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The Long Landing Scenario: Rebalancing from Overinvestment and Excessive Credit Growth. Implications for Potential Growth in China*

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Résumé

Après trois décennies de croissance rapide, l'économie chinoise ralentit. Par ailleurs, les inquiétudes liées à la soutenabilité de son modèle de croissance sont de plus en plus vives, appelant à un rééquilibrage urgent de l'économie. Ce papier évalue dans quelle mesure le processus de rééquilibrage pourrait affecter la croissance potentielle chinoise dans les quinze prochaines années. Après un examen des causes de la forte croissance et des déséquilibres passés (et notamment le rôle des distorsions sur les prix des facteurs), ainsi que l'augmentation récente des vulnérabilités (surinvestissement, hausse excessive du crédit, bulle immobilière), nous adoptons une approche par la fonction de production afin d'obtenir des estimations de croissance potentielle. Toutefois, nous nous différencions de la littérature par deux aspects méthodologiques spécifiques. Tout d'abord, nous corrigeons le stock de capital du surinvestissement en intégrant de l'information sur le cycle de crédit. Ensuite, nous distinguons les gains de productivité dus à la réallocation sectorielle des facteurs de production des gains de productivité intra-sectoriels, permettant ainsi une meilleure évaluation de la transition attendue de l'économie de l'industrie vers les services. Nos résultats indiquent que la croissance chinoise serait actuellement légèrement supérieure à son potentiel, avec un *output gap* positif, remettant ainsi en cause l'opportunité de mesures supplémentaires de soutien à l'activité. En outre, dans notre scénario le potentiel de croissance baisserait plus rapidement que prévu par le Consensus, à environ 5% d'ici 2020.

Mots-clés : Chine, croissance potentielle, surinvestissement, cycle de crédit, réallocation sectorielle, rééquilibrage

Codes JEL: E22, E24, E32, E51, O11, O47

Abstract

After three decades of rapid growth, the Chinese economy has been slowing; at the same time, concerns about the sustainability of its growth model are mounting, calling for urgent rebalancing. This paper provides an assessment of how, and to what extent, the rebalancing process may impact China's potential growth in the next fifteen years. After reviewing the main reasons behind China's high growth and imbalances (and the role of factor price distortions), as well as its rising vulnerabilities (overinvestment, excessive credit growth, and a real estate bubble), we adopt a production function approach to derive potential growth. However we depart from the standard methodology in two important ways: first, we correct China's capital stock for overinvestment by taking into account the credit cycle; second, we disentangle the effects of sectoral reallocations from within-sector productivity, allowing for a better assessment of the expected shift from manufacturing to services. Our results indicate that growth would be currently slightly higher than its potential, with a positive output gap, thus questioning the rationale for additional stimulus measures. Moreover, in our scenario potential growth would fall more quickly than currently expected by the Consensus, to around 5 percent by 2020.

Keywords: China, potential growth, overinvestment, credit cycle, sectoral reallocations, rebalancing

JEL Classification: E22, E24, E32, E51, O11, O47

Non-technical summary

China has been growing at around 10 percent per year over the last three decades, and is now the second largest economy in the world. However, growth in China has been slowing in recent years, and domestic imbalances have worsened. The fact that very few countries in history have ever recorded such a high investment-to-GDP ratio as China (47% in 2013) clearly raises concerns about overinvestment. Moreover, vulnerabilities have been on the rise ([IMF 2014a](#)), with rapid credit growth, part of which is due to the rapid expansion of shadow banking, and a potential real estate bubble.

There is now a wide consensus that China's past growth model has reached its limits, and that the economy urgently needs rebalancing. However, the implications of rebalancing for China's future growth prospects are still unclear. While the most common view is that China can rebalance its economy through a "soft landing", i.e. while maintaining growth at around 6.5 to 7 percent, some have voiced concerns that the slowdown in growth may be more pronounced than expected ([Eichengreen et al. 2012](#), [Pritchett & Summers 2014](#));

The aim of this paper is to provide an assessment of China's growth prospects and potential growth in the next fifteen years. In particular, we focus on the implications of domestic imbalances and vulnerabilities, and the way rebalancing may affect growth going forward.

