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Credit as an Instrument for Growth: A Monetary Explanation of the Chinese Growth Story

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Thomas Haas and Fabian Mayer

University of Würzburg

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1 Introduction

In the last four decades China has been able to achieve economic growth rates in aggregate and on a per capita basis that are unprecedented in history (see figure 1). How can one explain this economic miracle? There are countless books and academic publications that have tried to find answers to this question. We have composed this study because we are of the opinion that the widely prevailing explanatory approaches are incomplete in one essential point: They neglect or underestimate the role of the financial system, specifically the banking system, as a growth engine in its own right.

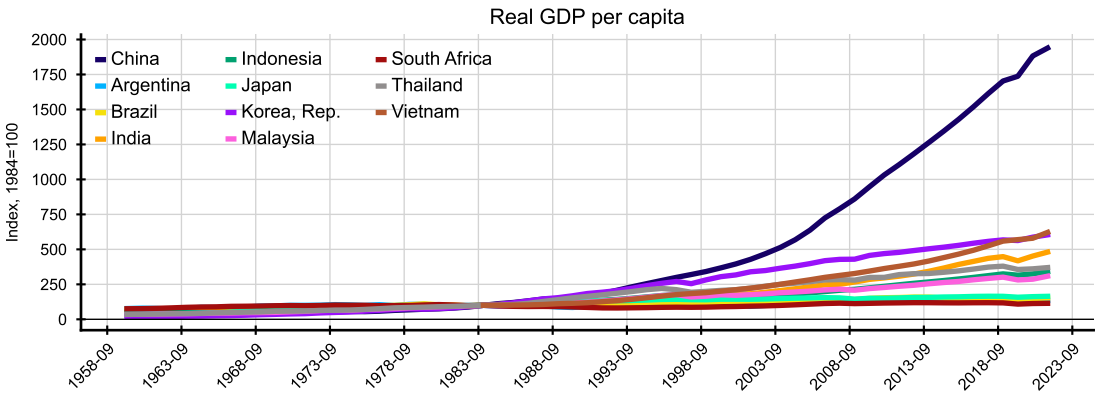


Figure 1: Real GDP per capita, Index: 1984=100 (Source: Worldbank).

It was Joseph Schumpeter who in his book *"The Theory of Economic Development"* (Schumpeter, 1934b) described this function very early and very clearly: Banks as *"producers of purchasing power"* enable investors to attract existing resources in order to establish new products and new technologies that increase a country's productivity and prosperity.

With its banking system, which is very large compared to other emerging markets and still growing to the last, China like no other country has used debt as an instrument to create growth. Its unique macroeconomic performance, characterized by more than four decades of high economic growth, and the ability to develop national champions while maintaining a macroeconomic balance, are proof that such a growth model can be successful, at least for large economies.

1.1 Dominance of the *"real analysis"* in narratives of the Chinese growth story

Given the unmissable role of the Chinese banking system, it is all the more surprising that its importance is only mentioned in passing in most academic studies. One important explanation for this omission is that the standard theoretical growth models portray a world without money.

Schumpeter speaks here of a "real analysis", i.e. a modelling that assumes that all relevant economic processes can be represented with an intertemporal exchange economy reduced to an all-purpose good.

Influenced by such theories, the importance of the financial system is often neglected in the analysis of concrete growth stories. For instance, in their widely acclaimed book on the *"Origins of power, prosperity and poverty"*, Robinson and Acemoglu (2012) only devote three pages to mention the role of banks in the growth process.

It is therefore not surprising that the blind spot regarding the role of the banking system in growth also characterises most studies on the Chinese growth model. This is true, for example, for the otherwise highly informative book by Naughton (2021) on industrial policy, which spends little more than one page on state-owned banks and who fails to see the outstanding importance of the Chinese banking system when he states: *"As in any economy, the banking system plays a fundamental role"* (Naughton, 2021, p. 122).

Even books like the one by Lee (2021), which deal explicitly with the significance of Schumpeterian theories for the Chinese growth model only focus on the importance of innovation and especially of technological leaps (*"leapfrogging"*) for the growth process. However, the monetary dimension of Schumpeter's growth theory remains unconsidered.

If one looks at collected works such as Garnaut, Song, and Fang (2018), comprehensive monographs such as Fang (2022) or studies published in high-quality journals such as Zhu (2012) or Yueh (2013), one always finds that the financial system does not feature in them at all.

Of course, there are a few exceptions like Nitsch and Diebel (2007), Herr (2010) and Burlamaqui (2015) who emphasise the importance of credit creation by banks for the growth process and explicitly refer to Schumpeter. But their contributions did not receive enough attention in the academic discussion.

There are also several econometric studies which analyze the finance and growth nexus in China. However, as we will show, most of them are based on the paradigm of the real analysis so that they fail to attribute a dominant role to the financial system within the growth process.

1.2 Monetary analysis contributes to a better understanding of the Chinese growth process

Our analysis tries to fill this huge analytical gap in the Chinese growth narrative. We want to show that a comprehensive Schumpeterian approach leads to a better understanding of important phenomena in the Chinese growth process:

- Focusing on banks as a central institution in the process of the allocation of resources helps to understand the *"**dual**"* or *"**hybrid**"* **nature** of the Chinese economic system that is often mentioned without clarifying its specific content. With a banking system under control of the state, the *"banker"* plays the dominant role that it is attributed by Schumpeter. Although he/she is involved in the political fabric, he/she has a degree of discretion that allows him/her to influence the allocation process by providing *"purchasing power"* to targeted industries. What matters is that this influence is less direct than in a centrally planned system where the government prescribes the firms which specific inputs to use and which specific outputs to produce. This point has been made very clear by Schumpeter (1939). In other words, the allocation via the banking system leaves firms more scope for decision-making than a centrally planned system. In China, the provision of funds at the provincial level provided additional elements of decentralization.

- In the narratives of Chinese growth, the **high investment and saving rates** play an important role. But they leave it open how China in the 1980s and 1990s, when it was still a very poor country, had been able to mobilize a sufficient amount of saving from its population to finance a huge investment process. From a Schumpeterian perspective the causation is different. The provision of bank loans to firms enabled them to invest and to generate incomes out of which private households were able to save. In other words, the Schumpeterian approach removes the saving constraint that characterizes standard growth models. In recent years this view has gained more prominence by the so-called Modern Monetary Theory which emphasizes that large countries do not face a financing constraint, not implying that there is no real constraint.

- Narratives of the Chinese model pay astonishingly little attention to the **macroeconomic dimensions of growth**. How had it been possible that China was able to achieve much higher growth rates than other developing and emerging market economies without running into macroeconomic disequilibria like high inflation or even hyperinflation. Agarwal (2023) speaks of the *"**growth strategy dilemma**"* which is shaped by a trade-off between high growth and macroeconomic stability. How was it possible that China could avoid currency crises and, at least so far, a Great Financial Crisis? Again, Schumpeter offers important insights. He was aware of the tensions that are associated with the provision of additional purchasing power to investors: *"the new 'order to the factors' comes, as it were, on top of the old one, which is*

not thereby canceled" (Schumpeter, 1939, p. 110). But while standard textbooks assume, based on the Quantity Theory of Money, that the creation of money and credit keeps the supply side of the economy unchanged, Schumpeter realized that credit-financed investments with a higher productivity than the existing use of resources stock can increase the supply side of the economy so that an initial inflationary effect of credit creation can dissipate over time. We show that debt as an instrument for growth becomes particularly powerful if it is used in the framework of a **well-designed industrial policy**.

- Another neglected phenomenon of the Chinese macroeconomic policy are the very high **fiscal deficits**, mainly of the provincial governments. While the official government deficits have been relatively low, the so-called augmented deficits which include *"local government financial vehicles"* (LGFV) and which are calculated by the IMF in its yearly Article IV reports show double-digit deficits for many years now. As the local governments used these funds mainly for investment in infrastructure providing attractive conditions for new firms, the negative effects that many economists attribute to high deficits did not materialize. Thus, China provides a role model for a deficit-financed fiscal policy that goes beyond the narrow perspective of the **neoclassical theory**, where government debt can only be explained as an instrument for reducing excessive investment and saving, and the **Keynesian theory** as well as **Modern Monetary Theory** where fiscal deficits are only regarded as an instrument for reaching full-employment.

- In the last few years, the picture of the Chinese growth model looks less promising. While debt ratios continue to rise, economic growth rates decline, and the real estate market shows **mounting disequilibria**. This is not a contradiction to the Schumpeterian approach, as Schumpeter was fully aware of the risk that credits can flow into unproductive channels:

  > *"[...] the processes of the secondary wave, in fact, supply us with plenty of instances of unproductive loans. [...] In these cases there is no increase in productivity at all, and it is this fact and this fact alone which is. responsible for a fall in prices sometimes spelling disaster, even without speculation in the narrower sense of the word, which however never fails to add to the structure of debt."* (Schumpeter, 1939, p. 152ff)

- Finally, the importance of such a monetary narrative of the Chinese growth model has implications that go beyond this specific context. It puts into question the widely accepted theorem of the **neutrality of money**. It argues that money (or credit) can only have temporary effects on growth. In the long-run only real factors matter. This is exactly what Schumpeter had in mind when he speaks of *"real analysis"*:

  > *"But so long as it [money] functions normally, it does not affect the economic process, which behaves in the same way as it would in a barter economy: this is essentially what the*

concept of Neutral Money implies." (Schumpeter, 1954, p. 264)

- Our explanation of the Chinese experience provides a comprehensive evidence of what Schumpeter calls *"monetary analysis"*:

  > *"Monetary Analysis, in the first place, spells denial of the proposition that, with the exception of what may be called monetary disorders, the element of money is of secondary importance in the explanation of the economic process of reality. [...] Money prices, money incomes, and saving and investment decisions bearing upon these money incomes, no longer appear as expressions—sometimes convenient, sometimes misleading, but always nonessential—of quantities of commodities and services and of exchange ratios between them: they acquire a life and an importance of their own, and it has to be recognized that essential features of the capitalist process may depend upon the 'veil' and that the 'face behind it' is incomplete without it."* (Schumpeter, 1954, p. 265)

In contrast to many other growth narratives, our study also provides comprehensive empirical analyses to support our Schumpeterian approach, above all with respect to effects of credit growth on economic growth and also with respect to effects of industrial policy on growth.

1.3 Outline of the study

Our study is organized as follows: In **section 2**, we describe the **stylized features of the Chinese success story**. It is characterized by an unparalleled growth dynamic, which by far outperforms the growth processes in other developing and emerging market countries. Important elements of this process are very high levels of investment and saving and strong export growth which made China the world's largest exporter of goods and services. Looking at the role of the financial system, one can see that since decades the ratio of bank credit to the non-financial private sector has significantly exceeded the values in other emerging countries which underlines the need to discuss the contribution of the banking system to growth systematically.

Astonishingly, despite the high growth rates of GDP and credit, China has been able to avoid major macroeconomic disequilibria which destabilized the growth processes in many other developing and emerging market economies. After two inflationary episodes in 1988/89 and 1993/95 inflation rates have remained well under control. In addition, the country never encountered current account deficits and currency crises which haunted many developing countries in their development process.

Instead, China was able to generate very high surpluses in the 2000s which at that time were regarded as disequilibrating factors for the global economy: *"excess savings"* causing a *"savings*

glut" (Bernanke, 2005). With the country's stellar performance, one should not overlook that its economic success is overshadowed by high income inequality and the fact that China has become by far the largest emitter of CO_2. As our study is purely economical it also does not address the severe political problems that are associated with China's development process.

In **section 3**, we present the main explanations for the Chinese economic miracle that can be found in the literature. Following Schumpeter we differentiate between *"real"* and *"monetary"* explanations. Real explanations focus on China's institutions, the system of coordination between the private and public sectors, a particular economic philosophy (the *"Beijing Consensus"*), the special use of labour and productivity growth, leapfrogging, the special role of state-owned enterprises and savings. Most of these explanations are of a qualitative nature and key concepts like *"Beijing consensus"* or *"gradualism"* are relatively vaguely defined. Compared with the many real explanations, there are relatively few papers that emphasize the importance of **monetary factors** and discuss them systematically.

In **section 4**, we present the Schumpeterian growth model and contrast it with the textbook models of the neoclassical growth theory while focusing on the role of banks within these models. Schumpeter (1954) makes the fundamental distinction between a ***"real analysis""*** and a ***"monetary analysis"***. The *"real analysis"* represents the economy with a model with only an all-purpose good. It serves interchangeably as consumption good, investment good (*"capital"*) and financial asset (*"funds"* or *"financial capital"*). Therefore, in neoclassical models, household saving is the only source of investment funds. As banks are unable to produce the all-purpose good, they are only intermediaries between savers and investors and cannot serve as an autonomous engine for growth. This is different in Schumpeter's monetary analysis, where the saving constraint on investment is removed: funds for investors are no longer an all-purpose good provided by savers, but bank deposits created by banks. Thus, the banker, as a producer of purchasing power, is placed at the center of economic events. His ability to differentiate between productive and unproductive investments is decisive for the success of the development process.

There are many empirical papers that have analyzed the **finance and growth nexus** referring to Schumpeter's theory. But at a closer look one can see that they present him as a representative of the *"real analysis"* although he explicitly rejected that paradigm. We show that this misinterpretation explains serious flaws of this literature: It has so far not been able to find convincing evidence for the effects of the financial system on growth in advanced economies. Additionally, it has also not been not able to deal with the negative effects of finance on growth and with such a fundamental concept as liquidity creation.

Thus, in **our empirical analysis** for the finance and growth nexus at the global level we take Schumpeter literally and estimate the effects of the financial system on GDP growth not by using a static variable as the level of credit to GDP, but by a **dynamic variable**, i.e. the change in the volume of credit. We present econometric evidence for this relationship using the BIS data base which includes 43 developed and developing countries. We can show that bank credit growth has a highly significant effect on GDP growth which is not the case for static measures of bank credit. Thus, our analysis supports the *"monetary analysis"* propagated by Schumpeter. It shows at the same time that static measures, which are used in most studies of the finance and growth nexus, cannot explain GDP growth. We also perform Granger causality tests that show a significant relationship between credit growth and GDP growth. In China the effect is especially pronounced with a mutual causation of credit growth and GDP growth.

In **section 5**, we analyse the **effects of the financial system on growth in China** asking the question whether it has been a brake or an engine for growth. In the literature one mainly finds the view that the financial system is inefficient, and that economic growth was possible in spite of such problems (Berger, Hasan, & Zhou, 2009). We start with a survey of the Chinese banking system, which at first sight shows the extreme size of the Chinese banking system, above all in relation to other developing and emerging market economies. A specific feature of the Chinese banking system is the dominance of state-owned banks which has persisted until today. Since the 2010s the role of capital market financing has increased. The main issuers are public entities, above all local governments while the main investors are commercial banks.

For a Schumpeterian explanation of the growth process, it is important, on the one hand, to describe the **specific form of allocation** that results from the creation of purchasing power and, on the other hand, to clarify what is meant by *"**the banker**"* in the Chinese case and what role he/she plays. We show that the allocation of resources via state-owned banks provides an improvement to the allocation in a centrally planned economy as it leaves enterprises the discretion what outputs to produce and what inputs to use. In China, the banker is a hybrid being, as it is appointed by the party organization, and has a political rank similar to government officials. At the same time, the banker has considerable discretion over loans for working capital and his remuneration depends to some degree on the quality of his lending. In addition, since the 2000s bank managers are individually responsible for non-performing loans if they do not follow loan assessment procedures. The improvement of the allocation process via banks instead of the central plan is supported by empirical studies.

Studies on the role of banks for economic growth come to mixed results. A starting point is the international experience with government-owned banks. While La Porta, Lopez-de Silanes, and

Shleifer (2002) conclude that there is a negative relationship, Andrianova, Demetriades, and Shortland (2010) show that government ownership has positive growth effects. Berger et al. (2009) find that the *"Big Four"* banks are by far the least profit efficient. But as Laurenceson and Chai (2001) argue, one can ask whether profitability is the right benchmark for banks following a development strategy. The picture is also not clear for studies on the general finance and growth nexus in China.

In order to put the analysis of the finance and growth nexus on a comprehensive empirical basis we have developed a new data set that we have constructed from official Chinese Provincial Yearbooks for 31 Chinese provinces between 1985 and 2020. Our data set has the specific advantage that it spans a very long time period and that it can differentiate between total credit and credit to the corporate sector. We can show that credit to the non-financial corporate sector has a significantly positive relationship with GDP growth. This is not the case for total credit growth which we attribute to a higher share of unproductively used credit. Also when considering provincial differences in the three main Chinese regions we find a positive relationship between credit growth and GDP growth which supports our Schumpeterian narrative.

We then estimate the impact of the size of the financial system on GDP growth by looking at the correlations between credit growth and GDP growth, differentiating between deciles in the total credit to GDP ratio. Also from a simple correlation plot with fitted values for the said deciles, one can see that for the 1st decile the slope is relatively stable while it is close to zero for the 10th decile. This could be due to the *"secondary wave"* (Schumpeter, 1939) where credit is provided for unproductive investments, above all real estate.

Section 6 focuses on industrial policy. We start with a general survey of the literature on industrial and innovation policy and the empirical evidence on the effectiveness of industrial policy. In general, the evidence for demand- and supply-side instruments is positive. This also applies to targeted industrial policy instruments. We then describe the development of industrial policy in China. With the strong role of state-owned enterprises and banks and the definition of sometimes very specific sectoral growth targets in the five-year plans and other official documents (Jigang, 2017) the state has always played a central role in shaping the structure of the economy. Naughton (2021) uses a narrow definition of industrial policy and therefore defines the year 2010 as its starting point. In his view *"leapfrogging"* is a key feature of industrial policy. We discuss in detail industrial policies in the field of the automotive industry and renewable energies. While China has been able to become a global champion in both areas, the literature points at inefficiencies of industrial policy in the field of renewable energies.

While industrial policy relies on many instruments, banks have played an important role in its

financing, either by direct loans to companies or as main sponsors of government sponsored investment funds (Naughton, 2021). With the database that we have constructed we are able to analyse the role of bank lending in the context of industrial policy empirically. In order to identify the effect of *"industrial policy"* we have followed the definition of Naughton (2021) according to which the year 2010 is the starting date of a narrowly defined industrial policy. Our econometric study shows that while GDP growth rates were significantly higher before 2010, the GDP growth effect of the growth of credit to the non-financial corporate sector was significantly higher after 2010. However, a closer look at credit to private industries and state-owned industries points to a less clear relationship. We attribute the difference to the previous results to the lack of joint ventures in our firm level data base. Joint ventures have however played an important role in the automotive industry and the semiconductor industry. This view is supported when we look at the isolated effects of credit in the targeted industries.

For the automotive industry we find a highly significant effect of credit provision on investment growth which is stronger than for the total industry sector. There is also a positive correlation of automobile investment of total real GDP growth. For the energy sector the effects are different. There are no significant effects of credit growth on investment and the effect of investment on GDP are negative in the energy sector. We mainly attribute this to inefficiencies in the renewable energies sector.

In **section** 7 we discuss the macroeconomic dimensions of the growth process which are often disregarded in the narratives of China's growth process. The key question is how China had been able to overcome the so-called ***"growth strategy trilemma"*** (Agarwal, 2023) with its three different objectives: establishing national champions through industrial policy, economic growth, and financial and fiscal stability. To answer this question, one must first look at the **role of fiscal policy** in China. Despite the high deficits in public finances, this aspect is left out of most analyses on the Chinese growth model. From a theoretical perspective, the problem is that there is no role model for this in the literature. The Keynesian literature, which is based on *"monetary analysis"*, focuses on macroeconomic stabilisation and in particular on ensuring full employment. This is also the main objective of Modern Monetary Theory. The neoclassical growth theory, based on *"real analysis"*, is indeed designed for the situation of full employment. However, it is not able to justify the function of the state as an investor. Thus, a theory of government debt is needed for full employment within the framework of monetary analysis. This can be called a Schumpeterian theory. Mariana Mazzucato (2013) speaks of the *"entrepreneurial state"*. In terms of macroeconomic functional mechanisms, such a fiscal policy is not fundamentally different from the financing of growth by predominantly state-owned banks.

The crucial question then is why growth driven so strongly by debt has not led to inflation. The key here is, again, the Schumpeterian growth theory, which emphasises the positive supply effects of credit-financed investment. The decisive factor is that the different use of available resources has productivity-increasing effects. Empirical studies show that in China it has continuously been possible to transfer workers from less productive jobs to more productive ones. We also present a simple macroeconomic model that can be used to schematically depict these processes.

In **section** 8 we discuss the lessons that can be drawn from the Chinese experience for other countries and also for economic theory. Above all, the Chinese performance demonstrates that a *"market driven and government guided"* strategy (Naughton, 2021) can be successful. As mentioned, the literature does not come to a clear assessment of the effectiveness of China's industrial policy. This also applies to our analysis which shows overall positive effects, but not for the energy sector. As a simple benchmark for the success of China's industrial policy one can ask whether it has succeeded in achieving its goals. From the many government statements, the main objective can be interpreted as the country's desire to achieve a strong position in the world economy, especially in innovative technologies. A relatively objective criterion for this is the Critical Technology Tracker developed by the Australian Strategic Policy Institute (ASPI) (see figure 40 in the Appendix). According to this, China has overachieved its goal, as it is considered to be a leader in 37 out of 44 cutting-edge technologies. In the remaining seven technologies, the US is the leader.

Another indication for the success of China's industrial policy is the fact that this strategy is now being copied by other major economies. This is especially true for the United States, which has implemented a broad and systematic industrial policy concept with the *"CHIPs and Science Act"* and the *"Inflation Reduction Act"*. The European Commission has also launched an active industrial policy through the *"Important Projects of Common European Interests"* and the *"Chips for Europe"* initiative. However, the funds made available for this are relatively limited.

The greatest resistance to industrial policy activities comes from German economists, who are still strongly attached to a market-liberal way of thinking. But on closer inspection, their criticism of a *"subsidy race"* that allegedly harms the prosperity of nations is not very convincing. Given the enormous challenges that climate change poses to the world, what is to be said against all major economies investing massive financial and real resources to find appropriate technological solutions? It would be desirable for this to take place in a cooperative manner. But it is better if such efforts exist at all and if the results can then be applied globally.

With the very high *"costs"* of an ambitious industrial policy, one must take into account that there are no real financial restrictions for large states and economic areas. However, the *"other use"* must

take into account the real resource constraint. This can, however, be overcome as Schumpeter shows theoretically, and as China shows in practial policy.

Finally, the Chinese success story also has implications for economic theory. It underlines the importance of the monetary analysis called for by Schumpeter and offers impressive empirical confirmation of this. For macroeconomic theory, China's success challenges the fundamental concept of the *"neutrality of money"* as recognised by Schumpeter more than a hundred years ago.

2 The Chinese success story

Historically, China has went through an unique evolution. From being a cultural and economic superpower from the 1st until the 19th century, to being among the poorest economies in the middle of the 20th century, China has experienced a remarkable economic development over the last 50 years. Today, it has become the second largest economy in the world, after the United States. To illustrate the extraordinary economic growth of China's economy it is helpful to compare it to countries with a similar economic starting point, such as Brazil, South Africa and India (see figure 2 (left)). While India and China show a rather similar development path until the end of the 1970s, China has now reached a similar GDP per capita value as Brazil and South Africa, even though China has a population about 6.5 times the Brazilian population and 24 times the South African population (as of 2019, World Bank data). At the same time, India's economy generates about half of the Chinese GDP per capita in 2019.

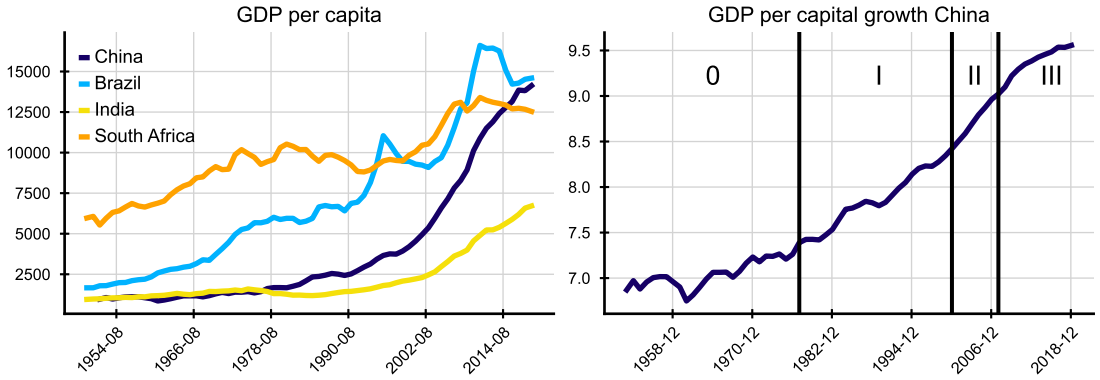


Figure 2: left: GDP per capita in international-$ at 2017 prices; right: Logarithm of GDP per capita in international-$ at 2017 prices, numbers indicate growth phases (Source: Penn World Table).

In the literature, the development of the Chinese economy is commonly split into four phases (phase 0 to III, see figure 2 (right)). After the Second World War and the establishment of the People's Republic of China (PRC), China was still a low-income agrarian economy (phase 0). At the time the first 5-Year plan was established in 1953, more than 80 percent of the labor force

worked in agriculture (Lin, 2013, p. 261). The attempt to catch up with more developed western economies led to the initiation of the 'Great Leap Forward', an initiative aiming at industrializing the economy, which however resulted in the 'Great Chinese Famine', due to a labor shortage in the agricultural sector. This huge failure finally led to a political upheaval that marks the beginning of an opening up process in the 1970s (phase I). According to Banga, Fortunato, Gottschalk, Hawkins, and Wang (2022) China then went through a period of successful industrialization and gradual integration into the global economy from 1978 to 2001. Following China's accession to the WTO in 2001, there were first policy shifts from a supply side approach towards a demand side approach and a growing emphasis on sustainable development (phase II, 2002-2008). Finally, after the Great Financial crisis in 2008, China increased investment in infrastructure at home and abroad and started to focus on more self-reliant innovation (phase III).

Coming back to China's salient economic development in comparison to Brazil, South Africa, and India, it is showing that China, even when having a similar development status as India in the early 1980s, exhibited particularly high investment to GDP rates of about 35 to 40 percent of GDP, compared to about 20 percent for both Brazil, India and South Africa (figure 3, left). The same applies for its strong saving rates, that also stood at around 30 percent in China and slightly below 20 percent for Brazil, South Africa and India in the beginning of the 1980s (see figure 3, right). Figure 3 also shows the significant increase in both investment and saving rates from 2001, when China entered the WTO. This observation coincides with a strong increase in Chinese home ownership ratios from around 20 percent to about 90 percent (L. Zhang et al., 2018), suggesting that high investment led to an increase in tangible asset formation. This resulted in higher net worth and thus the increase in the saving rate.

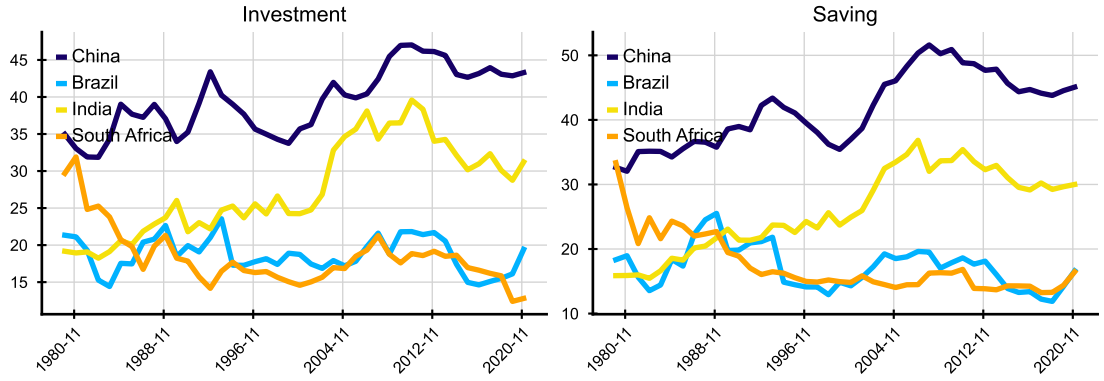


Figure 3: left: Ratio of total investment to GDP; right: Gross national saving to GDP (Source: World Economic Outlook Database, April 2023).

Another explanation for high saving is the persistent current account surplus of the Chinese economy, accompanying its strong GDP growth rates (see figure 4, left). In the same time period,

Brazil as well as India and South Africa tended to have a slightly negative current account balance. Figure 5 and 6 show the predominant role of China in the world economy that it has acquired over the last decades. As of 2022 it is by far the biggest exporter of goods worldwide and the second largest importer of goods after the United States. India ranks 16th in terms of exports of goods and 8th for imports. Brazil ranks 25th for exports and 25th for imports, and South Africa takes the 38th (exports) and 37th (imports) rank. It is remarkable that China shows similar, strong growth rates in exports and imports as Brazil, South Africa and India, that are still in an earlier development status (see figure 4, right).

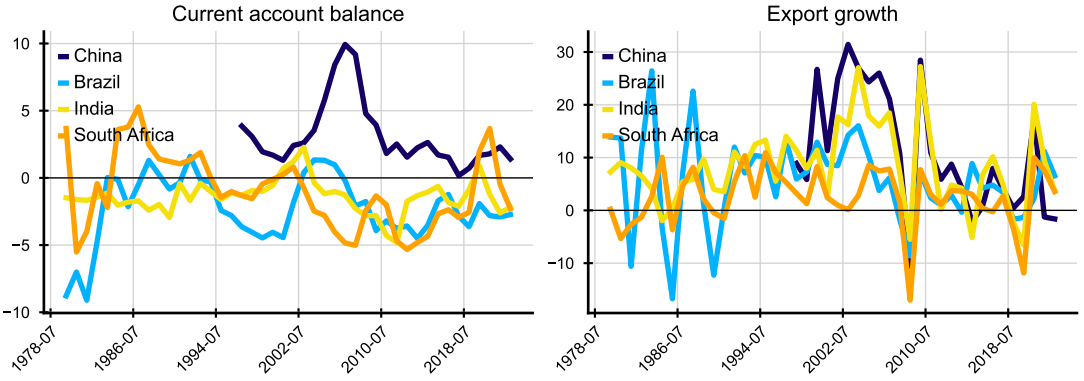


Figure 4: left: Current account balance to GDP; right: Growth of volume of exports of goods and services (Source: World Economic Outlook Database, April 2023).

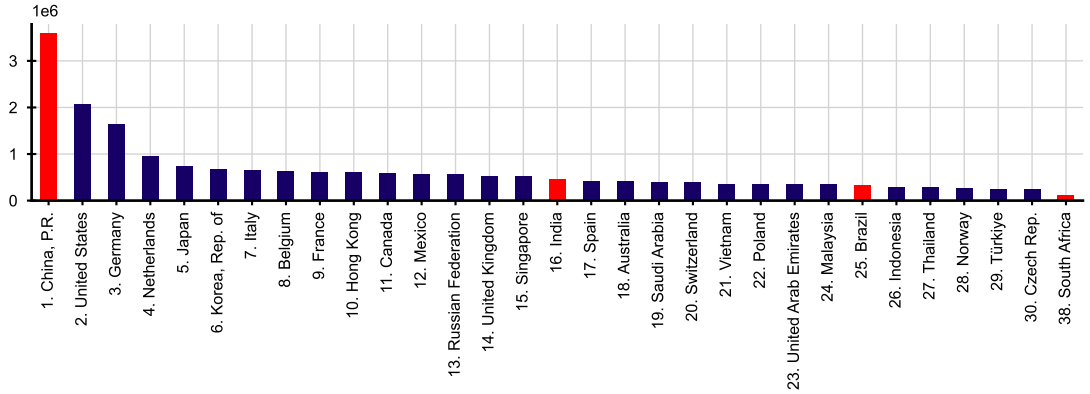


Figure 5: Value of exported goods by country, in Millions, 2022 (Source: IMF, Direction of Trade Statistics)

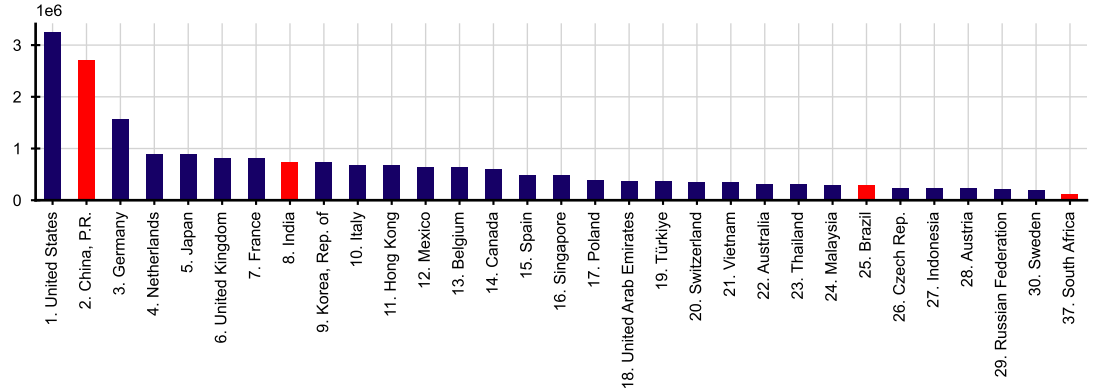


Figure 6: Value of imported goods by country, in Millions, 2022 (Source: IMF, Direction of Trade Statistics)

There are numerous attempts to explain the success of China's outstanding economic development. We will present some of the most prevalent theories in chapter 3. One feature that is particularly apparent, even though not discussed that prominently in the literature until today, is the strong role of the banking system for the evolution of China's economy. Figure 7 shows that the ratio of bank loans to GDP in China is not only significantly higher than that of the other three countries, but also indicates that its growth is more dynamic, especially in most recent times.

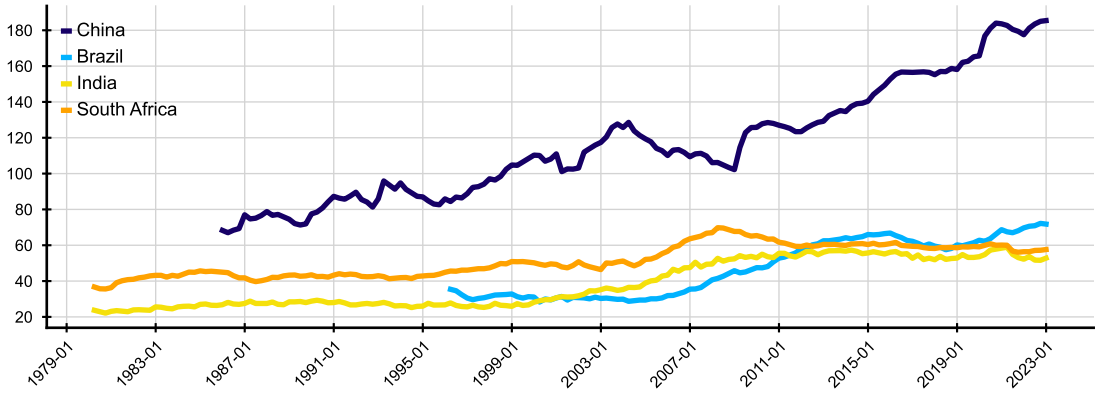


Figure 7: Bank credit to the non-financial private sector (Source: BIS)

Despite the strong surge in credit and persistently high growth dynamic of China's economy over the last decades, the country has managed to keep its inflation rate widely under control. There were two brief periods of temporary elevated inflation rates in 1988/1989 and 1994, however, price development came back to more moderate levels at the end of the 1990s. While India and South Africa also didn't experience periods of extraordinary high inflation rates, however, showing persistently higher rates than China, Brazil is obviously facing major inflation problems (see figure 8). A similar development can also be observed for the exchange rate, that China has been able to

keep under control. Brazil, South Africa and India, on the other hand, faced strong depreciation vis-à-vis the US Dollar (see figure 9).

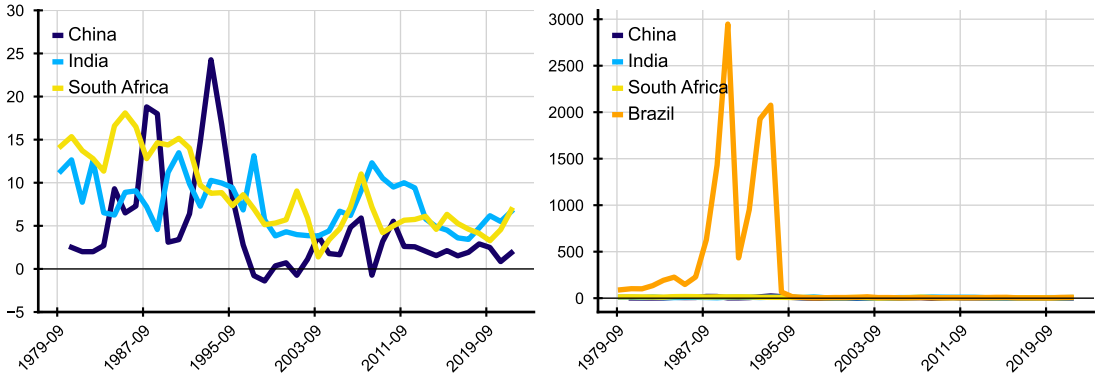


Figure 8: Inflation, average percentage change of consumer prices (Source: World Economic Outlook Database, April 2023)

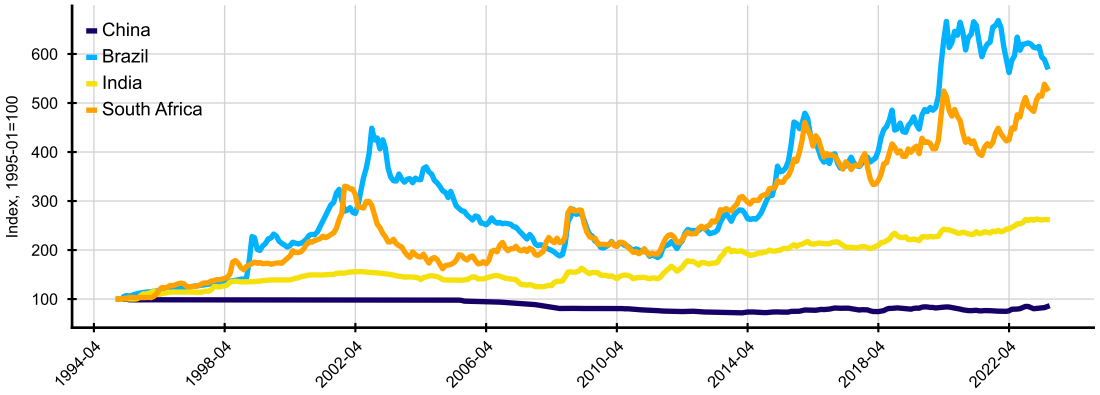


Figure 9: Brazilian Reals, Indian Rupees, Chinese Yuan Renminbi to U.S. Dollar Spot Exchange Rate (Source: FRED St. Louis Fed)

While the description of the Chinese development so far looks rather positive, there are also several downsides that have to be mentioned. Having a look at inequality and poverty measures (figure 10), it becomes clear that China as well as Brazil, India, and South Africa have elevated poverty shares and high income inequality, with Brazil and South Africa clearly outnumbering the other two. On a more positive note, however, China was able to lift more people out of of poverty in the last 10 years.

