	0.05	0.4884	0.02	37
BOE Technology Group	SZSE	0.17	3.7134**	0.67	6
Changchai Company	SZSE	0.19	6.862**	0.88	7
China CITIC Bank	HKEx	-0.02	-0.3561	0.02	13
China Construction Bank	HKEx	-0.07	-1.0032	0.10	9
China Eastern Airlines	HKEx	0.01	0.3271	0.00	108
China First Pencil	SSE	0.00	0.0744	0.00	70
China International Marine	SZSE	-0.92	-2.8100**	0.33	61
China Life Insurance	HKEx	-0.33	-3.0463**	0.45	16
China Merchants Bank	HKEx	0.15	3.8398**	0.54	20
China Railway Group	HKEx	-0.15	-1.9524*	0.28	5
China Shenhua Energy	HKEx	-0.09	-1.8428*	0.29	7
China Shipping Develop	HKEx	0.28	4.7875**	0.46	70
China Southern Airlines	HKEx	0.14	2.4652**	0.23	53
China Textile Machinery	SSE	-0.10	-3.4909**	0.22	74
China Vanke	SZSE	-0.46	-1.3129*	0.09	63
Chongqing Changan Automobile	SZSE	0.12	2.9207**	0.26	59
Chongqing Iron Steel	HKEx	0.01	0.2290	0.01	16
Dalian Refrigeration	SZSE	0.12	3.7392**	0.41	60
Danhua Chemical Technology	SSE	-0.07	-2.7395**	0.18	55
Datang International Power	HKEx	-0.03	-0.8735	0.05	17
Dazhong Transportation	SSE	-0.03	-0.8832	0.04	64
Dongfang Electric	HKEx	0.00	0.0458	0.00	114
Double Coin	SSE	-0.10	-3.2368**	0.18	115
Eastern Communication	SSE	0.00	0.0218	0.00	60
Foshan Electrical	SZSE	0.15	2.5919**	0.23	61
Guangdong Electric Power	SZSE	0.21	5.3052**	0.49	63
Guangdong Provincial Expressway	SZSE	-0.12	-2.2919**	0.18	110
Guangdong Sunrise	SZSE	-0.07	-3.1485**	0.38	48
Guangzhou Pharmaceuticals	HKEx	0.17	3.2625**	0.30	81
Guangzhou Shipyard Int.	HKEx	0.01	0.1218	0.00	114
Hainan Airlines	SSE	-0.17	-3.4528**	0.41	99
Hainan Dadonghai Tourism	SZSE	-0.12	-5.4192**	0.36	97
Hainan Pearl River	SZSE	-0.11	-2.3768**	0.13	100
Hefei Meiling	SZSE	-0.04	-1.3524*	0.10	64
Huadian Energy	SSE	-0.17	-4.043**	0.30	113
Huadian Power Int.	HKEx	0.25	4.4525**	0.39	38
Huaneng Power Int.	HKEx	0.23	4.4830**	0.48	63
Huangshan Tourism	SSE	0.08	3.1806**	0.25	63
Huaxin Cement	SSE	0.08	2.4325**	0.21	58

Company name	Stock ex-change	Co-efficent	t-statistic	R^2	monthly observations
Hubei Sanonda	SZSE	0.05	1.1544	0.07	13
ICBC	HKEx	0.06	1.2538	0.13	13
Inner Mongolia Eerduosi	SSE	0.09	2.1642**	0.18	13
Jiangling Motors	SZSE	0.14	5.2744**	0.56	39
Jiangsu Expressway	HKEx	0.22	2.2927**	0.18	8
Jiangxi Copper	HKEx	0.19	3.9225**	0.33	10
Jinan Qingqi Motorcycle	SSE	-0.17	-3.0533**	0.22	14
Jingwei Textile Machinery	HKEx	0.16	3.7882**	0.44	50
Jinshan Development	SSE	0.15	4.4051**	0.4	38
Jinzhou Port	SSE	-0.19	-4.2241**	0.46	6
Konka Group	SZSE	0.16	3.2659**	0.33	7
Livzon Pharmaceutical	SZSE	0.07	3.0535**	0.29	13
LUThai Textile	SZSE	0.07	1.2300	0.06	9
Maanshan Iron & Steel	HKEx	-0.01	-0.1218	0.00	109
Petro China	HKEx	-0.22	-3.5378**	0.65	71
SGSB Group	SSE	-0.11	-4.0630**	0.22	62
Shandong Chenming Paper	SZSE	0.11	1.7037**	0.17	17
Shandong Xinhua Pharmaceutical	HKEx	-0.05	-1.6982**	0.08	21
Shanghai Automation	SSE	-0.12	-3.7993**	0.25	6
Shanghai Baosight	SSE	0.00	-0.1485	0.00	8
Shanghai Chlor-Alkali	SSE	-0.09	-2.9532**	0.15	71
Shanghai Dajiang Group	SSE	-0.10	-3.5889**	0.20	54
Shanghai Diesel Engine	SSE	-0.02	-0.8324	0.03	75
Shanghai Dingli Technology	SSE	-0.14	-4.4044**	0.28	64
Shanghai Erfangji	SSE	-0.13	-3.5246**	0.21	60
Shanghai Friendship Group	SSE	0.15	3.1158**	0.35	17
Shanghai Haixin Group	SSE	0.15	3.0805**	0.27	61
Shanghai Highly Group	SSE	0.04	1.0768	0.05	56
Shanghai Jinjiang Int.	SSE	-0.12	-2.6676**	0.16	18
Shanghai Jinqiao Export	SSE	-0.09	-1.8302**	0.1	65
Shanghai Kaikai Industrial	SSE	-0.05	-1.9619**	0.14	115
Shanghai Lian Hua Fibre	SSE	-0.02	-0.7247	0.02	116
ShanghaiLujiazuiFina	SSE	0.07	2.6416**	0.23	61
Shanghai Material Trading	SSE	0.00	0.0205	0.00	62
Shanghai Mechanical	SSE	0.07	2.0128**	0.16	64
Shanghai Nine Dragon	SSE	0.05	1.3282*	0.07	110
Shanghai Potevio	SSE	-0.11	-4.4563**	0.27	48
Shanghai Sanmao	SSE	-0.17	-4.4055**	0.3	82
Shanghai Wai Gaoqiao	SSE	-0.08	-2.3047**	0.14	115
Shanghai Wingsung	SSE	-0.05	-1.6615*	0.08	100
Shanghai Worldbest	SSE	-0.17	-4.9499**	0.37	98
Shanghai Yaohua Pilkin Glass	SSE	0.23	4.8341**	0.57	100
Shanghai Zhenhua Port	SSE	0.23	2.2568**	0.23	65
Shenji Group Kunming Machine	HKEx	-0.04	-1.0633	0.03	114
Shenzhen Accord Pharmaceutical	SZSE	-0.10	-2.0403**	0.13	39
Shenzhen China Bicycle	SZSE	-0.13	-5.3956**	0.37	64
Shenzhen Chiwan Warf	SZSE	-0.04	-0.6085	0.02	64
Shenzhen Expressway	HKEx	0.37	6.1630**	0.61	59
Shenzhen Fiyta	SZSE	0.07	3.7227**	0.35	63
Shenzhen International Enterprise	SZSE	-0.08	-1.9936**	0.11	20
Shenzhen Nanshan Power	SZSE	0.16	5.3412**	0.50	65