Since domestic rebalancing will be closely linked to the future evolution of investment, we adopt a Cobb-Douglas production function approach with four components: capital stock, labor, human capital, and total factor productivity. However we depart from the standard literature on potential growth in two important ways. First, we build on recent work by [Borio et al. \(2013\)](#), which showed that including financial cycle variables into potential growth estimates leads to much more robust estimates; this is in our view crucial when it comes to China, given the very fast growth of credit observed in the country in recent years. We thus adapt their work to a production function framework, and correct investment, and hence capital stock, by "excessive" credit growth. The idea is similar to the "sustainable growth" concept developed in [Alberola et al. \(2013\)](#), where standard potential output estimates are corrected for imbalances.

Second, we disentangle the effects of sectoral reallocations from within-sector productivity in our total factor productivity estimates. This is an important point in the context of rebalancing: indeed, while TFP growth has been fast over the pre-crisis period in China, much of the TFP gains were achieved through a shift of labor from the low-productivity agricultural sector to the higher-productivity manufacturing sector. During the rebalancing process, labor shifts would be expected to take place from manufacturing to the lower-productivity services sector, with implications for overall TFP gains. [Haltmaier \(2013\)](#) looked

at such effects by decomposing output into labor and labor productivity; we extend her analysis in a Cobb-Douglas production function framework, incorporating sectoral reallocations for both labor and capital.

To assess China's growth prospects over the next fifteen years (2015–2030), and give some insights on the way rebalancing may affect potential growth, we project the evolution of the different production factors based on several assumptions. In a nutshell, our main assumption is that the Chinese authorities will implement the reforms they announced at the Third Plenum, which will progressively lead to a significant rebalancing (i) away from investment and towards consumption, (ii) away from manufacturing and towards services, and (iii) from an extensive to a more intensive growth model.

Our results suggest that potential growth in China could be lower than usually thought. In particular, we find that growth would currently be slightly higher than potential (estimated at around 7.3 percent in 2014); the output gap would still be positive in 2014-2015, thus questioning the rationale for additional stimulus measures. Our results provide empirical support for a progressive decrease of the official growth target as the economy rebalances. As opposed to most other studies on Chinese potential growth, we find that the upcoming slowdown may be more pronounced and faster than generally expected, to reach around 5% in 2020. These discrepancies underline the importance of accounting for overinvestment and for the changing pattern of sectoral reallocations when estimating potential growth in China. This also lends support to the point made by [Borio et al. \(2013\)](#) that financial variables should be included in potential growth estimates, since the results may differ significantly.

1 Introduction

China has been growing at around 10 percent per year over the last three decades, and is now the second largest economy in the world; according to recent estimates by the IMF, China may even have overtaken the United States in purchasing power parity terms. However, growth in China has been slowing in recent years, and domestic imbalances have worsened: very few countries in history have ever recorded such a high investment-to-GDP ratio as China, where it stands at 47 percent; this clearly raises concerns about overinvestment. Moreover, vulnerabilities have been on the rise (IMF 2014a), with rapid credit growth – part of which due to the rapid expansion of shadow banking – and a probable real estate bubble. There is now a wide consensus that China’s past growth model has reached its limits, and that the economy urgently needs rebalancing. The authorities are aware of the challenges and have announced a comprehensive set of reforms following the Third Plenum in late 2013. However, the implications of rebalancing for China’s future growth prospects are still unclear. While the most common view is that China can rebalance its economy through a "soft landing", i.e. while maintaining growth at around 6.5 to 7 percent, some have voiced concerns that the slowdown in growth may be more pronounced than expected (Eichengreen et al. 2012, RGE 2013, Pritchett & Summers 2014); given the size of the Chinese economy, such a scenario would have global implications (Ahuja & Nabar 2012, Gauvin & Rebillard 2013).

The aim of this paper is to provide an assessment of China’s growth prospects and potential growth in the next fifteen years. In particular, we focus on the implications of domestic imbalances and vulnerabilities, and the way rebalancing may affect growth going forward. Since domestic rebalancing will be closely linked to the future evolution of investment, we adopt a Cobb-Douglas production function approach with four components: capital stock, labor, human capital, and total factor productivity. However we depart from the standard literature on potential growth in two important ways.