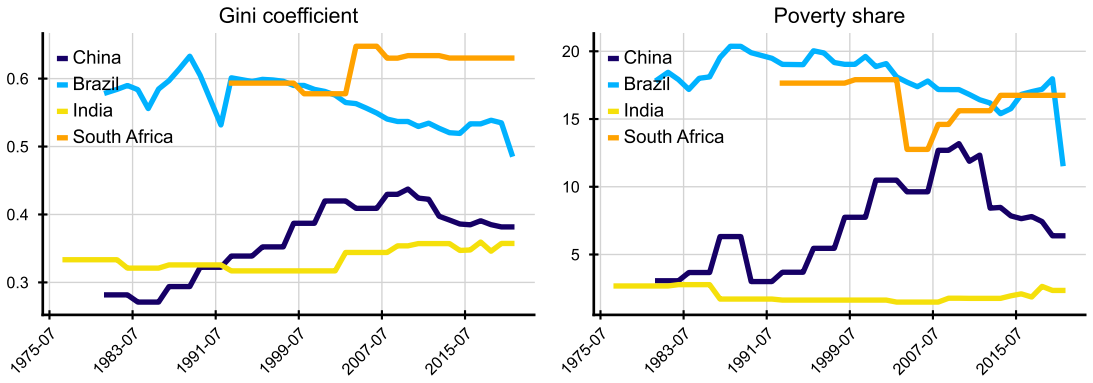


Figure 10: left: Gini index, after tax; right: Poverty rate, Share of people below 40% of the median income or consumption (Source: Our world in data)

At the same time, the Chinese economic success is accompanied by a drastic increase in CO_2 emissions per capita, standing at around 4 times of the Brazilian and the Indian CO_2 emissions, respectively. While South African CO_2 emissions per capita were consistently higher than the Chinese ones for years, they are now slightly below the Chinese numbers.

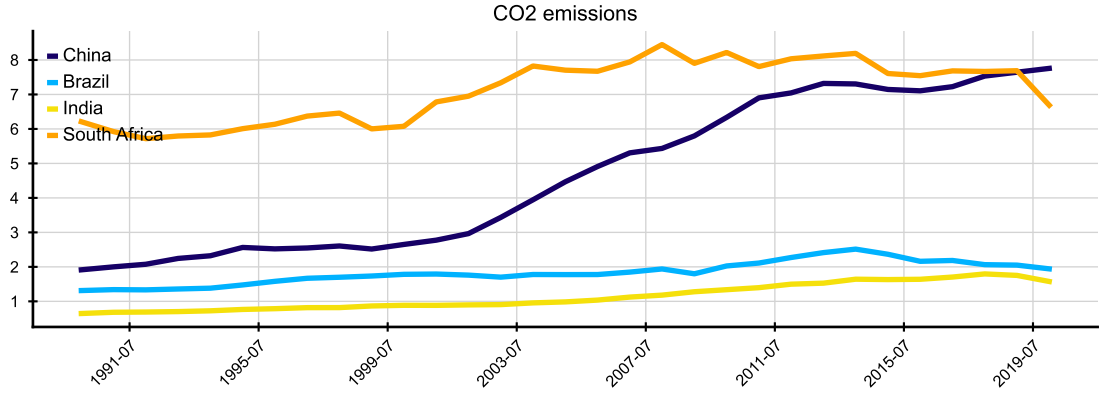


Figure 11: CO2 emissions, metric tons per capita (Source: World Bank

3 Explanations of the Chinese success story

In the following section, we present the explanations for China's economic success story as found in the literature. The arguments put forward by economists show great diversity in their specific emphasis on the key factors determining not only the economic catching-up process, but also China's emergence as a leading actor in several key sectors. The main distinction we make is between *"real"* and *"monetary"* explanations, as put forward by Schumpeter. Real explanations focus on China's institutions, the system of coordination between the private and public sectors, a particular economic philosophy (the *"Beijing Consensus"*), the special use of labour and productivity

growth, leapfrogging, the special role of state-owned enterprises and savings. Saving may seem to belong to the monetary sphere, but we include it in the real sphere because the mainstream view is that it only concerns the allocation of existing resources. Monetary explanations therefore only include measures that rely on credit creation, such as the targeted supply of credit and credit-driven development. While we will argue later that monetary factors are key to a thorough understanding of the Chinese success story, real explanations are much more prominent in the literature. The list of explanations for Chinese growth is obviously not exhaustive, but we hope to provide a brief overview of the main factors and their discussion in the economic literature.

One important issue that is also in the background of many genuine explanations of Chinese development is industrial policy (although the impact of industrial policy on Chinese development is also questioned by some authors, such as Naughton (2021)). While industrial policy may be related to some of the explanations presented below, industrial policy as such is a complex and much debated phenomenon with varying definitions. Therefore, we will not discuss industrial policy as a factor in its own right in this review, but will discuss the concept of industrial policy, its applicability to China, and its role in Chinese development in detail in section 6.

As will become clear in the following, most explanatory approaches suffer from being purely qualitative in nature. Moreover, central concepts such as *"Beijing consensus"* or *"dual system"* are only defined in a relatively vague way.

3.1 Real explanations

3.1.1 Institutions

First, it has been argued in the literature that the distinct set-up of Chinese institutions is one of the key components of Chinese development.

Banga et al. (2022) argue that there are three core elements of Chinese development policy: pragmatism, flexibility and gradualism, where the latter refers to an institutional policy of cautious, controlled change and reform. Banga et al. (2022) also argue that China owes its economic success to a large part to the **high level of ambition** set by the government that then transferred to the rest of the economy. Other key components are the **focus on structure adjustment** according to evolving policy goals on a medium-term time frame (often about a decade):

> *"Even though the focus of the industrial policy keeps changing, it follows a persistent principle: pushing the factor towards the sector that will generate the highest possible productivity and return. These measures are not simply defined as short-term profitability but more widely as trade revenues or other social-economic effects"* (Banga et al., 2022, p. 34).

Another crucial factor is **technology advancement** both through institutional protection and encouragement of research and constant industrial upgrading. This factor is also closely connected to the **integrated policy system** that expands focus beyond the mere industrial sphere and uses *"a multidimensional development that involves finance, technology, human capital, institutions, and productivity"* (Banga et al., 2022, p. 35). Finally, to balance economic development, the metaphor of ***"walking on two legs"*** has often been mentioned. In this context, it refers to balancing the use of both the domestic and the global market. This also includes a mixed approach to export-oriented and import-substitution strategies that takes into account changes in global and domestic markets to produce the optimum of economic development and growth (Banga et al., 2022).

The most important feature of the Chinese model, according to Breslin (2011), is the **state-led experimentation** that tries to gradually develop paths (usually first on sub-levels, then on a larger scale if proven successful) to achieve long-term economic and political goals. This also includes the 'managed globalization' that China has been subject to since at least the late 1970s.

Hofman (2018) underlines the importance of the **gradual change** in China as well. China first experimented with some market mechanisms, e.g. the agricultural household responsibility system (see below) and the township and village enterprises, before allowing for private companies on a larger scale. This gradual approach did not only appease internal critics, but also allowed the central government to gather information to find best practices while keeping overall risk low if the experiment was not successful. Provincial and local governments were also allowed to develop their own growth strategies, which led to a multitude of policies and a diversification of risk (Hofman, 2018). The evaluation of the different strategies could then be transferred to other provinces or be used to develop successful national strategies according to best practices on a local or provincial level.

Naughton (2021) criticizes the idea that China conducted industrial policy in a narrow sense before 2010. Instead, he argues in favor of a successful institutional set-up of regional experimentation and intensive investment. Large scale investment in infrastructure and human capital plus the promotion of growth by regional government authorities have been a much more decisive component of growth (Naughton, 2021).

3.1.2 Hybrid system of public and private sectors

Hou (2014) argues that the **dual structure** of the Chinese economy is fundamental to its success. However, in this case, this does not refer to the duality of the domestic and global market or export orientation and import substitution. It is a hybrid of private and public sectors, private firms and

SOEs, that allows for both flexibility and commitment to a larger strategy. To sustain this successful model, the balance between the private and the public sector has to be maintained. According to Hou (2014), the same holds true for the relationship between central and local rule which can also generate advantages if balanced correctly, but harm the developmental process otherwise. Relative autonomy of local governments can generate competition between provinces and benefit the national economy, but it can also lead to local protectionism and excess capacities (Hou, 2014).

Also addressing the strong connection between the public and the private sector, Yao (2014) argues that one of the key mechanisms for the success of the Chinese transition from a planning economy to a mixed economy is the creation of **transitory institutions bridging both economic systems**. China still shows features usually associated with a planning economy, such as investment-driven growth, high shares of manufacturing in the national economy, the fundamental role of SOEs and generally large influence of the state in the economy (Yao, 2014). On the other hand, productivity is often driven by private entrepreneurs which are, however, supported by a web of state-owned enterprises and banks, thus forming a special form of public-private partnerships.

This system of interlocking public and private companies is not new. In the eyes of Baek (2005), the Chinese model of development follows that of Taiwan in its dual system of public and private sectors, financing by state owned banks, and economies of scale by national monopolies. Also, both in China and Taiwan, the public and the private sector specialize in different forms of industrialization: the public sector focuses on capital-intensive goods and import substitution, while the private sector is export oriented. Due to its limited size, Taiwanese exports aim at niche markets, while China, with its huge domestic market, can also aim at more prominent markets.

3.1.3 The *"Bejing Consensus"*

The idea that there was a peculiar Chinese model of development gained traction after an op-ed in the Financial Times by Ramo (2004). In the article, this model of development was labeled 'Beijing Consensus' for the first time, in contrast to the Washington consensus which used to be the standard approach to development from 1980s on and consisted mostly of policies of deregulation, privatization and the removal of trade barriers. In his piece, Ramo describes the different approach of the *"Beijing Consensus"* as focused on "*growing while holding on to* [national] *independence*" (Ramo, 2004). In practice, this approach included very careful privatization and trade liberalization, a strong emphasis on innovation, and the targeted built-up of economic power (such as the massive US Dollar reserves of the Bank of China) (Ramo, 2004).

On the other hand, it has been argued that the strategy behind the *"Beijing consensus"* is not really

new, but instead a mixture of previously successful strategies for development:

> *"The CCP leadership is clearly pursuing a long term industrial and trade policy which is inspired from the South Korean and Japanese experiences and close to the conceptual framework of pragmatic economists like Friedrich List and Joseph Schumpeter. The main tools and objectives of this industrial policy have been consistent over the last two decades and should be maintained throughout the 2010s."*(Defraigne, 2014, p. 32)

Following the same line of argument, Breslin (2011, p. 1323) points out that

> *"[...] the Chinese 'model', while clearly having unique and country-specific features, can be seen as a variant of a relatively well-trodden statist development path, less peculiar or atypical than appears at first sight."*

In his view, the Chinese model is clearly influenced by the development strategies formulated in Friedrich List's *"The national system of the political economy"* that were then fitted to Chinese conditions and peculiarities (Breslin, 2011, p. 1324).

Using a slightly different definition, Hou (2014) characterizes the *"Beijing Consensus"* by three core components: innovation and constant experimentation, a more holistic approach to development that goes beyond GDP growth, and self-determination (Hou, 2014). As has already been shown in the discussion above, it can be questioned whether these core components were really at the heart of Chinese development policy and it can also be questioned whether the Chinese way was really genuinely Chinese or rather inspired by earlier successful development policies in other countries.

Naughton (2021) argues that from the opening-up in 1978 until 2000 policy makers and planners were unable to predict growth and the development of macroeconomic fundamentals. Therefore, they often had to change or abandon plans which eventually led to an approach that was more market-oriented and less focused on direct intervention. This market-oriented approach, the *"Beijing consensus"*, peaked during the early 2000s, after China's accession to the WTO did not lead to *"painful consolidation"* as feared by Chinese authorities but instead to an increase in growth (Naughton, 2021, p. 46).

Looking at the *"Beijing consensus"* from a political perspective, Dirlik (2012, p. 280f.) uses the term *"new authoritarianism"* to describe the economic and political model of China. He compares it to the development policies of Japan, South Korea, Taiwan, Singapore and that of Hong Kong under British colonial rule. This model relied and relies on the combination of political authoritarianism, the creation of export zones that lays the foundation for participation in global trade. Another factor is the rejection of Western values in a way that only the technological part of modernization is allowed into the country (Dirlik, 2012).

3.1.4 Labor and productivity

Zhu (2012) argues that Chinese growth was not driven by capital investment but rather by productivity growth with increases in human capital accumulation and labor participation playing only minor roles therein. Productivity growth, in turn, was made possible by *"gradual and persistent institutional change and policy reforms that have reduced distortions and improved economic incentives"*(Zhu, 2012, p. 104).

A major step towards higher productivity was the reform of the agricultural sector in 1978 (Zhu, 2012). Prices for agricultural goods were raised, but also the *"collective farming system"* was replaced by a *"household-responsibility system"*. Farm households had to sell fixed quotas at official prices but could now sell surplus grain at market prices. This reform gave an incentive for higher productivity and proved to be successful as agricultural productivity rose significantly during the subsequent years. This in turn freed labor from the agricultural sector that could then be used to build-up the Chinese industrial sector. As productivity is generally higher in the industrial sector than in the agricultural sector, this shift of labor supply increased overall productivity (Zhu, 2012). Fang (2022) also emphasizes the role of the household responsibility system for both the increase in agricultural productivity and the increase in labor supply for non-agricultural sectors. After the initial productivity growth impulse by the agricultural sector, it was the non-state sector, first in the form of township and village enterprises, later in the form of privately-owned firms, that accounted for the majority of productivity growth, even though productivity of the state-owned sector increased after 1998 due to restructuring (Zhu, 2012).

Fang (2022) emphasizes that the most important resource that enabled Chinese growth was labor. Labor was and is constantly withdrawn from low-productivity sectors towards more productive ones. This increases allocation efficiency mostly through labor transfer (Fang, 2022).

Lin and Monga (2011) argue that a key to Chinese success was the adoption of a dual-track approach, that consisted of two main mechanics: 1) giving surpluses to workers of collective farms and state-owned firms, thus creating incentives for greater productivity, and 2) protecting even unviable firms in priority sectors but also allowing for the entry of private firms, joint ventures and FDI in sectors in which China had a comparative advantage (usually labor-intensive work). This argument also underlines the importance of labor for Chinese economic development but also shows how market-based elements were introduced to increase productivity.

3.1.5 Leapfrogging

Lin (2013) argues that the catching-up of China relied on the advantage of *"economic backwardness"*

as described by Gerschenkron (1962). Gerschenkron's term of *"economic backwardness"* refers to the observation that the greater a country's degree of economic backwardness compared to the economically leading nations, the greater its speed of catching-up and its rate of manufacturing growth once industrialization starts (Barsby, 1969). In this way, China's high growth rates are, to some degree, the result of its initial low state of economic development. China was also able to leapfrog multiple costly stages of economic development by relying on the experience of other, more advanced economies. Leapfrogging thus means that China was not trying to catch-up but rather trying to gain leadership in emerging sectors that are not already dominated by other countries (Naughton, 2021).

Lin and Shen (2018) also emphasize China's latecomer advantage as the crucial factor behind China's extraordinary growth. Growth, both for developed and developing countries, relies on raising productivity through innovation and industrial upgrading. Generating innovation and industrial upgrading is very costly at the technological frontier, which explains the relatively low growth rates of developed countries. Developing countries can avoid these costs up to certain point if they "*acquire, imitate or borrow technologies, industries and institutions from the advanced high-income countries during the catch-up process*" (Lin & Shen, 2018, p. 121), which, according to them, is what China did after 1978.

Lee (2021) uses leapfrogging in a Schumpeterian sense that emphasizes the role of innovation and technological capabilities as key for economic catching-up. Catching-up, as defined by Lee (2021), does not mean following the path set by advanced nations, but rather to learn from their experience and skip intermediate steps to advance to the front of technological progress. Therefore, learning and access to foreign knowledge are the main goals for leapfrogging. China achieved these goals by trading is huge market for access to foreign technology through FDI and joint ventures, using forward engineering by university spin-off firms and by acquisition of foreign advanced technologies (Lee, 2021).

Foreign direct investment is also sometimes brought up as a foundation of Chinese development. Herr (2010, p. 74), however, argues that FDI was not as important as a source of financing, but rather as a means to gain access to foreign technology and know-how:

> *"Over the whole transition period, the high investment dynamics was almost exclusively financed by domestic sources and in domestic currency. It would be misleading to consider FDI the main factor behind the high Chinese investment and economic development. FDI undoubtedly added to the dynamics of the Chinese economy, but the main effect of FDI has to be seen in the transfer of technology and management skills, and the opening of export channels."*

In contrast, Baek (2005) argues that, even though only the eastern coastal parts of the country were

opened to foreign investors, FDI from the Chinese diaspora, along with other factors, played an important role in the process of Chinese development. China received massive FDI inflows from Chinese abroad and the township and village enterprises (TVEs) provided a base for growth in labor intensive industries and strengthened the rural areas (Baek, 2005).

3.1.6 State-owned enterprises

While most economists agree that the Chinese model of development was at least to some degree influenced by examples of its successful Asian neighbors, such as the Japanese keiretsu systems and the South Korean chaebol (see Baek (2005); Defraigne (2014)), China's strategy also differed in prominent points: the economy was dominated by SOEs instead of private companies. Japan and South Korea built up national champions that would then compete on global markets, but these champions were private companies. In contrast, at least in the early stages, Chinese national champions were SOEs and larger private enterprises appeared only at later stages of economic development.

SOEs are also core elements of Chinese growth policy and strategy because they can directly implement government policies and stimulate growth through high investment. The investment of SOEs is financed by state-owned banks and, more recently, also through local state-owned investment corporations and even by informal finance (Herr, 2010). The position of SOEs within the corporate sector has changed several times during the last decades. While SOEs were responsible for over 80 percent of industrial production in 1980, this share has declined steadily as private companies have been allowed to gain market shares. During the phase of opening-up in the 1990s, many SOEs came under pressure from private corporations and foreign enterprises. In reaction to this, the Chinese government implemented the strategy *"keep the big, dump the small"* during the late 1990s, leading to the close of smaller SOEs and the restructuring of larger ones (Herr, 2010, p. 76).

3.1.7 Savings

Baek (2005) argues that the high rate of domestic saving in China provided the financial funds that were important for the development and growth of SOEs. This view is based on the idea that in order to invest, one must first generate saving and distribute it through the financial system: *"The financial system [...] mobilises the savings of millions and loans that money to investors"* (Perkins, 2018, p. 144). In this very prominent view, that is relying on the real analysis, the financial system acts purely as a distributor of existing funds that are provided by savers and given to investors. As Chinese growth would not have been possible without large scale investment, there had to be a correspondingly large amount of saving to finance investment with. This view will be challenged when we present monetary explanations for Chinese growth.

Hofman (2018) agrees that high saving was used to boost investment and advance urbanisation which accelerated structural transformation and raised productivity. However, he points out that this large saving was only possible because of the stable macroeconomic environment created by the government. Large saving was thus just one building block of Chinese growth, but not the main cause or a Chinese speciality.

In economic theory, there are also detrimental effects of high saving, as a large saving rate is usually associated with weak demand and thus harmful to growth. In the case of China, it has however been argued that the high saving rate has actually been beneficial as both exports and investment had created such a strong demand that additional strong demand from households could have led to economic overheating (Herr, 2010). By encouraging households to at least partially and temporarily abstain from consumption, China was able to use resources to build infrastructure and develop industries.

3.2 Monetary explanations

In contrast to real explanations for the Chinese growth miracle, monetary explanations are significantly less frequent and only play a minor role in the economic literature. There are, however, some exceptions that we will present below.

3.2.1 Targeted credit

When financial factors are brought up as an explanation for Chinese growth, it is often the use of credit that is mentioned. In one of the most prominent examples, Banga et al. (2022, p. 72) explicitly underline the crucial role of targeted credit:

> *"China capitalized on its large domestic market and central control not only to implement the basic strategy associated with development finance, but pragmatically and flexibly implemented its strategy to ensure debt sustainability. Simply put, the key lesson is that debt should not be regarded as a burden but as a policy instrument. As mentioned above, well-targeted development investment was a key part of the strategy to ensure debt sustainability."*

The use of credit, that is not backed by saving, for investment is therefore sustainable and beneficial if the investment yields a positive return for the economy, which also includes infrastructure investment (to some degree). China used credit creation to supply funds for key industries and to develop infrastructure that raised productivity, e.g. by improving transportation networks.

In a similar vain, Herr (2010) argues that credit expansion was fundamental for Chinese economic development:

> *"Credits were allocated according to different priorities and motivations: Firstly, they were used to finance investment in selected industries, firms and regions. There was definitely not a coherent national development plan for industrial policy, but there was the general attitude on all levels to support development and efficiency. This credit expansion in the formal financial system became the backbone of the dynamic quantitative and qualitative investment development in China."*(Herr, 2010, p. 85)

3.2.2 Schumpeterian use of the banking system

Schumpeter's theory of economic development will be presented in section 4 in detail, but we also have to address it in this section as the Schumpeterian model as also been mentioned as an explanation for Chinese development by Burlamaqui (2015, 2018, 2020) and Burlamaqui and Kattel (2016).[1]

In short, the Schumpeterian growth theory focuses on two main economic actors, the entrepreneur and the banker. While it is the entrepreneur that ultimately determines the development of the economy through innovation, the banker enables him/her to do so through credit creation, a concept that is based on a distinctively monetary view. Burlamaqui connects this concept of Schumpeter with Mariana Mazzucato's concept of the **"entrepreneurial state"** (Mazzucato, 2013), which presents the idea that the state can not only act as an entrepreneur, but might even have advantages compared to private entrepreneurs, e.g. because of the state's special access to finance and the longer time horizon of investment. The Chinese state, Burlamaqui (2020) argues, merged the role of the entrepreneur and the banker through its state-owned banks and enterprises, thereby applying Schumpeter's theory at a greater scale. Similar ideas have also been brought up by Bertocco (2006), Dullien (2009), Herr (2010), and L. Zhang and Bezemer (2016).

4 Banks and economic growth in theory and empirics

The previous section discussed the uniqueness of the Chinese growth model and several possible reasons for its success. As we are particularly interested in the role of banks and finance for economic growth, we will now categorise their role for economic growth within a more theoretical framework. Other (certainly very decisive) growth factors, such as education or human capital in general, are left out of this discussion. To begin with, we will focus on the traditional growth

[1] Lee (2021) also discusses Schumpeter in the context of Chinese economic growth, but only in the context of innovation and catching-up, which belongs to the real sphere. Lee does not mention the important distinction between the real and the monetary sphere that is so crucial for an understanding of the Schumpeterian theory of economic development.

models from the literature.

4.1 Traditional growth models and their application to China

As figure 12 shows, classical growth theories can generally be divided into two categories. According to Solow (1956) (figure 12, left), a permanent increase in the saving rate can only lead to a temporary growth effect that ends as soon as a new, higher equilibrium is reached. The role of banks is limited to efficiently channeling saving to investors in order to increase capital accumulation and thus create growth. For banks (resp. saving) to generate a new growth impulse, there must be a new, exogenous and permanent increase in saving. However, as there is no long-term growth effect of saving, banks cannot generate long-term growth (only level effect). Only exogenous technological progress can promote growth in the long run. Ramsey (1928), Cass (1965) and Koopmans (1965) come to similar conclusions but determine the household saving rate endogenously i.e. through its rate of return and time preferences.

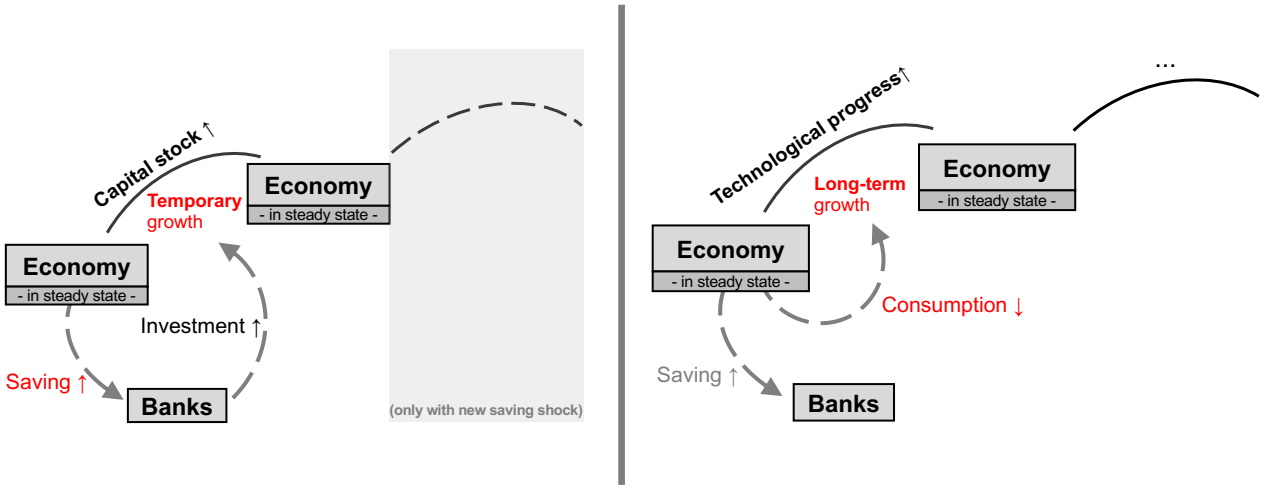


Figure 12: Growth through banks in the growth models by Solow (1956), Ramsey (1928), Cass (1965), and Koopmans (1965) (figure left) and by Romer (1990) (figure right).

Romer (1990), on the other hand, states that saving actually only has a long-term effect on growth, by enabling R&D (figure 12, right). According to his theory, an (endogenously determined) increase in the saving rate initially causes a reduction in consumption. If one assumes that in an economy there are only two sectors, i.e. (1) production of consumer goods and (2) research and development (to generate temporary monopoly profits through patents), a reduction in consumption leads to a decrease in the production of consumer goods and a reallocation of labour to the R&D sector. The research sector can thus generate more, new products and technologies, which (after the patents expire) have positive spill-over effects on overall economic growth in the long run. Romer has even gone so far as to say that the technological progress resulting from this process is the only

long-term source of growth. Banks or other financial intermediaries are not necessary to set this process in motion, however, since it is possible to forgo consumption without having to invest money. In the short-term, greater saving will also have a negative impact on growth as consumer goods production is cut back.

Raiser (2019) argues that *"China's success and recent growth moderation [...] provide ample evidence in support of traditional development theories"*. In fact, at least some components of the Chinese development model fit rather well with traditional growth models (S. Ding & Knight, 2009; Raiser, 2019; Song, Storesletten, & Zilibotti, 2011):

- The **Harrod-Domar model** (Domar, 1946; Harrod, 1939) argues that economic growth depends on the productivity of capital and investment. Especially the strong economic growth in the 1980s and 1990s in China is related to high capital productivity growth that declined only recently (Raiser, 2019; World Bank, 2019).
- The **Solow-Swan model** (Solow, 1956; Swan, 1956) adds labor or human capital to the production process. China invested substantially in human capital until around 2010. Since then, China experienced declining returns on physical investment. Additionally, the growth of the labor force declined (Raiser, 2019; World Bank, 2019).
- The **Lewis model** (Lewis, 1954) argues that reallocation of labor from low-productivity to high-productivity industries drives growth. China experienced a strong decline in the labor force in agriculture, which might disappear completely within the next years. The declining scope for further labor reallocation might explain a decreasing growth in China (Raiser, 2019; World Bank, 2019).
- The endogenous growth models or **Lucas-Romer models** (Lucas, 1988; Romer, 1990) focus on technological progress and total factor productivity as growth drivers. Both factors have been discussed extensively in the literature on Chinese growth (Raiser, 2019).

One factor for economic growth that is often left out or understated in traditional growth models is the **financial system**. Instead, banks are mere intermediaries of funds between savers and investors that cannot generate growth independently, but constitute 'frictions' for financial flows in the economic system (Woodford, 2010). Furthermore, in these growth models there is no active role for the state. As we will show in the second part of this paper, the missing role of the financial system and the state is particularly problematic when analysing China's economic development. For this reason we will now present an alternative growth model that allows for a salient role of the financial system and the state. This model is based on the work of Joseph Schumpeter.

4.2 Schumpeter's growth model

Schumpeter's theory of credit and growth in which money and bank credit play a fundamental role, has been set out most clearly in his book "The Theory of Economic Development". We present the core of his theory as briefly as possible before developing his thoughts in detail (figure 13):

I. Economy in equilibrium

In the status quo, the economy is in equilibrium, all resources are bound in existing combinations and are not available for innovative use. New (innovative) firms have no money and no access to productive resources in the economy.

II. Investment financed by credit

For the economy to break out of equilibrium, entrepreneurs need financial means to finance their investment projects. If these financial resources are not channelled to entrepreneurs by a central authority, they have to be initiated by banks. Banks themselves create credit. Credit enables a shift in purchasing power that allows firms to access productive resources in the economy.

III. Economic development through reallocation

To create substantial, innovative growth, the existing resources in the economy must be used differently. Without credit, this can only be achieved through direct control by a central authority. With bank credit, direct control is not necessary. Substantial growth relies on the reallocation of resources from their use within the steady-state economy towards innovative ventures. The economy reaches a 'new steady state' - higher than the initial steady state.

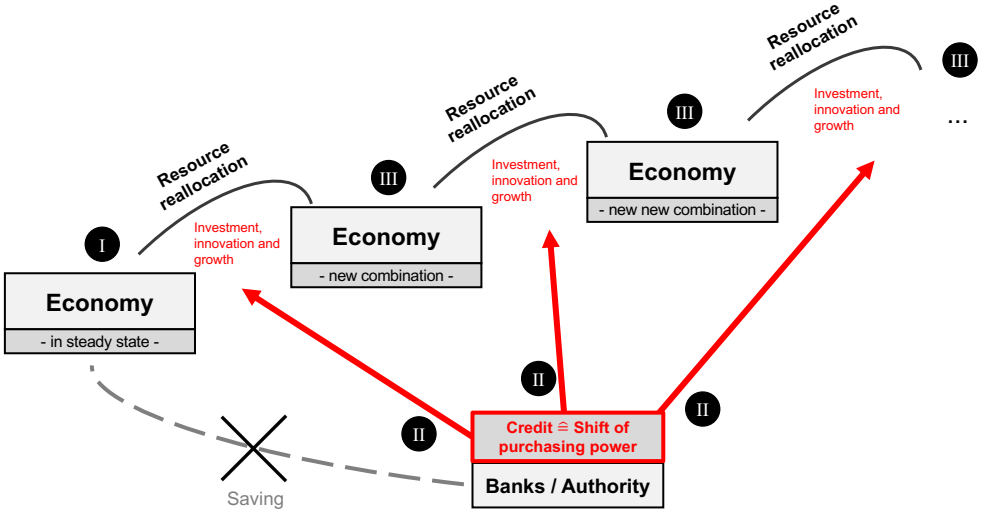


Figure 13: Growth through banks in the Schumpeterian growth model

We will now develop these points made by Schumpeter in detail:

I. Economy in Equilibrium

One of Schumpeter's key elements is that there is no such thing as an equilibrium in a growing economy, although he starts his theory of development from this theoretical concept. This out–of–equilibrium approach is closely related to Schumpeter's famous concept of 'creative destruction' which opposes a static view of the economy and argues instead that there is a constant process whereby more productive firms drain resources from less productive firms. This leads to the destruction or exit of the less productive enterprises while the more productive enterprises flourish. However, although his arguments lead to this dynamic view of the economy, Schumpeter begins to lay out his theory of economic development with the economy in equilibrium and develops his model from that point.

An economic equilibrium is characterized by the fact that all goods and all money are already scheduled for use: "*All money would circulate, would be fixed in definite established channels.*" (Schumpeter, 1934b, p. 72). If an economy is in equilibrium, this means that all of its rational agents have already used up all resources for production – or have scheduled the use of future resources for future production. In this case, no resources are or will be available for innovative processes. Only if individuals decide to change their plans (which should be unlikely given that their initial plans were rational) could they reallocate resources to new, innovative projects (cf. Schumpeter (1934b, p. 72)). To generate **substantial** growth, resources have to be freed from their intended use within the steady–state economy. There are two ways to initiate the redistribution of resources: A central authority could mandate that resources be allocated in a new and potentially more productive way. At the time Schumpeter developed his theses, totalitarianism was on the rise worldwide and central planners were more than just a theoretical argument, so this was considered a valid option. However, the other, more favorable option that Schumpeter saw was to redistribute resources in a more subtle way through credit creation.

In addition to this central point, Schumpeter's premises include a constant population, no major political and social changes and a generally stable environment without exogenous shocks. The only way for the economy to break out of equilibrium is if entrepreneurs start new investment projects.

II. Investment Financed by Credit

Thus, the only way to obtain the resources needed for (starting) innovative processes without direct force through a central authority is therefore to generate *new money*. Money therefore plays a central role in Schumpeter's growth model, as it not only serves as a numéraire good for all existing goods and services, but also sets in motion the reallocation of resources that is crucial for

economic development. While a reallocation of resources in Schumpeter's theory would imply a shift in purchasing power and thus a "*canceling of an old and the issuing of a new "order" to the owners of factors*" (Schumpeter, 1939, p. 110), reallocation through new money creation initiates a "*reduction of the purchasing power of existing funds which are left with the old firms while newly created funds are put at the disposal of entrepreneurs*" (Schumpeter, 1939, p. 110). Bank credit thus entails a restriction of GPG consumption in the first case, while money creation results in a shift of labor force to more productive (innovative) companies that can then pay higher wages, without cutting consumption in the latter. In this way, the bank-led creation of money 'generates' purchasing power in order to give entrepreneurs access to the goods they need for innovation and growth: *"It is always a question* [in money creation by banks] *, not of transforming purchasing power which already exists in someone's possession, but of the creation of new purchasing power out of nothing* [...] (Schumpeter, 1934b, p. 73). The fundamental function of credit for development is then closely linked to the role of the entrepreneur in Schumpeter's view of the economy: *"The creation of purchasing power characterises, in principle, the method by which development is carried out in a system with private property and division of labor. By credit, entrepreneurs are given access to the social stream of goods before they have acquired the normal claim to it."* (Schumpeter, 1934b, p.107). In a hypothetical example, Schumpeter (1939, p. 109) elucidates this idea as follows: "*Entrepreneurs borrow all the "funds" they need both for creating and for operating their plants—–i.e., for acquiring both their fixed and their working capital. Nobody else borrows. Those "funds" consist in means of payment created ad hoc. But although in themselves these propositions are nothing but pieces of analytic scaffolding, to be removed when they have served their purpose, the logical relation which they embody, between what is called "credit creation by banks" and innovation, will not be lost again.*"

By introducing new claims on goods and services (i.e. money), the existing claims are lowered, individuals within the economy experience a "*compressing* [of] *the existing purchasing power*"(Schumpeter, 1934b, p. 108f.). Those that gained their claim through providing goods or services will not receive their share of other goods and service in return as measured by their wages, but a smaller share. As the existing claims are reduced, some goods and services, resources, are freed up for other uses or taken from the circulation of goods as Schumpeter puts it (cf. Schumpeter (1934b, p. 96)). These other purposes are, or at least should be, innovative projects that lead to economic growth: "*Normal credit creates claims to the social dividend, which represents and may be thought of as certifying services rendered and previous delivery of existing goods. That kind of credit, which is designated by traditional option as abnormal, also creates claims to the social product, which, however, in the absence of past productive services or of goods yet to produced.*"(Schumpeter, 1934b, p. 101). Schumpeter emphasises that the claims on past output are in reality indistinguishable from claims on future output, since claims on money are treated like money in practice (see Schumpeter (1934b, p. 101)). This process may sound unfair at first, but it does not have to be so – for two reasons: First, not all claims will be

claimed. As mentioned above, there is an incentive to 'save', which means that some resources will be reserved for use emergencies or for retirement, etc. Second, while in the first step the new claims will lead to claims outweighing available goods and services, the freed resources will generate growth through innovative projects, at least at the macro level. This means that while reducing individual claims at first, the creation of money through productive credit will increase individual claims in the long run. Since in reality this process is not step–by–step but rather continuous, the effect will be positive at all times (abstracting from crises).

The importance of banks which is often neglected in modern economic theory, becomes very clear when following Schumpeter's theory and was emphasized by Schumpeter (1934b, p.74): *"The banker, therefore, is not so much primarily a middleman in the commodity "purchasing power" as a producer of this commodity.*[...]*He stands between those who wish to form new combinations and the possessors of productive means. He is essentially a phenomenon of development, though only when no central authority directs the social process. He makes possible the carrying out of new combinations, authorises people, in the name of society as it were, to form them. He is the ephor of the exchange economy.*" [2] This importance of banks and credit is often neglected in growth models based on Schumpeter's theories (e.g. Aghion et al. (2015); Aghion and Howitt (1990)).

However, there is of course an important difference between money that is already circulating within the economy and money that is being created. Undoubtedly, the ability to create money out of nothing has its limits. Bankers cannot create unlimited amounts of purchasing power, i.e. money, as this would have to lead to inflation at some point. Broken down radically, money can be seen as a claim on an economy's goods and services usually, but not necessarily, provided by supply of goods and/or services to the economy, which is usually, but not necessarily, in turn remunerated with money. Thus, money creation itself adds new claims on the existing goods and services of the economy without providing additional goods (yet). Like any other good, the value of money is determined relative to all other goods. If the money supply increases significantly without generating a similar rise in other goods, the value of money then must decline. The key point then is the productivity of the credit recipients.