Company name	Stock ex-change	Co-efficent	t-statistic	R^2	monthly observations
Shenzhen SEG	SZSE	-0.07	-2.6244**	0.18	60
Shenzhen Shenbao Industrial	SZSE	0.04	1.8542**	0.13	85
Shenzhen Special Economic Zone	SZSE	0.05	1.8483**	0.10	65
Shenzhen Tellus	SZSE	0.00	-0.0930	0.00	102
Shenzhen Textile	SZSE	-0.15	-2.8496**	0.31	41
Shenzhen Victor Onward	SZSE	0.02	0.8016	0.03	65
Shijiazhuang Baoshi Electronic Glass	SZSE	-0.11	-3.2844**	0.21	106
Sinopec Shanghai Petrochemical	HKEx	0.02	0.3214	0.00	63
Sinopec Yizheng Chemical	HKEx	0.07	2.6020**	0.17	57
SVAElectron	SSE	0.07	1.4827*	0.05	88
Tianjin Capital Environment	HKEx	-0.03	-0.6304	0.01	115
Tianjin Marine Shipping	SSE	-0.15	-4.3965**	0.32	7
Weifu High-Technology	SZSE	-0.06	-0.9328	0.03	116
Wuxi Little Swan	SZSE	0.06	1.6287*	0.12	88
Yantai Changyu Pioneer	SZSE	0.14	3.1195**	0.35	114
Yanzhou Coal Mining	HKEx	-0.04	-0.5020	0.01	113
Zhonglu	SSE	0.00	-0.1129	0.00	65
ZTE	HKEx	0.14	5.9690**	0.45	116

Results of univariate OLS regression of foreign and domestic share price and risk-free rate proxy quotients. The sample contains monthly observations between June 1998 and May 2008. Tests are performed on an individual company basis. The regression equation is structured as follows, with p being the company's price of A-shares (subscript d) and B-/ H-shares (subscript f), α being the constant term, r^f as 1-year US T-bond yield, r^d as the 1-year PRC deposit rate with γ being its factor loading, u the disturbance term and t the specific date:

$$\frac{p_t^B}{p_t^A} = \alpha + \gamma \frac{r_t^f}{r_t^d} + u_t, \quad where \quad H_0 : \gamma \leq 0$$

The regression is performed using heteroscedasticity and autocorrelation consistent covariances according to NEWEY/WEST (1987). ** and * is statistically significant at 5% and 10% level, respectively.

Appendix: 15 Stock price quotient and US-/PRC 10y T-bond yield quotient

Company name	Stock ex-change	Co-efficent	t-statistic	R^2	monthly observations
Air China	HKEx	0,57	6,2768**	0,74	12
Aluminum Corporation of China	HKEx	0,08	0,4767	0,02	12
Angang Steel	HKEx	0,65	9,4849**	0,78	12
Anhui Conch Cement	HKEx	0,10	0,8819	0,06	18
Anhui Expressway	HKEx	-0,25	-1,1269	0,24	5
Anhui Gujing Distillery	SZSE	0,18	1,2987	0,18	9
Bank of China	HKEx	0,48	3,4503**	0,68	13
Beiren Printing Machinery	HKEX	0,28	5,6654**	0,64	20
Bengang Steel Plates	SZSE	0,43	6,3641**	0,67	20
BOE Technology Group	SZSE	1,07	4,9192**	0,72	5
Changchai Company	SZSE	1,08	7,43**	0,80	6
China CITIC Bank	HKEx	0,14	0,7491	0,07	12
China Construction Bank	HKEx	0,06	0,1927	0,01	8
China Eastern Airlines	HKEx	0,16	2,1076**	0,27	22
China First Pencil	SSE	-0,10	-1,1612	0,11	23
China International Marine	SZSE	0,59	7,4435**	0,59	26
China Life Insurance	HKEx	-1,01	-4,8916**	0,56	16
China Merchants Bank	HKEx	0,42	5,2707**	0,75	20
China Railway Group	HKEx	-1,00	-2,075*	0,36	5
China Shenhua Energy	HKEx	-0,59	-3,2075**	0,53	7
China Shipping Develop	HKEx	0,45	5,4503**	0,62	26
China Southern Airlines	HKEx	0,50	6,7681**	0,52	26
China Textile Machinery	SSE	-0,13	-2,998**	0,28	20
China Vanke	SZSE	1,62	9,416**	0,70	28
Chongqing Changan Automobile	SZSE	0,39	4,0252**	0,44	23
Chongqing Iron Steel	HKEx	-0,01	-0,1196	0,00	15
Dalian Refrigeration	SZSE	0,24	4,5913**	0,48	25
Danhua Chemical Technology	SSE	-0,22	-4,1962**	0,40	24
Datang International Power	HKEx	0,00	-0,0677	0,00	17
Dazhong Transportation	SSE	-0,30	-5,4238**	0,56	28
Dongfang Electric	HKEx	0,29	2,4716**	0,36	26
Double Coin	SSE	-0,12	-1,8019**	0,08	27
Eastern Communication	SSE	-0,33	-2,0372**	0,19	23
Foshan Electrical	SZSE	0,79	13,7582**	0,82	28
Guangdong Electric Power	SZSE	0,61	9,0653**	0,76	28
Guangdong Provincial Expressway	SZSE	0,24	5,9956**	0,56	27
Guangdong Sunrise	SZSE	-0,16	-2,3326**	0,22	12
Guangzhou Pharmaceuticals	HKEx	0,29	5,6941**	0,60	25
Guangzhou Shipyard Int.	HKEx	0,28	3,6677**	0,28	27
Hainan Airlines	SSE	0,09	0,9248	0,06	26
Hainan Dadonghai Tourism	SZSE	-0,07	-1,6284*	0,16	21
Hainan Pearl River	SZSE	0,29	3,1314**	0,51	22
Hefei Meiling	SZSE	0,08	1,5405*	0,12	28
Huadian Energy	SSE	-0,02	-0,1642	0,00	26
Huadian Power Int.	HKEx	0,59	3,9159**	0,51	27
Huaneng Power Int.	HKEx	0,76	9,9593**	0,73	28
Huangshan Tourism	SSE	0,10	1,7599**	0,12	28
Huaxin Cement	SSE	0,14	2,4553**	0,23	22
Hubei Sanonda	SZSE	0,36	5,7695**	0,71	26