First, we build on recent work by Borio et al. (2013), which showed – on the examples of Spain, United Kingdom and the United States in the pre-crisis period – that including financial cycle variables into potential growth estimates leads to much more robust estimates; this is in our view crucial when it comes to China, given the very fast growth of credit observed in the country in recent years. We thus adapt their work to a production function framework, and correct investment – and hence capital stock – by "excessive" credit growth. The idea is similar to the "sustainable growth" concept developed in Alberola et al. (2013), where standard potential output estimates are corrected for imbalances.¹ In the case of China, Bailliu et al. (2014) adopt a very similar methodology and also correct for overinvestment due to excessive credit expansion. However, our work differs from theirs in the sense that we do not pass the effect

¹Alberola et al. (2013) focus on five countries, including China. However their estimate for sustainable growth in China, at around 10% in 2011, is surprisingly high; this may be due to their choice of relevant imbalances: the current account had already dropped significantly by 2011, and the official public balance figures give a very incomplete picture of the situation (IMF (2014a) provides "augmented" fiscal data to take into account local governments’ public finances).

of lower capital stock onto higher total factor productivity.² Finally, [Maliszewski & Zhang \(2015\)](#) also estimate finance-neutral measures of potential output in China by incorporating information on credit dynamics. However, their analysis links the credit gap directly to the output gap, without explicitly considering overinvestment.

Second, we disentangle the effects of sectoral reallocations from within-sector productivity in our total factor productivity estimates. This is an important point in the context of rebalancing: indeed, while TFP growth has been fast over the pre-crisis period in China, much of the TFP gains were achieved through a shift of labor from the low-productivity agricultural sector to the higher-productivity manufacturing sector; during the rebalancing process, labor shifts would be expected to take place from manufacturing to the lower-productivity services sector, with implications for overall TFP gains. [Haltmaier \(2013\)](#) looked at such effects by decomposing output into labor and labor productivity; we extend her analysis in a Cobb-Douglas production function framework, incorporating sectoral reallocations for both labor and capital.

Our results suggest that potential growth in China could be lower than usually thought. In particular, we find that growth would currently be slightly higher than potential (estimated at 7.3% in 2014); the output gap would still be positive in 2014, thus questioning the rationale for additional stimuli. In terms of policy implications, these results provide empirical support to the view that the growth target should be progressively lowered as the economy rebalances, as advised by [IMF \(2014a\)](#) and in accordance with the authorities' decision for 2015 (when they lowered the target from 7.5% in 2014 to 7% in 2015). Indeed in the medium term, in comparison to most other studies of potential growth in China, we find that the coming slowdown may be more pronounced and occur more quickly than generally expected, to around 5% in 2020. In contrast, [Bailliu et al. \(2014\)](#) estimate potential growth in 2020 at 6%, [World Bank \(2013\)](#) at 6 to 7%, [IMF \(2014b\)](#) at 6.3%. These discrepancies underline the importance of accounting for overinvestment and for the changing pattern of sectoral reallocations when estimating potential growth in China; this also lends support to the point made by [Borio et al. \(2013\)](#) that financial variables should be included in potential growth estimates, since the results may differ significantly.

The rest of the paper is organized as follows. Section 2 reexamines China's past growth model and imbalances, with a special focus on factor price distortions, and underlines the need for rebalancing in light of the rising vulnerabilities in recent years. Section 3 details the methodology and data used, as well as the assumptions underlying our forecasts. Section 4 presents and discusses the results and some policy implications. Section 5 concludes.

²More precisely, [Bailliu et al. \(2014\)](#) compute TFP as a residual of an equation incorporating the *corrected* capital stock; on the contrary, we use the *observed* capital stock to derive the TFP residual.

2 China's growth model so far, and the need to rebalance

Before making any attempt to assess China's future growth prospects, it is useful to have a closer look at China's performances and growth model so far. Subsection 2.1 provides a retrospective analysis of China's growth model over the past decades, emphasizing the role of key factor price distortions in driving growth while fostering imbalances; Subsection 2.2 focuses on the post-crisis period and the rise in vulnerabilities, highlighting the case for rebalancing.