Schumpeter is clear that credit creation is only beneficial if the credit is used productively: *"Granting credit in this sense operates as an order to the economic system to accommodate itself to the purposes of the entrepreneur, as an order on the goods which he needs: it means entrusting him with productive forces"*(Schumpeter, 1934b, p. 107). The main point here is that as long as loans made from freshly generated money are used productively and are not used for consumption or investment in existing assets (such as real estate), inflation should not be a problem. In fact, if the resources used by the

[2]Ephors were ancient Spartan magistrates and leaders who controlled the kings.

borrower lead to an overall increase in goods within the economy that is greater than the initial credit (this should be the case if the borrower has to pay positive interest rates), then the result would rather be a deflationary than an inflationary tendency (see Schumpeter (1934b, p. 110f)). The amount of potential credit is thus not limited by past and present goods in the economy, but rather by the realistic production of future goods (Schumpeter, 1934a, p. 165). This point was also made by Herr (2010, p. 80):

> "*Credit expansion can only lead to development when credits are used for investment in the real economy. If credit is expansion is used to finance asset price bubbles in the stock market or the real estate sector sustainable development is not possible.*"

In the eyes of Schumpeter (1939, p. 145f.), the effect of credit is veiled by the lack of distinction between productive credit ('primary wave' in Schumpeter's terms) and unproductive use of credit that follows the productive credit and consists mainly of speculation (secondary wave in Schumpeter's terms):

> "*This is one reason why the element of innovation has been so much neglected by the traditional analysis of the business cycle: it hides behind, and is sometimes entirely overlaid by, the phenomena of what appears at first glance to be simply a general prosperity, which is conspicuous in many branches and strata and apparently unconnected with any activity that could in any way be called innovating, let alone "inventing"*" (Schumpeter, 1939, p. 146)

Schumpeter (1939, p. 147f.) argues:

> "*The only conclusion that really follows* [from the problem of a 'secondary wave' of credit] *is that the credit machine is so designed as to serve the improvement of the productive apparatus and to punish any other use.* [...] *it should be pointed out that distinction between debts according to purpose, however difficult to carry out, is always relevant to diagnosis and may be relevant to preventive policy.*"

According to Otter and Siemon (2013b, p. 68f.), the creation of purchasing power during the Schumpeterian primary wave gets handed down from entrepreneurs to owners of goods necessary for innovation. This leads to a surge in overall demand that yields temporary profits across the whole economy (not just the innovative part) that in turn leads to an anticipation of prosperity. This anticipation leads to a general spread in loans for both businesses and private households that is called the 'secondary wave'.

> "*A country that is going to continue its catching-up or leapfrogging development process must have innovative entrepreneurs paving the way for all other kinds of entrepreneurs. These innovators have to be allowed, able, and willing to adapt and transform their resources ('input': knowledge, capital, natural resources, etc.) within their domestic markets in order to induce positive linkages to all sectors of industry.*" (Otter & Siemon, 2013a)

III. Economic Development through Reallocation

If the economy is in equilibrium, all production factors are used or their use is planned. Without additional bank credit, this would also mean that the money needed for these resources is tied up and not available for other uses. Since there are no 'free' resources – a statement that applies to an economy in equilibrium and is mostly true for the actual economy – real resources for innovative projects must be taken from other undertakings for which their use originally planned ("reallocation"): "*To produce other things, or the same things by a different method, means to combine these materials and forces differently.*" (Schumpeter, 1934b, p. 65). This reallocation of real resources, e.g. labour, machinery, etc., is realised with the financial means made available to entrepreneurs by banks. Thus, bank credit is the origin of the development process.

From all this, it is clear that an increase in credit is not just the by-product of a growing economy. Rather, Schumpeter argues that credit must be the source of all economic growth because it is the only way to free up means of production or resources for innovative use, which is the only way to generate growth: *"In one sense no goods and certainly no new goods correspond to the newly created purchasing power. But room for it is squeezed out at the cost of previously existing purchasing power"*(Schumpeter, 1934b, p. 109). This phenomenon was associated with the phrase "Vorschußökonomie" (advance-economics) by Schumpeter (see Schumpeter (1934b, p. 96)). "*And although the meaning and object of this process* [withdrawing means of production from the economy] *lies in a movement of goods from their old towards new employments, it* ***cannot*** *be described entirely in terms of goods without overlooking something essential, which happens in the sphere of money and credit and upon which depends the explanation of important phenomena in the capitalist form of economic organization, in contrast to other types*"(Schumpeter, 1934b, p. 71).

It should have become clear by now that the traditional and the Schumpeterian growth models differ fundamentally in terms of their sources for economic growth. This relies on the fact that the underlying assumptions of both approaches are based on different paradigms that are briefly described in Box 1.[3]

[3]For a more extensive analysis of the 'real' and 'monetary' paradigm see Bofinger (2020).

Box 1: Real analysis vs. monetary analysis

Schumpeter's most important insights into the role of the financial system are based on his critical view of 'real analysis', which can be approximated by the **loanable funds theory**. This theory explains the interest rate in terms of real factors, i.e. the consumption/saving decision and the investment decision. The theory is based on the critical assumption of a general-purpose good that can be used interchangeably as a consumption good, capital, 'savings', and as an investment good. In this model, saving is the only source of financial funds. Banks are reduced to the role of intermediaries 'easing financial frictions' between savers and investors.

The most important insights of **Schumpeter's 'monetary analysis'** are the following:

- Banks can independently create credit and thus money
- Banks play a crucial role in the process of economic development
- Savers are irrelevant to finance (or at least overvalued) because *'savings'* are not necessary as an input to the financial system: *"it is much more realistic to say that banks "**create credit**", that is that they create deposits in their act of lending, than to say that they lend the deposits entrusted to them. And the reason for insisting on this is that depositors should not be invested with the insignia of a role they do not play. The theory to which economists have clung so tenaciously [...] attributes to them an influence on the **'supply of credit'** which they do not have."* (Schumpeter, 1954, p. 1080). Schumpeter even goes so far as to call saving the *"**economic general disruptor**"* (Schumpeter, 1954, p. 267).
- The ***'monetary analysis'*** opens the perspective of financial instability that is missing in the ***'real analysis'***, where financing is identical with an increase in the capital stock: *"Speculation in the narrower sense will take the hint and [...] stage a boom even before prosperity in business has had time to develop. New borrowing will then no longer be confined to entrepreneurs, and 'deposits' will be created to finance general expansion, each loan tending to induce another loan, each rise in prices another rise. [...] Indeed, the phenomena of this secondary wave may be, and generally are, quantitatively more important than those of the primary wave. [...] the processes of the secondary wave do indeed provide us with a wealth of examples of unproductive credit"* (Schumpeter, 1939, p. 150-151).
- Schumpeter thus argued that, in contrast to 'real analysis', in the sphere of 'monetary analysis' **credit can be used both in a productive and an unproductive way**.

4.3 Empirical evidence on the finance and growth nexus

In the previous chapter we gave an overview on the most prevalent economic growth theories and their differences in terms of the role of banks. Now we want to empirically assess their practical relevance. In doing so, it is important to note that the standard 'finance and growth' studies, in fact, base their empirical approach on the classical ('real') paradigm. As we will show in section 4.3.1 this leads to several, wide-ranging problems. In our own empirical analysis (chapter 4.3.2) we therefore resort to the Schumpeterian approach to finance and growth. As these results indicate that this concept is better suitable to empirically assess the finance and growth nexus, we then also apply it to the Chinese case (see chapter 5).

4.3.1 Finance and growth in the empirical literature

Joseph Schumpeter made pioneering contributions to economic theory on the relationship between the financial system and economic growth. However, the economic literature has often misinterpreted his work, particularly on the importance of banks and liquidity creation for development. While Schumpeter advocated an approach in which money plays a dominant and independent role ('monetary analysis'), he is portrayed as advocating a school of thought in which the monetary sphere is merely a reflection of the sphere of goods ('real analysis'). We argue that a correct interpretation of Schumpeter helps to resolve many empirical puzzles which have emerged in the last decades, such as providing convincing evidence of positive effects of the financial system on growth in advanced economies, and generally explaining non-positive effects of credit. At the same time, no evidence has been found for the link between saving and credit growth, which is a central transmission channel of real analysis. As we will show in the following sections, a monetary, in fact Schumpeterian approach offers a more realistic framework for analysing the finance and growth nexus from an empirical point of view.

It is surprising that in the literature on the finance and growth nexus (e.g. Beck, Demirgüç-Kunt, and Levine (2000); King and Levine (1993); Levine (2005, 2021)), explicit reference is made to Schumpeter as a theoretical pioneer without addressing his fundamental distinction between **'real analysis'** and **'monetary analysis'**. Instead, the authors present him as a proponent of the loanable funds theory, in which banks merely act as intermediaries between savers and investors. For example, in Levine (2021, p. 13) the above quote (Schumpeter, 1934a, p. 62) is reproduced omitting the key passage *"in the commodity 'purchasing power' as the producer of this commodity"*:

> *"In 1912, Joseph Schumpeter argued: '[T]he banker is therefore not much primarily a middleman ... He authorizes people in the name of society ... to [innovate]. Schumpeter (1911, p. 74)*[4] *Schumpeter was stressing that one of the key functions of the financial system is to decide which firms and individuals get to use society's savings."*

[4] Schumpeter (1911) is the original German version of the English version (Schumpeter, 1934a).

In this sense, King and Levine (1993, p. 717) also state:

> *"In 1911, Joseph Schumpeter argued that the services provided by financial intermediaries - mobilising savings, evaluating projects, managing risk, monitoring managers and facilitating transactions - are essential for technological innovation and economic development."*

In our view, the misinterpretation of Schumpeter had negative consequences for research on the finance and growth nexus some of which have also been addressed by Bezemer (2014) and Bezemer, Grydaki, and Zhang (2016):

- After decades of research, Levine (2021, p. 8) admits that *"the literature does not yet provide a definitive answer to the questions: Does finance cause growth, and if so, how?"*.
- There are serious problems in the literature with the concept of *'liquidity creation'*, which, according to Levine (2021, p. 36), *"is one of the most important services that banks provide to the economy."* Beck, Döttling, Lambert, and Van Dijk (2020, p. 1) note that there is *"little research focusing specifically on whether and how liquidity creation, as a key function of banks to foster long-term investments, contributes to growth"*.
- It has led the research to an interpretation of *'financial development'* as a static concept, in contrast not only to Schumpeter (1934a) but also to Goldsmith (1969), who is considered another pioneer in this field. Thus, empirical papers try to explain the growth effects of the financial system with static variables, above all the level of private debt relative to GDP. While positive effects could be found for large panels dominated by developing countries, this is not the case for advanced economies with larger and more developed financial systems.
- Recent empirical analyses even show a negative growth effect above a certain debt threshold. Levine (2021, p. 29) notes that *"researchers have not explained what causes these nonlinearities"*.
- Finally, there is also no evidence for the crucial role that the literature attributes to the financial system in *'mobilising savings'* and for positive effects of *'savings'* on growth.

In our view, the problems in the literature are related to the use of *'real analysis'*, i.e. the loanable funds theory as a theoretical framework.

- At a general level, it is not surprising that a model in which the financial sphere is identical to the real sphere is unable to understand how finance causes growth in the modern financial system, where the financial system is often completely detached from the real sector.
- How can a model in which the role of banks is reduced to the intermediation of a general-purpose good understand the process of liquidity creation in reality? The only approach is the model of Diamond and Dybvig (1983), which is based on *"unrealistic critical assumptions"* (Rodrik, 2017). And even this model does not provide a consistent explanation of liquidity

creation (Bofinger & Haas, 2022). Papers by the Bundesbank (2017) and Bank of England researchers (McLeay, Radia, & Thomas, 2014) show that in a monetary framework, the mechanics of liquidity creation are relatively simple.

- Understanding the role of bankers as *'purchasing power producers'* implies that financial development is a dynamic concept, so that its impact on growth must be analysed with the **growth rates of financial aggregates**. Even the recent work by Beck et al. (2020) identifies *'liquidity creation'* with a static balance sheet concept.

- Since the loanable funds model assumes that financing always involves an increase in the capital stock, it is unable to deal with *"unproductive credit"* (Schumpeter, 1939), which finances consumption or the speculative purchase of existing assets (real estate, companies). Bezemer and Hudson (2016, p. 764), for instance, describe how the channeling of credit into the unproductive sector of financial and other assets, especially real estate, can create the illusion of wealth creation:

  > *"Bank credit is directed into the property sector, with preference to rent-extraction privileges, not the goods-and- service sector. In boom times, the financial sector injects more credit into the real estate, stock, and bond markets (and, to a lesser extent, to consumers via "home equity" loans and credit card debt) than it extracts in debt service (interest and amortization). The effect is to increase asset prices faster than debt levels. Applauded as "wealth creation," this asset-price inflation improves the economy's net worth in the short run."*

  This process has however inevitably come to an end which is then associated with an economic bust that usually also includes the real economy (Bezemer & Hudson, 2016, p. 764f.). Bezemer, Ryan-Collins, Van Lerven, and Zhang (2018, p. 2) furthermore describe a 'debt shift' that has been observed in industrialized economies over the past decades: the financial system has moved from providing working capital and investment funds to the private sector for investment and innovation. Instead of increasing productivity, the banking system has "*primarily lent against pre-existing assets, in particular real estate assets*"(Bezemer et al., 2018, p. 2). They continue: "*The source of debt problems and financial instability is not increases in credit **per se**, nor even the rise in credit relative to GDP, but the **type of credit** that is extended and the revenues it creates*" (Bezemer et al., 2018, p. 2).

- For monetary analysis, the lack of a link between *'savings'* and the financial system is not a challenge but a confirmation that finance is not based on *'savings'*.

4.3.2 Empirical analysis results

Addressing our previous critique, we therefore estimate a finance and growth panel model that includes monetary, non-static measures of financial development (such as bank credit growth, $\Delta CREDIT_{Bank}$, credit growth to the household sector $\Delta CREDIT_{Household}$ and credit to the non-financial corporate sector $\Delta CREDIT_{Corporate}$, all taken from the BIS data base) as independent variable, and the annual growth rate of GDP per capita as dependent variable. We also include standard measures of education, trade, government consumption and inflation as control variables. In our data set we include 43 countries over a period from 1940 to 2019, covering 25 developed and 18 developing countries worldwide. [5]

Our results from tables 1 and 2 show that there is generally a positive relationship between finance (i.e. bank credit growth) and GDP growth. This finding is robust on applying different panel estimation techniques (fixed effects (FE), random effects (RE) and instrumental variables (IV) analysis) and on applying 3- or 5-year moving averages to account for medium-term fluctuations in our data. This is particularly noteworthy because our panel includes almost equal numbers of developed and less developed countries, and the existing literature often fails to find significant positive effects of *"finance"* on growth.

			FE			
Dependent: GROWTH	(1)	(2)	(3)	(4)	(5)	(6)
log(INITIAL GDP)	-1.531**	-1.860***	-3.084**	-2.354***	-3.332**	-2.108***
	(0.630)	(0.514)	(1.294)	(0.565)	(1.244)	(0.583)
SCHOOL	0.013	0.019**	0.015*	0.019**	0.017*	0.020**
	(0.010)	(0.008)	(0.009)	(0.007)	(0.009)	(0.007)
GOV	-0.311***	-0.422***	-0.596***	-0.645***	-0.548***	-0.593***
	(0.090)	(0.063)	(0.140)	(0.106)	(0.145)	(0.109)
log(OPENNESS)	2.404**	2.287**	2.118**	1.660**	2.601***	2.067***
	(0.927)	(0.846)	(0.787)	(0.706)	(0.749)	(0.702)
INFL	-0.018***	-0.102***	-0.099***	-0.118***	-0.137***	-0.161***
	(0.003)	(0.016)	(0.032)	(0.042)	(0.035)	(0.049)
$\Delta CREDIT_{Bank}$		0.098***			0.075***	0.067***
		(0.016)			(0.023)	(0.021)
ΔNHS			0.000**		0.000***	
			(0.000)		(0.000)	
$\Delta NHSR$				0.000		0.000
				(0.000)		(0.000)
Constant	13.579**	17.022***	34.522**	30.285***	33.021**	24.657***
	(6.578)	(5.777)	(12.592)	(6.061)	(11.952)	(5.887)
Observations	1,509	1,399	842	936	834	928
Countries	41	41	31	34	31	34
Adj. R-squared	0.3172	0.4183	0.4504	0.4481	0.4863	0.4764

[5] A further description of the methodology and data sources can be found in Bofinger, Geißendörfer, Haas, and Mayer (2021).

	RE					
Dependent: GROWTH	(1)	(2)	(3)	(4)	(5)	(6)
log(INITIAL GDP)	-1.014***	-0.830***	-0.871***	-1.299***	-0.726***	-1.078***
	(0.252)	(0.244)	(0.217)	(0.402)	(0.212)	(0.301)
SCHOOL	0.018	0.021*	0.007	0.019***	0.008	0.015*
	(0.012)	(0.011)	(0.008)	(0.007)	(0.007)	(0.009)
GOV	-0.096*	-0.107**	-0.113*	-0.439***	-0.104*	-0.146**
	(0.049)	(0.048)	(0.066)	(0.083)	(0.063)	(0.066)
log(OPENNESS)	0.917***	0.727***	0.956***	1.513***	0.873**	0.767**
	(0.216)	(0.252)	(0.306)	(0.469)	(0.364)	(0.362)
INFL	-0.020***	-0.114***	-0.113***	-0.119***	-0.166***	-0.198***
	(0.003)	(0.014)	(0.039)	(0.042)	(0.030)	(0.035)
$\Delta CREDIT_{Bank}$		0.104***			0.086***	0.098***
		(0.015)			(0.021)	(0.020)
ΔNHS			0.000		0.000	
			(0.000)		(0.000)	
$\Delta NHSR$				0.000		0.000
				(0.000)		(0.000)
Constant	10.655***	8.580***	10.454***	17.235***	7.906***	12.468***
	(2.080)	(2.093)	(1.922)	(4.360)	(2.138)	(3.019)
Observations	1,509	1,399	842	936	834	928
Countries	41	41	31	34	31	34
Adj. R-squared	0.4285	0.5318	0.5178	0.5928	0.5503	0.6153

Notes: Heteroskedasticiy-consistent standard errors are indicated in parentheses. GROWTH=growth of GDP per capita in %; log(INITIAL GDP)=logarithm of current expenditure side GDP from previous period at current PPPs; SCHOOL=secondary school enrollment rate (% of population in secondary school age); GOV=general government final consumption expenditure (% of GDP); log(OPENNESS)=logarithm of trade as sum of exports and imports of goods and services (% of GDP); INFL=inflation in consumer prices (% change); $\Delta CREDIT_{Bank}$ = annual growth rate of domestic bank credit to non-financial private sector (%); ΔNHS=annual growth in household sector net saving (%); $\Delta NHSR$ = annual growth in share of net saving to net disposable income (household sector, %).

Table 1: Growth effects of credit growth, household saving growth and household saving rate growth, estimated with Fixed Effects and Random Effects

	IV					
Dependent: GROWTH	(1)	(2)	(3)	(4)	(5)	(6)
log(INITIAL GDP)	-0.824***	-0.802***	-0.675***	-1.089***	-0.668***	-1.039***
	(0.104)	(0.106)	(0.119)	(0.129)	(0.118)	(0.125)
SCHOOL	0.001	0.008*	0.002	0.007	0.005	0.011**
	(0.004)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)
GOV	-0.091***	-0.103***	-0.119***	0.162***	-0.114***	-0.152***
	(0.020)	(0.022)	(0.032)	(0.030)	(0.033)	(0.031)
log(OPENNESS)	0.702***	0.564***	0.739***	0.590***	0.663***	0.483**
	(0.148)	(0.153)	(0.210)	(0.194)	(0.223)	(0.204)
INFL	-0.019***	-0.065***	0.033	-0.047	-0.060	-0.088*
	(0.004)	(0.018)	(0.043)	(0.042)	(0.047)	(0.045)
$\Delta CREDIT_{Bank}$		0.053***			0.033*	0.050***
		(0.018)			(0.020)	(0.019)
ΔNHS			0.000		0.000	
			(0.000)		(0.000)	
$\Delta NHSR$				-0.001***		-0.001***
				(0.000)		(0.000)
Constant	9.173***	8.725***	7.776***	13.181***	7.442***	12.273***
	(0.878)	(1.018)	(1.365)	(1.415)	(1.389)	(1.396)
Observations	1,509	1,387	842	936	832	926
Countries	41	41	31	34	31	34
Adj. R-squared	0.1582	0.2351	0.1066	0.2058	0.1585	0.2695

Notes: Heteroskedasticiy-consistent standard errors are indicated in parentheses. Instrumented variable: $\Delta CREDIT_{Bank}$ (instrumented by annual growth rate of domestic bank credit to non-financial private sector (%) of previous period (t-1)). GROWTH=growth of GDP per capita in %; log(INITIAL GDP)=logarithm of current expenditure side GDP from previous period at current PPPs; SCHOOL=secondary school enollment rate (% of population in secondary school age); GOV=general government final consumption expenditure (% of GDP); log(OPENNESS)=logarithm of trade as sum of exports and imports of goods and services (% of GDP); INFL=inflation in consumper prices (% change); ΔNHS=annual growth in household sector net saving (%); ΔNHSR=annual growth in share of net saving to net disposable income (household sector, %).

Table 2: Growth effects of credit growth, household saving growth and household saving rate growth, estimated with Instrumental Variables

In the extended version of our paper (see Bofinger et al. (2021)) we have a closer look at the background to this relationship and show that

1. Bank credit growth generally has highly significant effects on GDP growth, while static measures of bank credit do not (table 3)

Dependent Variable: GROWTH	(1)	(2)
log(INITIAL GDP)	-0.883***	-0.802***
	(0.107)	(0.106)
SCHOOL	0.004	0.008*
	(0.005)	(0.005)
GOV	-0.104***	-0.103***
	(0.023)	(0.022)
log(OPENNESS)	0.603***	0.564***
	(0.158)	(0.153)
INFL	-0.017**	-0.065***
	(0.008)	(0.018)
$CREDIT_{Bank}$	0.000	
	(0.000)	
$\Delta CREDIT_{Bank}$		0.053***
		(0.018)
Constant	10.066***	8.725***
	(0.960)	(1.018)
Observations	1,399	1,387
Countries	41	41
Adj. R-squared	0.1483	0.2351

Note: Heteroskedasticiy-consistent standard errors are indicated in parentheses.

Table 3: Growth effects of dynamic and static bank credit, estimated with Instrumental Variables

2. Bank credit growth is on average stronger associated with GDP growth than total credit growth or capital market lending. While both lending to the household sector and lending to the non-financial corporate sector is positively related to GDP growth, credit to non-financial corporations seems to have a stronger GDP growth effect (table 4)

Dependent: GROWTH	Total credit	Bank credit	Alternative credit	Credit to Households	Credit to Corporations
log(INITIAL GDP)	-1.822***	-1.860***	-1.837***	-2.290***	-2.126***
	(0.501)	(0.514)	(0.581)	(0.579)	(0.744)
SCHOOL	0.018**	0.019**	0.016*	0.015**	0.012
	(0.009)	(0.008)	(0.009)	(0.007)	(0.008)
GOV	-0.415***	-0.422***	-0.439***	-0.548***	-0.524***
	(0.062)	(0.063)	(0.083)	(0.096)	(0.090)
log(OPENNESS)	2.278**	2.287**	2.413**	1.941**	2.134***
	(0.893)	(0.846)	(1.005)	(0.891)	(0.778)
INFL	-0.098***	-0.102***	-0.022	-0.095***	-0.133***
	(0.018)	(0.016)	(0.015)	(0.012)	(0.017)
$\Delta CREDIT$	0.089***	0.098***	0.005*	0.010***	0.068***
	(0.016)	(0.016)	(0.003)	(0.002)	(0.019)
Observations	1,411	1,399	1,370	1,034	1,021
Countries	41	41	41	41	41
Adj. R-squared	0.3921	0.4183	0.3307	0.4745	0.4905

Note: Heteroskedasticiy-consistent standard errors are indicated in parentheses.

Table 4: Growth effects of dynamic credit indicators, estimated with Fixed Effects

3. There are significant differences in the empirical assessment of the finance and growth nexus depending on the development level of a country: While bank credit growth is positively influencing GDP growth for developing and developed countries, the effect of capital market lending is considerably more important for developed countries than for developing economies (table 5). This also becomes obvious when looking at the time dimension of

the relationship between finance and growth: We show that for advanced economies, the impact of bank credit growth on GDP growth has declined in the past two decades, while the importance on non-bank lending has increased. In contrast, there is an increase in the growth effect of credit in less developed countries over the past decades, whereas the impact of capital market financing is not significant throughout (see Bofinger et al. (2021)).

	Bank credit		Alternative credit	
Dependent: GROWTH	Developed countries	Less developed countries	Developed countries	Less developed countries
log(INITIAL GDP)	-4.375***	-2.023*	-3.798***	-2.169
	(0.644)	(1.024)	(0.791)	(1.455)
SCHOOL	0.007	0.023	0.003	0.019
	(0.006)	(0.022)	(0.006)	(0.031)
GOV	-0.468***	-0.332***	-0.473***	-0.296*
	(0.106)	(0.103)	(0.101)	(0.147)
log(OPENNESS)	2.435**	1.670	2.325**	1.953
	(1.040)	(1.182)	(1.080)	(1.435)
INFL	-0.156***	-0.088***	-0.129***	-0.014
	(0.034)	(0.018)	(0.035)	(0.012)
ΔCREDIT	0.086***	0.090***	0.026*	0.002
	(0.020)	(0.021)	(0.015)	(0.003)
Observations	918	481	918	452
Countries	24	17	24	17
Adj. R-squared	0.5295	0.4154	0.5000	0.3277

Note: Heteroskedasticity-consistent standard errors are indicated in parentheses.

Table 5: Growth effects of bank credit and alternative credit by development level, estimated with Fixed Effects

While these results provide a rather positive perception of the relationship between finance and growth, one has to bear in mind that those findings are only giving hints at average, non-causal effects and therefore not indicating any direction of the said link. In other words, we do not know whether more finance necessarily leads to more GDP growth, on average, or whether more GDP growth creates more credit growth. The latter might be quite straightforward and can be explained by second order effects of economic growth, which are rooted in income effects that facilitate the credit provision of banks - and thus increase credit growth (Bofinger & Schächter, 1995). Therefore, we also conducted Granger causality tests and Forecast Error Variance Decompositions (FEVD) and found that there is generally evidence for causality running in both directions. However, the direction running from credit growth to economic growth is more common among all countries, than the other way around.

Additionally, we also find some results that are inconclusive, i.e., where there is neither a positive impact of credit growth on GDP growth, or from GDP growth on credit growth. These results could be seen as an indication for Schumpeter's distinction between productive and unproductive credit (*'secondary wave'*). While credit can be used for investment, i.e. for the production of new real assets, they can also be used for pure financial transactions, i.e. the purchase of existing real assets. The latter transactions only influence prices but not economic growth. We will discuss these results in more detail when analysing the finance and growth nexus for China (chapter 5.5).

5 The financial system in China: A brake or an engine of growth?

In most of the literature on the Chinese growth model, the financial system is not regarded as an engine for growth. Either it is not mentioned at all or it is overwhelmingly regarded as a brake for growth. Berger et al. (2009), for example, after stating that *"China's legal and financial systems are not well developed – even by the standards of most developing nations."* (Berger et al., 2009, p. 113) argue: *"China has maintained high growth in spite of these problems"* (Berger et al., 2009, p. 114). Dobson and Kashyap (2006, p. 103) note *"that the bank-dominated financial system is the economies Achilles' heel"*.

But this discussion raises a puzzle that is not often realized. Hale and Long (2011, p. 316) put as follows:

> *"In spite of the numerous inefficiencies in the financial sector and the apparent discrimination against private firms, the Chinese economy has maintained one of the fastest growth rates throughout human history."*

Or in the words of Yeung (2021, p. 200):

> *"How can we reconcile the rapid growth in China at a time when its banking system is [...] inefficient and with lending policies unfavourable to private enterprises?"*

For a Schumpeterian explanation of growth the mainstream view of an inefficient banking system is especially challenging, as it implies that *"the banker"* has not been able to allocate purchasing power to productive investors.

In this chapter we will try to shed light in this decisive feature of the Chinese growth story. We start with a short survey of the development of the Chinese banking system since the 1980s. We will then try to elaborate on the role that banks have played in the allocation of resources. After a survey of the existing empirical studies we will present our own econometric analysis for which we have constructed a new database for the years 1985 to 2020.

5.1 A survey over the Chinese banking system

When the communist party under the leadership of Mao came into power in the late 1940s, the Chinese banking system was extensively centralized and put under direct state control. Consequently, there was only one bank, the People's Bank of China (PBoC), that performed both central bank and commercial bank duties. The PBoC was operating under the direct authority of the Ministry of Finance (MoF).

In the course of the reform and opening policy under Mao's successor, Deng Xiaoping, China's banking system was then broadly reformed (Tobin & Volz, 2018). Since then, it has been subject to a continuous process of change. After China abolished the Mono-banking system, the PboC was authorized to exercise the rights of a stand-alone central bank. In 1978, its commercial functions were transferred to the so-called *"Big Four"* banks (Agricultural Bank of China, Bank of China, Construction Bank of China and Industrial and Commercial Bank of China) that are still dominating the Chinese banking system today, in particular in terms of assets and lending.

The size of the Chinese banking system measured by the relation of bank credit to GDP is very large. E.g. in 2000, it by far exceeded the ratios of other developing or emerging economies. In 2020, it even exceeded the United States. Only in Hong Kong an even larger ratio can be observed (figure 14).

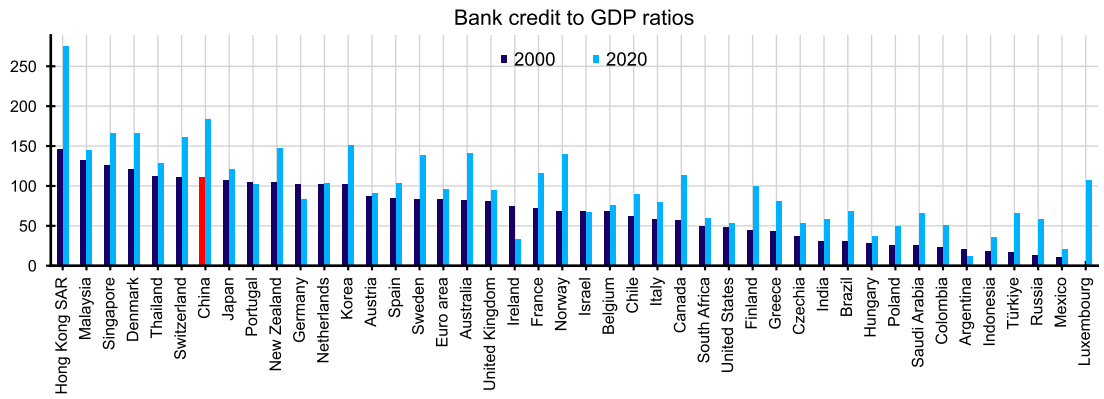


Figure 14: Bank credit to GDP ratios (Source: BIS).

Even today the "Big Four" banks (plus the Bank of Communications, *"Big Five"*)[6] are under significant state control and are therefore referred to as *"state-owned commercial banks"* (SOCB) (Tobin & Volz, 2018). This state influence is reflected not only in the fact that the state is the clear majority shareholder of SOCB (L. Lu, 2016), but also because all of the bank's board members and senior managers are appointed by the government, i.e. the State Council (Dong et al., 2016). In this way, state-owned banks in China receive extensive financial support, for example through capital increases and the provision of liquidity at costs below those of the market rates. About half of all credit from state-owned banks goes to state-owned enterprises (Vernikov, 2015).

In China, each type of banking institution has been constructed to perform specific and differentiated tasks in order to serve the real economy (Williams, 2018). Whereas the SOCB's purpose is to finance mainly large, state-owned companies in specific branches of the economy, the Chinese

[6]The Bank of Communications was redefined as a state-owned commercial bank in 2006 by the CBRC (Dong, Firth, Hou, & Yang, 2016).

banking landscape was also complemented by *"joint-stock banks"* (JSCB, with both state and private shareholding through the stock market) and three state-owned *"policy banks"* in the 1980s and 1990s to finance development objectives respectively (e.g. agriculture, exports and overall economic development). While the higher private share in joint-stock banks should enhance a more active risk management than in the SOCBs, development financing should remain under state control (Tobin & Volz, 2018), so that policy banks are completely state-owned and under direct leadership of the State Council (Sun, 2020). Nevertheless, JSCBs are also subject to a not insignificant amount of state influence, as they were often originally founded by Chinese local governments (L. Lu, 2016).

Besides the five SOCB's, 12 joint-stock banks and the three policy banks, another major pillar of the Chinese banking system are so-called city commercial banks. *"City Commercial Banks"* (CCBs) were originally intended to support the development of their home cities by a large degree of regionally specialized lending and with focus on small and medium-sized companies. They are also used to finance local government projects. By now, however, those banks have expanded widely, as banks with outstanding performance were allowed to operate across provincial borders until recently (Williams, 2018). CCBs, like many JSCBs, were also originally fully owned by local governments, though the ownership structure has become somewhat more diversified since the 2000s. Today, the city commercial banks are thus subject to less government influence than the state banks or policy banks (Dong et al., 2016; Sun, 2020).

Rural commercial banks, a small number of foreign banks and an even smaller amount of privately owned banks complete the picture of banking institutions in China, albeit having a significantly lower weight than the previously mentioned bodies. Rural Commercial banks were set up to finance the development of specific regions, mainly in the inland of China, and thereby reduce the huge income gap between the rural and urban regions. Accordingly, those banks are also under considerable state control (Vernikov, 2015).

Even though foreign banks, like HSBC, Citibank, Deutsche Bank and UBS have been granted more and more rights in operating various business segments in China, they still form a minority in today's banking landscape (Tobin & Volz, 2018), with market shares of generally below 3% (Sun, 2020). The main reason for the increasing importance of foreign banks is their role in supporting the *"going out"* policy and in improving the performance of national banks (Williams, 2018). Also the existence of privately-owned banks is scarcely noticeable in China (regarding number and market size). In 2014 the Chinese government granted permission to set up privately funded banks. in order to improve banking efficiency and expand financing for China's small and medium sized companies. Especially those banks are, however, tightly monitored by Chinese officials and are therefore not able to operate independently (L. Lu, 2016). Figure 15 provides an overview of the

asset share of different banks in total assets in the banking sector.

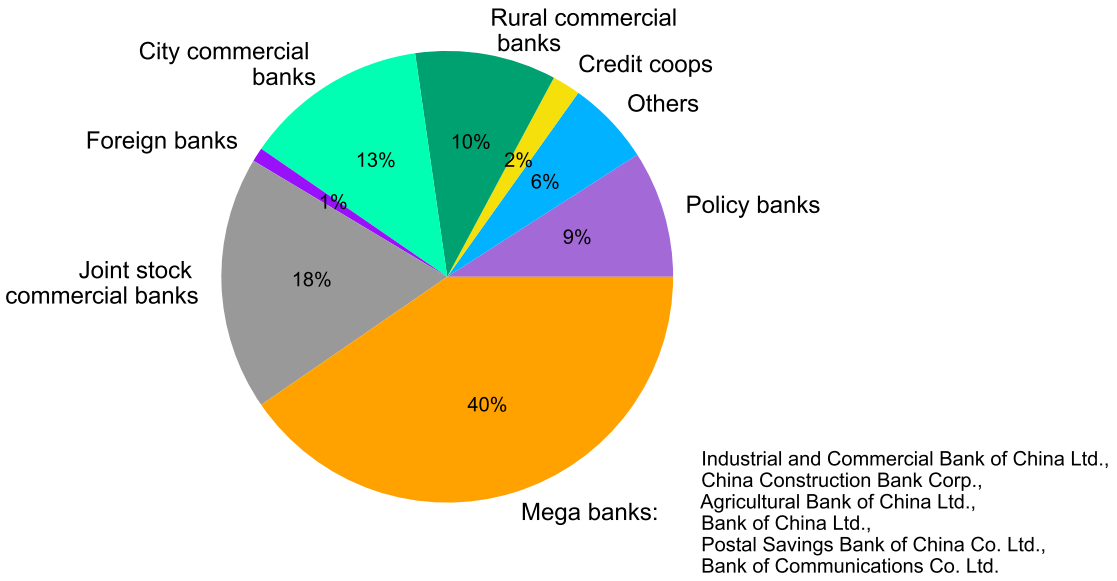


Figure 15: Share of bank type total assets of banking sector in 2020 (Source: S&P Global Ratings (2021)).

Thus, in spite of an ongoing critique from western economists (above all Lardy (1998) and Berger et al. (2009)), the dominance of the state-owned banks in the Chinese system has not fundamentally changed. Since the 2010s the role of the bond market as a financing source has increased which is reflected in the growing difference between total non-financial private and bank lending to the non-financial sector (figure 16).

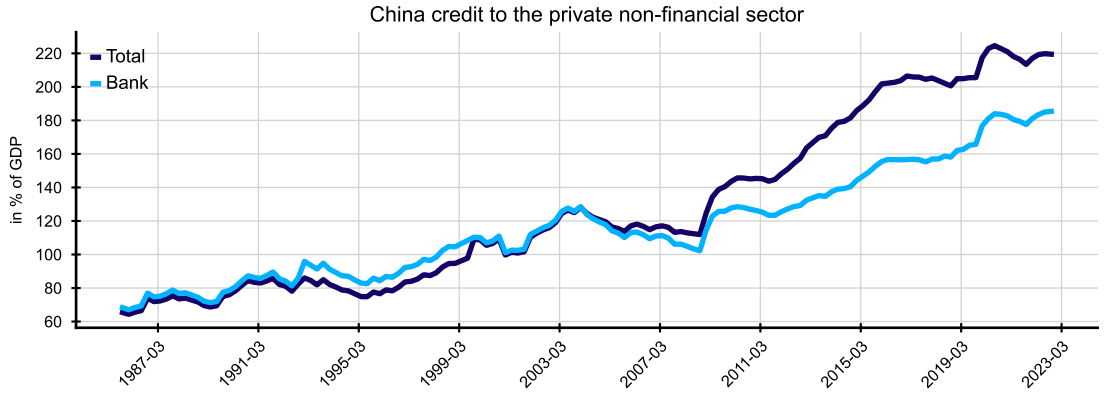


Figure 16: China credit to the private non-financial sector (Source: BIS).

A large share of the bond market goes to public lenders, above all the local governments (25%) and the central bank (18%). Policy banks (15%) can also be attributed to the public sector. The share of

the corporate sector (15%) is relatively small so that its external financing still mainly depends on bank loans (figure 17).