Company name	Stock ex-change	Co-efficent	t-statistic	R^2	monthly observations
ICBC	HKEx	0,28	2,7353**	0,45	19
Inner Mongolia Eerduosi	SSE	0,11	1,6737*	0,20	28
Jiangling Motors	SZSE	0,44	13,8416**	0,91	24
Jiangsu Expressway	HKEx	0,22	3,9399**	0,32	27
Jiangxi Copper	HKEx	0,38	4,4484**	0,39	28
Jinan Qingqi Motorcycle	SSE	0,01	0,1818	0,00	28
Jingwei Textile Machinery	HKEX	0,22	2,16**	0,27	27
Jinshan Development	SSE	0,00	0,035	0,00	28
Jinzhou Port	SSE	0,02	0,3141	0,01	27
Konka Group	SZSE	0,44	3,5583**	0,47	28
Livzon Pharmaceutical	SZSE	0,25	3,4969**	0,51	21
LUThai Textile	SZSE	0,53	3,9824**	0,49	27
Maanshan Iron & Steel	HKEx	0,59	7,9892**	0,69	28
Petro China	HKEx	-1,05	-2,0029*	0,49	6
SGSB Group	SSE	-0,27	-2,3708**	0,23	27
Shandong Chenming Paper	SZSE	0,51	8,4547**	0,80	28
Shandong Xinhua Pharmaceutical	HKEx	0,12	2,4925**	0,23	26
Shanghai Automation	SSE	0,08	1,341*	0,10	24
Shanghai Baosight	SSE	-0,08	-1,0264	0,06	28
Shanghai Chlor-Alkali	SSE	-0,28	-3,3362**	0,29	28
Shanghai Dajiang Group	SSE	-0,04	-0,676	0,02	23
Shanghai Diesel Engine	SSE	-0,02	-0,2593	0,01	23
Shanghai Dingli Technology	SSE	-0,17	-1,7733**	0,18	26
Shanghai Erfangji	SSE	-0,01	-0,0623	0,00	28
Shanghai Friendship Group	SSE	0,02	0,1554	0,00	28
Shanghai Haixin Group	SSE	-0,03	-0,4022	0,01	28
Shanghai Highly Group	SSE	-0,21	-2,9552**	0,30	28
Shanghai Jinjiang Int.	SSE	-0,05	-1,0569	0,06	28
Shanghai Jinqiao Export	SSE	0,22	6,2311**	0,57	28
Shanghai Kaikai Industrial	SSE	-0,03	-0,4414	0,01	24
Shanghai Lian Hua Fibre	SSE	-0,17	-2,8796**	0,32	25
ShanghaiLujiazuiFina	SSE	0,03	0,5318	0,01	28
Shanghai Material Trading	SSE	-0,22	-2,4164**	0,20	28
Shanghai Mechanical	SSE	0,02	0,197	0,00	28
Shanghai Nine Dragon	SSE	0,27	2,8953**	0,31	28
Shanghai Potevio	SSE	-0,10	-1,2558	0,09	27
Shanghai Sanmao	SSE	-0,07	-0,7258	0,03	27
Shanghai Wai Gaoqiao	SSE	0,08	1,4799*	0,08	25
Shanghai Wingsung	SSE	-0,29	-3,1414**	0,38	28
Shanghai Worldbest	SSE	-0,09	-0,985	0,09	26
Shanghai Yaohua Pilkin Glass	SSE	0,11	2,7935**	0,13	28
Shanghai Zhenhua Port	SSE	0,01	0,0543	0,00	28
Shenji Group Kunming Machine	HKEx	0,04	0,2786	0,00	26
Shenzhen Accord Pharmaceutical	SZSE	0,36	7,4001**	0,77	28
Shenzhen China Bicycle	SZSE	0,00	0,0023	0,00	13
Shenzhen Chiwan Warf	SZSE	0,43	9,5985**	0,84	27
Shenzhen Expressway	HKEx	0,50	7,2898**	0,71	28
Shenzhen Fiyta	SZSE	0,08	2,0738**	0,16	27
Shenzhen International Enterprise	SZSE	0,27	6,2772**	0,59	28
Shenzhen Nanshan Power	SZSE	0,36	4,6946**	0,55	28
Shenzhen SEG	SZSE	0,15	2,1948**	0,30	28

Company name	Stock ex-change	Co-efficent	t-statistic	R^2	monthly observations
Shenzhen Shenbao Industrial	SZSE	0,19	3,7288**	0,50	28
Shenzhen Special Economic Zone	SZSE	0,09	1,6592*	0,09	28
Shenzhen Tellus	SZSE	0,33	7,7418**	0,68	27
Shenzhen Textile	SZSE	-0,05	-0,4442	0,02	28
Shenzhen Victor Onward	SZSE	0,12	2,3027**	0,18	27
Shijiazhuang Baoshi Electronic Glass	SZSE	0,18	3,9847**	0,42	26
Sinopec Shanghai Petrochemical	HKEx	0,48	7,0434**	0,51	28
Sinopec Yizheng Chemical	HKEx	0,25	6,397**	0,41	28
SVAElectron	SSE	-0,23	-1,3692*	0,07	24
Tianjin Capital Environment	HKEx	0,27	3,0116**	0,34	28
Tianjin Marine Shipping	SSE	0,11	2,5489**	0,30	23
Weifu High-Technology	SZSE	0,60	9,5899**	0,74	28
Wuxi Little Swan	SZSE	0,27	2,4772**	0,36	26
Yantai Changyu Pioneer	SZSE	0,04	0,7384	0,03	28
Yanzhou Coal Mining	HKEx	0,32	5,1353**	0,39	28
Zhonglu	SSE	-0,08	-1,0973	0,05	28
ZTE	HKEx	0,31	7,9148**	0,66	28