2.1 High growth and imbalances: the role of factor price distortions

China has achieved impressive growth over the last three decades, at an average of around 10 percent per year. It has now overtaken Japan as the world's second-largest economy, and may even have surpassed the United States in PPP terms. High growth helped lift millions of people out of poverty, with the poverty rate sharply down from 84 percent in 1981 to 13 percent in 2008 (*World Bank Development Indicators*). From a supply-side perspective, such remarkable outcomes in terms of growth have been achieved mainly through strong productivity gains and, most importantly, rapid capital accumulation. The former – productivity gains – followed sweeping reforms, starting with the development of private sector initiative under Deng Xiaoping in the 1980s; reforms of public sector enterprises in the 1990s; and China's integration into global markets since its accession to the World Trade Organization in December 2001. The latter – capital accumulation – may have been related, at least initially, to a catch-up process: due to a low capital stock and important needs, firm profitability has been high in China and provided strong incentives for firms to invest (Bai et al. 2006, Knight & Ding 2010, OECD 2013).

However, it is difficult to argue that reforms and the catch-up process *alone* can explain such high growth rates over such a long period. After all, greater trade openness has been a general trend among emerging economies, and relatively low capital stocks are a common characteristic for all developing nations; yet, China's performance is rather unique. From a demand-side perspective, high growth in China has been accompanied by worsening external – until 2007 – and domestic imbalances: the current account surplus widened to 10 percent of GDP in 2007, led by a surge in exports and strong international market share gains; investment now represents 45 percent of GDP, up from around 25 percent in 1990, while the consumption-to-GDP ratio continuously decreased over the same period (see figure B.1). Other countries, especially in Asia – Japan, Korea, Taiwan – had in the past adopted similar investment- and export-led growth models. However, in none of these countries have imbalances become so acute as in China; and, interestingly, while these three Asian economies enjoyed long periods of high growth, none of them experienced such a protracted phase of very high growth as in China.

In fact, high growth and imbalances appear to be deeply interrelated: [Huang & Wang \(2010\)](#), [Huang & Tao \(2011\)](#), and [Dorrucci et al. \(2013\)](#) argue that imbalances are an inherent feature of the Chinese growth model. Both growth and imbalances can be seen as – partly – deriving from three key factor price distortions, regarding the exchange rate, wages, and interest rates.

Undervalued exchange rate

First, an undervalued exchange rate has enabled China to reap considerable benefits from its accession to WTO from end 2001 onwards ([Rodrik 2008](#), [Goldstein & Lardy 2009](#)). Strong price competitiveness has boosted manufactured exports and allowed China to strongly increase its global market shares. Exports dynamism also supported related investment in the manufacturing sector, part of it being funded through high national savings, and the remainder by strong FDI inflows (again attracted by an undervalued exchange rate, as argued by [Xing \(2006\)](#)). FDI inflows also facilitated technology transfers that helped boost domestic productivity ([Yao & Wei 2007](#)). At the same time, the undervalued exchange rate weighted on household consumption by slowing their purchasing power gains.

Low wages

Second, low wages have been another key factor to boost export price competitiveness. Along with the undervalued exchange rate, they have arguably been one of the reasons for China to become the "world's factory". Indeed, while still dynamic when compared to other countries, wages have progressively lost ground in relation to nominal GDP growth throughout the 2000s, revealing an increasingly unequal sharing of the value added. This has been a consequence of abundant rural labor supply and of the hukou system, which regulates internal migrations from rural to urban areas, but also of the lack (and poor enforcement) of workers' rights. Lower income growth in relation to nominal GDP growth (rather than rising households' savings), by constraining households' purchasing power gains, has been the main factor behind the decrease of the ratio between private consumption and GDP ([Aziz & Cui 2007](#)).

Financial repression

Third, very low interest rates have helped support strong investment growth. Financial repression is indeed a key feature of the Chinese growth model ([Johansson 2012](#)). One of its particular characteristics is the system of administered benchmark interest rates, the higher one being (until recently) a floor for lending rates, and the lower one being a ceiling for the remuneration of deposits ([Feyzioglu et al. 2009](#)). As such, it has been guaranteeing a net interest rate margin for banks. Since both benchmark rates were set at very low levels (in particular, the remuneration rate of deposits has been slightly below inflation on average since 2003), households' interest earnings have been compressed while cheap funding was available for investment. [Lardy \(2008\)](#) estimates the implied transfer from the household sector to the banking sector to have amounted to some 4.1 points of GDP in the first quarter of 2008 alone, thus providing an

additional explanation to the decrease in the private-consumption-to-GDP ratio.