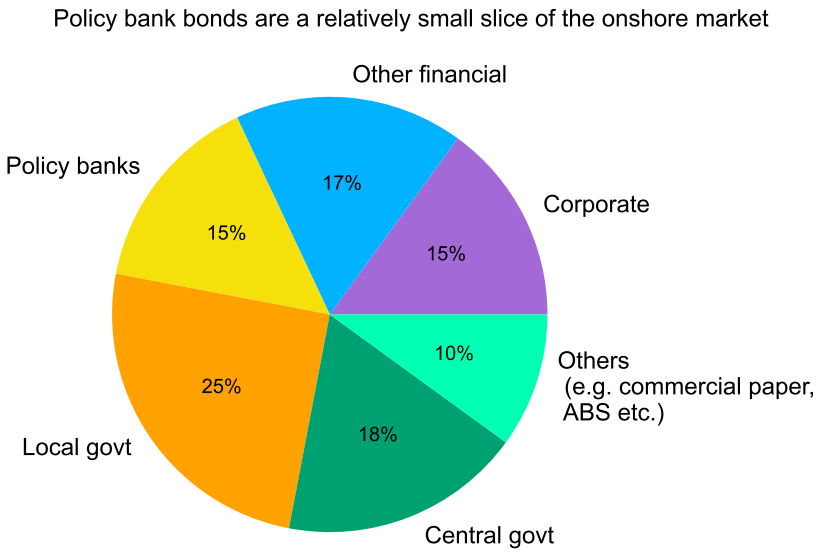


Figure 17: Policy bank bonds share of onshore market (Source: Lau and Chan (2022), WIND, JPMorgan).

As far as the bond market investors are concerned, there is clear dominance by commercial banks so that the largest share of bond market can be regarded as an indirect form of bank lending (figure 18).

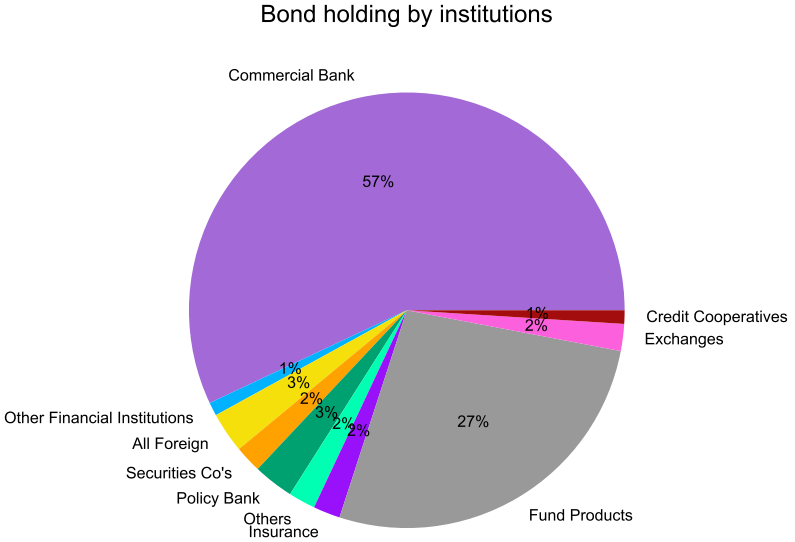


Figure 18: Bond holdings by institutions (Source: Bloomberg (2022), CCDC, SCH).

5.2 Who is the Schumpeterian *"banker"*?

Given the unbroken dominance of the banking system in China, it is natural to explain its growth story in terms of the Schumpeterian paradigm. There are two aspects to this:

- The specific form of resource allocation that results from the production of purchasing power by banks and its allocation to investors.
- The ability of the banker to perform this function by identifying the most productive investors in the process.

As far as the allocation of resources is concerned, Schumpeter (1939) differentiates between three different modes:

- **Centrally planned system:** *"Since the central authority of the socialist state controls all existing means of production, all it has to do in case it decides to set up new production functions is simply to issue orders to those in charge of the productive functions to withdraw part of them from the employments in which they are engaged, and to apply the quantities so withdrawn to the new purposes envisaged."* (Schumpeter, 1939, p. 110)
- **Capitalist system:** *"In capitalist society the means of production required must also be withdrawn from their employments—the case of unemployed resources can easily be taken into account—and directed into the new ones but, being privately owned, they must be bought in their respective markets. [...] If innovation were financed by savings, the capitalist method would be analogous, for the way in which saving and lending to entrepreneurs effects a shifting of factors through a shifting of means of payment may, indeed, be likened to the canceling of an old and the issuing of a new 'order' to the owners of factors."* (Schumpeter, 1939, p. 110)
- **Credit financed innovation:** *"But if innovation is financed by credit creation, the shifting of the factors is effected not by the withdrawal of funds — 'canceling the old order' — from the old firms, but by the reduction of the purchasing power of existing funds which are left with the old firms while newly created funds are put at the disposal of entrepreneurs: the new 'order to the factors' comes, as it were, on top of the old one, which is not thereby canceled."* (Schumpeter, 1939, p. 110f.)

In other words, the allocation via the banking system is an alternative to the allocation via the centrally planned system. This is particularly the case if the banks are state-owned and if the *"banker"* is installed by political bodies. Compared with the centrally planned system, such a regime has the advantage that the government can still exercise control over the economic processes but it requires less information and leaves more discretion to the management of the firms. In fact, this happened in the 1980s when SOEs became independent accounting units and were thus confronted with a hard budget constraint. As the government reduced the direct funding of enterprises, the banks that had been transformed from *"government accountants/cashiers into modern financial institutions"*

(Hale & Long, 2011, p. 316) became the main source for financial funds (figure 19).

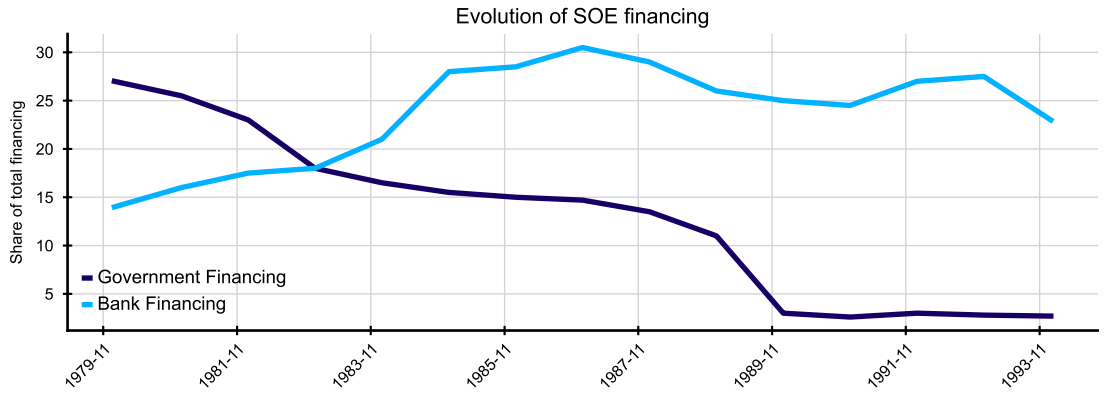


Figure 19: Evolution of SOE financing (Source: based on Cull and Xu (2000)).

As Elliot and Yan (2013) show, executives in the large state-owned financial institutions are effectively high-level government officials. They explain this with three points:

- Leading bank executives have political ranks similar to local and central government officials. This grants them implicit political capital that they can use in dealing with local politicians.
- The highest executives are appointed by the party organization in same way as local and central government officials.
- Bank executives have a chance to obtain top government jobs. Elliot and Yan (2013) mention that former Prime Minister Zhu Rongji once was the CEO of China Construction Bank.

With this strong involvement of the government into the banking system it is not surprising that western economists doubt the qualification of the banking system to allocate resources efficiently (Dobson & Kashyap, 2006). In many papers, the 1990s are mentioned as an example of the inefficiency of the Chinese system. In this period the asset quality of state-owned banks deteriorated significantly due to problems in state-owned enterprises. The government had to support the banks by establishing three policy banks in 1994 that took over the policy-lending activities from the state-owned banks. In 1999, state-owned asset management companies bought 1.4 trillion RMB of non-performing loans from the Big Four at face value (Berger et al., 2009).

But there are also authors with a more positive view of the credit allocation by the Chinese banking system. Based on an econometric study, Cull and Xu (2000) argue that there was a positive association between bank credit and SOE productivity in the 1980s, while there was no such relationship between direct government transfers and productivity. The authors conclude that bank employees assessed SOE credit risks substantially better than the bureaucrats responsible for allocating direct

transfers, above all by imposing harder budget constraints on SOEs than the bureaucrats. However, those constraints eased and in the late 1980s, bank credit was also positively associated with productivity. As Cull and Xu (2003) show, the association between bank finance and profitability weakened in the 1990s as the government shifted bailout responsibilities to the banks.

The authors explain the positive performance of bank financing with the fact that banks had considerable discretion over loans for working capital. Interviews conducted by Cull and Xu (2003) with bank staff revealed that their remuneration is partly linked to the quality of their lending. Thus, while being forced to make many loans under the state plan, there were financial incentives for them from identifying good credit risks (Cull & Xu, 2000).

In addition, Yeung (2021) reports that credit managers are individually responsible for new NPLs incurred under the tenure unless it can be demonstrated that they have followed the loan assessment procedures fully. *"According to the CBIRC, 176 senior bank managers (involved in a total of 2.93 trillion yuan) were sacked for violation of CBIRC regulatory policies in 2017."* Yeung (2021, p. 208)

Overall, Yeung (2021, p. 200) also comes to a positive assessment of the hybrid character of the Chinese financial system:

> *"The hybrid nature of SOCB property rights maintains its credibility by allowing the state to provide counter-cyclical lending to contain any exogenous (economic) shocks and provide long-term financial support for development purposes in the transitional economy and can thus contribute to the socio-economic and political stability of China."*

5.3 Existing empirical studies on China

Andrianova et al. (2010, p. 1) argue that due to the absence of government owned banks in the United Kingdom and the United States *"it is not surprising that there is a deeply ingrained hostility in these countries towards the notion that governments can run banks efficiently."* Empirical evidence for the negative effects of government ownership is provided in a paper by La Porta et al. (2002, p. 267) that comes to the conclusion *"that higher government ownership of banks is associated with slower subsequent development of the financial system, lower economic growth, and, in particular, lower growth of productivity."*

In their analysis Andrianova et al. (2010) show the results of La Porta et al. (2002) "*are fragile to extending the set of conditioning variables to include more "fundamental" determinants of economic growth such as institutional quality / quality of governance*" (Andrianova et al., 2010, p. 3). As the main empirical contribution of their paper, they show that government ownership of banks has been

associated with higher average growth rates during 1995–2007.

In the case of China, Berger et al. (2009, p. 128) come to a very negative assessment of the Chinese state-owned banks:

> *"The Big Four are by far the least profit efficient, due in large part to poor revenue performance and high non-performing loans. The majority foreign banks are the most profitable, so shifting resources from state-owned banks – particularly the Big Four – to foreign ownership is likely to raise China's banking system efficiency appreciably."*

But in the context of a development strategy one has to ask whether the profitability is the right benchmark for their efficiency. Laurenceson and Chai (2001, p. 221) put it as follows:

> *"In this paper we have argued that the commercial banking criteria by which the performance of China's SBs are typically evaluated is inappropriate, and can even be misleading in terms of designing effective economic development policy. If SBs were solely attempting to maximize profits they would be failing in their part role of development banking institutions."*

In general, the empirical literature on the finance and growth nexus in China presents a rather mixed picture. While some studies report overall negative effects of the financial system on growth (T. Chang, 2002; Guariglia & Poncet, 2008; Ma & Jalil, 2008; Xu, 2016)), others find more positive effects (Han & He, 2018; Jalil, Feridun, & Ma, 2010; Y. Zhang, Yao, & Zhang, 2020). Interestingly, the perception of the finance- and growth nexus in the literature on China is changing in the opposite direction to the perception in the general finance and growth literature: While this nexus is generally perceived more negatively due to the presence of vanishing effects, studies in China have recently found more positive results. Of course, there is also a problem of causality in these studies, especially since the data situation for China is generally worse than for cross-country studies. Maswana (2006) and J. Shan and Jianhong (2006) for example show that there might be bidirectional causality between measures of financial development and GDP growth, while J. Z. Shan, Morris, and Sun (2001), J. Shan (2005) and Liang and Jian-Zhou (2006) find unidirectional causality from economic growth to financial development. T. Chang (2002) found neither direction of causality to be statistically significant. J. Li (2009) finds hints for causality running from financial development to economic growth but also reports government distortions in the financial sector that appear to hinder economic growth.

Most studies with positive aggregate effects point to several caveats in their findings: Yao (2010) finds an overall positive effect but signs for inefficiencies in the credit provision. Allen, Qian, and Qian (2005) find overall positive effects of the financial system but attribute them more to alternative financing sources. Bank credit is mainly issued to state owned companies and the banking system is described as inefficient. Similarly, Cull and Xu (2000) argue that while banks

chose to lend to state-owned enterprises with higher subsequent productivity in the 1980s, it softened lending constraints to SOEs in the 1990s. Aziz and Duenwald (2002) find overall positive effects but show that the effect is strongly driven by foreign investment and non-bank sources of finance. They also attribute the negative effects to large proportions of lending flowing to the SOE sector. The negative effects of the strong interrelation between the banking system and the state are also confirmed by Hasan, Wachtel, and Zhou (2009), who also finds positive aggregate effects of the financial system but not of bank lending. Finally, L. Zhang and Bezemer (2016) find positive effects of credit flows on economic growth but negative effects of credit stocks. They explain their findings with inefficient over-investment in gross capital formation and exports relative to consumption, which led to a reallocation of resources that was detrimental to income growth.

The finance and growth studies on China also frequently address the role of different types of banks (e.g. Andersson, Burzynska, and Opper (2016); Boyreau-Debray (2003); Wei and Wang (1997); J. Zhang, Wang, and Wang (2012)), especially state-owned banks. Those studies for example find that bank lending in China is favouring state-owned companies, lowering the effectiveness of other policies to promote growth in non-state industrial sectors. On the other hand, P. C. Chang, Jia, and Wang (2010) finds that lending by state-owned banks in China has become more effective recently due to market-oriented reforms. Du and Girma (2009) and Ayyagari, Demirgüç-Kunt, and Maksimovic (2010) show the general importance of bank credit as a source of financing for enterprise growth in China.

Besides, there are also a few studies with a stronger focus on regional differences. K. Chen, Wu, and Wen (2013) for instance show that there is a strongly positive effect of finance on economic growth in high-income provinces, and a negative one for low-income provinces. Tsai, Weng, and Chang (2016) find that the positive relationship between finance and growth is especially pronounced in the eastern Chinese provinces, and more negative for western and central Chinese regions. The authors attribute this partly to the fact that lending in western regions was for a long time dominated by state-owned banks that directed credit to less efficient, state-owned enterprises.

Lastly, there are also a few studies that examine the role of stock market development for growth in China. Levine (1998) and Pan and Mishra (2018) show in this context that there is generally a rather weak relationship between stock market variables and GDP growth (especially in the short run), as capital markets in China are relatively underdeveloped. Levine (1998) therefore argues that the role of banks for liquidity creation in China is of particular importance.

As Schumpeter (1934a) made clear, a critical question concerning the empirical relationship between the financial system and growth is, of course, how the respective credit is used (cf. for

instance Bezemer et al. (2016)). Assuming that credit can be used either in a productive or a less productive way, the relationship between finance and growth might be less clear cut than it might seems at a first glance.

One of the key papers with regard to the connection between credit and (unproductive) real estate investment is by Deng, Morck, Wu, and Yeung (2015), who describe the dynamics of credit supply and real estate price. They also examine the link between government owned enterprises and rising real estate price. Facing the global financial crisis, the Chinese government tried to stabilize the economy by monetary expansion. The Chinese Communist Party ordered banks to lend and firms to invest. In order to minimize risks, large state-owned banks lent primarily to large SOEs which increased their borrowing and used the funds to invest in real estate as real estate can generate observable short-term profit, unlike productive investment in factories, technology or R&D, which is costly. While this strategy was effective on paper, it also led to a surge in real estate prices, especially since SOEs paid significantly more for real estate than any other interested parties.

Cong, Gao, Ponticelli, and Yang (2019) furthermore find that before the stimulus period, after the Great Financial crisis (2009-2010), China experienced a gradual reallocation of capital form low- to high-productivity firms. During the stimulus period, the trend was reversed and low-productivity SOEs received more capital. This trend reversal did not end with the stimulus in 2010, but persisted.

Banga et al. (2022, p. 73) argue that local government officials were judged on the GDP performance of their province, leading to a significant increase in local government debt, which relied on Local Government Funding Vehicles (LGFVs) that used land owned by local governments as capital and collateral for borrowing from infrastructure banks, especially the CBD. This procedure is not without risk: "*Between 2010 and 2014, local government debt grew by over 20 per cent p.a, and this, together with reliance on land as collateral, increased risks - at the same time contingent liabilities remained obscure*" (Banga et al., 2022, p. 73). Therefore, LGFVs were banned in 2014 and local government had to finance themselves through bond markets instead. This led to greater involvement of banks, non-financial corporations and shadow banks and the establishment of public-private partnerships. The Chinese government has also started to deleverage the non-financial corporate sector, which saw its debt-to-GDP ratio rise from 95% to 158% between 2008 and 2016. Since 2018, this ratio has been falling. (Banga et al., 2022, p. 73f.).

5.4 Empirical analysis results - Provincial panel analysis

Based on our previous cross-country findings we now have a closer look at the finance and growth nexus within the People's Republic of China. As we suppose that resorting to aggregate country-

level statistics would average out some interesting findings[7], we now resort to provincial level panel data. Referring to data from the official Chinese Provincial yearbooks we account for the development in 31 Chinese provinces between 1985 and 2020.

As we show in more detail in our paper (see Geißendörfer and Haas (2022)) we also find a robust and significantly positive relationship between *"finance"* (i.e. credit growth) and GDP growth for all Chinese provinces. Analogous to our previous cross-country analysis we show that variables with a rather high proportion of unproductively used credit (i.e. total credit indicators, $\Delta CREDIT_{tot}$) do not seem to have a significant relationship with GDP growth. Credit growth to the non-financial corporate sector in China ($\Delta CREDIT_{NFC}$), however, has a significantly positive growth effect, also when looking at a time lag of one year (tables 6 and 7).

					FE				
Dependent: ΔGDP_{real}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$log(INITIALGDP)$	-0.118***	-0.124***	-0.131***	-0.101***	-0.0974***	-0.0982***	-0.109***	-0.118***	-0.128***
	(0.0239)	(0.0238)	(0.0237)	(0.0231)	(0.0194)	(0.0230)	(0.0212)	(0.0210)	(0.0185)
$SCHOOL$	0.0899	0.0863	0.0790	0.0791	0.0710	0.0913	0.0730	0.0738	0.0727
	(0.0562)	(0.0569)	(0.0563)	(0.0583)	(0.0554)	(0.0583)	(0.0609)	(0.0619)	(0.0624)
$log(GOV)$	0.118***	0.119***	0.122***	0.107***	0.103***	0.107***	0.114***	0.118***	0.122***
	(0.0220)	(0.0222)	(0.0219)	(0.0202)	(0.0190)	(0.0206)	(0.0194)	(0.0194)	(0.0183)
$log(OPENNESS)$	-0.00903**	-0.00923**	-0.0106**	-0.00838*	-0.00979*	-0.00724*	-0.00952**	-0.00967*	-0.0125**
	(0.00409)	(0.00434)	(0.00458)	(0.00414)	(0.00493)	(0.00382)	(0.00462)	(0.00528)	(0.00502)
$\Delta CREDIT_{tot}$	7.47e-07**								
	(3.32e-07)								
$\Delta CREDIT_{tot(l1)}$		1.65e-06***							
		(4.31e-07)							
$\Delta CREDIT_{tot(l2)}$			6.11e-07						
			(4.16e-07)						
$\Delta CREDIT_{NFC}$				0.0151*					
				(0.00778)					
$\Delta CREDIT_{NFC(l1)}$					0.0162*				
					(0.00916)				
$\Delta CREDIT_{NFC(l2)}$						-0.00116			
						(0.0142)			
ΔINV_{credit}							0.00249		
							(0.00248)		
$\Delta INV_{credit(l1)}$								0.000559	
								(0.00287)	
$\Delta INV_{credit(l2)}$									-0.00403
									(0.00324)
Constant	0.281***	0.311***	0.340***	0.248***	0.240**	0.239**	0.289***	0.323***	0.351***
	(0.0960)	(0.0964)	(0.101)	(0.0890)	(0.0876)	(0.0899)	(0.0971)	(0.0991)	(0.0962)
Observations	981	957	931	1,040	1,016	1,009	891	877	863
Number of Provinces	31	31	31	31	31	31	31	31	31
Adj. R-squared	0.726	0.719	0.714	0.736	0.749	0.742	0.726	0.715	0.711

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Growth effects of dynamic credit indicators and lagged credit indicators, estimated with Fixed Effects

[7] A simple OLS analysis on the relationship between credit growth and GDP growth based on the data from the previous data base (BIS) for China yields coefficients of on average zero.

	RE								
Dependent: ΔGDP_{real}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$log(INITIALGDP)$	-0.0102*	-0.0126**	-0.0206***	-0.0142***	-0.0175***	-0.0144**	-0.0313***	-0.0212***	-0.0151**
	(0.00549)	(0.00558)	(0.00579)	(0.00548)	(0.00543)	(0.00606)	(0.00697)	(0.00627)	(0.00594)
$SCHOOL$	0.00352	0.0149	0.0435	-0.00208	-0.00227	0.00451	0.0296	0.00115	-0.0262
	(0.0618)	(0.0611)	(0.0583)	(0.0621)	(0.0587)	(0.0624)	(0.0624)	(0.0647)	(0.0653)
$log(GOV)$	0.0179**	0.0214**	0.0331***	0.0249***	0.0298***	0.0242**	0.0502***	0.0348***	0.0260***
	(0.00862)	(0.00897)	(0.00958)	(0.00923)	(0.00921)	(0.00999)	(0.0111)	(0.0103)	(0.00958)
$log(OPENNESS)$	0.000609	0.000732	0.000185	0.000656	2.15e-05	0.000720	0.000113	0.00109	0.00180
	(0.00215)	(0.00222)	(0.00249)	(0.00223)	(0.00236)	(0.00227)	(0.00246)	(0.00243)	(0.00238)
$\Delta CREDIT_{tot}$	1.66e-06***								
	(4.62e-07)								
$\Delta CREDIT_{tot(l1)}$		2.91e-06***							
		(5.41e-07)							
$\Delta CREDIT_{tot(l2)}$			1.77e-06***						
			(5.08e-07)						
$\Delta CREDIT_{NFC}$				0.0261***					
				(0.00944)					
$\Delta CREDIT_{NFC(l1)}$					0.0253**				
					(0.0109)				
$\Delta CREDIT_{NFC(l2)}$						0.00939			
						(0.0175)			
ΔINV_{credit}							0.00590**		
							(0.00274)		
$\Delta INV_{credit(l1)}$								0.00404	
								(0.00275)	
$\Delta INV_{credit(l2)}$									-0.00197
									(0.00292)
Constant	0.140***	0.138***	0.126***	0.137***	0.129***	0.145***	0.151***	0.166***	0.178***
	(0.0334)	(0.0340)	(0.0362)	(0.0375)	(0.0316)	(0.0340)	(0.0288)	(0.0287)	(0.0285)
Observations	981	957	931	1,040	1,016	1,009	891	877	863
Number of Provinces	31	31	31	31	31	31	31	31	31
Adj. R-squared	0.715	0.707	0.701	0.724	0.740	0.732	0.713	0.701	0.697

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Growth effects of dynamic credit indicators and lagged credit indicators, estimated with Random Effects

Looking at the literature on China's economic development, however, it becomes clear that a purely aggregate view of the relationship between credit and growth is probably too generalizing. As figure 20 shows, there is a considerable gap in the development of real GDP among Chinese regions that needs to be accounted for in our further empirical analyses. While the eastern provinces of China still account for the highest real GDP values, there is a significant *'catching up'* process observable for the other regions, especially for the Western part of the country. In absolute terms, eastern Chinese regions still dominate the economies of western and central/northern China with a GDP of approximately RMB 50.98 trillion (about USD 7.61 trillion), making up about 51.9 percent of China's total GDP today (as of 2019). In the same year, central and northern China had a combined GDP of RMB 26.76 trillion (USD 4.0 trillion) and western China had a GDP of RMB 20.49 trillion (USD 3.06 trillion). This goes back to historic reasons: The east coast was the first region in China that benefited from the opening up policy of the Chinese government, first and foremost through the generation of special economic zones (SEZs). Due to their favourable location, they were originally initiated in the provinces of Shanghai, Guangdong, Fujian and Hainan (Crane, Albrecht, Duffin, & Albrecht, 2018).

The idea then was that there would soon be spillover effects to other Chinese provinces, that would subsequently also benefit from the export-oriented policies of the general government. However, as those spillover effects did in fact not (or not sufficiently) materialize, and strong regional disparities became apparent, the government decided to launch development programs for the regions that were left behind. In the late 1990s, the *'China Western Development Program'* was therefore initiated, followed by the *'Rise of Central China'* and *'Revitalize Northeast China'* programs in the early 2000s.

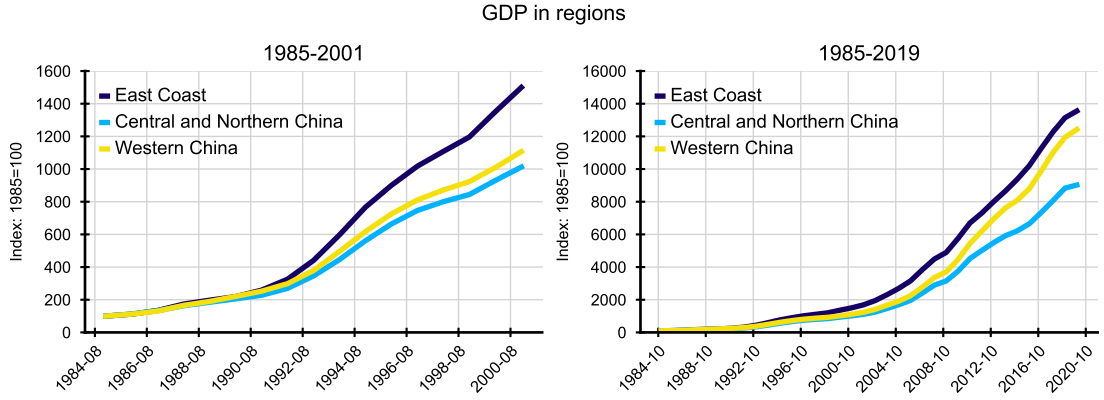


Figure 20: Based on Geißendörfer and Haas (2022). Indexed means of GDP by Chinese region (1985 = 100) (Source: China Provincial Statistical Yearbooks)

As a results, those regions received financial support, for example for infrastructure, education or health care projects, as well as preferential policies for foreign direct investment (FDI). The Belt and Road initiative starting from 2009 is also favouring the development of China's western regions (Crane et al., 2018).

In contrast to the western regions that slowly started to catch up, the central and northern provinces of China, however, still had severe structural problems related to the predominance of state-owned enterprises, that resulted in a lower FDI inflow and reduced productivity (Crane et al., 2018). Especially the provinces of Heilongjiang and Jilin are therefore also referred to as China's *'Rust Belt'* (Rechtschaffen, 2017).
In an extension of our empirical analyses to include this regional component, we come to the following conclusions:

1. Generally there is a positive relationship between GDP growth and the growth of credit to the corporate sector in China, while total credit provision does not necessarily have a positive relationship with GDP growth

2. While the development process started considerably earlier in China's East coast region, growth in the central, northern and western regions took place later, i.e. after China's entry into the WTO in 2001. As a result, there is no statistically significant difference in GDP growth among the Chinese regions after 2001 (table 8)

	RE								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent: ΔGDP_{real}					year <2001			year >= 2001	
$log(INITIALGDP)$	-0.0174**	-0.0201***	-0.0459***	-0.0141	-0.00821	-0.0275**	-0.0325***	-0.0350***	-0.0388***
	(0.00793)	(0.00763)	(0.0106)	(0.0148)	(0.0134)	(0.0121)	(0.00903)	(0.00852)	(0.00949)
$SCHOOL$	0.0431	0.0295	0.0551	0.00384	-0.0269	-0.0435	0.0599	0.0614	0.0631
	(0.0552)	(0.0547)	(0.0566)	(0.0705)	(0.0635)	(0.0691)	(0.0530)	(0.0489)	(0.0518)
$log(GOV)$	0.0292**	0.0341***	0.0698***	0.0282	0.0212	0.0451***	0.0505***	0.0543***	0.0600***
	(0.0114)	(0.0112)	(0.0146)	(0.0190)	(0.0166)	(0.0173)	(0.0140)	(0.0131)	(0.0143)
$log(OPENNESS)$	-0.00613*	-0.00549	-0.00784**	-0.00171	5.40e-05	-0.00243	-0.00495	-0.00432	-0.00379
	(0.00335)	(0.00334)	(0.00360)	(0.00450)	(0.00418)	(0.00471)	(0.00386)	(0.00370)	(0.00390)
$\Delta CREDIT_{tot}$	2.41e-06***			0.00456			1.47e-06***		
	(5.93e-07)			(0.00418)			(3.92e-07)		
$\Delta CREDIT_{NFC}$		0.0256***			0.0256			0.0201***	
		(0.00854)			(0.0200)			(0.00672)	
ΔINV_{credit}			0.00417			0.00971			0.00247
			(0.00261)			(0.00936)			(0.00316)
$GEO_{centralnorth}$	-0.0271***	-0.0261**	-0.0332***	-0.0322***	-0.0298***	-0.0363***	-0.0207*	-0.0184	-0.0171
	(0.0104)	(0.0102)	(0.0124)	(0.0103)	(0.00973)	(0.0122)	(0.0124)	(0.0119)	(0.0128)
GEO_{west}	-0.0168	-0.0167	-0.0295**	-0.0270*	-0.0225*	-0.0350**	-0.00906	-0.00933	-0.00890
	(0.0112)	(0.0110)	(0.0135)	(0.0142)	(0.0127)	(0.0146)	(0.0116)	(0.0111)	(0.0121)
Constant	0.115***	0.117***	0.144***	0.132***	0.140***	0.182***	-0.110**		-0.0609
	(0.0328)	(0.0354)	(0.0256)	(0.0378)	(0.0380)	(0.0300)	(0.0546)		(0.0662)
Observations	981	1,040	891	402	424	351	579	616	540
Number of Provinces	31	31	31	29	31	30	31	31	31
Adj. R-squared	0.715	0.724	0.713	0.700	0.705	0.708	0.691	0.713	0.658

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Growth effects of dynamic credit indicators with dummy variable for regions, estimated with Random Effects

3. Corporate credit provision to the Chinese East coast region was also significantly more effective in terms of GDP growth than lending to the other regions. It seems, however, that there might be a vanishing effect of those significant differences after 2001. Also, total credit provision to central and northern regions of China seems to be less growth enhancing than total lending to China's western regions, particularly after 2001 (table 9)

	RE								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent: ΔGDP_{real}					year <2001			year >= 2001	
$log(INITIALGDP)$	-0.0171**	-0.0191**	-0.0522***	-0.0134	-0.00769	-0.0277**	-0.0262***	-0.0343***	-0.0320***
	(0.00796)	(0.00748)	(0.0116)	(0.0142)	(0.0133)	(0.0117)	(0.00932)	(0.00833)	(0.00883)
$SCHOOL$	0.0386	0.0185	0.0589	0.0178	-0.0265	-0.0393	0.0539	0.0524	0.0591
	(0.0567)	(0.0546)	(0.0564)	(0.0673)	(0.0640)	(0.0683)	(0.0554)	(0.0521)	(0.0540)
$log(GOV)$	0.0287**	0.0332***	0.0783***	0.0275	0.0208	0.0452***	0.0423***	0.0536***	0.0501***
	(0.0114)	(0.0111)	(0.0156)	(0.0183)	(0.0166)	(0.0168)	(0.0139)	(0.0130)	(0.0139)
$log(OPENNESS)$	-0.00606*	-0.00502	-0.00842**	-0.00206	-0.000133	-0.00286	-0.00488	-0.00404	-0.00430
	(0.00332)	(0.00310)	(0.00361)	(0.00410)	(0.00413)	(0.00469)	(0.00378)	(0.00357)	(0.00381)
$\Delta CREDIT_{tot}$	0.0125			0.0755			0.00398		
	(0.0162)			(0.0732)			(0.00539)		
$\Delta CREDIT_{NFC}$		0.0878***			0.0611***			0.0589***	
		(0.0165)			(0.0220)			(0.0220)	
ΔINV_{credit}			0.00972*			0.0284			0.000555
			(0.00558)			(0.0238)			(0.00520)
$GEO_{centralnorth}$	-0.0245**	-0.0154	-0.0333***	-0.0348*	-0.0211**	-0.0339**	-0.0185	-0.0129	-0.0151
	(0.0110)	(0.00960)	(0.0127)	(0.0179)	(0.0103)	(0.0132)	(0.0124)	(0.0107)	(0.0130)
GEO_{west}	-0.0144	-0.00468	-0.0313**	-0.0105	-0.0127	-0.0280**	-0.0189	-0.00351	-0.00791
	(0.0116)	(0.0103)	(0.0138)	(0.0193)	(0.0114)	(0.0139)	(0.0116)	(0.00995)	(0.0119)
$\Delta CREDIT_{tot} * GEO_{centralnorth}$	-0.0125			0.0210			-0.00398		
	(0.0162)			(0.0735)			(0.00539)		
$\Delta CREDIT_{tot} * GEO_{west}$	-0.0119			-0.0756			0.0751***		
	(0.0160)			(0.0732)			(0.0262)		
$\Delta CREDIT_{NFC} * GEO_{centralnorth}$		-0.0678***			-0.0511			-0.0402*	
		(0.0176)			(0.0316)			(0.0235)	
$\Delta CREDIT_{NFC} * GEO_{west}$		-0.0769***			-0.0558**			-0.0421*	
		(0.0199)			(0.0271)			(0.0253)	
$\Delta INV_{credit} * GEO_{centralnorth}$			-0.00915			-0.0125			-0.00988
			(0.0107)			(0.0304)			(0.0115)
$\Delta INV_{credit} * GEO_{west}$			-0.00879			-0.0319			0.00515
			(0.00629)			(0.0259)			(0.00679)
Constant	0.113***	0.110***	0.144***	0.106***	0.132***	0.175***			
	(0.0326)	(0.0353)	(0.0273)	(0.0378)	(0.0384)	(0.0288)			
Observations	981	1,040	891	402	424	351	579	616	540
Number of Provinces	31	31	31	29	31	30	31	31	31
Adj. R-squared	0.715	0.725	0.712	0.703	0.704	0.708	0.692	0.712	0.659

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

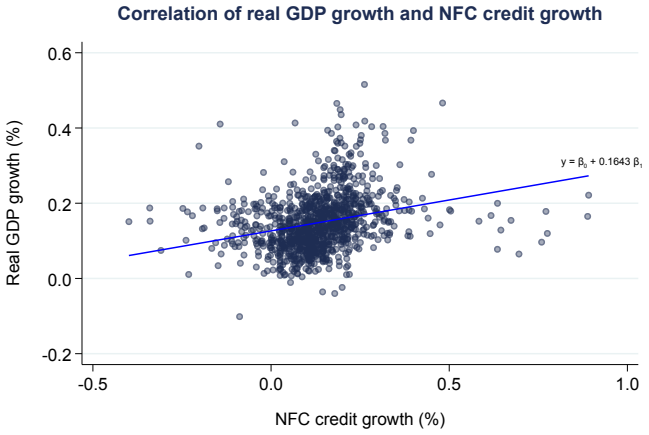
Table 9: Growth effects of dynamic credit indicators with dummy variable for regions, estimated with Random Effects

In line with the general literature on finance and growth we have then also taken a closer look at the role of the size of the financial system. As indicated in our previous literature review, a substantial part of the literature after the global financial crisis finds that the initially positive

relationship between finance and growth might turn negative after a certain size of the financial system is reached.

A first glance at the data in Figure 21 provides evidence that this also might be the case for China. We see that the correlation between real GDP growth and the growth of credit provision to the non-financial corporate sector differs fundamentally when differentiated by the size of the financial system, measured as total credit to GDP. One can see that the fitted values for the first decile of credit to GDP (containing all observations that belong to the bottom 10 percent of total credit to GDP in our data set) has the steepest slope, while there is almost no positive correlation between NFC credit growth and real GDP growth for the highest 10 percent of total credit to GDP observations.

(a) Overall correlation



(b) Correlation by selected deciles of total credit to GDP

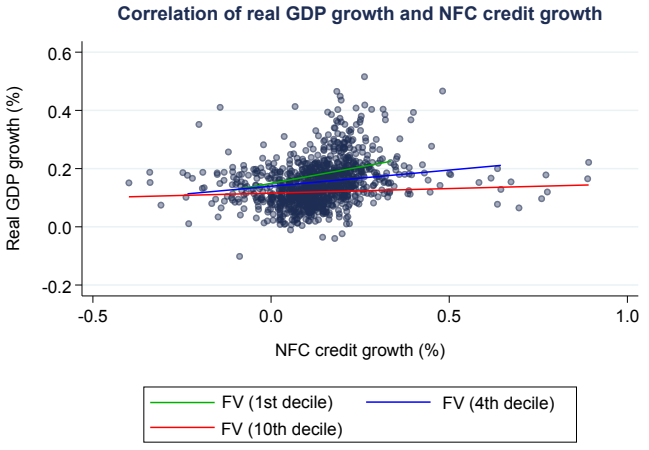


Figure 21: Based on Geißendörfer and Haas (2022). Correlation of real GDP growth and NFC credit growth for all provinces and years (Source: China Provincial Statistical Yearbooks).

Accordingly we have repeated our baseline panel estimations by differentiating between deciles in the total credit to GDP ratio. First, we found that there are generally higher growth rates in provinces that have higher credit to GDP ratios, which is not surprising. However, we also found that there is a negative interaction between credit provision and an observation belonging to the top 10 percent of credit to GDP. In other words, credit provision to provinces with lower credit to GDP ratios makes more sense from a GDP growth perspective, than lending to provinces that already have a lot of financial resources for growth (table 10).