Specification see Appendix: 14

Appendix: 16 Models used for computing implicit discount rates

Model according to GEBHARDT/LEE/SWAMINATHAN (2001)

$$p = bps_0 + \frac{froe_1 - r}{1+r} \cdot bps_0 + \frac{froe_2 - r}{(1+r)^2} \cdot bps_1 + \frac{froe_3 - r}{(1+r)^3} \cdot bps_2 + TV \text{, where CSR}$$

The specification of the RIV is based on book value per share (bps) and three-year forecasted return on equity (froe) used to compute abnormal returns on equity ($froe_t$-r). After three years the terminal value is set through linear interpolation over nine years to a 10-year average industry value based on industry classification by Thomson Financial (see for the detailed calculation GEBHARDT/LEE/SWAMINATHAN (2001, p 142 and Appendix A on p. 173). In order to compute bps for future periods, actual dividends per share data is assumed constant for the next periods, so that corresponding book value per share is computed as ($bps_t \equiv bps_{t-1}+eps_t-dps_{t-1}$).

Pro: Specification has been chosen due to their positive reception in other studies.

Contra: Terminal value depends on the industry mean specification, requiring generalization. Assumption on constant dividends questionable. Disregarding publicly available data forecasted long term growth.

Modification model according to GEBHARDT/LEE/SWAMINATHAN (2001)

$$p = bps_0 + \frac{froe_1 - r}{1+r} \cdot bps_0 + \ldots + \frac{froe_{12} - r}{(1+r)^{12}} \cdot bps_{11} \text{, where CSR}$$

The specification of the RIV is based on book value per share (bps) and twelve-year forecasted return on equity (froe) used to compute abnormal returns on equity ($froe_t$-r). Two year earnings forecast are used with subsequently computing forecasts by a linear process reverting to a ten percent return on equity. The terminal value is assumed to be zero after twelve years. In order to compute bps for future periods, actual dividends per share data is assumed constant for the next periods, so that corresponding book value per share is computed as ($bps_t \equiv bps_{t-1}+eps_t-dps_{t-1}$).

Pro: Objective since every industry is treated equally.

Contra: Arbitrary truncation after twelve periods. Disregarding publicly available data forecasted long term growth. Implicit assumption of constant dividends questionable.

Model according to OHLSON/JUETTNER (2003)

$$p = \frac{1}{r} \cdot \frac{g_2 - (\gamma - 1)}{r - (\gamma - 1)} eps_1 \text{, where } \gamma < 1 + r \text{ and } g_2 > LTG$$

This rearrangement of the CIM applies 1-year forecasted earnings (eps) and dividends per share. Furthermore a short and a long-term growth rate are applied. The short term growth rate (g_2) is computed using one and two year earnings forecasts. Forecasted long term growth rates are used for the long term (γ). The specific computation is presented in Section 2.3.9.

Pro: Does not require clean surplus relation to hold.

Contra: Growth factor has a heavy impact and needs to be positive. A positive change in forecasted earnings is required for the model to be applicable.

Appendix: 17 Descriptive statistics for implicit discount rate differential (GM)

Company name	arithmetic mean	maxi-mum	mini-mum	monthly obser-vations	standard deviation
Air China	3.35%	4.52%	1.94%	9	0.0096
Aluminum Corp. Of China	2.42%	3.99%	1.62%	13	0.0059
Angang Steel	0.41%	2.40%	-1.67%	13	0.0125
Anhui Conch Cement	0.99%	2.78%	-0.30%	9	0.0110
Anhui Expressway	1.38%	1.78%	1.00%	8	0.0024
Bank Of China	2.22%	3.07%	1.43%	6	0.0067
Bengang Steel Plates	2.74%	3.49%	2.23%	4	0.0058
China Citic Bank	2.35%	2.83%	2.07%	4	0.0035
China Construction Bank	1.40%	2.03%	0.63%	6	0.0051
China Eastern Airlines	2.84%	5.37%	0.42%	11	0.0165
China International Marine	-0.61%	2.57%	-3.44%	55	0.0192
China Life Insurance	0.94%	2.60%	-0.63%	17	0.0110
China Merchants Bank	0.51%	1.38%	-0.62%	12	0.0066
China Railway Group	0.37%	0.62%	0.14%	5	0.0021
China Shenhua Energy Company	1.28%	1.59%	0.93%	8	0.0025
China Shipping Container Lines	4.15%	5.59%	2.52%	3	0.0154
China Shipping Development	1.91%	6.32%	-0.71%	71	0.0184
China Southern Airlines	1.52%	3.71%	0.27%	54	0.0088
China Vanke Company	-1.59%	2.20%	-3.63%	59	0.0170
Chongqing Changan Automobile	2.77%	6.30%	1.34%	52	0.0105
Chongqing Iron & Steel	3.18%	3.18%	3.18%	1	n.a.
Datang International Power	3.34%	5.72%	1.03%	18	0.0129
Dongfang Electric	1.60%	2.53%	0.43%	9	0.0084
Double Coin Holdings	8.13%	10.53%	5.08%	14	0.0185
Foshan Electrical & Lighting	2.20%	2.86%	1.58%	9	0.0049
Guangdong Electric Power	4.07%	5.15%	2.95%	9	0.0069
Guangdong Provincial Express	5.58%	5.93%	5.33%	5	0.0023
Guangzhou Pharmaceutical	3.27%	4.85%	1.92%	9	0.0093
Guangzhou Shipping International	2.94%	4.70%	1.42%	9	0.0116
Hainan Airlines	1.17%	3.99%	-0.08%	20	0.0142
Huadian Energy	4.37%	9.43%	0.40%	30	0.0293
Huadian Power International	2.42%	5.90%	-0.24%	39	0.0160
Huaneng Power International	1.18%	3.20%	-1.55%	64	0.0122
Huangshan Tourism Development	1.11%	1.94%	0.47%	9	0.0048
Huaxin Cement Company Limited	1.45%	2.38%	0.57%	8	0.0062
ICBC	1.10%	1.87%	0.55%	9	0.0044
Inner Mongolia Eerduosi	2.57%	3.23%	2.01%	8	0.0042
Jiangling Motors Corp.	2.92%	3.89%	2.17%	9	0.0059
Jiangsu Expressway	0.85%	1.68%	0.12%	17	0.0044
Jiangxi Copper	2.40%	5.02%	0.38%	59	0.0119
Jingwei Textile Machinery	3.20%	4.38%	2.50%	7	0.0068
Livzon Pharmaceuticals Group	2.31%	2.78%	1.81%	6	0.0041
LU Thai Textile Company Limited	2.77%	4.60%	-0.16%	9	0.0134
Maanshan Iron & Steel	2.23%	9.57%	-1.07%	53	0.0253
Petrochina	2.69%	3.41%	2.22%	7	0.0039
Shandong Chenming Paper	2.92%	5.92%	1.49%	38	0.0099
Shandong Xinhua Pharmaceutical	11.95%	12.85%	10.96%	5	0.0073
Shanghai Friendship Group Inc	1.43%	1.80%	0.72%	9	0.0036
Shanghai Highly	2.04%	3.12%	1.05%	8	0.0074