Achieving such high investment rates and strong capital accumulation would not have been possible without exceptionally high national savings, which increased from 36.4 percent of GDP in 1992 to 51.8 percent in 2013. As national savings have exceeded investment in the last decade, China did not have to rely on external financing to fund investment and therefore was able to maintain current account surpluses.

A lot of research has been conducted to explain the high level of household savings in China, and several reasons have been put forward. [Modigliani & Cao \(2004\)](#) highlight the role played by demographics and the one-child policy, which generated a drastic decline in the ratio of people under the age of fifteen (who consume but do not save) to the working population, and undermined the traditional role of the family in providing old-age support (thus encouraging provisions through individual accumulation); the life-cycle and permanent income hypotheses in a context of high growth should also lead to higher household savings, especially when taking into account China's changing age-earnings profiles ([Song & Yang 2010](#)).³ Others emphasize the role of precautionary savings: [Ma & Wang \(2010\)](#) argue that the end-1990s large-scale restructuring and downsizing of SOEs led to greater income uncertainty and weakened the enterprise-based social safety net (the so-called "iron rice bowl"); households thus had to save more to self-insure against risks related to health, pensions, and for education ([Meng 2003](#), [Blanchard & Giavazzi 2006](#), [Chamon & Prasad 2010](#)). Similarly, rising housing prices (following the 1998 privatization of the housing stock) may have been another possible driver of households savings ([Chamon & Prasad 2010](#), [Bussière et al. 2013](#)).

However, as argued by [Ma & Wang \(2010\)](#), household savings as a percentage of GDP are not exceptionally high in China⁴, and only account for about half of national savings; what really makes China an exception compared to other countries, even in Asia, is the combination of high savings in each of the three main institutional sectors (corporates, households, government). And here again, distortions – in the context of a partially closed capital account – may be an important feature of the Chinese model.

Borrowing constraints and financial repression

As regards the corporate sector, [Aziz & Cui \(2007\)](#) and [Geng & N'Diaye \(2012\)](#) emphasize financial underdevelopment and borrowing constraints faced by SMEs of the private sector, as a key factor behind high savings: SMEs have to rely on high retained earnings (thus compressing wages) and their own savings to finance investment. This explanation has much to do with financial repression, in the context of a dual productive system (SOEs versus SMEs). With interest rates at an artificially low level (see above), China

³Another demography-related factor stems from a highly imbalanced sex ratio and its implications in terms of accrued competition in the "marriage market" ([Wei & Zhang 2011](#)).

⁴They are lower than in India.

had to rely on quantitative control of credit as the main instrument of monetary policy (Feyzioglu et al. 2009). Credit quotas have been allocated to banks (of whom the biggest are state-owned), who in turn tend to lend more to large and well-connected enterprises, mainly SOEs (Wei & Wang 1997, Walter & Howie 2011). While SOEs, although less productive, thus benefitted from cheap credit, more productive SMEs have been credit-constrained and forced to save in order to fund investment (Song et al. 2011). The same argument is also valid for households, as they face similar borrowing constraints deriving from financial repression: Wen (2009) develops a model where borrowing constraints and uninsured risks, in a context of high growth, leads to higher households savings. Additionally, under the "target saving" hypothesis, low interest rates may have caused household savings to rise (Nabar 2011).

"Political" distortions

In the corporate sector, Allen et al. (2005) highlighted the role played by corporate governance and dividend policy; in particular, SOEs were not required to pay dividends to the State until 2007 (Geng & N'Diaye 2012). In the government sector, the 1994 tax-sharing system reform led to "federal fiscal imbalances", as local governments have since been responsible for 80 percent of government expenditure (including health, education...) while receiving only slightly more than 40 percent of tax revenues (World Bank 2013); this gap helps explain why social spending and government consumption have not followed the accelerating trend of fiscal (central and local) revenues, thus leading to a rise in savings. Moreover, and most importantly, local government officials have strong incentives to finance investment projects (thereby boosting short term growth) rather than social spending, since their promotions are likely granted according to performance criteria that include growth in their jurisdiction (Li & Zhou 2005).⁵