	FE						RE					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent: ΔGDP_{real}				$d(CREDIT/GDP) \leq 9$						$d(CREDIT/GDP) \leq 9$		
$log(INITIALGDP)$	-0.120***	-0.107***	-0.107***	-0.135***	-0.119***	-0.112***	-0.00927	-0.0133**	-0.0295***	-0.00644	-0.00816	-0.0140*
	(0.0242)	(0.0233)	(0.0214)	(0.0247)	(0.0238)	(0.0208)	(0.00631)	(0.00628)	(0.00742)	(0.00765)	(0.00759)	(0.00846)
$SCHOOL$	0.106*	0.0968	0.0851	0.0890	0.0731	0.0834	0.0378	0.0284	0.0424	0.0185	0.00578	-0.0169
	(0.0598)	(0.0612)	(0.0619)	(0.0717)	(0.0765)	(0.0701)	(0.0616)	(0.0628)	(0.0624)	(0.0637)	(0.0637)	(0.0698)
$log(GOV)$	0.118***	0.109***	0.114***	0.141***	0.128***	0.135***	0.0162*	0.0227**	0.0471***	0.0117	0.0144	0.0234*
	(0.0220)	(0.0201)	(0.0194)	(0.0205)	(0.0187)	(0.0172)	(0.00958)	(0.0102)	(0.0117)	(0.0110)	(0.0111)	(0.0122)
$log(OPENNESS)$	-0.00771*	-0.00875**	-0.00985**	-0.00799*	-0.00934*	-0.0139**	-2.86e-05	-0.000101	-0.000361	0.00122	0.00109	0.00136
	(0.00441)	(0.00423)	(0.00474)	(0.00468)	(0.00464)	(0.00543)	(0.00222)	(0.00228)	(0.00239)	(0.00225)	(0.00210)	(0.00202)
$\Delta CREDIT_{tot}$	7.70e-07**			7.16e-07*			1.73e-06***			1.95e-06***		
	(3.43e-07)			(3.96e-07)			(4.73e-07)			(4.95e-07)		
$\Delta CREDIT_{NFC}$		0.0212**			0.0200**			0.0318***			0.0323***	
		(0.00848)			(0.00812)			(0.0113)			(0.0111)	
ΔINV_{credit}			0.00563			0.00427			0.00938**			0.0103**
			(0.00403)			(0.00404)			(0.00412)			(0.00462)
$d10(CREDIT/GDP)$	0.0133	0.0163**	0.00976				0.000419	0.00892*	0.00359			
	(0.0111)	(0.00712)	(0.00833)				(0.00588)	(0.00482)	(0.00553)			
$d10(CREDIT/GDP) * \Delta CREDIT_{tot}$	-0.0134						0.0259					
	(0.0300)						(0.0207)					
$d10(CREDIT/GDP) * \Delta CREDIT_{NFC}$		-0.0292*						-0.0265				
		(0.0160)						(0.0189)				
$d10(CREDIT/GDP) * \Delta INV_{credit}$			-0.00797						-0.00888*			
			(0.00475)						(0.00469)			
Constant	0.294***	0.260***	0.273***	0.304**	0.262**	0.209**	0.126***	0.122***	0.145***	0.138***	0.136***	0.170***
	(0.0998)	(0.0902)	(0.0991)	(0.113)	(0.106)	(0.0993)	(0.0342)	(0.0388)	(0.0292)	(0.0317)	(0.0350)	(0.0280)
Observations	928	960	856	834	858	771	928	960	856	834	858	771
Number of Provinces	31	31	31	31	31	31	31	31	31	31	31	31
Adj. R-squared	0.720	0.727	0.726	0.723	0.727	0.725	0.708	0.715	0.712	0.713	0.715	0.712

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Growth effects of dynamic credit indicators with dummy variable for credit to GDP share, estimated with Fixed Effects and Random Effects

In summary, we found temporal and geographic differences in the growth process of Chinese regions, as well as with respect to the role of credit in it. We also covered the importance of the size of the financial system and showed that it is crucial to differentiate by the recipients of credit, in order to evaluate its effectiveness in terms of GDP growth. In this context there is also a growing literature that observes credit bubbles in China and warns of possible risks associated with it (M. Chen, 2018). Inefficient lending or use of credit or overinvestment can lead to such bubbles, which can result in financial crises and economic collapses and/or inflation. As we have shown in the beginning of this paper, Chinese economic policy has so far managed to control risks to the extent that the Chinese economy has continued to grow strongly without high inflation or bursting financial bubbles.

5.5 Empirical analysis results - Granger causalities and FEVD

In Bofinger et al. (2021) we further elaborate on the direction of effects of the financial system on economic growth and the presence of unproductive credit in the finance and growth nexus that were already mentioned in chapter 4.3.2, and which is still an open topic as e.g. Asanović (2020, p. 102) points out: *'Despite the large volume of empirical research, many questions still remain unresolved and there is still no consensus on the direction of the relation between financial and real sector.'* Therefore, we now examine the directions of the relationship between credit (financial sector) and economic growth (real sector) with a special focus on the effects for China.

A standard approach to determining the usefulness of one time series for forecasting another is the so-called 'Granger causality test' even though the assertion of causality by this test would be too far-fetched. In short, the test is based on the idea that one series (call it x) Granger-causes another series y if the forecasts of y improve when x is included in the forecasting process (Granger, 1969).

Our results indicate that for a majority of countries there is a significant relationship between credit growth and GDP growth. The number of countries in which GDP growth leads to credit growth is higher than the share of countries for which the data infer growth-generating lending. In about a third of the countries we find significant effects from credit growth on GDP growth and vice versa. In 20% of the countries, there is no empirical evidence for any relationship between finance and growth (these results are reflected by the coloring of the bars in figures 22 and 23 and can be found in more detail in Bofinger et al. (2021)).

Beyond that we also apply Forecast Error Variance Decomposition (FEVD). This approach is based on estimating a bivariate vector autoregressive model (VAR) from the data and then using the fitted model to forecast multiple periods by implementing exogenous shocks. Thereby we measure the proportion of forecast error variance of variable x that can be attributed to an exogenous shock

to variable y (Lütkepohl & Krätzig, 2004, p. 180f). For example, a credit shock explains 16% of the variation in GDP in China, but only 6% in the US (see figure 22). Analogously, in China about 10% of the variation in credit growth comes from a GDP shock, while in the US this accounts for 12% (figure 23).

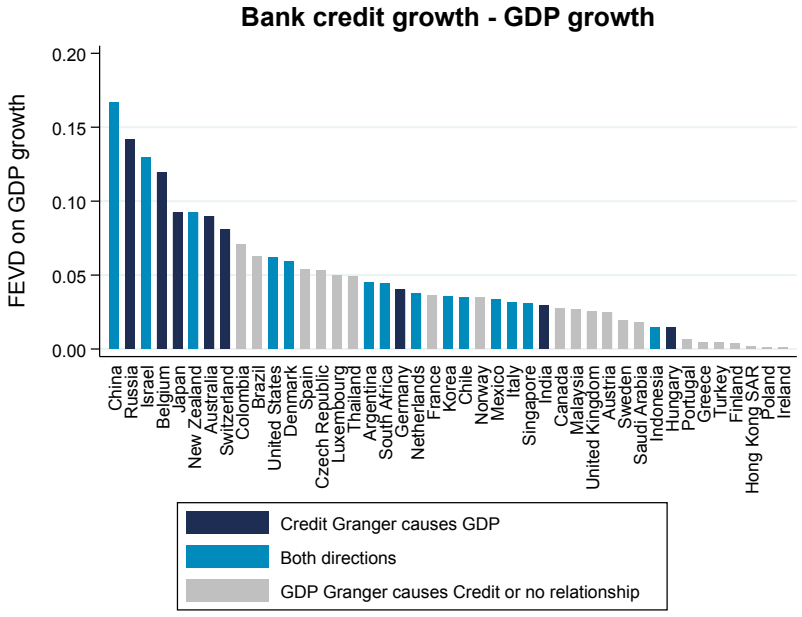


Figure 22: FEVD for GDP with credit shock.
Based on Bofinger et al. (2021)). Color of bars indicate results of Granger causality tests between credit growth and GDP growth.

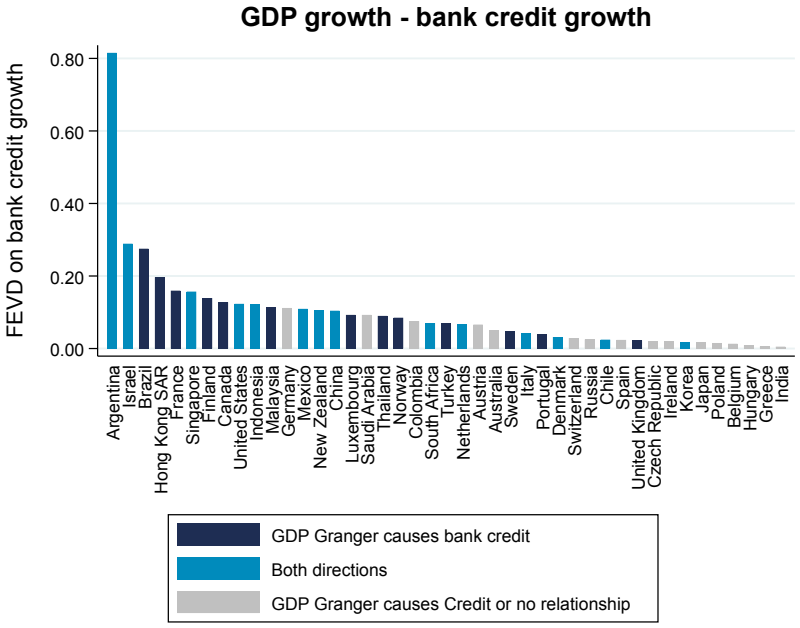


Figure 23: FEVD for Credit with GDP shock.
Based on Bofinger et al. (2021)). Color of bars indicate results of Granger causality tests between credit growth and GDP growth.

Our FEVD findings thus generally match with and confirm the results from the Granger causality tests. For countries where we find that credit growth Granger causes GDP growth or the Granger tests suggest a both way significant relationship, we also find a high effect of credit growth on GDP growth. The same applies for countries where GDP growth Granger causes credit growth or Granger tests suggest a both way significant relationship. From figure 23 we can see that for China, the effect from credit growth on GDP is particularly pronounced, compared to the other countries in our sample.

6 Industrial policy and banks in China

In summary, the Schumpeterian approach to the finance and growth nexus seems to fit quite well in explaining China's economic development. However, it would be short sighted to purely focus on the role of banks without discussing the role of the Chinese state within the banking system. We argue that China constitutes a **hybrid form of the Schumpeterian growth model**. Schumpeter states that the growth process is initiated either by a central planner (e.g. the state) that directly shifts resources to more productive use or by banks that generate purchasing power by the provision of credit. In the Chinese hybrid model, there is a centrally planned purchasing power provision for resource allocation: Banks provide loans but the state determines the strategic direction of this credit (for example specific industrial policy programs). For this reason, we will now focus on the role of the state within the finance and growth nexus in China with a special

focus on industrial policy.

6.1 Literature on industrial and innovation policy

Industrial policy has returned to the center of the economic policy debate in recent years. While it has often been dismissed as an inefficient tool that disrupts free market forces, its usefulness as a tool to manage economic shocks and, more importantly, to steer long-term trends is now being discussed more openly (OECD, 2022b). There is broad consensus that industrial policy should be pursued in a horizontal way, for example, to close gaps between social and private returns (externalities) when it comes to developing new technologies and products (Sachverständigenrat, 2019; Stiglitz, Lin, & Monga, 2013). Moreover, most countries are pursuing some form of industrial policy (Terzi, Singh, & Sherwood, 2022). However, there is still no consensus on the proper design of industrial policy and more generally on the overall framework or even which policies should be considered industrial policy (OECD, 2022b; Rodrik, 2009).

6.1.1 Industrial policy strategies and instruments

Industrial policy can be defined as *'interventions intended to improve structurally the performance of the domestic business sector'* (OECD, 2022b, p.4). **Industrial policy strategies** are a coherent and articulated set of policy instruments aimed at achieving a specific policy objective (OECD, 2022b). While such strategies have traditionally focused on sectoral or locational orientations, more recent strategies are focused on specific technologies or follow a mission-oriented approach (Larrue, 2021; Mazzucato, 2015, 2016; OECD, 2022b).

A classic industrial policy strategy is **sectoral strategies**. These target specific sectors or groups of sectors (European Commission, 2021). While the focus has traditionally been on innovation and productivity growth, strategic autonomy or resilience are now also discussed within these strategies (OECD, 2022b).

Technology-focused strategies aim in particular at the creation of innovations and technologies. Unlike sectoral strategies, technology-focused strategies are cross-sectoral (OECD, 2022b).

Mission-oriented strategies are also less focused on specific sectors and instead formulate a society-wide goal to be achieved across all sectors. Mission-oriented industrial policies therefore allow for more focused coordination of different actors and resources towards a common goal. Because spillover effects can occur during the process, the mission-oriented approach also provides welfare effects for society as a whole that go beyond the achievement of the primary goal. While the mission-oriented approach has its origins in the defense and space sectors (*"Manhattan Project"*,

"Apollo Program"), it has been increasingly used, at least since the beginning of the 21st century, for targeted and proactive policies to address societal challenges such as climate change (Larrue, 2021; Mazzucato, 2015, 2016; OECD, 2022b).

Another category of industrial policy strategies is **regional industrial policy** or place-based strategies. Here, the focus is on regional economic development at the national or supranational level, which plays a crucial role in the catching-up process of less developed regions, mainly due to persistent regional disparities, e.g., in unemployment, income, or income inequality (OECD, 2022b; Sachverständigenrat, 2019).

In actual implementation, the individual strategies are less isolated but often overlap. For example, mission-oriented strategies often contain elements of sectoral strategies or technology-oriented strategies.

Industrial policy strategies use different **industrial policy instruments** to achieve their predefined goals. Industrial policy instruments are usually distinguished between horizontal and vertical policies (e.g., OECD (2016, 2022b); Sachverständigenrat (2019)).

Horizontal - or untargeted - industrial policy focuses mainly on promoting R&D or general market development independently of company sectors, technologies or locations. By providing sector-independent support, this form of industrial policy is more protected from political influence by individual groups. A basic idea of horizontal industrial policy lies in the insight that the state is worse at identifying future markets and technologies than a decentralized market process. Horizontal industrial policy aims to create a legal framework and ensure functioning competition between market participants. While the superiority of horizontal industrial policy instruments is still the prevailing view in the literature, the effectiveness and relevance of horizontal policies are increasingly questioned (Franco-German Manifesto, 2019; Larrue, 2021; OECD, 2022b).

Vertical - or targeted - industrial policies explicitly target specific business sectors, technologies, or locations. While perceptions of targeted industrial policy appear to be changing (Bofinger, 2019; Mazzucato, 2018; Rodrik, 2008), it is still met with skepticism, often focused on the assumption that it increases inefficiencies, reduces competition, and slows productivity by favoring certain firms ('picking winners') (OECD, 2016, 2022a; Warwick, 2013). On the other hand, Larrue (2021) argues that concentration on certain firms could be welfare enhancing overall in cases of imperfect markets and sector-specific market failures. Mazzucato (2013) argues for vertical industrial policy, for example, with positive externalities on other innovation inputs in the military sector, Targeted industrial policy can further ensure lower barriers to entry in certain markets or, in oligopolistic

markets, ensure the existence of domestic firms through targeted subsidies, thereby increasing national welfare (Sachverständigenrat, 2019). Through the targeted promotion of certain technologies, the state can support winners of technological change and initiate or accelerate development processes. However, it is questionable to what extent the state is superior to a decentralized market decision in selecting the *"winners"*.

A recent distinction regarding industrial policy instruments is that between **demand-side instruments** and **supply-side instruments** (Edler, Gök, Cunningham, & Shapira, 2016; OECD, 2022a, 2022b). The former are instruments that affect consumption decisions, i.e., demand for products and services, and the latter affect production decisions. Supply-side instruments are further distinguished between those that affect efficiency **within** firms, e.g., investment incentives and firm performance, and those that affect the allocation of factors of production **between** firms, e.g., via labor mobility, competition policy, or intellectual property policy (OECD, 2022a). Typical *"within"* instruments are R&D tax credits, grants, or subsidies. *"Between"* instruments are, for example, framework instruments that affect the tax system or the redistribution of factors of production. Demand-side instruments affect the demand for certain products and services by lowering their price or increasing public demand. Typical examples are carbon pricing (Pigouvian taxes) or public procurement instruments. While demand side instruments tend to be vertical or targeted instruments, *"between"* supply instruments tend to be horizontal instruments. *"Within"* supply instruments can be both, vertical and horizontal (OECD, 2022b).

6.1.2 Rationales and objectives for industrial policy

The goals of industrial policy are often innovation, productivity or economic growth, and the preservation and strengthening of competition or strategic autonomy. Increasingly, industrial policy strategies also address societal challenges (Anderson et al., 2021; Berlingieri, Calligaris, Criscuolo, & Verlhac, 2020; J. Ding & Dafoe, 2021; European Political Strategy Centre, 2019; OECD, 2022b).

As described at the outset, industrial policy can help close gaps between social and private returns, i.e., externalities, such as in the development of new products and technologies (Stiglitz et al., 2013). While vertical industrial policies are often seen as anti-competitive, this need not always be the case, depending on how they are designed. For example, addressing externalities or setting market promises can lead to overall positive effects without having negative effects on competition. On the contrary, if industrial policies increase the returns of a project, this may even lead to more firms entering a market and competition may even be enhanced (Aghion et al., 2015; OECD, 2022a).

The extent to which competition always leads to more innovation remains empirically unclear (e.g., Aghion, Bloom, Blundell, Griffith, and Howitt (2005); Bloom, Van Reenen, and Williams (2019); Hashmi (2013)). When the level of competition is generally low, an increase in competition tends to increase the pressure on firms to innovate in order to differentiate themselves from their competitors. When competition is already strong, additional competition may have a negative impact on innovation, for example, because all firms use similar technologies and operate at similar levels (Acemoglu & Cao, 2015).

Industrial policies, especially targeted ones, can also be justified on the basis of market imperfections. In this case, the redistribution of resources can be welfare enhancing for society as a whole. More active industrial policies by the government may also be justified if the underlying idea is not to do something that is already being done by the private sector, but to focus on areas that are not currently covered by the private sector at all (Keynes, 1926). Especially in addressing major global societal challenges, a push by public impetus and guidance is of great importance.

Following Bofinger (2019) and Mazzucato (2015), public industrial and innovation policies may also be justified in cases of **uncertainty**, such as when private actors refrain from investing, not because they are seen as fundamentally negative, but because of high uncertainty (H.-J. Chang, Andreoni, & Kuan, 2013). Here, countries have often shown a willingness to invest early in new technologies to secure or maintain a global leadership position (Franco-German Manifesto, 2019; OECD, 2022b).

In addition, **network effects and externalities**, such as innovative technologies that depend on strong interdependencies between multiple industries, can be a reason for active industrial policy (Tassey, 2010). The positive externalities resulting from interdependent innovation processes are regularly not sufficiently taken into account by individual companies in their decisions. *"Industrial commons"* can in this regard contribute to more innovation (Pisano & Shih, 2009).

Path dependencies resulting from high fixed costs and the long lifetime of investments in fundamental innovations imply externalities for firms and lead to sticking to existing solutions (Aghion, Boulanger, & Cohen, 2011). Targeted industrial policy interventions can also reduce societal impacts such as geographic or income inequality or counteract wage polarization (Rodrik & Sabel, 2020).

Finally, industrial policy intervention may also be justified when it compensates domestic firms for a competitive disadvantage caused by foreign competition policy through industrial policy measures in other countries (Bofinger, 2019; OECD, 2022b).

6.1.3 Empirical evidence on industrial policies

In the empirical evaluation of industrial policy measures, there is often the problem of a missing counterfactual scenario (Sachverständigenrat, 2019). Nevertheless, the literature tries to find methodological approaches to solve this problem. In this context, a change in the perception of vertical industrial policy measures can be identified in particular. While older studies were still very skeptical of industrial policy in Japan and Korea (for example Beason and Weinstein (1996); Lawrence and Weinstein (1999); Pack (2000)), more recent studies with better data and more up-to-date methodology show a much more differentiated picture (Barwick, Kalouptsidi, & Zahur, 2019; Lane, 2014; Pons-Benaiges, 2017).

With regard to **supply-side instruments** for firms to promote investment (*"within"* instruments), the empirical literature finds evidence of mostly positive effects. Bonus depreciation is considered a particularly effective tool to stimulate investment (Eichfelder, Jacob, & Schneider, 2020; House & Shapiro, 2008). While aggregate effects at the macro level tend to be positive, there is evidence of a decline in the quality of investments made and lower positive effects, especially for smaller firms (Calvino et al., 2022; Eichfelder et al., 2020). Predominantly positive effects can be found for R&D tax credits as well as direct R&D support (Appelt, Bajgar, Criscuolo, & Galindo-Rueda, 2016; Bloom et al., 2019; Dechezleprêtre, Einiö, Martin, Nguyen, & Van Reenen, 2016; Le & Jaffe, 2017). Patent boxes (or innovation boxes) are considered an alternative to incentivize R&D. However, empirical studies show that these are very inefficient, for example, because they favor already successful firms or lead to biases in favor of patentable innovations (Bloom et al., 2019; European Commission, 2014; OECD, 2015). Public credit and public credit guarantees have also been shown to have more positive effects on employment and physical investment (Bachas, Kim, & Yannelis, 2021; Bertoni, Martí, & Reverte, 2019; De Blasio, De Mitri, D'Ignazio, Russo, & Stoppani, 2018; Hottenrott & Richstein, 2020; Uesugi, Sakai, & Yamashiro, 2010).

Instruments that focus on the (re)allocation of resources between firms (*"between"* instruments) tend to be evaluated more positively in the empirical literature. These include, for example, studies on labor market mobility (Aghion, Bergeaud, & Van Reenen, 2021; Bambalaite, Nicoletti, & Von Rueden, 2020) or well-functioning capital markets that can ease financial constraints (Demmou, Stefanescu, & Arquie, 2019; OECD, 2019).

Demand-side instruments are often used in the area of mission-oriented industrial policy, e.g. in the context of environmental and industrial policies. For example, Aghion, Dechezleprêtre, Hemous, Martin, and Van Reenen (2016) study the impact of fuel taxes on innovation and find a

positive effect on *"green"* patents. In addition, demand-side instruments can have a positive impact on technology diffusion, for example by contributing to higher cost efficiency (Popp, Newell, & Jaffe, 2010). In the area of electric vehicle promotion, there is also evidence in the empirical literature of positive effects of demand-side instruments on electric vehicle diffusion (e.g., Muehlegger and Rapson (2018); Tal and Nicholas (2016). However, more comprehensive studies that consider not only the diffusion of electric vehicles but also the overall effects on avoided externalities such as greenhouse gas emissions or reduced oil dependence show that there are strong regional differences in the evaluation of demand-side instruments (Rapson & Muehlegger, 2021). Studies also point to positive effects of demand-side instruments on domestic and foreign innovation (Fabrizio, Poczter, & Zelner, 2017; Peters, Schneider, Griesshaber, & Hoffmann, 2012). Demand-side instruments also include public procurement, i.e., the purchase of technologies and innovative products and services by the public sector (OECD, 2022a). While the empirical literature in this area provides a rather mixed picture, there is nevertheless evidence of positive effects (Warwick & Nolan, 2014).

The empirical evidence for **targeted industrial policy instruments** is also positive, but with some limitations (OECD, 2022a). Because targeted support is often provided to regions and industries affected by market failures or negative shocks, there is a regular bias in evaluating effectiveness. Studies of targeted investment subsidies show mostly positive effects on employment and growth, but the effects on productivity are more mixed (Bernini & Pellegrini, 2011; Criscuolo, Martin, Overman, & Van Reenen, 2019; Lane, 2020; Pellegrini & Muccigrosso, 2017; Ramboer & Reynaerts, 2020). For example, for targeted industrial policies for the heavy and chemical industries in Korea, Choi and Levchenko (2021) not only find positive effects for the subsidized firms, but also show that these effects have significant impacts more than 30 years after the subsidies end. These long-lasting positive effects are attributed to learning-by-doing and a reduction in financial constraints. Overall, a positive welfare effect of targeted industrial policy can be assumed. For targeted R&D subsidies, the empirical assessment is mixed, although significant positive effects are observed here as well. Bronzini and Piselli (2016) and Lanahan and Feldman (2018) find positive effects for small firms, especially for patent applications. Lechevalier, Ikeda, and Nishimura (2010) find positive effects for research productivity, and Moretti, Steinwender, and Van Reenen (2019) and Pallante, Russo, and Roventini (2021) find crowding-in effects for privately funded R&D in addition to positive productivity effects for defense R&D grants. Girma, Görg, and Stepanok (2020) find a positive effect on export market participation for manufacturing subsidies in China, although negative effects are observed for nonsubsidized firms. These results, positive effects for subsidized firms and negative effects for nonsubsidized firms, are also observed for subsidies to smaller firms in India (Rotemberg, 2019). Studies on targeted industrial policies at the sector or country level find rather ambiguous results (Blonigen, 2016; Kalouptsidi, 2018; Manelici & Pantea, 2021; Pons-Benaiges,

2017).

An important limitation of the empirical analysis of industrial policy approaches is that the focus of this empirical work is primarily on individual instruments and their impact on innovation, productivity and growth, rather than on the **overall industrial policy strategy** that combines several industrial policy instruments (OECD, 2022b). While causal interpretations of empirical evaluation of industrial policy instruments are often limited, some recent empirical work discussing the causal effects of industrial policy finds a significant positive effect (e.g., Choi and Levchenko (2021); Criscuolo et al. (2019); Juhász (2018); Kalouptsidi (2018). In their assessment of industrial policy strategies, Cherif and Hasanov (2019) argue that successful implementation relies on both active government intervention and goal setting and market signal-based decision making and accountability. They see the implementation of such policies over time as a key contributor to the Asian Miracle, in which the state set ambitious targets while ensuring accountability and market discipline for the industries and firms it supported. Gang (2015) argues along similar lines with regard to the success of state capitalism in his analysis of the Chinese solar industry.

6.1.4 Conclusion

The previous section provided an overview of the current state of research on industrial policy. In addition to industrial policy strategies, various industrial policy instruments were presented in particular. The assessment of industrial policy has changed considerably in recent years. While industrial policy was often seen as inefficient and unproductive, there is now consensus on the welfare-enhancing effects of industrial policy instruments. However, there is still disagreement about the concrete design of an industrial policy strategy. While supply-side or horizontal instruments are often seen as the most promising, there are also increasing arguments for more targeted industrial policy interventions. Empirical evidence on industrial policy underscores the fundamentally more positive perception of industrial policy instruments. Significantly positive welfare effects are found for most industrial policy instruments, albeit often with certain limitations.

The question of the efficiency of a horizontal or vertical orientation of industrial policy cannot be answered conclusively, despite increasing empirical evidence. However, there are indications of **complementarities** between different policy instruments that may justify the use of industrial policy strategies. There is an opportunity to combine both orientations as part of a comprehensive industrial policy strategy and using modern analytical techniques in the field of Big Data and machine learning (OECD, 2022b). Horizontal tools can then be used first to identify the sectors and companies that are best suited. Based on this, vertical or targeted industrial policies can then be used to provide targeted support to these sectors and firms. Demand-side instruments that

influence aggregate demand for specific products through targeted interventions are particularly relevant here. Thus, these instruments have a more uniform effect than many supply-side instruments for all relevant firms, regardless of their size or interest group (OECD, 2022b). This approach could generate additional efficiency gains and positive welfare effects.

6.2 Development of industrial policy in China

The idea of Chinese industrial policy originated in the search for a new economic strategy after the death of Mao Zedong in 1976 (Shih, 2015). Before that, there was immense state intervention in the form of centralized planning, which replaced any form of market economy (Defraigne, 2014). When a more moderate government - compared to Mao's radical leadership style - began to assert itself in the CCP, it began to search internationally for instruments to revive the inefficient state-owned enterprises with the help of exploratory journeys. Among the destinations of these trips were mainly China's neighboring countries, i.e. Japan and the Tiger States, but also the USA and Western European countries, such as Germany and France. The government thereafter sympathized with the Japanese approach in particular, so that Chinese industrial policy was strongly influenced by it (Heilmann & Shih, 2013; Shih, 2015), even though there are some clear differences.

For one thing, China's industrial policy has a much larger financial and political scope than measures in Japan or Korea. Secondly, the starting positions of Japan and China are not comparable. While Japan launched its industrial policy measures to revive its war-torn economy, which already had market-economy structures, China first had to master the transition from a centrally-planned economy. Moreover, the purpose of Japan's and China's industrial policy measures was and is fundamentally different: while Japan's (and also Korea's) strategy was to use state support to catch up with the industry giants in the U.S. or Europe, China sees the task of its industrial policy to this day in particular as being to play a pioneering role in less penetrated markets with less incumbents from more developed countries (Naughton, 2021).

Depending on whether one wants to follow a broad or a more narrow definition of *"industrial policy"*, China's active industrial policy began with the reform and opening-up policy from 1978, or only from the mid-2000s. It was first officially designated as an instrument of economic policy in the 7th Five-Year Plan for the years 1986 to 1990 (Naughton, 2021). Prior to this, there were measures to support heavy industry that could be considered industrial policy, but these were shaped by central planning (e.g., rigid production plans, central allocation of resources, etc. (Heilmann & Shih, 2013)) and thus went beyond pure industrial policy thinking (Schüller, 2015).

6.2.1 Industrial policy as of 1978 - Rebalancing the economy and opening up

China's era of economic reform began with the famous 'Third Plenum' meeting in late 1978. Although the foundations for industrial policy in a narrower definition were already laid here, a fundamental reorganization of the Chinese economic system had to take place first. Since the Chinese government did not want to accomplish the economic transition to a market economy with a 'big bang', but gradually by leading structural change (Naughton, 2021), this can, however, already be defined as industrial policy in the broader sense, as we will now map out in detail.

Particularly in the early years of economic transformation, the initial focus of measures was on correcting imbalances in the economic structure, which stemmed from central planning (Jigang, 2017). To prevent instability, this restructuring was to take place gradually, i.e., successively in different sectors and at different speeds. Naughton (2021) identifies a total of 7 waves of state-led economic transformation:

- **1) Agricultural economy** (1979 - 1983): After the massive problems in supplying the population during the Great Chinese Famine, the farmers initially became the focus of restructuring. They were now given the opportunity to decide independently when, what and how much they wanted to produce.
- **2) Rural non-agricultural economy** (1979-1983): In addition, the rural population was now allowed for the first time to open their own businesses and to employ workers in it. This opportunity was used in particular to carry out labor-intensive manufacturing of simple products within the framework of township and village enterprises (TVEs), that were the first to compete with the former monopolist SOEs (although the latter of course continued to dominate the economy).
- **3) Urban economy** (1983 - 1993): After the easing of regulations for the rural population, there were also easings for the urban economy. High-level authorizations were no longer required to start a business, and property rights for private companies were established. As a result, many new businesses were set up in the service and retail sectors, and later also smaller industrial enterprises.
- **4) State industry** (1990s): Due to increasing competition from TVEs and private firms from urban areas, SOEs experienced a drastic decline in profits and an increase in bankruptcies toward the end of the 1990s. Smaller SOEs were privatized or closed, the larger SOEs that were not yet bankrupt were largely restructured and transformed into semi-state-owned, joint-stock companies, allowing them to become profitable again in most cases (*'grasping the large and letting the small go'* (Defraigne, 2014, p. 14)). Freed-up labor, land, and other resources were then often taken over by more private businesses. At the same time, the

Chinese government had to adapt the legal framework to the now stronger market-based structures (Naughton, 2021). Also direct government intervention was gradually reduced and shifted to more indirect measures, starting to less actively promoting the development of pillar industries and high-tech industries (Jigang, 2017). State-owned enterprises were, however, not abolished, but remained in place as the backbone of the industrial sector (state-private duality of the business sector) (Schüller, 2015).

- **5) Urban - rural disparities** (1990s - 2010): After migration between rural and urban regions within China was previously very difficult, depending on the individual state of premanent household registration, regulations were eased starting in the 1990s, but not completely until the mid-2000s. Naughton (2021) argues that the subsequent free flow of labor was one of the key drivers of growth in the early 21st century.

- **6) Urban housing** (late 1990s): Since most of the urban housing belonged to the employer, but many SOEs went bankrupt in the course of the advancing marketization, it was legislated at the end of the 20th century that the apartments became the property of the workers who lived there. As a result of following real estate speculation, there was a great housing boom, which also contributed to China's high growth rates in the first part of the 21st century.

- **7) Export orientation** (2001 - 2005): China's accession to the WTO and its preparations marked the beginning of the country's strong export orientation (Naughton, 2021), which was a substantial part of its industrial policy strategy. In the beginning, China mainly exploited its comparative advantage in providing cheap labor for the production of labor-intensive products such as clothing, shoes, and household goods. In addition to China's own integration on world markets, however, the focus was also on importing foreign know-how and capital (Defraigne, 2014). Despite the obligation to reduce discrimination against foreign investors, which was a prerequisite for WTO accession, these have not been completely eliminated to this day. Part of the Chinese strategy was, for example, barriers for foreigners to entry in economic sectors in that Chinese firms are not yet internationally competitive, and the transfer of technical and management know-how through the integration of Chinese companies into foreign value chains and businesses. For example, foreign companies couldn't open businesses in China without the active participation of a Chinese (e.g. compulsory Joint-Ventures) and were forced to commit themselves to produce at least some share of their products in China (Schüller, 2015).
  China's industrial policy orientation at that time consisted on the one hand of supporting foreign trade and adapting regulations and processes to WTO requirements, and on the other hand of making domestic industry competitive and upgrading it (Jigang, 2017).

In summary, there is much to suggest that the measures taken between 1978 and the early 2000s had an industrial policy character. However, the initial focus was on transforming the centrally

planned system into a market economy. Only after the fundamental restructuring had taken place (and a *"new normal"* economy had been established), the focus shifted more strongly to the further development of this market economy in the sense of a future-oriented development strategy (Naughton, 2021), which we understand as *"industrial policy in the narrower sense"*. This view is also held by Heilmann and Shih (2013, p. 3), who argue that *"The quantity and sectoral coverage of national programs, however, remained strikingly limited until the mid-2000s. Between 1989 and 2004, we only find individual sectoral restructuring programs"*. Nevertheless, already at this stage, the Chinese government had selected specific *"national champions"* who, because of their position in key industries, were specially protected from foreign competition during China's opening-up process (Defraigne, 2014). In addition, in the 1980s and 1990s, entire industries (e.g., engineering, building materials, automotive, and petrochemical) were supported under tax and interest rate concessions, protected from foreign competition under customs policies, and assisted in the acquisition of foreign know-how through the targeted channeling of FDI. In addition, there was support for science and technology research under the High Tech Research and Development Program (colloquially known as the 863 Program), which was established in 1986. Nevertheless, as mentioned, the number and financial scope of these measures were still rather limited (Schüller, 2015).

6.2.2 Narrower industrial policy - 2006 until 2015

With the publication of the 11th Five-Year Plan (FYP) for the years 2006 to 2010, designated industrial policy strategies were communicated by the Chinese government for the first time (Heilmann & Shih, 2013). While the number of national industrial programs was already on the rise from 2006, their scale has increased manifold since the 2008 financial crisis. The background to this was the Chinese government's objective of creating more independent innovation capacities and thus becoming less dependent on foreign investment (State Council of the People's Republic of China, 2006b). The internationalization of Chinese companies was to be promoted, and access to resources abroad was to be secured through Chinese foreign investment (Schüller, 2015). This *"go global"* strategy was, amongst others, supported through subsidies, aid programmes in developing countries and simplified access to investment capital through the state-owned Export-Import Bank of China (Defraigne, 2014).

The first phase of China's strengthened industrial policy between 2005 and 2015 is in the literature usually divided into three core elements: the launch of the *"Medium to Long term Program of Science and Technology"* (MLP), the crisis measures following the financial crisis in 2008, and the formulation of the *"Strategic Emerging Industry"* (SEI) program.

(1) The Medium to Long term Program of Science and Technology (MLP)

Although the MLP cannot be seen as an industrial policy strategy in itself, it contains many smaller programs that provided the impetus for subsequent industrial policy measures, as we will outline in the next section of this chapter. The MLP had a duration of fifteen years (2006 to 2020) and contains, on the one hand, rather general approaches to strengthening the innovation environment, but on the other hand also a list of a total of 16 *"megaprojects"* to be funded by the government. The purpose of these projects has always been to replicate existing, particularly important products and innovations in developed countries in order to become independent of them (Naughton, 2021).

In an accompanying document to the MLP, that is not publicly available, the megaprojects are concretised and assigned both specific administrative units as well as more detailed targets and policy instruments. The overall lead for the 13 megaprojects was carried out by the Ministry of Science and Technology (MoST) (Naughton, 2021). The megaprojects include 13 publicly known and 3 non-communicated projects from the defense sector. The publicly known projects are 1.) Core electronic components, high-end microchips and basic software, 2.) Ultra Large-Scale Integration technology (production of semiconductor microchips), 3.) Broadband wireless mobile communication, 4.) High-end machinery, 5.) Mining technologies for oil, gas and coal-bed methane, 6.) Pressurized water reactor and nuclear power plants, 7.) Water treatment technologies to control water pollution, 8.) Genetic engineering and development of more resistant breeds, 9.) Research and production of new medication for the Chinese market, 10.) Development of new vaccines and medical treatment methods, 11.) Earth-observation systems, 12.) Passenger aircraft and 13.) Manned space flight. The three unknown projects are suspected to be part of the defense sector, as for example the building of an own navigation network. The financial scope of the publicly known projects ranged from a total of RMB 15 billion (nuclear sector) to RMB 200 billion (aviation sector) between 2006 and 2020. Funding was either granted by outsourcing research projects to research institutes and companies, or by the realization of holistic and centralized projects, e.g. in the aerospace sector. (Naughton, 2021).

(2) Measures in the wake of the financial crisis

In the aftermath of the financial crisis at the end of 2008, China was confronted with a situation in which, on the one hand, global demand had fallen and, on the other, protectionist tendencies coupled with global uncertainty gained ground. In addition, China had cyclical and structural problems, such as overcapacities in certain industries, the still lacking independent innovation capacities, high energy consumption and great interregional inequality (Jigang, 2017).

Therefore, although China was relatively less affected by the financial crisis compared to the rest of the world, the Chinese government countered the declining GDP growth rates by launching a massive economic stimulus program. As part of this, significantly more capital was used for

industrial policy measures, and China's direct state influence in its own industrial sector rose again significantly, compared to the years before (Schüller, 2015): Whereas in 2008 around 6 billion RMB flowed into the 16 megaprojects alone, spending rose to 33 billion RMB in 2009 and leveled off at around 45 to 50 billion RMB annually in the subsequent years (Naughton, 2021).