Company name	arithmetic mean	maxi-mum	mini-mum	monthly obser-vations	standard deviation
Shanghai Jinqiao Export Processing	1.81%	2.93%	1.04%	9	0.0063
Shanghai Lujiazui Finance	1.17%	1.69%	0.70%	9	0.0034
Shanghai Mechanical & Electrical	2.17%	2.99%	1.02%	8	0.0082
Shanghai Potevio	5.71%	7.17%	4.51%	7	0.0092
Shanghai Wai Gaoqiao	3.10%	3.79%	1.86%	5	0.0079
Shanghai Worldbest	4.85%	5.20%	4.48%	5	0.0030
Shanghai Zhenhua Port Machinery	2.25%	4.73%	0.17%	52	0.0142
Shenzhen Chiwan Warf	0.76%	2.57%	-0.73%	49	0.0077
Shenzhen Expressway	3.81%	9.30%	-0.21%	68	0.0288
Sinopec Shanghai Petrochemical	4.76%	12.33%	0.43%	105	0.0268
Sinopec Yizheng Chemical Fibre	5.24%	14.51%	1.39%	110	0.0266
SVA Electron	-3.03%	-2.59%	-3.50%	8	0.0029
Tianjin Capital Environmental	4.74%	9.09%	1.51%	69	0.0206
Weifu High Technology	2.43%	5.59%	0.58%	29	0.0162
Yanzhou Coal Mining	2.86%	9.27%	-0.42%	94	0.0247
ZTE	2.08%	3.70%	1.00%	19	0.0086

Results show the difference between foreign and domestic implicit discount rate derived from the model based on GEBHARDT/LEE/SWAMINATHAN (2001). Sample contains monthly observations between June 1998 and May 2008. Differences are computed on an individual company basis. Differences are obtained as follows, where r is the implicit discount rate derived from domestic market prices (subscript d) and foreign market prices (subscript f), p as the corresponding share price, bps as book-value of equity per share, froe the forecasted return on equity used to compute abnormal returns on equity ($froe_t - r$) and t the specific date. After three years the terminal value is set through linear interpolation over nine years to a 10-year average industry value based on industry classification by Thomson Financial

$$r^{\Delta} = r^{r} - r^{d}, \quad \textit{where} \quad p = bps_0 + \frac{froe_1 - r}{1+r} \cdot bps_0 + \frac{froe_2 - r}{(1+r)^2} \cdot bps_1 + \frac{froe_3 - r}{(1+r)^3} \cdot bps_2 + TV$$

Appendix: 18 Descriptive statistics for implicit discount rate differential (MGM)

Company name	arithmetic mean	maxi-mum	mini-mum	monthly obser-vations	standard deviation
Air China	3.29%	4.42%	1.97%	9	0.0088
Aluminum Corp. Of China	2.58%	4.22%	1.75%	13	0.0061
Angang Steel	0.48%	2.49%	-1.48%	13	0.0121
Anhui Conch Cement	0.67%	2.64%	-0.29%	21	0.0074
Anhui Expressway	1.28%	1.67%	0.89%	8	0.0023
Bank Of China	1.24%	2.73%	-0.22%	14	0.0095
Beiren Printing Machinery	3.98%	6.46%	2.40%	25	0.0100
Bengang Steel Plates	5.20%	9.12%	0.69%	28	0.0266
BOE Technology Group	3.50%	4.67%	2.04%	6	0.0101
China Citic Bank	2.14%	3.00%	0.98%	13	0.0057
China Construction Bank	1.33%	1.93%	0.62%	6	0.0048
China Eastern Airlines	3.10%	5.27%	0.65%	50	0.0117
China First Pencil	5.43%	10.12%	0.86%	27	0.0356
China International Marine	-0.81%	2.73%	-3.77%	59	0.0205
China Life Insurance	0.96%	2.66%	-0.66%	17	0.0112
China Merchants Bank	0.35%	1.19%	-0.62%	21	0.0049
China Railway Group	0.38%	0.64%	0.14%	6	0.0019
China Shenhua Energy Company	1.28%	1.51%	0.96%	8	0.0020
China Shipping Container Lines	3.90%	5.21%	2.54%	3	0.0134
China Shipping Development	1.78%	5.77%	-0.71%	71	0.0168
China Southern Airlines	1.63%	3.92%	0.31%	54	0.0093
China Textile Machinery	5.04%	7.28%	2.77%	6	0.0229
China Vanke Company	-1.84%	2.17%	-4.47%	64	0.0178
Chongqing Changan Automobile	2.47%	4.16%	1.04%	60	0.0090
Chongqing Iron & Steel	3.67%	5.25%	2.35%	17	0.0090
Dalian Refrigeration	1.46%	2.53%	0.39%	23	0.0058
Datang International Power	2.84%	4.75%	0.87%	18	0.0108
Dazhong Transportation (Group)	5.03%	6.01%	4.39%	17	0.0040
Dongfang Electric	1.39%	3.27%	-0.37%	25	0.0099
Double Coin Holdings	4.09%	11.29%	0.13%	44	0.0384
Eastern Communications Company	5.08%	6.73%	3.98%	15	0.0091
Foshan Electrical & Lighting	0.57%	2.73%	-1.14%	42	0.0111
Guangdong Electric Power	1.95%	4.08%	0.16%	64	0.0115
Guangdong Provincial Express	2.97%	7.16%	0.40%	84	0.0199
Guangzhou Pharmaceutical	2.62%	4.81%	1.52%	25	0.0081
Guangzhou Shipping International	1.55%	3.84%	0.24%	24	0.0109
Hainan Airlines	1.38%	5.06%	-0.08%	53	0.0159
Hainan Donghai Tourism	9.35%	9.61%	9.09%	2	0.0037
Huadian Energy	2.94%	7.56%	0.52%	87	0.0212
Huadian Power International	2.06%	5.36%	-0.20%	39	0.0142
Huaneng Power International	0.99%	2.89%	-1.17%	64	0.0102
Huangshan Tourism Development	1.50%	2.62%	0.51%	44	0.0064
Huaxin Cement Company Limited	1.35%	2.34%	0.52%	26	0.0048
Hubei Sanonda	1.50%	1.70%	1.31%	6	0.0017
ICBC	0.86%	1.72%	-0.15%	19	0.0042
Inner Mongolia Eerduosi	2.39%	3.43%	1.59%	16	0.0054
Jiangling Motors Corp.	2.32%	4.00%	0.73%	63	0.0074
Jiangsu Expressway	0.62%	1.42%	-0.01%	25	0.0041
Jiangxi Copper	2.76%	7.31%	0.34%	65	0.0163