2.2 The case for rebalancing: worsening imbalances and vulnerabilities

The 2008-09 *Great Recession* and its aftermath had significant implications for China, whose growth model evolved from being investment- and export-led before the crisis, to an increasingly credit-fuelled investment-led variant after the crisis. Indeed, except during a brief rebound immediately following the international crisis, exports were no longer able to support China's growth. On one hand, the prolonged sluggishness in advanced economies' activity hampered China's external demand. On the other hand, an appreciating yuan and faster rises in wages (partly related to labor shortages, especially within the coastal areas, although whether this can be explained by China reaching the Lewis Turning Point is not clear) implied some loss of price competitiveness.⁶ However the export sector was playing a crucial role in the original model: given the economy's domestic imbalances – high investment, low consumption –, production

⁵This mechanically pushes government savings higher, because public consumption – by definition – includes social spending but not public investment.

⁶It has been argued that as China progressively upgrades its exports, it may be now less sensitive to price competitiveness. Poncet & Starosta de Waldemar (2013) cast doubts on the extent of China's exports upgrading.

capacities were much larger than the domestic absorption capacity, and the excess production had to be exported⁷ (which was made possible by an undervalued exchange rate; see subsection 2.1 and [Dorrucci et al. 2013](#)). In the wake of the crisis, the global economy was no longer able to absorb China's excess production, and excess capacities worsened. Paradoxically, China sought to compensate for weak external demand through a surge in investment, thereby exacerbating excess capacities. Moreover, investment has been financed through a rapid increase in credit, which added to the rising vulnerabilities of the Chinese growth model.

Overinvestment

The surge in investment following the *Great Recession* has been mainly due to measures implemented by the authorities to maintain high growth rates. First, a massive stimulus package, amounting to around 13 percent of GDP according to official figures, focused on infrastructure investment in 2009-10 while a loosening of credit controls (previously set up at the end of 2007 to prevent overheating) enabled a rebound in the real estate market. Later, from 2012 onwards, periodic "mini-stimulus" packages aiming at speeding up infrastructure projects have been used to prevent growth from falling below the official growth target. As a result, the investment-to-GDP ratio jumped from 39 percent in 2007 to 46 percent in 2013 (see figure [B.1](#)). This has led to rising excess capacity in a number of sectors, as evidenced by the continuous decrease of the producer price index since early 2012; [IMF \(2012\)](#) estimated that the capacity utilization rate dropped from almost 80 percent before the crisis, to around 60 percent in 2012. Programs set up by the authorities as early as 2003 to reduce excess production capacities in capital-intensive sectors were extended in 2013 to 19 industrial sectors and to more than 1,400 public enterprises.

These excess capacities induced a lower productivity of capital. According to [OECD \(2015\)](#), the annual return on capital in China has decreased from an average of 14 percent prior to the crisis to 9 percent in 2014 (see figure [B.2](#)). This is also observed through the significant increase in the Incremental Capital-Output Ratio (ICOR)⁸ in the post-crisis period (see figure [B.3](#)), from 4 on average during 2000-07, to more than 6 in 2013. At the same time, total factor productivity has decreased ([Hoffman & Polk 2014](#)). Taken together, these elements point to an accumulation of idle capital ([Delozier & Rebillard 2010](#)). Concerns about overinvestment are not new ([Dollar & Wei, 2007](#)), but they have been exacerbated since the 2009 investment surge. In a recent paper based on cross-country comparisons, [Lee et al. \(2012\)](#) estimate that China may have overinvested between 12 and 20 percent of GDP from 2007 to 2011. Additionally, [Standard & Poor's \(2013\)](#) finds that, among a 32-country sample, China has the highest downside risk of an economic correction because of low investment productivity over recent years.

⁷[Bussière & Mehl \(2008\)](#) showed that the overall degree of China's trade intensity prior to the crisis was higher than fundamentals would have suggested, when considering trade in goods.

⁸ICOR is calculated as the ratio between investment in year t and GDP variation between years t and $t+1$; it represents the amount of investment necessary to achieve one additional unit of GDP.