However, it was not only the financial capacities for already existing programs that were expanded. The Chinese government additionally recognized that the country's economic future would depend, on the one hand, on supporting traditional industries (such as the steel or automotive industries) in order to stabilize growth, and, on the other, on fostering emerging industries in order to become global pioneers in that fields (Jigang, 2017). The substantial idea that crises were usually followed by large-scale technological breakthroughs, and that countries that were particularly successful in adapting to these became global leaders (Naughton, 2021) also becomes apparent in the following statement by Jiabao (2012), former prime minister of the PRC: *'Major scientific and technological breakthroughs in the wake of a large-scale economic crisis have always provided a new growth engine'*.

In addition to direct fiscal and monetary policy measures to stimulate domestic demand (e.g. through a massive expansion of bank loans), the Chinese government therefore started to undertake targeted interventions, not only in sectors particularly hit by the crisis (*"industrial revitalization policies"*) but also in innovative industries. These measures were the cornerstone of the *"Strategic Emerging Industries"* (SEI) program announced in 2009, which was fleshed out a year later in the 12th FYP. At the latest, the implementation of the SEI program represents the beginning of targeted government industrial policy, by any definition (Naughton, 2021).

(3) The Strategic Emerging Industries (SEI) Program

With the *"State Council's Decision on Accelerating the Cultivation and Development of Strategic Emerging Industries"*, published in October 2010, the Chinese government substantiated the concept of the Strategic Emerging Industries Program. The document starts with emphasizing the forward-looking role of the SEI:

> *"Strategic emerging industries are an important force to guide future economic and social development. The development of strategic new industries has become a major strategy for leading countries in the world to seize the high ground in the new round of economic and technological development. China is in the critical period of building a moderately prosperous society (...). Strategic emerging industries are based on major technological breakthroughs and important development needs. They are knowledge- and technology-intensive industries with low consumption of material resources, high growth potential and good comprehensive benefits. Accelerating the cultivation and development of strategic new industries is of strategic*

importance to the modernization of China." (State Council of the People's Republic of China, 2010, p. 1, translated)

The program document then goes on to state that the industries that are characterized as SEIs are those that are considered to be particularly important in the future and in which no competitors have yet established themselves worldwide (State Council of the People's Republic of China, 2010). This decision represents a U-turn from China's strategy of learning and adapting from established market players, that they accelerated in previous decades. The SEI's include 20 industries that can be summarized in the following industry areas: 1.) Environmental protection and energy conservation, 2.) Information Technology (e.g. Core electronic components and high end software), 3.) Biotechnology (e.g. biopharmaceuticals and biological agriculture), 4.) (Precision) Machinery (e.g. satellites, aircraft and smart manufacturing equipment), 5.) New Energy (e.g. wind and solar power), 6.) New Materials and 7.) New Energy Vehicles (i.e. electric vehicles and hybrid vehicles) (Naughton, 2021).

There are thus some overlaps with the industries that were considered for the 13 megaprojects, however, while the megaprojects were rather specific, directly government-funded projects, the support framework for the SEI is more complex. The general idea is, that the government sets favourable conditions for the firms that are part of the SEI, for example through preferential granting of credit (by state-owned financial institutions), increased investment funds (e.g. venture funds), tax exemptions or regulatory facilitation. By these means, in principle all companies within the SEI have access to (mostly indirect) governmental support, whereas with the megaprojects, targeted, direct funding was mostly provided to selected companies or (research) institutes (Naughton, 2021).

The Chinese government has set quite specific targets and timelines for the SEI program, not only in the concept paper already presented, but especially in the subsequent sector-specific five-year plans published in 2012 as part of the adoption of the 12th FYP (covering the years 2011 to 2015). These are discussed in more detail in the following section 6.2.4, by example of the renewable energy sector and the automobile sector. To date, the SEIs remain an important part of China's industrial policy strategy, although the SEI program was substantially updated in 2016 (Naughton, 2021).

6.2.3 Industrial policy from 2015 until today

After the SEI was established, the Chinese government tried to integrate its target industries more and more into a common overall concept in order to form a consistent industrial policy with a long-term orientation that would not only enable China to hold its own in the global economy, but also to play a dominant role in it. The key elements with which China intends to gain these global comparative advantages lie in the ecological and digital transformation of existing and

emerging industries. This must be framed in particular against the backdrop of the problems China faced in the mid-2010s: Due to rising wages, China's absolute cost advantages in the production of labor-intensive but low-skill manufacturing threatened to disappear. In addition, protectionist tendencies were becoming increasingly apparent abroad. In order to maintain its price competitiveness against other developing countries, while at the same time becoming less dependent on products and technologies from abroad, and to change its image from the *"workshop of the world"* to an innovative nation (Schüller, 2015), the Chinese government continued to expand its previous industrial policy efforts (Naughton, 2021).

The *"Made in China 2025"* plan and the *"Internet Plus Program"*, both released in 2015, were the first steps for this new, holistic industrial policy approach. While *"Made in China 2025"* mainly focused on implementing and expanding the usage of industrial robots in manufacturing and encouraging smart manufacturing networks to automate processes, the *"Internet Plus program"* aims for introducing new technologies (e.g. internet of things or other IT technologies) in traditional industries. One year later, in 2016, the Chinese government finally introduced the *"Innovation-driven Development Strategy"* (IDDS) plan, which is the framework for China's aforementioned long-term industrial policy plan, and which, among other things, incorporates the two previous, shorter-term programs. The IDDS not only covers significantly more industries than any of the previous industrial policy programs, but also links them more closely in terms of a unified strategy. Moreover, it is, due to its form of publication and wording, more binding than the previous policies. With regard to the time frame, the IDDS plan contains three milestones: China is to be an *"innovative nation"* by 2020, a *"leading innovative nation"* by 2030, and a *"technological superpower"* by 2050 (Naughton, 2021). In this way, China wants to establish new global, technological standards in the long term and make itself further independent of foreign technology (Defraigne, 2014).

The core of the IDDS therefore consists of investing in both upstream and downstream industries, as well as in a variety of infrastructure projects. A substantial share of resources should, for example, flow in the production and design of semiconductors or in advancements in Artificial Intelligence (AI) (upstream investment). Investment in downstream parts of the value chain, on the other hand, was aimed at industries that are early adopters of new technologies. For this reason, there was also an update of the previous SEI program from 2010: On the one hand, five particularly important economic sectors were selected from the SEIs, i.e. information technology (IT), high-quality industrial equipment, bioeconomy and pharmaceuticals, new energy vehicles and new energies, as well as digital media. On the other hand, the creation of industrial clusters in that areas were emphasized. Specific targets for output values in 2020 ranged between RMB 8 trillion (USD 1,19 trillion, digital media) and RMB 12 trillion (USD 1,79, each for IT and industrial equipment industries). Investment in infrastructure development is based on on information

infrastructure (e.g. 5G networks, industrial internet of things, data centers and AI), innovation infrastructure (such as the expansion of research facilities) and other infrastructure, as charging stations for electric vehicles, ultra-high voltage electric transmission lines or railway transportation within and between cities (Naughton, 2021).

In order to achieve these ambitious goals, significantly more financial resources were made available directly, and a new additional means of financing was established, the so-called government industrial guidance funds. These public-private investment funds are intended to ensure that the financing of government industrial policy is expanded to include a market component. This would have the advantage that, on the one hand, significantly more funding could be called up and, at the same time, the markets could discipline the respective firms (Naughton, 2021). Due to unrealistic targets, bureaucratic hurdles, and a lack of market discipline, those government industrial guidance funds have, however, often failed to meet these expectations. Until the first quarter of 2020, the governmental guidance funds, that had a targeted size of about RMB 11 trillion (USD 1.55 trillion), have raised only RMB 4.76 trillion (672 billion USD) of private investment means (Luong, Arnold, & Murphy, 2021). Another criticism is that China's industrial policy strategy is not yet consistent in itself, especially in the ecological sense. For example, despite the green energy goals, there are still high subsidies for the extraction of fossil fuels (Schüller, 2015).

To sum up, we can observe an increase in active industrial policy activities by the Chinese state after 2006, but especially after the 2008 financial crisis. Before that, the government also strongly and actively steered the Chinese economy, but only to a limited extent at the level of individual selected industries. With the IDDS, a new level of Chinese commitment to strong industrial policy is evident. The latest 14th Five-Year Plan, approved by the party leadership in March 2021, continues China's ambition to become a market leader in human capital-intensive industries. Titled *"Innovation 2030"*, it promotes, among other things, scientific and technological research, particularly in the fields of artificial intelligence, healthcare, biotechnology and smart manufacturing. However, in addition to funding research centers, the main aim is to promote industry as a source of innovation (Poo, 2021). Table 11 provides a brief overview of the major industrial policies in China over time.

Years	Objectives / programmes	Focus industries	IP Definition
1950 - 1970	Industrialization, autonomy	Heavy industry	Central planning
1980 - 2000	Opening up, restructuring of economy and SOEs; fostering FDIs	Mechanical engineering, automotive, electronics, building materials, petrochemicals, aerospace	Broad IP
2000 - 2005	WTO accession, strengthening of trade and internationalization of Chinese firms		Broad IP*
2005 - 2015	**Strengthening own innovation capacities**		-
2005	Launch of 11th Five Year Plan (FYP)	High-tech industries, energy, automobile, (steel), information technology, mechanical engineering, biotechnology	Narrower IP
2006	Start of the Medium and Long Term Program of Science and Technology (MLP)		Narrow IP
2010	Start of Strategic Emerging Industry (SEI) program		Narrow IP
2011	Start of 12th FYP period with sector-specific FYPs		Narrow IP
2015 - today	**Establishing a single, long term industrial strategy based on digitalization and ecological transformation**	Information technology, biotechnology, environmental-friendly technologies, service sector	-
2015	Made in China 2025 / Internet Plus		Narrow IP
2016	Innovation-driven development strategy (IDDS); SEI-Update (13th FYP)		Narrow IP

* With some forms of more narrow IP.

Table 11: Major industrial policies over time (Source: Based on Schüller (2015) and Naughton (2021)).

Both the financial background and the general approach have become steadily more specific since the rather experimental and broad approaches of the megaprojects and the MLP, although the Chinese financing strategy involving the market in particular is not yet fully developed. The Chinese approach has also changed from a vertical to a more horizontal one, although vertical interventions are still present. Criticism is frequently levelled at the (difficult to measure) cost-efficiency of the policies (Naughton, 2021).

By now, it should have become clear that Chinese industrial policies are often pragmatic and adaptive, and, at least until recently, have not followed a prescribed long-term path. Between 1978 and 1991, the instruments used to implement industrial policy decisions consisted primarily of direct state intervention, such as direct investment by the state, the granting of credit (through state-owned banks) and tax benefits for target industries (Jigang, 2017). In addition, by merging selected, large SOEs, the state actively carried out large-scale restructuring of the corporate landscape to shape national *"champions"*. These were subsequently given special protection, e.g., through the erection of technical or administrative barriers and access to government procurement (Defraigne, 2014). To this day, some state-owned but also private companies are still directly supported by the Chinese government. These direct and clear state interventions once again show the difference to the industrial policy of Japan and Korea, which is mainly based on preferential policies (Naughton, 2021).

Until recently, Chinese direct government intervention has declined somewhat, and the government is increasingly relying on more indirect, or market-involving, instruments to achieve its industrial policy goals. These now increasingly include tax exemptions and export tax rebates, subsidized depreciation, the already discussed public-private investment funds and other preferential policies. Lending for investment at home and abroad also continues to be an important policy tool. As

a crisis mechanism, e.g. in the context of the financial crisis, the Chinese state also relied on consumer subsidies for the purchase of e.g. cars or electronic appliances and the targeted award of government contracts (Morrison, 2009). Today (since the IDDS program), these measures are also financed and implemented by all political levels, whereas for a long time this task was primarily in the hands of local governments (Naughton, 2021).

6.2.4 Industrial policy measures with focus on new vehicles and renewable energies

To go into more detail regarding the practical implementation of the industrial strategies from the previous chapter, we will now focus on two exemplary industries. Due to the industries' special importance for Germany and Europe, as well as their ecological significance, we have chosen the renewable energies industry on the one hand, and and the new vehicles / automobile sector on the other.

1.) Industrial policy measures in specific industries - Automobile sector

China has the largest automotive market in the world in terms of the number of new car registrations. In 2021, 36.6% of all new car registrations worldwide were completed in China, compared to 37.5% in 2020 and 33.1% in 2019 (OICA, 2022a). In addition, the country is now the largest producer of automobiles: in 2021, China produced about 32.5% of all vehicles worldwide (2020: 32.5%; 2019: 27.9%) (OICA, 2022b). The Chinese automobile industry is therefore of great strategic importance for the country, but also for the rest of the world.

Before China's reform and opening-up phase, the country already had its first automotive plants, such as the First Auto Works (FAW) founded in 1950, but these focused on the production of trucks, as passenger cars were regarded as luxury goods. Russian production technology was predominantly used for this purpose (Chu, 2011).

It was therefore not until 1986 that the automotive industry was identified as a strategically important key industry and production was expanded to include passenger cars. The goal here was to substitute automobile imports from abroad. By the mid-1990s, the Chinese government had partly achieved this goal, but Chinese vehicles were still relatively expensive, technologically behind international standards and thus not competitive. Thus, in order to obtain urgently needed technological knowledge from abroad, it was decided to enter into large-scale joint venture partnerships with foreign companies, many of which still exist today. The partners from abroad (e.g. VW, Peugeot or Jeep) received access to the Chinese market in return for providing production technologies and training. Often, they also brought their supplier companies to China, which also entered into joint ventures with Chinese companies (Schüller, 2015). In 1988, under the *'three majors and three minors'* strategy, three large automobile companies (FAW, SAW (today 'Dongfeng'), and SAIC) and three small ones (Beijing, Tianjin, and Guangzhou companies) were selected and

brought together with foreign joint-venture partners. This market concentration should enable an agglomeration of resources and reaching economies of scale, therefore also a minimum output was required for new automobile firms to enter the market.[8] Selected firms were then protected from foreign competition entering the market, for example through high tariffs and other barriers to entry. Additionally, foreign investors were given tax exemptions if they established a local production and up to 50% of foreign direct investment was subsidized (Shih, 2015). As a result, however, the joint-venture firms, protected from foreign competition, did not sufficiently invest in technology research and overpriced their products compared to global price levels (Chu, 2011).

In 1997, during the preparation for WTO entry, China opened its market for more foreign investors, increasing competition and fostering innovation and new technologies. At the same time, Chinese consumers became more wealthy and started to demand a wider range of individual cars, whereas automobile demand before was mainly driven by government usage. Starting in 2001, the first purely Chinese automobile manufacturers, such as Chery (state-owned), Geely or BYD (both privately owned) were opening business (Chu, 2011). The establishment of the first two Chinese automotive companies, Chery and Geely, was driven and supported by the respective provincial governments of Anhui and Zhejiang, but not by the central government, which continued its approach of supporting only a few business groups in partnership with foreign companies. However, after the two startups were a success, the central government declared them 'models of independent innovation' and granted assembly licenses to other Chinese companies as well. The industrial policy strategy subsequently changed so that Chinese automotive companies would develop independently, but based on the purchase of licenses, technical equipment, and poaching of skilled workers from the joint venture models. The target group of these Chinese companies was, in particular, price-conscious consumers (Schüller, 2015).

As already shown, the automotive sector in the field of 'new energy vehicles' (NEV, i.e. energy-saving vehicles with new technologies, such as electric cars or hybrid cars) is today part of the strategic emerging industries (SEI) and the IDDS (e.g. 'Made in China 2025'). In this way, China wants to pursue environmental policy goals on the one hand, but also strengthen its position in the international automotive market on the other (Schüller, 2015). Preparations for the development of Chinese NEVs were made as early as 2001, when the Ministry of Science and Technology (MOST) adopted the '*Electric Vehicle Special Project*' under the National High-Tech R&D Program ('*863 Program*'). The initial focus was on providing financial support for R&D, as well as establishing test platforms and setting industry standards (Pelkonen, 2018). In 2004, the Chinese government then already explicitly encouraged domestic automakers to invest in electric and hybrid technologies

[8] This minimum output level was met with the production of at least 100,000 units per year, which could, at that point in time, only be reached by the three major companies FAW, SAW and SAIC. In 2004, the minimum output level rule was changed: To enter the Chinese market, a company now had to invest at least RMB 2 billion (about USD 300 million) and have at least RMB 800 million (USD 119 million) as equity capital, but there was now no minimum output level (Shih, 2015).

and develop prototypes. To this end, the central and local governments provided the industry with financial support totaling around USD 290 million. Between 2006 and 2010, this funding volume increased to a total of around USD 1.5 billion (Gong, Wang, & Wang, 2012).

Targets for the automotive sector were largely set in the sector-specific 12th Five-Year Plan and its accompanying 'Energy-Saving and New Energy Vehicle Industry Plan for 2012 to 2020', and adjusted in 2020 as part of the 'New Energy Vehicle Industrial Development Plan for 2021 to 2035'. In the 12th FYP, policy makers initially focused on setting regulatory standards for NEVs, automobile parts (such as batteries) and infrastructure. Additionally, direct government subsidies were granted for pilot programs in implementing NEVs into public fleets and for private NEV purchases. For selected producers of NEVs, and companies that manufactured central components for the production of NEVs, there were direct governmental subsidies and business tax omissions (ICCT, 2021). In addition, China has subsidized the purchase of NEVs from the beginning, with the level of subsidy depending on the driving range of the vehicles, among other factors, in order to incentivize the production of longer-range battery EVs (iea, 2022), and the vehicle tax for NEVs was omitted (Yuan, Liu, & Zuo, 2015).

By the mid of the 2010s, subsidies for hybrid vehicles have been reduced to fully support the development of all-electric vehicles instead (Yu, Zhang, Yang, Lin, & Xu, 2019). Since 2015 there has therefore been increased investment in the expansion of public charging infrastructure. To this end, on the one hand, standardizations were carried out and, on the other, private-public partnerships were established to install charging stations throughout the country (X. Zhang & Bai, 2017). In addition, to also provide non-financial incentives on the demand side to buy NEVs, many major Chinese cities introduced special regulations for the registration of electric vehicles: While in many cities, car registration is tied to lotteries and quotas, which lead to long waiting periods for a new car to be put into service, electric vehicles were excluded from all these limitations (S. Li, Zhu, Ma, Zhang, & Zhou, 2022). Financial incentives in the form of car purchase subsidies were gradually reduced from 2017 on, as the Chinese government now considered the electric vehicle industry to be competitive (X. Zhang & Bai, 2017). Due to the Corona crisis, however, those subsidies were again increased considerably, but only temporary until end of 2022 (iea, 2022).

By all these means, the Chinese government in 2012 hoped to reach an annual production and sales of 500,000 pure electric and hybrid vehicles units by 2015, and 2 million by 2020. With around 331,000 vehicles sold in 2015, this target was initially missed by a wide margin, and also the 2020 goal was missed with an actual annual sale of around 1.367 million NEVs (CAAM, 2022). Furthermore, average fuel consumption should drop to 6.9 liters/100 km by 2015 and to 4.5 liters/100 km by 2020; maximum speed of purely electric and hybrid vehicles should exceed 100 km/h and its

electric driving range should not be less than 150 km (hybrid: 50 km) by 2015 (State Council of the People's Republic of China, 2012a, 2012b).

The newest plan for the years 2021 to 2035 contains rather specific targets on the growth of the NEV market. Until 2025, the government for example hopes to have at least 80% of newly purchased public fleets as NEV, and annual sales of at least 20% NEV in the automobile market. Average power consumption of purely electric passenger cars should be decreased to 12 kWh/100 km. Until 2035 the plan indicates to have 100% electric public fleets and battery electric vehicles as the standard in vehicle sales. Paralleling, China will lay the foundation for a supply system of hydrogen fuel. To meet these targets, the 'New Energy Vehicle Industrial Development Plan for 2021 to 2035' substantiates specific tasks, as for example incentivising cooperation among the large NEV companies and founding national research institutes for manufacturing (especially on topics as battery cost and battery life, intelligent technology, driving motors and vehicle operating systems). Furthermore, the NEV sector will be integrated into related sectors, such as energy (using green energy for charging), transportation (public fleets and smart traffic control systems), and information (e.g. data collection and sharing). This is closely related to the expansion of the physical and digital infrastructure. In addition, Chinese manufacturers of NEVs should increasingly enter into foreign cooperative ventures with other manufacturers or research institutions, also to work in the formulation of international standards based on the Chinese model. For the producing companies, but as well for consumers, there will be tax exemptions (no business taxes, resp. vehicle purchase taxes) and drivers of NEVs will also be given subsidies for charging and parking. (ICCT, 2021; State Council of the People's Republic of China, 2020). In addition to central regulations, there are also various facilitations at the local level, such as local subsidies or tax breaks, as well as financial aid and relaxed procurement restrictions (iea, 2022). Overall, the focus of governmental industry support is now increasingly on tax breaks and indirect incentive schemes, rather than direct business subsidies (ICCT, 2021).

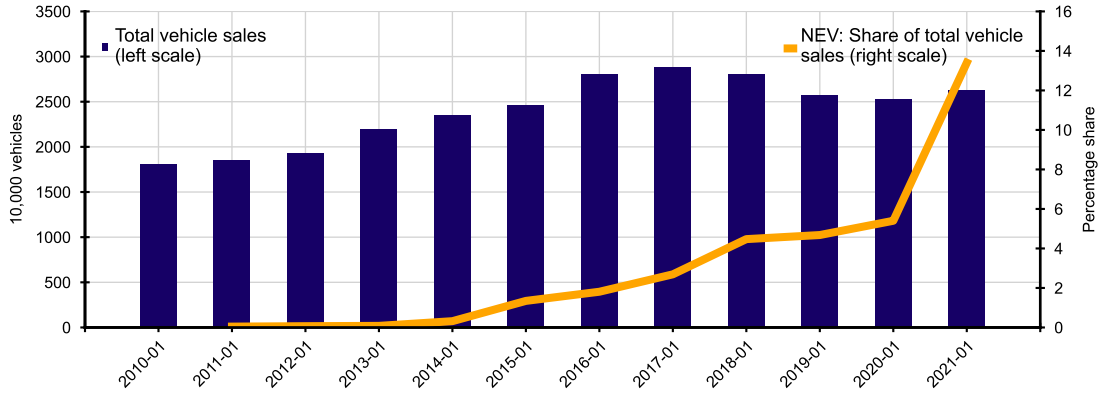


Figure 24: Annual vehicle sales and share of NEV in China (Source: CAAM)

From Figure 24 we can see that the share of NEVs sold, as a percentage of all vehicles sold in China, has increased significantly since 2011. According to a recent report of the International Energy Agency (iea), more e-vehicles were sold in China in 2021 (about 3.5 million) than in the entire world in 2020. However, the particularly sharp increase in 2021 can be partly attributed to the fact that subsidies for the purchase of NEVs will expire at the end of 2022.
Sales of e-cars accounted for about 9% of the global automotive market in 2021, an increase of about 400% compared to 2019. The net increase in these sales can be attributed almost entirely to China, where the number of NEVs sold has nearly doubled since 2019. In China, NEV sales accounted for about 13.4% of all vehicle sales in 2021 (CAAM, 2022). China is also a leader in the manufacture of batteries, producing around two-thirds of all lithium-ion batteries and between 70 and 85% of the most important components for battery production. China now also has around 85% of the world's fast-charging stations, making it the world's number one country for the availability of public charging stations (iea, 2022).

An important part of China's industrial strategy is to become less dependent on foreign countries and to produce independent innovations. As can be seen in Figure 25, the market share of Chinese car brands has been rising steadily since the mid-2000s. Japanese models are currently only in second place, together with German brands. Car brands from the USA and Korea come last, with market shares of currently 10% and 2% of all vehicle sales in China respectively.

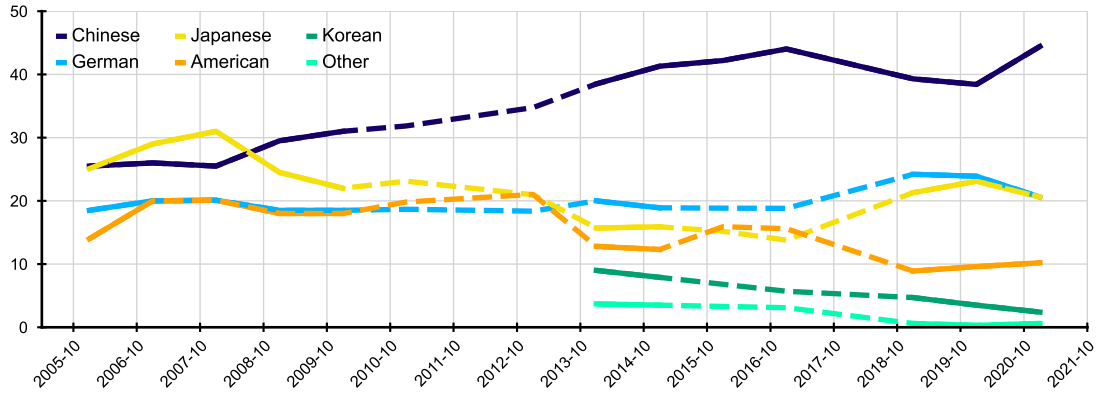


Figure 25: Market shares in passenger vehicles by brand country (Source: CAAM)
Note: Dashed lines indicate linear projections due to limited data availability.

Most of the NEVs sold are battery electric vehicles (BEVs), whose average driving range has increased by about 50% since 2016. The market concentration among NEV manufacturers is very high in China, but also worldwide. In 2021, for example, the top 6 companies accounted for around 52% of global production. The three largest producers worldwide, Tesla (USA), Volkswagen (Germany) and BYD (China) produced about one third of the global EV volume this year. Impressively, BYD was not even in the global top 6 in 2020 (iea, 2022).

In China, the top 3 companies (SAIC, FAW and Dongfeng) produced about 46% of total market sales by Chinese firms in 2021 (top 5: 63%, top 10: 86%). The share of the top 10 companies has changed only slightly since 2010. If only sales within China are taken into account, SAIC, Chang'an and Geely top the list of the most successful Chinese automakers (see Figure 26) (CAAM, 2022). While almost all traditional Chinese automakers have also established NEV divisions or subsidiaries (e.g. SAIC, Chery, Chang'an, BYD), there are also manufacturers that specialize exclusively in new forms of propulsion, such as e-cars. These include NIO, BYTON, XPENG, HOZON and Aiways.

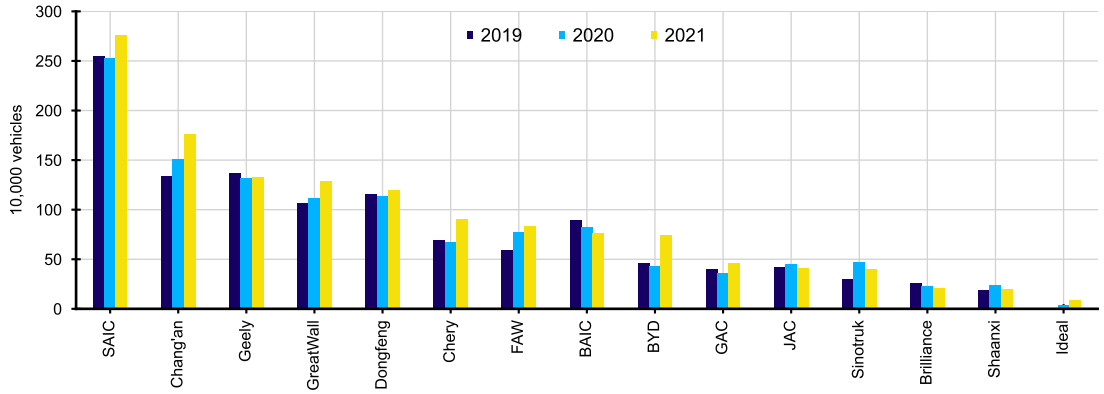


Figure 26: Top 15 automobile groups in China 2021, by vehicle sales volumes in 2019 - 2021 within China (Source: CAAM)

China currently offers the largest selection of NEV vehicles with around 300 models, compared to 184 in Europe and around 65 in the U.S. Most of the Chinese models are SUVs, followed by small and mid-sized cars. At 36.5% of all EVs, the share of small to mid-sized vehicles is higher than in Europe (31.5%) and the US (23.8%). Smaller vehicles, along with lower production costs, make Chinese e-vehicles significantly cheaper compared to foreign models. For example, the price of EVs in China in 2021 was only around 10% higher than for traditional vehicles, whereas these were around 45-50% more expensive in Europe and the USA (iea, 2022).

In summary, it seems that China's industrial policy strategy could show considerable success in the market for new vehicles. In particular, Chinese firms seem to be able to compete with large global players, like Volkswagen or Tesla, and were also able to establish a substantial domestic demand for Chinese vehicles. However, the use of resources to achieve this goal, and thus the cost-return efficiency, is often criticized (e.g. Naughton (2021); Schüller (2015)). Furthermore, Gomes, Pauls, and ten Brink (2023) argue that market growth mainly concentrates in a few Chinese cities that implemented wide-reaching and coordinated policies, like for example Shenzhen. Also, industrial policy was comparatively more successful in automotive segments where demand is strongly

state-driven, like for public buses. In later chapters, we will take a more detailed, empirical look at the overall, macroeconomic success of those industrial policy measures.

2.) Industrial policy measures in specific industries - Renewable energy sector

A second key industry for China, which is closely intertwined with the NEV industry due to its environmental scope, is the expansion of renewable energy. According to the Global Carbon Project (2022) China has been the largest emitter of Carbon dioxide worldwide since 2006. Most recently (as of 2020), the country emitted more than twice as much as the second-placed country, the USA. At the same time, China is also the largest consumer of energy, accounting for 25% of global energy consumption in 2021 (Enerdata, 2022). Thus, securing long-term energy sources is a top priority for China. The Chinese government sees risks in particular in 1) increasing competition for energy resources with developed, but mainly by developing countries, 2) political instability mainly in African countries that are major oil exporters, 3) high volatility in global energy markets, also due to speculation, 4) climate change, and 5) increasing resource constraints. At the same time, China sees opportunities in the national development of energy technologies and innovations to play a leading role in the global energy transformation (State Council of the People's Republic of China, 2013).

The first beginnings of involvement in solar and wind energy can be found in China in the late 1990s. This was motivated by the fact that large areas, particularly in the west and north of the country, were without electricity because the central power grids were far away from these regions. The 'Brightness program' therefore aimed to supply around 23 million inhabitants with local renewable energy from the sun and wind by 2010 (NREL, 2004). In 2002, the Chinese government provided approximately CNY 2.6 billion for the production of solar photovoltaic systems in the western provinces as part of the 'Township electrification program' and the 'Western development program'. In addition, cooperation projects were entered into with foreign countries in order to generate investments and transfer know-how (Shyu, 2010). Although the measures increased the capacity generated by renewable energies from 6.63 MWp (1995) to 55 MWp (2003), the quality of Chinese products was not yet internationally competitive and there were few incentives to maintain or improve the plants that had been built (S. Zhang, Andrews-Speed, & Ji, 2014; S. Zhang & He, 2013).

China's coordinated, industrial strategic efforts in renewable energy, however, fundamentally started from 2005, with the announcement of the 11th FYP and the passing of the Renewable Energy Law. Most of the industry policy measures in the renewable energy sector were implemented between 2005 and 2013. As indicated in the Renewable Energy Law, the renewable energy sector thereby mainly includes the hydropower industry, wind power, solar power, biomass power,

geothermal power and ocean power. The 11th FYP states the aim to *'[c]arry out preferential finance and taxation and investment policies and mandatory market share policies, encourage the production and consumption of renewable energy resources and increase its proportion in the primary energy consumption'* (State Council of the People's Republic of China, 2006a). In detail, the government initially resorted to the following instruments to achieve its target of expanding capacities through renewable energies (S. Zhang et al., 2014; S. Zhang, Andrews-Speed, Zhao, & He, 2013):

- **Guaranteed power grid connection and full purchase**: Power grid operators are obligated to buy the total amount of energy that was generated through renewable energy generation, and enable grid-connection and technical support (amendment from 2009: purchase is only obligatory for renewable energy generators that fulfil specific technical requirements).

- **Grid price setting**: There is a fixed pricing policy for renewable energy feed-in to the grid, (since 2013: depending on technical performance, geographical location and general energy availability). This price is higher than that for electricity from traditional energy sources (S. Zhang & He, 2013).

- **Mandatory market share**: Energy companies have to meet a certain and increasing share of renewable energy. Until 2010, 1% of all power generation had to originate from renewable energies, going up to 3% until 2020. For electricity producers with capacities higher than 5 GW, those shares increased to 3% until 2010 and 8% until 2020 (National Energy Administration, 2007).

- **Financial support**: There was direct government funding for R&D expenditures, as well as for research in renewable energy technologies (e.g. as part of the *'863'* and the *'973'* program). For example, the *'Renewable Energy Development Special Fund'* provided funding for research, pilot projects and projects on power generation in areas that are not well connected to the power grid (Ministry of Commerce PRC, 2013). Solar companies also received land at significantly discounted prices, and companies that supplied components for the production of renewable energy systems received discounts in the price of electricity (Andrews-Speed & Zhang, 2015). Additionally, state-owned banks and local governments provided a substantial amount of financial resources, that include low-cost credit (for investment or export), as well as export guarantees and insurances (S. Zhang et al., 2013). During the period of the 11th FYP, the majority of investments in energy-saving technologies were financed through direct government funding and bank credit (Climate Policy Initiative, 2012).

- **Tax exemptions**: Key parts that were required for the development of Chinese products, for example for the import of foreign equipment, were exempted from taxes.

- **Local manufacturing requirements for foreign firms**: Sellers of renewable energy products in China were required to purchase a certain share of their equipment from Chinese manu-

facturers (wind power concessions: 70% in 2004). With China's access to the WTO, this rule was laid off.

With the global financial crisis, the Chinese government faced a major problem in the renewable energy market. In contrast to the wind industry, which could rely on domestic sales due to cost advantages, the solar sector suffered from dropping foreign demand (S. Zhang et al., 2014). Already in 2004, the export share of photovoltaic (PV) systems in China was about 80%, and despite significantly increasing production volumes, the peak was reached in 2008 with an export rate of 98.5%. Only after that, the capacity volume of domestically installed PV systems also increased, and the export share decreased significantly (T.-J. Chen, 2016). In order to strengthen domestic demand, especially for solar energy, the Chinese government therefore adopted several programs in 2009, including the '*Golden Sun Demonstration Program*', that subsidized PV investment costs between 2009 and 2011 (50% of the costs for on-grid systems, and 70% if the systems were out of grid), and the '*Rooftop Subsidy Program*', that subsidized photovoltaic systems on buildings (S. Zhang & He, 2013). The problem with these programs was that the amount of subsidies was linked solely to the level of investment, so that investment projects were subsidized regardless of their efficiency or quality (S. Zhang et al., 2014).

Starting in 2009, national concession programs were initiated, where investors were bidding on projects and the Chinese government then guaranteed to purchase all energy from those projects and to coordinate connection to the power grid (S. Zhang et al., 2013). Additionally, the renewable energy industry was supported through China's state-owned banks, in particular through the China Development bank, that offered credit extensions of around CNY 250 billion to the industry in general, and USD 30 billion for the production of solar cells and modules (S. Zhang et al., 2014).

China's energy industrial policy goals over time are shown in Table 12. In 2012, the Chinese government declared that oil, natural gas, coal, renewable energies and nuclear energy are to go hand in hand for China's energy political future (State Council of the People's Republic of China, 2013). Nevertheless, special emphasis is laid on renewable energies (i.e. hydropower, wind power, solar power, biomass power, geothermal power and ocean power).

Table 12: Key objectives of Chinese renewable energy industrial policy over the years

Key objectives	12th FYP (2011-2015)	13th FYP (2016-2020)	14th FYP (2021-2025)
Energy consumption	- Standard coal: max. 4 billion tons - Electricity consumption: max. 6.15 trillion kWh - Energy consumption per unit of GDP: - 16%	- Standard coal: max. 4 billion tons - Electricity consumption: max. 6.15 trillion kwh - Energy consumption per unit of GDP: - 15%	- Annual per capita electricity consumption: 1,000 kWh - Energy consumption per unit of GDP: - 13.5%
Energy production	- Standard coal: 4.3 billion tons (domestic production: 3.66 billion tons) - External dependence on oil: -63%	- Standard coal: 4 billion tons (domestic) - Crude oil: 200 million tons - Natural gas: 220 billion cubic meters - Installed power generation capacity: 2 billion kw	- Standard coal: 4.6 billion tons (domestic) - Crude oil: 200 million tons - Natural gas: 230 billion cubic meters - Installed power generation capacity: 3 billion kw
Energy structure	- Share of non-fossil energy in energy consumption: 11.4% - Share of non-fossil energy in power generation: 30% - Share of coal in energy consumption: 65%	- Share of non-fossil energy in energy consumption: 15% - Share of coal in energy consumption: 58%	- Share of non-fossil energy in energy consumption: 20% - Share of non-fossil energy in power generation: 39% - Share of coal in energy consumption: 58%
Environmental protection	- CO2 emissions per unit of GDP: - 17%	- CO2 emissions per unit of GDP: - 18%	- CO2 emissions per unit of GDP: - 18%
R&D	-	-	- Average annual investment in R&D: +7% - Number of key technological breakthroughs: 50

Note: Changes are compared to the last year before the FYP, absolute numbers are compared to the end of the planning period of the FYP.
Sources: State Council of the People's Republic of China (2011), State Council of the People's Republic of China (2016), State Council of the People's Republic of China (2021)

According to the 12th FYP, hydropower stations with a total capacity of 120 million kW should be installed by 2015, as well as on- and offshore wind power plants with an additional capacity of about 70 million kW, and solar energy stations accounting for a capacity of over 5 million kW. Due to the large land availability, the latter should be installed mainly in the western regions of China, i.e. Tibet, Inner Mongolia, Gansu, Ningxia, Qinghai, Xinjiang and Yunnan (State Council of the People's Republic of China, 2011). By 2020, solar power should produce more than 110 million kilowatts, and wind power should have a capacity of about 210 million kilowatts (State Council of the People's Republic of China, 2016).

In Figure 27, we present the evolution of different energy sources in China's total energy production since 1980 (indexed to 2000). It can be seen that the importance of crude oil has been steadily declining since the turn of the millennium, whereas the share of coal has remained almost constant and 'other' energy sources (wind, solar and geothermal energy) and nuclear energy have been gaining significantly in importance. Natural gas and hydro power have also gained in popularity. In absolute terms, however, the largest share of Chinese energy production today (as of 2019) still comes from coal (68.5%), followed by hydro power (9.8%) and crude oil (6.9%). Other energy sources account for 6.6%, natural gas is 5.6% and nuclear 2.6%. In 1980, coal and crude oil together accounted for 93.2% of total energy production. In the ranking of business sectors that consume the most energy, industry unsurprisingly finds itself in first place in 2019, with the 'Smelting and Pressing of Ferrous Metals' and 'Manufacture of Raw Chemical Materials and Chemical Products' sectors consuming the most energy within it. Automotive manufacturing is in the middle of the pack.