Company name	arithmetic mean	maxi-mum	mini-mum	monthly obser-vations	standard deviation
Jinan Qingqi Motorcycles	4.57%	8.52%	0.00%	27	0.0296
Jingwei Textile Machinery	3.82%	6.95%	1.63%	32	0.0154
Jinzhou Port	3.48%	7.04%	0.39%	35	0.0254
Konka Group Company Limited	-1.71%	-0.63%	-2.99%	39	0.0054
Livzon Pharmaceuticals Group	2.20%	3.17%	1.04%	44	0.0045
LU Thai Textile Company Limited	1.60%	5.43%	-0.14%	72	0.0107
Maanshan Iron & Steel	4.46%	11.90%	-0.91%	100	0.0360
Petrochina	2.82%	3.61%	2.29%	7	0.0043
Sgsb Group	4.47%	9.45%	1.35%	17	0.0326
Shandong Chenming Paper	2.35%	6.38%	0.14%	62	0.0119
Shandong Xinhua Pharmaceutical	8.68%	15.50%	4.48%	71	0.0328
Shanghai Automation	10.45%	11.55%	9.40%	6	0.0079
Shanghai Baosight Software	2.80%	2.80%	2.80%	1	n.a.
Shanghai Chlor-Alkali Chemical	6.60%	13.05%	1.45%	38	0.0442
Shanghai Dajiang Group Stock	9.98%	10.76%	9.38%	9	0.0045
Shanghai Diesel Engine	2.88%	3.32%	2.46%	3	0.0043
Shanghai Dingli Technology	4.28%	10.05%	0.91%	16	0.0398
Shanghai Erfangji	7.54%	9.04%	5.76%	9	0.0117
Shanghai Friendship Group Inc	1.50%	3.11%	0.51%	28	0.0055
Shanghai Haixin Group	6.16%	6.90%	5.02%	5	0.0069
Shanghai Highly	3.65%	9.87%	1.13%	25	0.0189
Shanghai Jin Jiang International	6.98%	13.95%	1.24%	26	0.0478
Shanghai Jinqiao Export Processing	4.23%	9.08%	1.19%	43	0.0293
Shanghai Kaikai Industry	2.07%	4.02%	1.51%	12	0.0064
Shanghai Lujiazui Finance	1.98%	3.51%	0.78%	40	0.0083
Shanghai Mechanical & Electrical	2.12%	3.13%	1.00%	20	0.0062
Shanghai Nine Dragon	0.84%	1.34%	0.42%	13	0.0029
Shanghai Potevio	4.99%	8.42%	1.68%	24	0.0237
Shanghai Sanmao Enterprise (Group)	8.50%	9.01%	8.09%	5	0.0034
Shanghai Wai Gaoqiao	5.87%	8.31%	2.08%	20	0.0173
Shanghai Worldbest	5.68%	10.05%	0.69%	38	0.0295
Shanghai Yaohua Pilkington	1.88%	2.93%	0.62%	30	0.0063
Shanghai Zhenhua Port Machinery	2.89%	5.54%	0.15%	64	0.0175
Shenji Group Kunming Machinel	2.16%	4.62%	-0.37%	16	0.0132
Shenzhen Accord Pharmaceutical	3.34%	8.94%	1.34%	33	0.0242
Shenzhen China Bicycle	2.37%	3.78%	1.01%	9	0.0119
Shenzhen Chiwan Warf	0.77%	2.77%	-0.77%	63	0.0083
Shenzhen Expressway	3.21%	7.87%	-0.18%	77	0.0241
Shenzhen Fiyta Holdings Limited	2.60%	2.60%	2.60%	1	n.a.
Shenzhen International Enterprises	7.84%	8.16%	7.55%	3	0.0031
Shenzhen Nanshan Power	1.71%	2.34%	0.96%	5	0.0055
Shijiazhuang Baoshi	0.72%	0.82%	0.65%	3	0.0009
Sinopec Shanghai Petrochemical	4.27%	9.92%	0.37%	117	0.0212
Sinopec Yizheng Chemical Fibre	5.00%	9.79%	1.57%	114	0.0185
SVA Electron	-4.68%	-2.91%	-6.92%	50	0.0131
Tianjin Capital Environmental	4.85%	11.67%	1.20%	103	0.0232
Tianjin Marine Shipping	8.44%	9.21%	7.62%	3	0.0080
Weifu High Technology	2.29%	6.54%	-0.75%	109	0.0176
Yanzhou Coal Mining	3.31%	9.58%	-0.43%	115	0.0251
ZTE	1.97%	3.70%	1.07%	42	0.0065

Company name	arithmetic mean	maxi-mum	mini-mum	monthly obser-vations	standard deviation