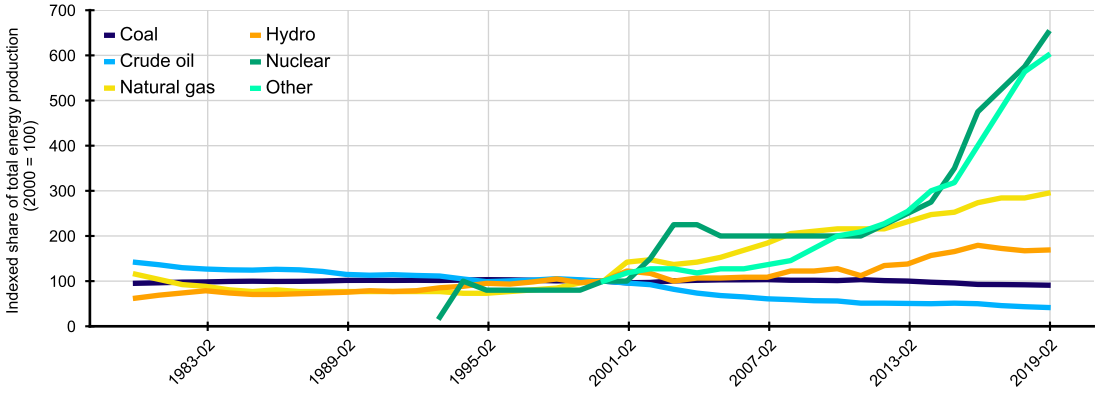


Figure 27: Shares of energy sources in total energy production (2000 = 100) (Source: China Statistical Yearbooks)

Note: Other energy sources include wind power, solar power and geothermal power.

The production of wind and solar energy is regionally concentrated, partly due to the regional distribution of subsidies, for example in Inner Mongolia, Xinjiang and Hebei (wind energy, Figure 28), and additionally in Jiangsu, Shandong and Qinghai (solar energy, Figure 29). Northern and western regions of China are thus leading the national wind energy production in particular.

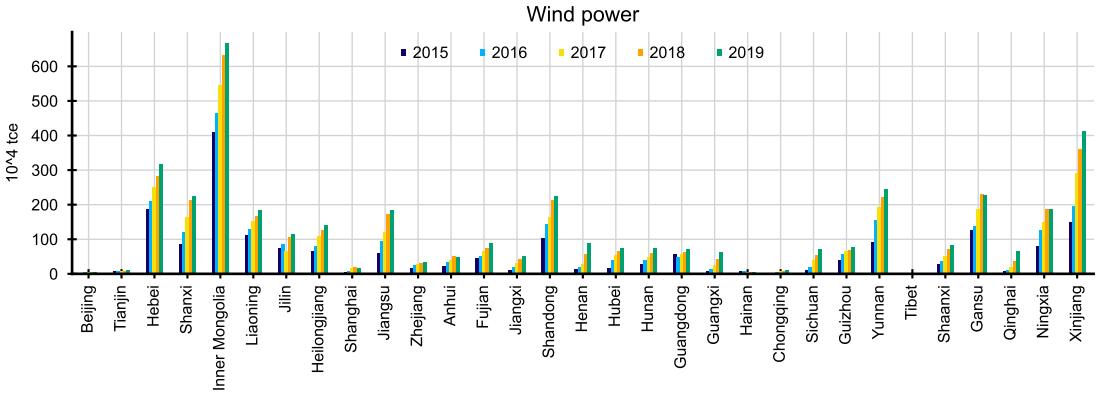


Figure 28: Production of wind by Chinese province (Source: China Statistical Yearbooks)

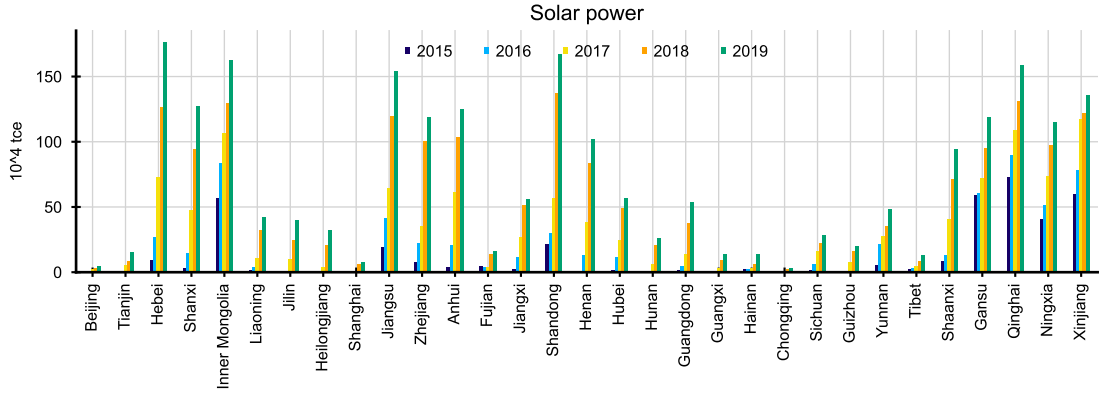


Figure 29: Production of solar power by Chinese province (Source: China Statistical Yearbooks)

Today, China is leading the global photovoltaic and wind energy markets: In 2020 China accounted for 33.2% of annually installed PV capacity, and 33.1% of cumulative PV capacity. Additionally, China is the largest producer and consumer of photovoltaic cells (77.7% of 2020 global production in China) and modules (69.8%), as well as the largest producer of upstream products for the production of PV systems (such as PV wafers (96% of global production in 2020), or polysilicons (76%)). Of the top 5 manufacturers of solar cells, four are Chinese, as are the top 5 manufacturers of PV modules (including one Canadian company that does most of its manufacturing in China). Among the largest Chinese manufacturers of PV cells and modules are Tongwei Solar, LONGi Green Energy Technology, Jinko Solar, Trina Solar and JA Solar Technology (iea, 2021).
China also holds the leading position in the global wind energy sector. China's share of new global wind power capacity installations was 56% in 2020. Both the onshore and offshore wind markets are experiencing above-average global growth. Globally, China accounts for approximately 39% of all onshore and 28% of all offshore wind energy installations in 2020 (GWEC, 2021).

In addition to the already known question of the cost-effectiveness of those industrial policy measures, there is, however, criticism of the implementation of the measures in the case of renewable energies, especially in the case of promoting solar energy. For example, subsidies were little controlled, especially at the beginning of the industrial policy measures, and were awarded regardless of the efficiency and profitability of the investments. Moreover, they were not adjusted to changes in production and material prices, resulting in significant overproduction. This overproduction also caused world market prices for PV systems to plummet, prompting the EU and US to respond with import tariffs on Chinese PV products to protect their own industries (G. Chen, 2015). Another criticism is that the subsidies were initially only directed at the production of PV systems, but not at the construction and operation of these systems within China. Construction and operation of PV system was thus financially unattractive for a long time and therefore over 90% of PV systems were exported (Andrews-Speed & Zhang, 2015). In addition, power grid operators were often

overwhelmed by the later, rapid construction of PV systems, so that some PV systems could not be connected to the power grid after their completion (Wang, Zheng, Zhang, & Zhang, 2016). The targeted government support of 'national champions' also created disincentives which led companies to produce as large quantities of PV systems as possible, as this protected them from potential competitors by the local or central government. In addition, in the event of financial difficulties, they received emergency loans on the order of the government, such as the company 'Wuxi Suntech Power Co. Ltd.' in 2012. For this reason, however, innovations often failed to materialize (G. Chen, 2015).

6.3 Financing of Chinese industrial policy

As we have shown in chapter 5.1, the 5 major state-owned banks constitute the backbone of China's financial system (Herr, 2010). Although their dominance has fallen since the 1980s (Ye, Xu, & Fang, 2012), these banks still account for about 37% of total assets in China today (Almanac of China's Finance and Banking, data for 2018). The second largest category of banks includes joint-stock commercial banks (18% of total assets), followed by city commercial banks (13%), policy banks (10%) and rural commercial banks (9.7%). Around 88% of total assets can thus be attributed to financial institutions under full or partial state control. The same holds for lending, where *'[a] few large state-controlled banks form the core of the credit system in China'* (Vernikov, 2015, p. 180). In 2018, the 'Big Five' SOCB's accounted for about 39.4% of total lending (Almanach of China's Finance and Banking and Sun (2020)). Andersson et al. (2016) show that lending of the four dominating banking forms in 2008 (SOCBs, JSCBs, Policy Banks and rural commercial banks) had a combined market share of about 85% of total lending.

From all of the above we therefore argue that bank lending in China is highly dominated by the state. X. Chen and Wohlfarth (2019, p. 1, 25) find that *'for individual banks and bank groups bureaucratic variables are very significant* [in driving bank credit growth] (...) *which is consistent with the state retraining quite a lot of control.* (...) *Bank lending through systematically relevant and state-owned commercial Chinese banks hence appears to be rather driven by policy'*.

If the government wants to promote the development of certain strategically important industries as part of its industrial policy, one of the most important aspects is to create a financially favorable environment. Ji and Zhang (2019), for instance, provide evidence, that about 42.4% of the variation in the growth of the Chinese renewable energy sector can be attributed to the development of the financial sector. Thereby bank and credit market lending are the most important sources for firm financing worldwide (Ji & Zhang, 2019). When looking at data for the sources of investment in the Chinese industry sector, however, it becomes clear, that - after self-financing - financing through credit is the most important financial resource in China, accounting for on average 22%

of all financing. China's financial system is thus traditionally characterized as being bank-based (Herr, 2010), which is also reflected in its relatively low stock market capitalization (average for the years 2010 to 2017: 56% of GDP) (Beck et al., 2000; Beck, Demirgüç-Kunt, & Levine, 2009; Čihák, Demirgüç-Kunt, Feyen, & Levine, 2012). Therefore, bonds account only for about 0.4% of total investment financing (China Provincial Statistical Yearbooks).[9]

Naughton (2021) also points out that an immense share of the financing of industrial policy in China comes from the state banking system. While the megaprojects under the MLP were still predominantly financed directly by the state, the SEI program provided companies with increased indirect support, such as loans from state-owned financial institutions (i.e. at least all major commercial (state-owned) banks and policy banks) (Ji & Zhang, 2019). In addition to traditional credit, industrial guidance funds (IGF) have recently been launched, but state-owned banks, especially the China Development Bank, also played a leading role in their initiation.[10] In addition, a smaller portion of industrial policy funding is also provided through state investment corporations (Naughton, 2021).

All of these findings lead us to believe that banks, as vehicle of the state, have a particular importance in the financing of industrial policy projects in China, which we will therefore analyse in more detail and in an empirical way in the next chapter. As Naughton (2021, p. 122) puts it:

> *'Indeed, the commitment from the banking system inevitably sets the overall framework for the volume of resources flowing through the overall industrial policy program.'*

6.4 Empirical role of banks for industrial policy in China

We will therefore now come to our empirical analysis on the role of credit provision for industrial policy and growth in China. An extended version of this analysis can be found in Geißendörfer and Haas (2022).

Our subsequent results were obtained by examining a data set based on the official Chinese statistical provincial yearbooks, again covering 31 Chinese provinces from 1985 to 2019. In addition, we applied data from an aggregate firm balance sheet data set that provides information by industrial sector, but also differentiated by ownership group. However, the latter data set is more fragmented than the general provincial yearbook data and usually does not start until the mid-2000s or - in the case of the automotive sector - even later, i.e. from 2012.

[9] Other sources of investment finance (averages): self-financed: 63.5%; state-financed: 10.6%; foreign-financed: 4.7% (China Provincial Statistical Yearbooks).

[10] IGFs are funds that are set up as limited partnerships or non-listed joint ventures, with an SOE or a government institution as initiator and managing partner, and with a predetermined purpose in financing a specific industrial policy project (Naughton, 2021).

Due to these data limitations we had to face a few restrictions in terms of econometric methodology and causality. A further examination of the relationship between credit, industrial policy and growth will therefore be interesting when there is a larger data coverage in the future. In the following we will present a summary of our main results:

1.) Role of credit after 2010

One challenge in conducting our empirical analysis was that isolating the effect of 'industrial policy' - also due to the limiting data situation - was not straightforward. Due to the complexity of the measures and the large interlinkages between industries, we therefore decided to use a temporal industrial policy indicator. As we have outlined in chapter 6.2, we argue that a particularly targeted, vertical form of industrial policy did not take place until the mid-2000s, and that the Strategic Emerging Industries (SEI) Program marked the beginning of the large-scale industrial policy approach in China. For this reason, we start to use a time dummy for the year 2010 as an indicator for industrial policy in our empirical analysis.

Our results, presented in Table 13, show that, while GDP growth rates were significantly higher before 2010, the effect of the growth of credit to the non-financial corporate sector was significantly higher after 2010, than before 2010. At the same time, credit provision generally has a positive relationship with GDP growth. Both results are robust when including lags, logarithmic growth rates and moving averages. On the other hand, there is no significant structural break after 2010 in the GDP growth effect of total credit growth.[11]

These results could thus be a first hint that credit might have been used more efficiently after 2010 (i.e. after the beginning of increased lending to targeted SEI industries).

[11] This could be due to the emergence of the global financial crisis in 2008 and its accompanying increase in mortgage credit to households that is included in the total credit indicator (see e.g. Bezemer et al. (2016)).

	RE			
Dependent: ΔGDP_{real}	(1)	(2)	(3)	(4)
$log(INITIALGDP)$	-0.0174**	-0.0174**	-0.0201***	-0.0150**
	(0.00793)	(0.00793)	(0.00763)	(0.00761)
$SCHOOL$	0.0431	0.0413	0.0295	0.0209
	(0.0552)	(0.0556)	(0.0547)	(0.0539)
$log(GOV)$	0.0292**	0.0290**	0.0341***	0.0272**
	(0.0114)	(0.0114)	(0.0112)	(0.0110)
$log(OPENNESS)$	-0.00613*	-0.00613*	-0.00549	-0.00476
	(0.00335)	(0.00334)	(0.00334)	(0.00332)
GEO_{west}	-0.0168	-0.0169	-0.0167	-0.0141
	(0.0112)	(0.0112)	(0.0110)	(0.0106)
$GEO_{centralnorth}$	-0.0271***	-0.0269***	-0.0261**	-0.0241**
	(0.0104)	(0.0104)	(0.0102)	(0.0101)
$\Delta CREDIT_{tot}$	2.41e-06***	0.00419		
	(5.93e-07)	(0.00420)		
$\Delta CREDIT_{NFC}$			0.0256***	0.0203**
			(0.00854)	(0.00943)
$year_{>2010}$		-0.180***		-0.190***
		(0.0326)		(0.0326)
$year_{>2010} * \Delta CREDIT_{tot}$		-0.00419		
		(0.00420)		
$year_{>2010} * \Delta CREDIT_{NFC}$				0.0452**
				(0.0216)
Constant	0.115***	0.114***	0.117***	0.120***
	(0.0328)	(0.0327)	(0.0354)	(0.0343)
Observations	981	981	1,040	1,040
Number of Provinces	31	31	31	31
Adj. R-squared	0.715	0.715	0.724	0.725

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Growth effects of dynamic credit indicators with time dummy variable for industrial policy (SEI), estimated with Random Effects

2.) Recipients of credit in China

Parts of the literature on China's industrial policy, however, question the success of those measures as they argue that there might be a risk of credit 'sweeping away'. In detail, they are concerned that credit could be provided to firms that do not use the provided capital for GDP-enhancing investments, but for unproductive use. It is often argued that this might be particularly the case for the large state-owned industrial sector due to their inefficiency. We will therefore now have a closer look at the effects of credit provision by different ownership types of firms. We will have to focus on private vs. state-owned firms in doing so, as we do not have any detailed sector data for other highly interesting firm types, as for example joint-ventures.

Our empirical results show that

- Credit provision to both the private and state-owned industrial sector has no significantly positive effect on real GDP growth (Table 14)
- There is also no structural break after 2010, i.e. credit provision has not significantly improved after the start of the SEI measures (Table 14)
- There are no robust findings whether these results differ when regressing the credit variables on total investment growth. While our baseline estimations show no investment growth effect of credit, and no structural improvement in the use of credit after 2010 (Table 15), we find other evidence in the robustness checks. When using logarithmic credit growth rates we find negative investment effects, and improvements in the use of credit after 2010 for the private sector. Credit provision to the state-owned industrial sector, however, does not show any positive investment effect of credit, also after 2010.
- Credit-financed investment in general has a positive effect on real GDP growth (Table 16)

	RE	
Dependent: ΔGDP_{real}	(1)	(2)
$log(INITIALGDP)$	-0.0280**	-0.0347**
	(0.0130)	(0.0141)
$SCHOOL$	0.125*	0.135**
	(0.0639)	(0.0650)
$log(GOV)$	0.0421**	0.0517***
	(0.0178)	(0.0190)
$log(OPENNESS)$	0.000615	0.00226
	(0.00572)	(0.00561)
GEO_{west}	-0.000214	-0.00117
	(0.0126)	(0.0124)
$GEO_{centralnorth}$	-0.0182	-0.0177
	(0.0146)	(0.0148)
$\Delta CREDIT_{priv}$	-0.000366***	-7.45e-05
	(4.57e-05)	(0.000480)
$\Delta CREDIT_{state}$	0.00343	0.00161
	(0.00280)	(0.00327)
$year_{>2010}$		-0.0621**
		(0.0272)
$year_{>2010} * \Delta CREDIT_{priv}$		-0.000265
		(0.000489)
$year_{>2010} * \Delta CREDIT_{state}$		0.00481
		(0.00496)
Constant	0.0168	0.0138
	(0.0529)	(0.0565)
Observations	374	374
Number of Provinces	29	29
Adj. R-squared	0.685	0.684

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: Growth effects of industry credit growth with time dummy variable for industrial policy (SEI) by ownership, estimated with Random Effects

	RE	
Dependent: ΔINV_{tot}	(1)	(2)
$\Delta STATECAP_{ind}$	-0.0213**	-0.0207**
	(0.0105)	(0.0103)
$\Delta FORECAP_{ind}$	-0.00868	-0.00831
	(0.00717)	(0.00741)
ΔREV_{ind}	0.304**	0.291*
	(0.155)	(0.161)
$GEO_{centralnorth}$	0.0204	0.0219
	(0.0174)	(0.0189)
GEO_{west}	0.0294**	0.0270**
	(0.0117)	(0.0129)
$\Delta CREDIT_{priv}$	0.000620	-0.00147
	(0.000384)	(0.00161)
$\Delta CREDIT_{state}$	0.00791	0.00198
	(0.00665)	(0.00529)
year >2010		-0.111**
		(0.0444)
$year_{>2010} * \Delta CREDIT_{priv}$		0.00216
		(0.00171)
$year_{>2010} * \Delta CREDIT_{state}$		0.0193
		(0.0118)
Constant	0.101***	0.104***
	(0.0211)	(0.0220)
Observations	365	365
Number of Provinces	29	29
Adj. R-squared	0.425	0.423

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: Investment effects of industry credit growth with time dummy variable for industrial policy (SEI) by ownership, estimated with Random Effects

Thus, while we did not find any (robust) signs that there were structural differences in the use of credit after 2010 for private and state-owned firms, we do find structural improvements on the aggregate level. We argue that this might be due to the role of other types of firms, that we could not analyse on the sector level due to data limitations, but that are included in the general credit indicators. We therefore conclude that it might have been mainly non-private and non-state firms that have probably used credit in a more efficient way after the start of the SEI measures in 2010. In particular, we assume that joint-ventures have had a significant impact on China's economic development in the past (see Chapter 6.2 and in detail Chapter 6.2.4) and could have substantially contributed to the recent efficiency improvements in the use of credit.

3.) Effects of credit on investment in targeted industries

We then checked the previous results by applying our estimations on the industry level, more specifically, on the two industries that we have already looked at in Chapter 6.2.4, i.e. the automobile and the energy sector. For this purpose we refer to the annual aggregate firm level data by industry, and as already mentioned, there is a smaller data coverage here, so that we cannot divide this data set into the period before and after 2010. As we have data starting in 2005 for the energy sector, and data starting in 2012 for the automobile sector at our disposal, we can, however, draw comparisons on the effects of credit between the two industries while being promoted under the SEI program and subsequent industrial policy programs.

	RE	
Dependent: ΔGDP_{real}	(1)	(2)
$log(INITIALGDP)$	-0.0459***	-0.0488***
	(0.0106)	(0.0110)
$SCHOOL$	0.0551	0.0586
	(0.0566)	(0.0562)
$log(GOV)$	0.0698***	0.0737***
	(0.0146)	(0.0150)
$log(OPENNESS)$	-0.00784**	-0.00811**
	(0.00360)	(0.00363)
GEO_{west}	-0.0295**	-0.0312**
	(0.0135)	(0.0137)
$GEO_{centralnorth}$	-0.0332***	-0.0340***
	(0.0124)	(0.0126)
$year_{>2010}$		-0.281***
		(0.0380)
ΔINV_{credit}	0.00417	0.00447
	(0.00261)	(0.00403)
$year_{>2010} * \Delta INV_{credit}$		-0.00113
		(0.00620)
Constant	0.144***	0.144***
	(0.0256)	(0.0267)
Observations	891	891
Number of Provinces	31	31
Adj. R-squared	0.713	0.713

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Growth effects of investment financed by credit with time dummy variable for industrial policy (SEI), estimated with Random Effects

	RE		
Dependent:	(1) ΔINV_{tot}	(2) ΔINV_{auto}	(3) ΔINV_{energy}
ΔREV_{ind}	0.302**	0.834	-10.72
	(0.151)	(0.645)	(9.862)
$\Delta CREDIT_{firm}$	0.00436	0.557***	-0.101
	(0.00763)	(0.163)	(0.199)
$\Delta STATECAP_{ind}$	-0.00370	-0.267***	0.270
	(0.0111)	(0.0901)	(0.456)
$\Delta FORECAP_{ind}$	-0.00736	-0.0314	0.227
	(0.00917)	(0.103)	(0.371)
$GEO_{centralnorth}$	0.0228*	-0.0756	1.084
	(0.0138)	(0.0565)	(1.126)
GEO_{west}	0.0344***	-0.0651	2.485
	(0.0117)	(0.132)	(2.202)
Constant	0.0914***	0.154	0.0711
	(0.0184)	(0.514)	(0.337)
Observations	501	128	390
Number of Provinces	30	22	29
Adj. R-squared	0.432	0.540	0.044

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 17: Investment effects of industry credit growth by industrial sector, estimated with Random Effects

Our results, as shown in Table 17, indicate that there is a highly significant and large-scale effect of credit provision to the automobile sector and investment growth in the same sector. This effect is also significantly stronger than for the total industrial sector. Interestingly, having a higher share of government capital in owner's equity also seems to significantly lower automobile investment. On the other hand, there is no significant effect of credit provision on investment growth for the energy sector. We mainly attribute this to inefficiencies in the renewable energies sector, as we assume

that, due to China's industrial policy objectives, the majority of financial resources flow to 'green' energy producers. Nevertheless, there is also the possibility that the production of non-renewable energy skews our results in parts.

These findings fit well with our previous results and with the presentation of both industries in chapter 6.2.4: While in the automotive sector the majority of the firm landscape is made up of joint venture firms, the renewable energy sector contains significantly more private firms.

6.5 Summary: Industrial policy for growth in China

This section discussed industrial policy with a focus on the development of the Chinese economy and the role of credit for industrial policy in China. A first assessment on current research on industrial policy shows that the appraisal of industrial policy in the literature changed considerably in recent years towards a more open and positive approach to industrial policy. This is underscored by several empirical studies. Our study then looks at industrial policy in China in particular and identifies two broad periods. Between 1978 and the early 2000s, Chinese economic policy had an industrial policy character but the main focus was on a transformation of the economy to a market economy. After that, China started to pursue a more clear industrial policy that targets specific industries and sectors, but also technologies and projects. As we show, China's financial system is mainly bank-based and thus it is likely that banks also played an important role in the conduct of industrial policy. This is also what we show in the accompanying study (Geißendörfer & Haas, 2022). Our results show that, while GDP growth rates were significantly higher before 2010, the effect of the growth of credit to the non-financial corporate sector was significantly higher after 2010, than before 2010. At the same time, credit provision generally has a positive relationship with GDP growth. We did, however, not find any (robust) signs that there were structural differences in the use of credit after 2010 for private and state-owned firms. Still, we found hints that there might have been a positive effect at an upstream stage, i.e. with respect to investment growth in particular of private firms. These results could thus be a first hint that credit might have been used more efficiently after 2010 (i.e. after the beginning of increased lending to targeted SEI industries). We also find significant effects of credit provision on investment in the automobile sector - a sector that has been intensively targeted by industrial policy in China. We did not find these results for the energy sector, which could be due to the market structure in the two markets. While a majority of firms in the automobile sector is made up of joint venture firms (Y. Chen, Lin Lawell, & Wang, 2020; Liu & Kokko, 2013; Schüller, 2015), the renewable energy sector contains mainly private firms Chiu (2017). The insignificant results for the energy sector could also be attributed to inefficiencies as we have shown above. This is also in line with the literature that finds strong inefficiencies and overinvestment in the renewable energy sector (e.g. Bu and Tu (2017); Shen and Luo (2015)).

The general inefficiencies of SOEs but also of purely private Chinese firms have already been addressed in the literature from various angles (e.g. Dougherty, Herd, and He (2007); S. Li, Lin, and Selover (2014); L.-Y. Zhang (2004)) and can thus be confirmed in the context of this study from the side of the use of credit. In addition to inefficiencies in the use of credit, it would also be conceivable, especially in the case of private companies, that more credit would not lead to an increase in investment on the same scale, for example due to bureaucratic or similar hurdles.

The discrepancy between the significantly growth-enhancing credit use by the corporate sector in general, and the sometimes negative or non-significant results when looking at purely private or purely state-owned firms in isolation could be attributed to the existence of other types of firms. We have already suggested that joint venture firms may be particularly relevant in this context, which is also shown in the literature (e.g. Jiang, Keller, Qiu, and Ridley (2018); Y. Lu, Tao, and Zhu (2017)). Furthermore, there is a range of literature that suggests that the existence of joint-ventures positively influences the success of private firms in China through spillover effects (Jiang et al., 2018; Van Reenen & Yueh, 2012). Overall, it could thus be argued that credit after the start of SEI measures is being used more efficiently and in a growth-enhancing way, primarily by joint-venture firms (or other non-private and non-state firms), and that these positive effects are also slowly spreading to Chinese private firms. Jiang et al. (2018) also show that firms that receive government subsidies - implicitly, firms with well-developed political connections - are also more likely to be selected as joint venture partners and thus benefit from foreign expertise. Particularly with regard to state subsidies, this can also be seen as an indirect positive effect of industrial policy in China.

In sum, our consideration of China's industrial policy to be positive overall lies in the fact that the Chinese government has in the end achieved its designated goal of global dominance both in the NEV market and in the market for renewable energies. China is now considered one of the world's leading economies in both markets, although the Chinese approach to the development of the two sectors has been fundamentally different. Due to the lack of foreign expertise in the renewable energy sector, achieving market dominance there in particular was associated with extremely high costs. As a result, it is not uncommon for studies to come to a rather negative assessment of industrial policy success in this area (e.g. Bu and Tu (2017); Shen and Luo (2015)). We have not performed a cost-benefit analysis of the industrial policy measures in the context of our accompanying study. This is partly because an objective assessment of all costs is insufficiently possible due to the availability of data, and partly because an assessment at this stage is probably too early - especially since the overall benefits of the industrial policy measures cannot even be seen at present. At the same time, it must be discussed whether the activity of the state per se does not have to go far beyond a pure cost-benefit consideration. The remainder of this chapter will therefore briefly describe the role of the Chinese state as an entrepreneurial state in the sense of

Schumpeter's growth theory.

Schumpeter's growth theory was described at the outset, and China was described as a hybrid between a central planner and a private banking system. The banker described by Schumpeter thus changes from a private institution to a state institution, and the state becomes an active player on its own right. This concept of the **'entrepreneurial state'** was elaborated by Mazzucato (2013), but can already be traced back to Schumpeter (Burlamaqui, 2020). The correspondence between the Schumpeterian growth model and the entrepreneurial state in China was described by Burlamaqui (2020, p.14) as follows: *'[F]rom a Schumpeterian (rekindled) perspective, the Chinese entrepreneurial state encompasses the functions of ephor, entrepreneur-in-chief and policy coordinator.'* Burlamaqui (2015, p.730) argues that the Chinese economic model shows all the elements contained in Schumpeter's vision of successful state involvement in economic activity, such as

> *'[t]he centrality of credit for innovation and development (instead of 'savings'), the key role of the State in steering and governing the development process (instead of 'free markets'), the strategic role of investment-development banks to provide the necessary funding, and the functionality of financial restraint to avoid the buildup of 'financial casinos'.*

This model of the entrepreneurial state in the Schumpeterian sense could be the key to the Chinese growth miracle as Herr (2010, p.86) argues:

> *'The secret of Chinese success seems to rest on a productive combination of government interaction and market forces. China has managed to create a sustainable Schumpeterian-Keynesian credit-investment-income-creation process which has led to economic prosperity. This process was domestically driven by political credit expansion and allocation, and by a dynamic private sector including foreign enterprises.'*

The empirical analysis in the accompanying study (Geißendörfer & Haas, 2022) provides additional confirmation of this account of the Chinese growth model.

7 How China had been able to overcome the *"growth strategy trilemma"* – at least so far

7.1 Trade-offs in the growth process

The extensive literature on the Chinese growth model pays relatively little attention to the macroeconomic dimension. As the experience of many Latin American countries illustrates, a stable macroeconomic environment is not self-evident. At the same it is central to the sustained success of a growth strategy.

Agarwal (2023) has presented the trade-offs that developing and emerging countries are facing in the growth process with a so-called *"growth strategy trilemma"*. It shows the interrelationships between three different objectives:

- establishing national champions through industrial policy,
- economic growth, and
- financial and fiscal stability.

In the view of Agarwal (2023), it is not possible to reach all three targets simultaneously. Therefore, as shown in Figure 30, a choice has to be made between three different growth strategies:

- Strategy A prioritizes **financial and fiscal stability** so that it only supports "safe champions" and is thereby willing to accept lower growth rates.
- Strategy B focuses on supporting **bold champions**. It emphasizes economic growth and the selection of risk-taking national champions. Governments that pursue this strategy must be willing to accept a higher risk of instability to pursue higher growth.
- Strategy C **("fair-market capitalism")** prioritizes stability along with economic growth—without a focus on national champions. This strategy aims at a dynamic market economy along with free entry and ensuring that businesses operate in a fair and competitive marketplace.

Figure 30: Promoting national champions: The Growth Strategy Trilemma. Source: based on Agarwal (2023)

Looking at the Chinese growth model from this perspective raises the question of how China had been able, at least for many decades, to avoid this trilemma:

- As we have shown in section 2, China had been able to achieve **very high rates economic growth**, even in comparison with other developing countries.
- It had been very successful in **establishing national champions** through industrial policy that play leading or dominant roles in the world economy.
- It had been able most of the time to preserve a **stable macroeconomic environment** with relatively low inflation, current account surpluses, and a stable exchange rate supported by a high amount of foreign exchange reserves. This feature is especially obvious if one compares China with many Latin American countries that were suffering from high inflation and recurrent currency crises.

7.2 The role of fiscal policy in the Chinese growth process

Before answering this question, it seems necessary to have a look at Chinese fiscal policy. It reflects the neglect of the macroeconomic dimension in the Chinese growth story, that little attention is paid to role and size of direct government policies. In addition to lending funds to the corporate sector via the mainly state-owned banking system, the Chinese government also used its fiscal space for financing large-scale infrastructure projects, predominantly at the level of local governments. The extensive use of deficit-financing by these actors is reflected in the IMF data on the 'augmented fiscal deficit' which augments to the official deficits of the central government and the local governments by

- additional **Local government financing vehicle** (LGFV) debt *"possible to be recognized"*, and
- additional debt tied to **Special Construction Funds**, which are designed for infrastructure financing, and **Government Guided Funds** which are an important funding source for China's private equity market, directing capital to the emerging strategic industries like semiconductors, healthcare and high-end manufacturing.

The strong reliance of the Chinese government sector of deficit financing becomes obvious if one compares the official deficits with the augmented deficits. For many years now these deficits are in a double-digit range (see Figure 31).

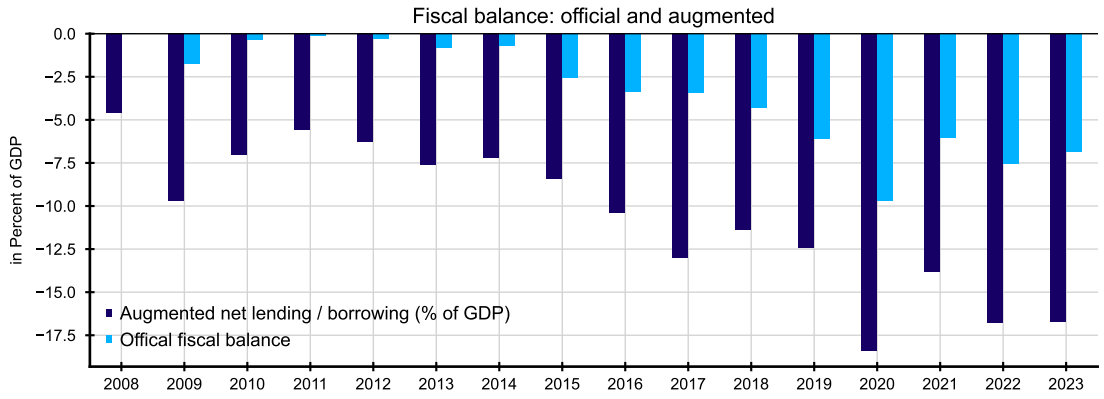


Figure 31: China fiscal balance: official and augmented (Source: IMF WEO, IMF (2023)).

As a result of this *"hidden"* lending, the *"augmented debt"* of the Chinese public sector is also much higher than its *"official debt"*. In addition, one can see in Table 18 that the BIS credit statistics for *"private non-financial corporations"* must include LGFV debt. Therefore, the debt of the private corporate sector is significantly lower than reflected in the data of the BIS statistics.

China: Nonfinancial sector debt (percent of GDP)		
	IMF Statistics	BIS Credit Statistics
Official government debt	51	75,2
Local goverment financial vehicle (LGFV)	48	
Government funds	11	
Augmented Government Debt	110	
Households	63	61,3
Corporates ex LGFV	115	
Total debt	291	297,2
Corporates incl. LGFV	163	158

Table 18: China: Nonfinancial sector debt (Source: IMF (2023), Article IV China).

The high deficits of the government sector in years of buoyant growth and low unemployment are difficult to reconcile with the textbook models of fiscal policy. As Blanchard (2023) shows, there are two dominant theoretical approaches to fiscal policy and public debt:

- the **neoclassical growth theory** based on a *"real analysis"* (Box 1 in section 4.2)
- the **Keynesian theory of *"deficit spending"*** based on the *"monetary analysis"* which Blanchard labels as *"functional finance"*.

The **neoclassical theory** is characterized by full employment. Due to its key assumption that the economy can be represented with an all-purpose commodity, it has no creative role for government debt. As there is only one production function, government investment, i.e. borrowing the all-purpose good from households and investing it, cannot provide additional growth effects. Therefore, the only rationale for government debt is a situation with **private over-investment**. By

borrowing the all-purpose good from households and redistributing it to them in a different way, the government can increase the welfare of the society. In other words, due to the restrictive model setup, public debt can only be used for reducing private investment and increasing consumption, i.e. government transfers to the household sector.

The **Keynesian theory of deficit spending** has been designed for situations with unemployment. It focuses on the stabilization role of fiscal policy, especially in situations of unemployment. This focus also characterizes the Modern Monetary Theory which beyond the target of full employment aks for a *"**job guarantee**"*:

> *"It is neither an emergency policy nor a substitute for private employment, but would become a permanent complement to private sector employment. A direct job creation program can provide employment at a basic wage for those who cannot otherwise find work. No other programme can guarantee access to jobs at a decent wage."* (Mitchell, Wray, & Watts, 2019, p. 295)

With both approaches it is difficult to explain the active role of fiscal policy in China. As Bofinger (2022) has shown and as apparent in Table 19, what is lacking is fiscal theory that combines a monetary analysis with a role for a debt-financed fiscal policy in situations with full employment.

The mechanisms are relatively like those of the bank financing of enterprises. In both cases the debt financing of additional expenditures means *"new orders"* that come on top of the existing orders. In the case of fiscal policy, the financing is mainly via the capital market but as we have seen banks are the most active investor in the Chinese capital market. Fiscal policy then has the option of providing grants to enterprises which increase the purchasing power of this sector (see Figure 32). Alternatively, it can directly spend the funds for investments or consumptive expenditures. Direct public expenditures are required for investments with high externalities, above all infrastructure investments, or for grants to enterprises which engage in very risky investments, i.e. investments in new technologies.

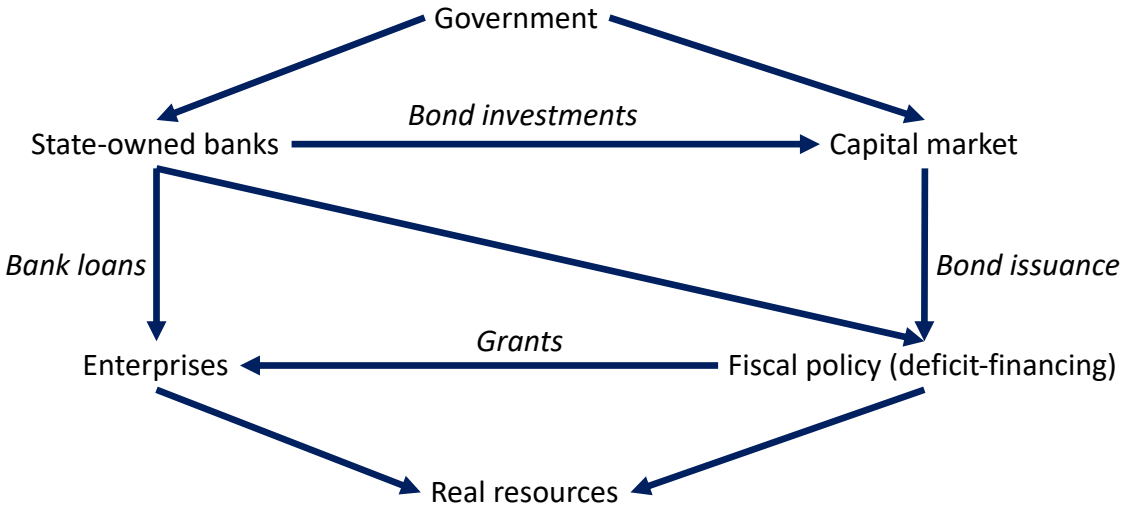


Figure 32: China's financing channels.