Results show the difference between foreign and domestic implicit discount rate derived from a modification of the model based on GEBHARDT/LEE/SWAMINATHAN (2001). Sample contains monthly observations between June 1998 and May 2008. Differences are computed on an individual company basis. Differences are obtained as follows, where r is the implicit risk-free rate derived from domestic market prices (subscript d) and foreign market prices (subscript f), p as the corresponding share price, bps as book-value of equity per share, froe the return on equity used to compute abnormal returns on equity ($froe_t$-r) and t the specific date:

$$r^{\Delta} = r^{r} - r^{d}, \quad \textit{where} \quad p = bps_0 + \frac{froe_1 - r}{1+r} \cdot bps_0 + \ldots + \frac{froe_{12} - r}{(1+r)^{12}} \cdot bps_{11}$$

Appendix: 19 Descriptive statistics for implicit discount rate differential (OJM)

Company name	arithmetic mean	maxi-mum	mini-mum	monthly obser-vations	standard deviation
Air China	1.09%	1.71%	0.60%	6	0.0048
Anhui Expressway	1.81%	1.95%	1.64%	4	0.0013
Bengang Steel Plates	5.22%	6.79%	4.49%	4	0.0106
China Eastern Airlines	2.00%	4.18%	0.97%	7	0.0114
China International Marine	-0.93%	1.02%	-2.75%	19	0.0107
China Life Insurance	0.01%	0.01%	0.01%	1	n/a
China Merchants Bank	-0.14%	-0.09%	-0.21%	3	0.0006
China Railway Group	0.01%	0.01%	0.01%	1	n/a
China Shenhua Energy Company	0.11%	0.14%	0.07%	3	0.0004
China Shipping Development	1.54%	3.48%	-0.40%	7	0.0152
China Southern Airlines	2.60%	6.80%	0.13%	27	0.0175
China Vanke Company	-1.20%	0.91%	-3.01%	51	0.0095
Chongqing Changan Automobile	3.07%	7.07%	0.60%	24	0.0162
Datang International Power	1.92%	4.27%	0.68%	9	0.0133
Dongfang Electric	0.48%	0.48%	0.48%	1	n/a
Foshan Electrical & Lighting	4.52%	4.52%	4.52%	1	n/a
Guangdong Electric Power	2.76%	5.27%	1.51%	7	0.0131
Guangdong Provincial Express	7.97%	8.84%	6.50%	5	0.0089
Guangzhou Pharmaceutical	1.97%	2.81%	1.00%	3	0.0091
Huadian Energy	2.31%	4.47%	0.94%	3	0.0190
Huadian Power International	2.09%	6.56%	-0.23%	34	0.0177
Huaneng Power International	1.10%	4.02%	0.00%	22	0.0102
Huangshan Tourism Development	0.48%	0.77%	0.15%	8	0.0025
Huaxin Cement Company Limited	0.16%	0.16%	0.16%	1	n/a
Inner Mongolia Eerduosi	2.11%	4.73%	1.14%	4	0.0175
Jiangling Motors Corp.	1.25%	2.69%	0.21%	6	0.0089
Jiangsu Expressway	0.59%	0.87%	0.08%	8	0.0025
Jiangxi Copper	1.78%	2.95%	0.84%	3	0.0108
Jingwei Textile Machinery	3.57%	4.96%	2.22%	5	0.0101
LU Thai Textile Company Limited	3.21%	3.21%	3.21%	1	n/a
Maanshan Iron & Steel	1.48%	4.53%	-1.59%	29	0.0157
Shandong Chenming Paper	3.32%	6.26%	0.52%	21	0.0151
Shandong Xinhua Pharmaceutical	10.77%	13.69%	8.63%	5	0.0215
Shanghai Highly	0.77%	1.26%	0.49%	3	0.0042
Shanghai Jinqiao Export Processing	1.31%	1.65%	0.87%	8	0.0030
Shanghai Lujiazui Finance	0.83%	1.92%	0.39%	9	0.0057
Shanghai Potevio	3.79%	5.25%	2.72%	7	0.0090
Shanghai Wai Gaoqiao	1.74%	1.77%	1.71%	2	0.0005
Shanghai Zhenhua Port Machinery	2.12%	6.60%	0.05%	23	0.0217
Shenzhen Chiwan Warf	0.31%	1.60%	-0.32%	19	0.0060
Shenzhen Expressway	2.77%	7.47%	-0.21%	34	0.0237
Sinopec Shanghai Petrochemical	4.19%	7.21%	1.47%	45	0.0150
Sinopec Yizheng Chemical Fibre	5.12%	13.42%	0.86%	73	0.0372
SVA Electron	0.10%	0.10%	0.10%	1	n/a
Tianjin Capital Environmental	4.24%	9.17%	0.15%	38	0.0254
Weifu High Technology	0.77%	2.48%	0.01%	16	0.0092
Yanzhou Coal Mining	2.21%	7.51%	0.04%	57	0.0196
ZTE	1.52%	2.35%	0.61%	10	0.0063

Results show the difference between foreign and domestic implicit discount rate derived from the long-term perpetual growth model based on OHLSON/JUETTNER (2003). Sample contains monthly observations between June 1998 and May 2008. Differences are computed on an individual company basis. Differences are obtained as follows, where r is the implicit risk-free rate derived from domestic market prices (subscript d) and foreign market prices (subscript f), p as the corresponding share price, bps as book-value of equity per share, eps forecasted earnings per share, γ as the long-term growth rate, d as dividend per share and t the specific date:

$$r^{\Delta} = r^{r} - r^{d}, \quad \textit{where} \quad p = \frac{1}{r} \cdot \frac{g_2 - (\gamma - 1)}{r - (\gamma - 1)} \cdot eps_1 \quad \textit{and} \quad g_2 = \frac{(e_2 - e_1)}{e_1 + r(d_1 / e_1)}$$

Appendix: 20 Relationship cumulative implied discount and risk-free rate quotients (bank deposit rate)

Model	α	t-value	γ	t-value	R^2	monthly observations
GM	1.83	6.2860**	0.16	0.8202	0.0148	114
MGM	0.99	1.8893*	0.90	2.1747**	0.1700	116
OJM	0.67	2.3634**	0.55	2.2043**	0.2680	105

Results of univariate OLS regression of cumulative implied discount rate quotients and risk-free rate proxy quotients. Sample contains monthly observations between June 1998 and May 2008. Quotients are obtained as follows, where x_{it} is the implied risk-free rate for company i at time t from domestic market prices (index d) and foreign market prices (index f), N the number of companies, α the intercept, r^f the 1-year US T-bond yield, r^d the 1-year PRC bank deposit rate with γ being its factor loading and u as disturbance term.

$$\frac{x_t^f}{x_t^d} = \alpha + \gamma \frac{r_t^f}{r_t^d} + u_t, \quad where \quad \frac{x_t^f}{x_t^d} = \frac{\frac{x_{1t}^f}{x_{1t}^d} + \frac{x_{2t}^f}{x_{12}^d} + \ldots + \frac{x_{Nt}^f}{x_{Nt}^d}}{N} \quad and \quad H_0 : \gamma = 0$$

The regression is performed using heteroscedasticity and autocorrelation consistent covariances according to NEWEY/WEST (1987). ** and * is statistically significant at 5% and 10% level, respectively.

Appendix: 21 Relationship cumulative implied discount and risk-free rate quotients (T-bond yield)

Model	α	t-value	γ	t-value	R^2	monthly observations
GM	2.03	13.9001**	-0.53	-5.3155**	0.4713	25
MGM	1.76	23.8618**	-0.38	-6.7795**	0.6354	25
OJM	1.33	9.6942**	-0.04	-0.5176	0.0086	25

Specification see Appendix: 20

Appendix: 22 Panel analysis GM

Dependent Variable: yGM
Method: Pooled Least Squares
Date: 11/12/09 Time: 20:37
Sample (adjusted): 2 119
Included observations: 114 after adjustments
Cross-sections included: 65
Total pool (unbalanced) observations: 1542
White cross-section standard errors & covariance (d.f. corrected)
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.804991	0.062138	29.04820	0.0000
DEPOSIT1YTBONDUS	-0.116811	0.051929	-2.249445	0.0246

R-squared	0.484641	Mean dependent var	1.652509
Adjusted R-squared	0.461946	S.D. dependent var	0.922812
S.E. of regression	0.676903	Akaike info criterion	2.099281
Sum squared resid	676.2995	Schwarz criterion	2.327877
Log likelihood	-1552.545	F-statistic	21.35420
Durbin-Watson stat	0.230372	Prob(F-statistic)	0.000000

Dependent Variable: yGM
Method: Pooled Least Squares
Date: 11/22/09 Time: 17:33
Sample (adjusted): 85 115
Included observations: 25 after adjustments
Cross-sections included: 54
Total pool (unbalanced) observations: 590
White cross-section standard errors & covariance (d.f. corrected)
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.181065	0.121175	17.99928	0.0000
US10DIVPRC10Y	-0.648783	0.091287	-7.107064	0.0000

R-squared	0.683597	Mean dependent var	1.394387
Adjusted R-squared	0.651661	S.D. dependent var	0.401432
S.E. of regression	0.236926	Akaike info criterion	0.046448
Sum squared resid	30.03167	Schwarz criterion	0.454764
Log likelihood	41.29792	F-statistic	21.40525
Durbin-Watson stat	0.509930	Prob(F-statistic)	0.000000

Appendix: 23 Panel analysis MGM

Dependent Variable: yMGM
Method: Pooled Least Squares
Date: 11/12/09 Time: 20:34
Sample (adjusted): 1 118
Included observations: 116 after adjustments
Cross-sections included: 99
Total pool (unbalanced) observations: 3337
White cross-section standard errors & covariance (d.f. corrected)
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.414165	0.128563	10.99978	0.0000
DEPOSIT1YTBONDUS	0.387285	0.111213	3.482367	0.0005

R-squared	0.464643	Mean dependent var	1.963889
Adjusted R-squared	0.448270	S.D. dependent var	2.806470
S.E. of regression	2.084604	Akaike info criterion	4.336544
Sum squared resid	14066.63	Schwarz criterion	4.519727
Log likelihood	-7135.524	F-statistic	28.37815
Durbin-Watson stat	0.227258	Prob(F-statistic)	0.000000

Dependent Variable: yMGM
Method: Pooled Least Squares
Date: 11/22/09 Time: 17:38
Sample (adjusted): 5 35
Included observations: 25 after adjustments
Cross-sections included: 73
Total pool (unbalanced) observations: 1136
White cross-section standard errors & covariance (d.f. corrected)
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.701861	0.082191	20.70629	0.0000
US10DIVPRC10Y	-0.337004	0.059934	-5.622919	0.0000

R-squared	0.712881	Mean dependent var	1.270155
Adjusted R-squared	0.693145	S.D. dependent var	0.399614
S.E. of regression	0.221364	Akaike info criterion	-0.115096
Sum squared resid	52.04005	Schwarz criterion	0.212905
Log likelihood	139.3746	F-statistic	36.12083
Durbin-Watson stat	0.483695	Prob(F-statistic)	0.000000

Appendix: 24 Panel analysis OJM

Dependent Variable: yOJM
Method: Pooled Least Squares
Date: 08/23/10 Time: 14:28
Sample (adjusted): 14 119
Included observations: 105 after adjustments
Cross-sections included: 48
Total pool (unbalanced) observations: 677
White cross-section standard errors & covariance (d.f. corrected)
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.286020	0.070567	18.22418	0.0000
DEPOSIT1YTBONDUS	0.083698	0.045824	1.826535	0.0682

R-squared	0.876836	Mean dependent var	1.402426
Adjusted R-squared	0.867422	S.D. dependent var	1.199554
S.E. of regression	0.436773	Akaike info criterion	1.250819
Sum squared resid	119.8040	Schwarz criterion	1.577800
Log likelihood	-374.4022	F-statistic	93.14328
Durbin-Watson stat	0.502637	Prob(F-statistic)	0.000000

Dependent Variable: yOJM
Method: Pooled Least Squares
Date: 08/23/10 Time: 14:23
Sample (adjusted): 85 115
Included observations: 25 after adjustments
Cross-sections included: 32
Total pool (unbalanced) observations: 252
White cross-section standard errors & covariance (d.f. corrected)
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.832725	0.088057	20.81293	0.0000
US10DIVPRC10Y	-0.461740	0.066700	-6.922598	0.0000

R-squared	0.871996	Mean dependent var	1.254837
Adjusted R-squared	0.853292	S.D. dependent var	0.550347
S.E. of regression	0.210797	Akaike info criterion	-0.154296
Sum squared resid	9.731337	Schwarz criterion	0.307891
Log likelihood	52.44130	F-statistic	46.62117
Durbin-Watson stat	1.015540	Prob(F-statistic)	0.000000

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