A main difference between enterprise-financed and government finance expenditures concerns the decision-making process. As we have seen, the *"banker"* plays an important role in bank financing of Chinese enterprises. In the case of direct government financing this role is limited and the decisive actor is the politician. But like the banker, the politician must be able to identify productive investments if he/she wants to avoid that in situation of full employment his *"additional orders"* lead to inflation. Therefore, one could speak of a Schumpeterian politician or a Schumpeterian fiscal policy. This approach come close to the model of the *"entrepreneurial state"* which has been developed by Mariana Mazzucato (2013).

	Real Analysis	**Monetary Analysis**
Unemployment	-	Functional finance: Keynesian deficit spending, Modern Monetary Theory
Full employment	Neoclassical theory: Government debt reduces excess investment	Schumpeterian fiscal policy Entrepreneurial State

Table 19: Real analysis vs. Monetary analysis

From a macroeconomic perspective it does not make a fundamental difference whether the credit-financed new orders come from enterprises or directly from the government. In both cases, the main question is how China had been able to overcome the *"growth strategy trilemma"* successfully at least for the time being. In other words, one must ask why the very high credit growth in China did not lead to high inflation.

7.3 A Schumpeterian theory of inflation

7.3.1 Overcoming the supply constraint of the Quantity Theory

Starting from the Quantity Theory of Money one would be tempted to expect that a strong increase in private and public debt causes inflation. As bank credit creation goes hand in hand with money creation, the growth rate of the Chinese money supply has been very high in the past. With the growth of the Chinese capital market in the 2010s, the growth of the money supply was lower than the growth of debt but still higher than the growth rate of nominal GDP (figure 33).

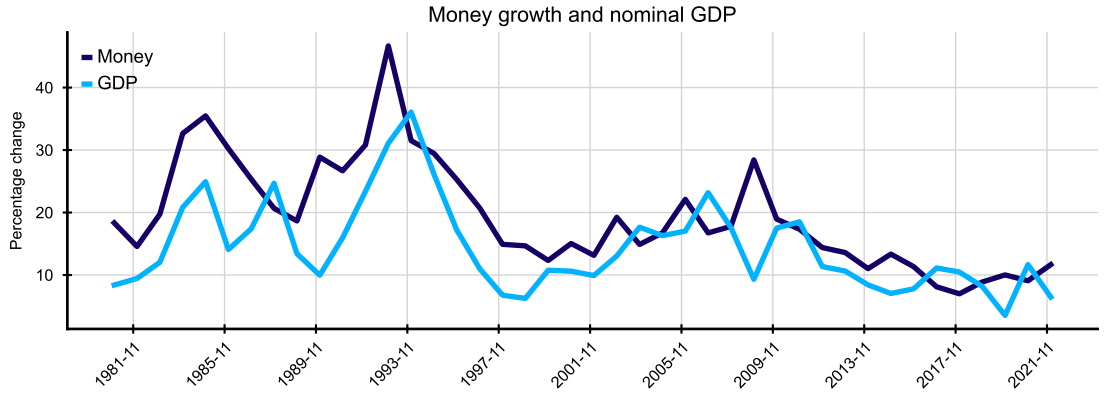


Figure 33: China money growth and GDP growth (Source: Worldbank).

In its simple version, the Quantity Theory assumes that real GDP and the velocity are constant so that an increase in the money stock leads to an increase of the price level. In other words, it assumes that the increase in the money stock has no effect on the supply side of the economy. This a logical consequence of the narrow framework of the real analysis. As the *"capital market"* is presented with loanable funds model, there is no connection between the increase of the money stock and an increase in the supply of funds for investments. The money supply comes from heaven (helicopter money).

This is different in the paradigm of the monetary analysis, especially with a Schumpeterian focus on banks. Here the money supply is identical with a supply of loans. If loans are used in a productive way, they increase the supply side and thus remove the supply constraint of the Quantity Theory. As we have seen in this study there is evidence that the enterprises had been able to use the purchasing power provided to them by bank loans in a growth-enhancing way.

A study by the World Bank (Brandt et al., 2020) illustrates this process for the years 1978-2010. It shows that in the case of China labour was shifted from the agricultural sector with very low productivity to higher-productivity sectors, above all manufacturing, construction, trade, restaurants

and hotels (see figure 34).

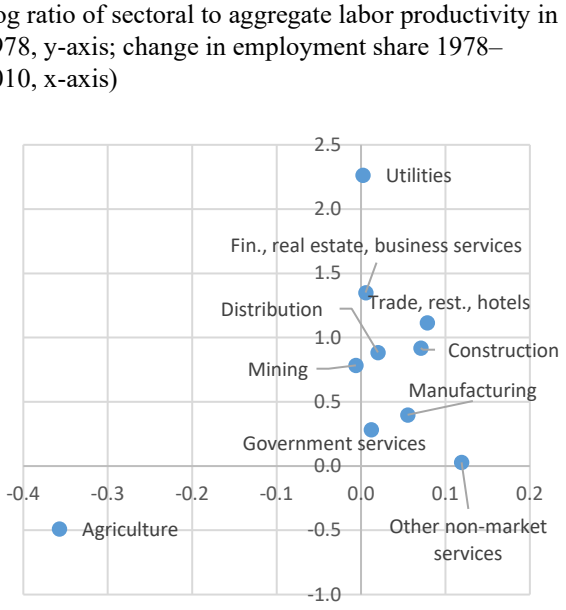


Figure 34: China Labor moving out of agriculture (Source: Brandt et al. (2020, p. 5)).

Schumpeter was aware of the fact that the initial effect of using existing resources in a different way has an inflationary effect. But he argued that the transformation to sectors with higher productivity increases the production potential so that the increased aggregate supply restores price stability.

> *"After completing his business — in our conception, therefore, after a period at the end of which his products are on the market and his productive goods used up — he has, if everything has gone according to expectations, enriched the social stream with goods whose total price is greater than the credit received and than the total price of the goods directly and indirectly used up by him. Hence the equivalence between the money and commodity streams is more than restored, the credit inflation more than eliminated, the effect upon prices more than compensated for there is no credit inflation at all in this case — rather deflation — but only a non-synchronous appearance of purchasing power and of the commodities corresponding to it, which temporarily produces the semblance of inflation."* (Schumpeter, 1934b, p. 96f.)

As Banga et al. (2022, p. 34) emphasize, in the Chinese growth model the principle of using resources in a more productive way was used on an ongoing basis:

> *"In the early 1980s, the government pushed investment towards the light industry, mainly textile. Then in the later 1980s, fundamental industries such as energy and transportation became the focus as they could support industry development across the board. In the 1990s, the government started targeting both infrastructure and high-tech industries, proposing the concept of pillar industry and strategic industry reconfiguration. Since 2001, China has*

put high-tech, information, equipment manufacturing, renewable energy and other 'strategic emerging' industries at the core."

The authors conclude:

"Even though the focus of the industrial policy keeps changing, it follows a persistent principle: pushing the factor towards the sector that will generate the highest possible productivity and return. These measures are not simply defined as short-term profitability but more widely as trade revenues or other social-economic effects." (Banga et al., 2022, p. 34)

7.3.2 A simple macroeconomic model explaining non-inflationary growth in China

The macroeconomic effects of the Chinese growth process can be described within a simple $IS/PC/MP$-model (Bofinger, 2022). Graphically the model can be presented by

- an IS-curve depending on the real interest rate,
- an MP-curve describing the central bank's policy which is implemented by targeting the (real) interest rate, and
- a Phillips-curve (PC) which depends on the output-gap and expected inflation.

We start with an equilibrium situation (**A**) where the output is at the full employment level (Y^F), i.e., the output gap is zero (Y_0^*), and the inflation rate is equal to the inflation target (π_0*). This situation is characterized by a macroeconomic optimum as there is neither an inflation-gap nor an output-gap.

If additional purchasing power is provided to an entrepreneur or to the government from the banking system, aggregate demand increases, and the IS curve shifts upwards from IS_0 to IS_1 (figure 35). In the Phillips curve diagram, the higher output level leads to an inflation rate π_1 which is above the central bank's target inflation rate π^*. If the central bank reacts immediately to the increase in inflation and raises the interest rate to r_1 (MP_0 shifts to MP_1) the Schumpeterian process is stopped.

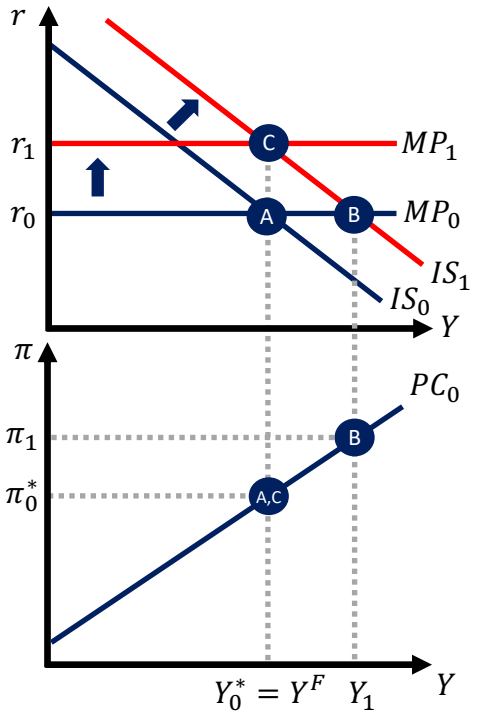


Figure 35: $IS/PC/MP$-model with IS shift.

With a **flexible inflation targeting**, i.e. if the central bank is willing to allow a temporary deviation from its inflation target, there is scope for a Schumpeterian development process. If the growth process is successful and *"enriched the social stream with goods whose total price is greater [...] than the price of the goods directly or indirectly used up"* (Schumpeter, 1934b, p. 96) by the investor, the potential output of the economy increases from Y_0^F to Y_1^F so that the full employment output shifts from Y_0^* to Y_1^*. The positive output-gap vanishes. As the Phillips-curve is defined for the output gap, it shifts downwards from PC_0 to PC_1 so that the inflation rate declines to the inflation target (figure 36).

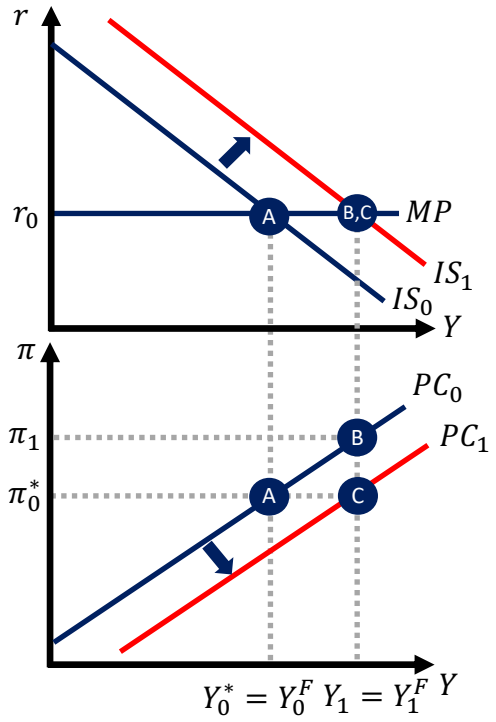


Figure 36: $IS/PC/MP$-model with shift of potential output Y^F.

In other words, a more than transitory trade-off between macroeconomic stability and economic growth can be avoided or at least mitigated if the transfer of resources from existing to new uses is accompanied by productivity increases.

7.3.3 Specific macroeconomic stabilization tools

With its extensive control over the economy, the Chinese government has **specific tools for fighting even temporary inflationary tendencies**. A comprehensive survey of **price controls** in China with a focus on the 1980s and 1990s can be found in Weber (2021). The Chinese government still **controls strategic prices**, above all energy processes (WTO, 2018) and also has a strong influence on wage determination:

> *"There are significant institutional constraints on the extent to which wage rates are determined through free bargaining between labor and management. The Chinese government prohibits the formation of independent trade unions to represent labor, and workers do not have the legal right to strike, which is an important lever in collective action and negotiation with management over wages. Labor unions are under the control and direction of the All-China Federation of Trade Unions (ACFTU), a government-affiliated and CCP organ."* (WTO, 2018, p. 4)

Another important macroeconomic instrument in the Chinese toolkit is so-called window guidance, which has played and still plays an important role. With this instrument the central bank gives the

banks informal targets for lending growth. The most recent IMF report on China (IMF, 2023, p. 34) notes:

> *"These policies, which induce banks to increase net lending through non-interest rate means, have long featured in China's policy toolkit. Their use has recently expanded given their promise of more precisely controlling credit growth and avoiding financial risk-taking. Adjustments to policy interest rates have become less frequent, both relative to China's recent past and to other emerging markets."*

Finally, China has a long history of **capital controls** (Herr, 2010; Yang, 2020). For a development model that uses the creation of *"purchasing power"* as a main driver of growth, it is indispensable to prevent an uncontrolled outflow of newly created money. It could lead to a depreciation of the currency and with limited foreign exchange reserves to a currency crisis. In the literature such currency crises are labelled as ***"first generation models"***. They are based on *"the assumption that the government of the target economy was engaged in steady, uncontrollable issue of money to finance a budget deficit."* (P. R. Krugman, Rogoff, Fischer, & McDonough, 1999, p. 423) Thus, the financial constraint which is absent for large economies cannot easily be removed for smaller economies.

7.3.4 Summary: Debt not as a burden but as a policy instrument

Overall, China, more than any other developing country, has managed to reconcile strong economic growth with an overall stable macroeconomic equilibrium and, at the same time, the successful promotion of national and even global champions. The very strong position of the banking system compared to other countries played a central role in this. It made possible a hybrid growth model in which the state was able to steer companies in the direction it wanted by providing credit, but without setting concrete targets for inputs and outputs, as in a planned economy. It speaks for this model that China was able to translate the impulses provided by the financial system into productivity gains in such a way that, apart from the 1980s and 1990s, there were no major macroeconomic imbalances, especially in the form of currency and debt crises.

In keeping with Schumpeter's growth theory, China has thus succeeded in using the debt potential available to the state in a large and relatively closed economy as a key instrument for growth. Or in the words of Banga et al. (2022, p. 72):

> *"Simply put, the key lesson is that debt should not be regarded as a burden but as a policy instrument."*

8 Lessons to be learnt from China for economic policy and theory

There is no doubt that China is a very special case due to the size of the country and its population, its history and culture as well as its political and economic system. Nevertheless, we think that there are important lessons that other countries can draw from the impressive Chinese success story of last four decades.

- A *"market driven, and government guided"* (Naughton, 2021) approach to economic policy can be successful. This applies specifically to the vigorous industrial policy that was followed in China since 2010.
- An ambitious industrial policy is not a free lunch. Or as Naughton (2021, p. 104) has put it: *"Chinese policy-makers are willing to spend a lot of money"* and *"are paying a huge price for their industrial policies."*
- This price can be paid by debt. Debt is not a burden, but an instrument that can play a constructive and strategic role in development (Banga et al., 2022).
- A *"monetary analysis"* provides better insights for explaining economic growth than *"real analysis"*.

8.1 Lessons for industrial policy

There is a long debate among economists about the merits of industrial policy and above all the question whether governments are able to pick winners. A recent literature survey by the OECD (2022a, p. 3) comes to the result that *"the review of existing empirical evidence strongly supports the premise that well-designed economic incentives for firms and good framework conditions are effective. At the same time, it emphasises the limited and inconclusive nature of the evidence regarding the increasingly frequent targeted and demand-side instruments."*

We have shown that as far as China is concerned the literature does not come to a clear result. While our estimates show an overall positive effect of industrial policy since 2010 and also in the automotive sector, there are negative effects for the energy sector. Even Naughton (2021, p. 99) who praises *"the increasingly sophisticated technological rationale"* of China's industrial policy states: *"Policy makers do not have a clearer vision of the future than individual entrepreneurs, and the ultimate impact of their policy interventions"* (Naughton, 2021, p. 134). Consequently, he also is not sure, whether China's industrial policy can be regarded as a success: *"Chinese industrial policies are so large, and so new, that we are not yet in a position to evaluate them. They may turn out to be successful, but it is also possible that they will turn out to be disastrous"* (Naughton, 2021, p. 136)

But as we have argued, a simple and effective indicator for the success of industrial policy is whether it has achieved the ambitious targets of the Chinese government, i.e. reaching a global dominance in new technologies in a process of leapfrogging established technologies. A useful tool for such an evaluation is the **Critical Technology Tracker** which has recently been developed by the Australian Strategic Policy Institute (ASPI) (Gaida et al., 2023). The indicator focuses on a key performance measure of scientific and technological capability—high-impact research—and reveals where countries, universities and companies around the world have a competitive advantage across the 44 technologies. The Institute chooses technologies which *"are foundational for our economies, societies, national security, energy production, health and climate security"* (Gaida et al., 2023, p. 3). The result of this evaluation clearly speaks for the success of China's industrial policy:

> *"China's global lead extends to 37 out of 44 technologies that ASPI is now tracking, covering a range of crucial technology fields spanning defence, space, robotics, energy, the environment, biotechnology, artificial intelligence (AI), advanced materials and key quantum technology areas. For some technologies, all of the world's top 10 leading research institutions are based in China and are collectively generating nine times more high-impact research papers than the second-ranked country (most often the US). [...] The US comes second in the majority of the 44 technologies examined in the Critical Technology Tracker. The US currently leads in areas such as high performance computing, quantum computing and vaccines"*[12] (Gaida et al., 2023, p. 1)

For the rest of the world the Technology Tracker comes to the result that *"there is a large gap between China and the US, as the leading two countries, and everyone else."* One can present the performance of the top 10 countries in a medal table (Table 20). Especially for Germany the result should be a wake-up call.

[12] The full list is provided in Appendix A.1.

		Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
1.	China	37	7			
2.	United States	7	32	4	1	
3.	India		4	15	5	5
4.	South Korea		1	5	8	6
5.	United Kingdom			13	8	8
6.	Italy			3	2	2
7.	Germany			2	13	2
8.	Japan			1	1	2
9.	France			1		1
10.	Australia				2	7
11.	Iran				2	4
12.	Canada				1	3
13.	Singapore				1	
14.	Malaysia					1
15.	Netherlands					1
16.	Russia					1
17.	Saudi Arabia					1

Table 20: "Medal table" based on Gaida et al. (2023).

Anecdotal evidence of the technological leadership that China has achieved in many areas is **Volkswagen's** announcement to cooperate with the relatively small Chinese manufacturer XPeng (Handelsblatt, 2023). The company brings software solutions, applications in automated driving and intelligent voice assistants to the cooperation. This is an obvious sign for *"leapfrogging"* as German carmakers are unable to produce competitive cars without the help of Chinese carmakers.

Another indication for the success of the Chinese industrial policy is the fact that it is now increasingly copied by other countries. This applies above all to the United States. While Mazzucato (2013) has shown that this country already has a long tradition in fostering new technologies by the state, with the CHIPs and Science Act, the Infrastructure Investment & Jobs Act and the Inflation Reduction Act, US industrial policy has reached a new dimension. Credit Suisse (2022) estimates the federal climate spending at over US$800 billion, doubling the baseline of more than US$400 billion. With the multiplier effect on private investments and green financing programs, Credit Suisse (2022) expects total spending could reach nearly US$1.7 trillion over the next ten years.

The report argues that *"the IRA magnifies the strategic advantages the US already holds (natural resources, infrastructure, geologic storage, technical expertise and technology talent) and enables the industry to become a dominant energy supplier in the low carbon economy. The stacked benefits of the clean electricity and manufacturing tax credits would make US solar and wind the cheapest in the world."* (Credit Suisse, 2022, p. 5)

The incentive effects of IRA compared to the subsidies in the European Union were calculated by VDMA (2023):

- US support for a factory in the **battery sector** is around 3 to 20 times higher than the support available in Europe (depending on size and reference to IPCEI (R&D sector or full commercial sector) or the EU ETS Innovation Fund).
- US support for a factory in the **solar sector** is about 9 times higher than the support available in Europe (EU ETS Innovation Fund).
- US support for a factory in the **wind sector** is about 8 to 14 times higher than the support available in Europe (EU ETS Innovation Fund).

As figure 37 shows, a positive feature of the IRA is its systemic approach which tries to subsidize the whole ecosystem of renewable energies:

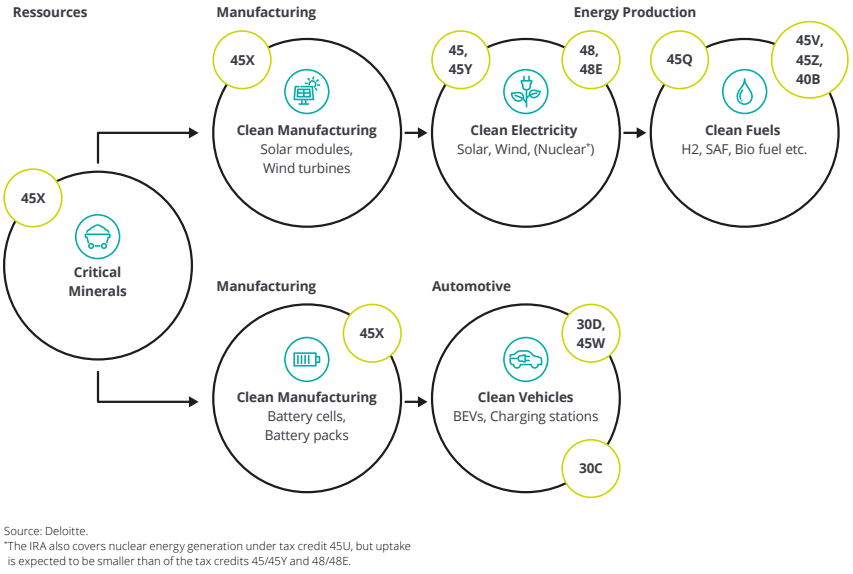


Figure 37: Systemic approach of the IRA. Source: Deloitte (2022, p. 12).

The **European Union** has also increasingly realized the need to pursue a comprehensive industrial policy. With the *"Important Projects of Common European Interest"* (IPCEI) the EU has created a new instrument for the approval of state aid supporting new technologies. So far six IPCEIs were approved which are summarized in Table 21. But compared with the IRA, the public funding of 26,7 billion euro is relatively small.

	First ICPEI on Microelectronics (2018)	First IPCEI on Batteries (2019)	Second ICPEI on Batteries - EuBatIn (2021)	First hydrogen IPCEI - Hy2Tech (2022)	Second hydrogen IPCEI - Hy2Use (2022)	Second IPCEI on Microelectronics and Communication Technologies (2023)	Total
Participating Companies	29	17	42	35	29	56	208 179*
Participating Projects	43	22	46	41	35	68	255
State Aid approved (EUR billion)	1.9	3.2	2.9	5.4	5.2	8.1	26.7
Expected private investments (EUR billion)	6.5	5	9	8.8	7	13.7	50
Participating Member States	FR, DE, IT, UK, AT	BE, FI, FR, DE, IT, PL, SE	AT, BE, HR, FI, FR, DE, GR, IT, PL, SK, ES, SE	AT, BE, CZ, DK, EE, FI, FR, DE, GR, IT, NL, PL, PT, SK, ES	AT, BE, DK, FI, FR, GR, IT, NL, PL, PT, SK, ES, SE + NO	AT, CZ, FI, FR, DE, GR, IE, IT, MT, NL, PL, RO, CZ, ES	21**

*excluding the companies that participated in more than one IPCEI
**With UK included as a Member State, plus Norway participated in at least one IPCEI

Table 21: Approved Important Projects of Common European Interest (IPCEI) (Source: European Commission (2023).

A related initiative of the European Union is the **Chips for Europe Initiative**. It combines investments from the Union, Member States and the private sector, through a strategic reorientation of the Key Digital Technologies Joint Undertaking (renamed *"Chips Joint Undertaking"*). With a support of 6.2 billion euro for the period until 2027, the size of the initiative is also relatively small, especially if its compared with US CHIPS and Science Act.

This support will come in addition to €2.6 billion public funding already foreseen for semiconductor technologies. The €6.2 billion will support activities, such as the development of a design platform and setting up of pilot lines to accelerate innovation and production.

However, while the Chinese example is followed by other global players, many German economists still think within the lines in traditional market paradigm. In a Policy Brief on the IRA, The German Council of Economic Experts (Grimm, Malmendier, Schnitzer, Truger, & Werding, 2023, p. 1) argued:

> *"An increase in the volume of EU subsidies for low-emission technologies in response to the IRA could lead to a subsidy race which would result in a loss of welfare for both the EU and the US. This should be avoided."* (translated from German by authors)

From a competitive perspective, this position is not as convincing as it may sound at first glance. It is true that economics textbooks are always about competition between firms. And it is therefore understandable when famous economists like Paul P. Krugman (1994, p. 44) argue that there is no such thing as the competitiveness of nations:

> *"So let's start telling the truth: competitiveness is a meaningless word when applied to national economies. And the obsession with competitiveness is both wrong and dangerous."*

This is different, however, when the development of new technologies is no longer about individual isolated products, but about entire ecosystems that cannot be established by companies acting in isolation. Since the existing externalities can only be internalised by the states, they move to the centre of the action.

Competition between companies thus becomes, at a higher level, competition between states for the development of new technologies. Is this competition detrimental to the prosperity of individual states and the world as a whole as the Council states in its Policy Brief?

Let us imagine that China had followed the prescription of market-liberal economists and refrained from ambitiously promoting renewable energies and other new technologies. If President Biden would have also adopted the advice of such economists, there would be also no IRA. But does this mean that the welfare of those countries and the global economy would be higher?

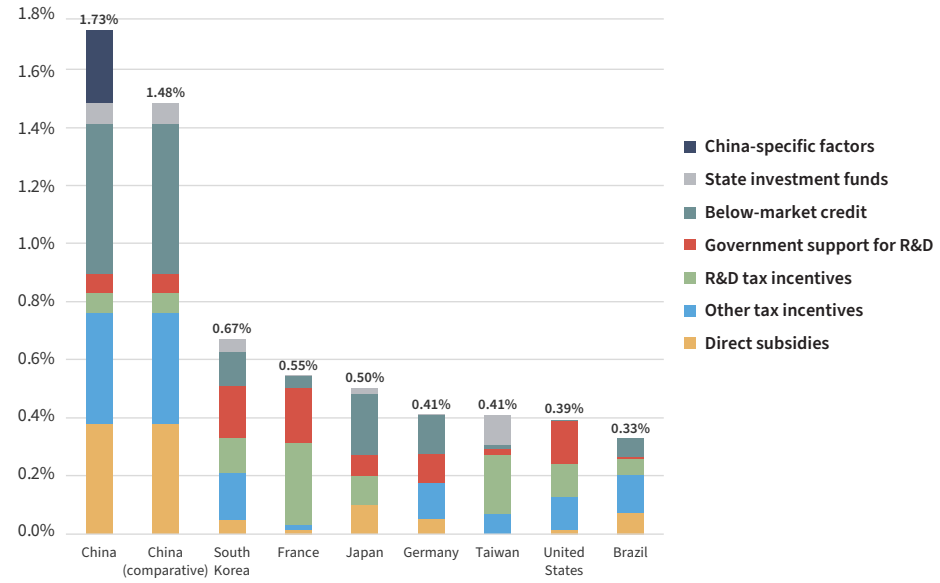
In view of the threatening development of the world's climate, can there be anything better than the major states of this world making huge efforts, using extensive financial and real resources, to develop technological solutions to these major challenges? In a wishful world, they would implement these activities in a coordinated manner. In reality, if they each do this for themselves, it is unproblematic as long as they make the solutions they develop available to the world as a whole. If there is duplication, that is an unpleasant side effect, but it is not an argument for simply remaining inactive. The positive effects of these measures on climate change are already becoming apparent, as a recent study by Economist Intelligenece Unit (2023, p. 5) shows.:

> *"However, the sheer size of the subsidies will alter the incentives for decarbonisation significantly. As a result, we have revised down our forecasts for greenhouse gas emissions by 2030: in the US, we now expect a 29% decline from 2005 levels, compared with a 26% decline prior to the passage of the IRA, with similar declines in other advanced economies."*

8.2 The "costs" of industrial policy

There is relatively little information on the costs of industrial policy. A recent project (DiPippo et al., 2022) has tried to quantify the size of total industrial policy spending in China and compared it to other economies. Figure 38 shows that China is spending more than the United States and that other countries are providing significantly less funds for that purpose.

Figure 3.4: Industrial Policy Spending in Key Economies, 2019
% of GDP



Note: Estimates only include instruments with sufficient data for quantification. China estimates are conservative.

Source: Authors' calculations; please refer to the appendix for detailed information.

Figure 38: Industrial policy spending in key economies in 2019. Source: DiPippo et al. (2022, p. 30).

As the Inflation Reduction Act and the CHIPs and Science Act show, fostering new technologies is not a free lunch. How can the huge amounts of money that are required be financed? From a Schumpeterian perspective the answer is simple: Use the money creation potential of the banking system (including the central bank) to produce the purchasing power that is needed. We have shown in this study that China might have been using this instrument successfully to finance its growth process and also to finance its industrial policy. In the case of the United States, the IRA includes significant tax increases that could compensate a major part of the program (Wamhoff, 2022). But as the country is running very high deficits, it would not be able to finance the IRA if it tried to achieve a *"black zero"* or if it had to operate under a debt brake. In this regard, Germany is an outlier in the Group of large economies by not using the financial space that government lending offers for large economies as can be seen in Figure 39.

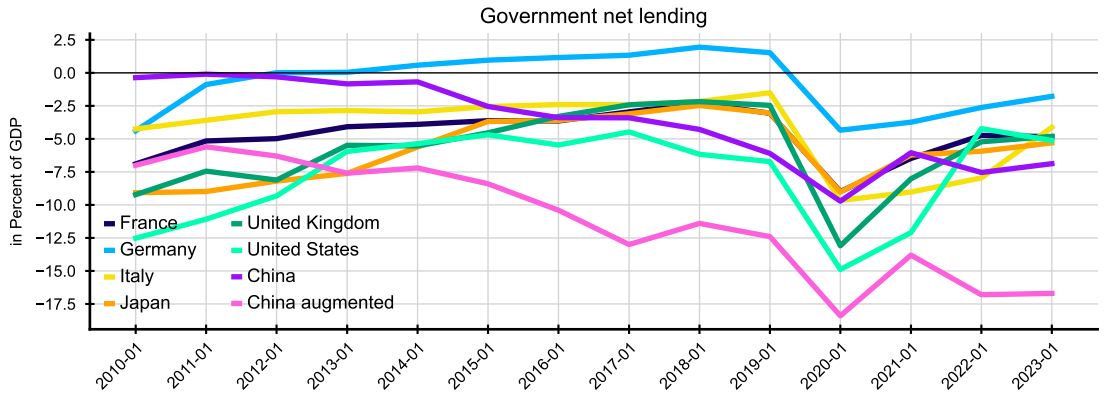


Figure 39: Government net lending (Source: OECD Economic Outlook).

As the Schumpeterian growth model shows and what Modern Monetary Theory emphasizes, there is no financial constraint for large economies. What always matters are the real constraints set by the availability of real resources. But again, the Schumpeterian approach helps to see that the potential output, Y^F, is not a constraint for economic growth, if the existing resources are shifted to new uses where they generate a higher productivity way and shift potential output to a higher level. This potential can be used for the financing of enterprises as well as for the financing of governments. The Chinese growth model is an impressive example that governments can be able to use this potential in an intelligent way thereby fostering the well-being of their citizens.

In other words, there are no financial costs of industrial policy. What matters are the opportunity costs of no longer employing resources in the existing uses. As long as inflation remains low, one can assume that these costs are lower than the benefits provided by the new uses.

By not using this potential, countries have a disadvantage in the global competition for new technologies. This applies above all to Germany, that in spite its very low level of public debt to GDP, is forced to adhere to balanced budget by the debt-brake enshrined in its constitution. It also applies to the European Union. It had been able to raise funds on the capital market for the NextGenerationEU strategy, a one-time opportunity during the COVID crisis, but due to the EU Treaty it is unlikely that it will be able to use it as a normal financing tool.

9 Outlook: The merits of *"monetary analysis"*

The starting point of our project was Schumpeter's differentiation between a *"real analysis"* and *"monetary analysis"* which in this conciseness cannot be found by any other author.[13] We tried to show in this study that China's growth model with its **dominant role of the banking system and *"the banker"*** is a perfect illustration of the necessity and power of *"monetary analysis"*. It has enabled us to elaborate theoretically and empirically the **uniqueness of the Chinese model** that, as many of the existing narratives show, has remained unnoticed in approaches which are written in the spirit of a *"real"* paradigm. While we have focused in our study on the financial side, we are, of course, aware of the fact the that real side of the economy matters a lot. But without taking into account the monetary dimension, an explanation of China's growth process stands metaphorically on one leg only.

However, the insights gained by our monetary analysis go far beyond the analysis of China's growth model. They open-up the perspective for a **monetary growth theory** that frees itself from the constraints of the neoclassical paradigm. A monetary paradigm is not constrained by the availability of saving, nor by the limitations arising from a model world with only an all-purpose commodity. A monetary analysis also offers a new perspective on **fiscal policy** that goes beyond the traditional functions of Keynesian stabilisation policy as well as that of absorbing excessive capital accumulation in the neoclassical model (Bofinger, 2022). For monetary theory, the Schumpeterian growth theory offers a new interpretation of the **Quantity Theory of Money**. It helps to understand that an expansion of the money supply is not exogenous to the real sphere and therefore not necessarily inflationary: If money growth is the result of loans provided to productive innovators, it leads in the medium and long-term to an increase in potential output and not to a higher price level.

In Bofinger, Geißendörfer, Haas, and Mayer (2023) we have shown that the monetary analysis has important implications for the analysis and prevention of **financial crises in the national and international context**. While models of *"real analysis"* are unable to understand the mechanics of credit and liquidity creation, these processes are in the center of *"monetary analysis"*.

In sum, our study of the Chinese growth model shows that Schumpeter is right when he questions the widely accepted theorem of the **neutrality of money**, according to which money (or credit) can only have temporary effects on growth.[14] He is right when he argues that money is not of secondary importance and that *"the essential features of the capitalist process may depend upon the 'veil'*

[13] Keynes (1933, p. 408) comes very close to this: *"Most treatises on the principles of economics are concerned mainly, if not entirely, with a real exchange economy; and – which is more peculiar – the same thing is also true of most treatises on the theory of money. [...] The theory which I desiderate would deal, in contradistinction to this, with an economy in which money plays a part of its own and affects motives and decisions and is, in short, one of the operative factors in the situation, so that the course of events cannot be predicted, either in the long period or in the short, without a knowledge of the behaviour of money between the first state and the last."*

[14] *"But so long as it [money] functions normally, it does not affect the economic process, which behaves in the same way as it would in a barter economy: this is essentially what the concept of Neutral Money implies"* (Schumpeter, 1954, p. 264).

of money and that the 'face behind it' is incomplete without it" (Schumpeter, 1954, p. 265).

Given the enormous challenges that the world as well as the national economies are facing due to climate change, digitalization, and demographics, the key message of this study, at least for large economies, is as simple as powerful:

> Debt should be regarded as an instrument, rather than a burden for development.[15]

But of course, as in medicine, the dose makes the poison, and it cannot be ruled out that an overdose of debt in the second half of the 2010s will leave China with major problems in the years ahead. Schumpeter (1939) was aware of such risks when he warned of the problems of a *"secondary wave"* of debt financing unproductive investment. But whatever happens in the future, it cannot overturn an impressive growth story that has so far lasted more than four decades.

[15] This sentence goes back to Banga et al. (2022, p. 75): *"In ensuring that debt was employed as an instrument for development, rather than a burden, China's approach provides several lessons to debt sustainability."*

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Appendix

A Appendix Country Ranking

A.1 ASPI Ranking

Table 1: Lead country and technology monopoly risk.

Technology	Lead country	Technology monopoly risk
Advanced materials and manufacturing		
1. Nanoscale materials and manufacturing	China	high
2. Coatings	China	high
3. Smart materials	China	medium
4. Advanced composite materials	China	medium
5. Novel metamaterials	China	medium
6. High-specification machining processes	China	medium
7. Advanced explosives and energetic materials	China	medium
8. Critical minerals extraction and processing	China	low
9. Advanced magnets and superconductors	China	low
10. Advanced protection	China	low
11. Continuous flow chemical synthesis	China	low
12. Additive manufacturing (incl. 3D printing)	China	low
Artificial intelligence, computing and communications		
13. Advanced radiofrequency communications (incl. 5G and 6G)	China	high
14. Advanced optical communications	China	medium
15. Artificial intelligence (AI) algorithms and hardware accelerators	China	medium
16. Distributed ledgers	China	medium
17. Advanced data analytics	China	medium
18. Machine learning (incl. neural networks and deep learning)	China	low
19. Protective cybersecurity technologies	China	low
20. High performance computing	USA	low
21. Advanced integrated circuit design and fabrication	USA	low
22. Natural language processing (incl. speech and text recognition and analysis)	USA	low
Energy and environment		
23. Hydrogen and ammonia for power	China	high
24. Supercapacitors	China	high
25. Electric batteries	China	high
26. Photovoltaics	China	medium
27. Nuclear waste management and recycling	China	medium
28. Directed energy technologies	China	medium
29. Biofuels	China	low
30. Nuclear energy	China	low
Quantum		
31. Quantum computing	USA	medium
32. Post-quantum cryptography	China	low
33. Quantum communications (incl. quantum key distribution)	China	low
34. Quantum sensors	China	low
Biotechnology, gene technology and vaccines		
35. Synthetic biology	China	high
36. Biological manufacturing	China	medium
37. Vaccines and medical countermeasures	USA	medium
Sensing, timing and navigation		
38. Photonic sensors	China	high
Defence, space, robotics and transportation		
39. Advanced aircraft engines (incl. hypersonics)	China	medium
40. Drones, swarming and collaborative robots	China	medium
41. Small satellites	USA	low
42. Autonomous systems operation technology	China	low
43. Advanced robotics	China	low
44. Space launch systems	USA	low

Figure 40: Government net lending (Source: Gaida et al. (2023, p. 8)).