Some argue that the capital stock in China is still low compared to advanced economies: in 2010, capital stock per capita in China represented only 7 percent of that in the United States ([Dragonomics 2011](#)); consequently, China would still have room to invest more, especially as its infrastructure lags behind those of advanced economies. However, the relevance of such comparisons remains questionable, given the differences in technology, economy structure, and labor qualification between the two countries. Capital-output ratios are typically within the range of 2-3 for all economies, advanced and developing alike, which suggests a very strong relationship between a country's per capita capital stock and its level of development (proxied by its GDP per capita): the apparently "low" per capita capital stock in China compared to the United States simply reflects the difference in the level of development between the two countries.⁹ Thus comparing China's capital stock to that of other emerging economies would be more appropriate, and by this metric China is now on the high side.¹⁰ As regards infrastructure, [Canning & Pedroni \(2008\)](#) argue that beyond some optimal level, investing in infrastructure can have a negative impact since it diverts resources from other more productive uses.¹¹ Similarly, focusing on China, [Lee et al. \(2013\)](#) and [Shi & Huang \(2014\)](#) find evidence of overinvestment in infrastructure in western provinces – although the poorest ones –, *as early as 2008*, casting some doubt on the economic efficiency of the *Go West* policy.

Real estate bubble

Real estate investment deserves particular attention since, as argued by [IMF \(2014a\)](#), it has become a major driver of Chinese growth in recent years. While credit to the real estate sector had been tightened in December 2007 to prevent overheating, the loosening in credit conditions as a response to the global crisis triggered a sharp rebound in this sector. Real estate now accounts for 15 percent of GDP (compared to 4 percent in 1997), and even 33 percent when including upstream and downstream sectors; it also represents 14 percent of urban employment¹², 20 percent of credit, and 25 percent of investment ([IMF 2014a](#)).

Such developments raise the possibility of a real estate bubble. [Wu et al. \(2012\)](#) and [Gaulard \(2014\)](#) document the rising trend of price-to-rent and price-to-income ratios in major Chinese cities (see figures [B.4](#) and [B.5](#)). While acknowledging these price trends in large cities, [IMF \(2014a\)](#) also points to oversupply in smaller cities (including the so-called "ghost towns"), as well as for commercial real estate. Indeed, basic statistics such as cement production per capita suggest that oversupply may be a generalized phenomenon: by this metric, China is now well above Spain at its peak in 2007, or any other country that experienced

⁹Accordingly, stating that overinvestment in China is unlikely *because of its low per capita capital stock compared to the United States* is equivalent as stating that overinvestment is *by definition* impossible in any emerging or developing country; this seems highly questionable.

¹⁰[Dragonomics \(2011\)](#) also argues that China's per capita capital stock stands at 25 percent of that of the United States in 1930 (the respective levels of development being comparable); however, aside from the fact that such calculations rely on the accuracy of deflators over extended periods of time, the choice of year 1930 for the United States, at the onset of the *Great Depression* following a period of overinvestment, may not be an appropriate reference.

¹¹According to the authors, African countries would be over-invested in roads.

¹²With a sharply accelerating trend from 2010 onwards; this helps explain some of the deceleration in TFP noted above, as labor has been reallocated from the more productive manufacturing sector to the less productive construction sector.

recently a real estate bubble (see figure B.6).¹³ China's development stage clearly cannot explain this pattern (see figure B.7); nor can urbanization, the pace of which has remained fairly stable in the past few years (in sharp contrast with cement production trends).

The Chinese context is indeed especially prone to the development of real-estate bubbles (Ahuja et al. 2010, Wu et al. 2012). On one hand, with a partially closed capital account, under-developed bond markets, and following the 2007 stock market crash, housing has been the main alternative investment vehicle for households in search of higher returns than the capped-rate deposits, including for speculative purposes.¹⁴ On the other hand, land sales are an important source of funds for local governments, since their spending needs cannot be met by their limited fiscal revenue and Central Government transfers;¹⁵ local governments thus have strong incentives to maintain a buoyant real estate market.

Should China's real-estate bubble burst, it would have severe consequences on local public finances, real activity, and the banking system (Ahuja et al., 2010), given strong interlinkages (something described in IMF 2014a as a "web of vulnerabilities"). Indeed banks and shadow banking institutions are exposed through loans to developers, some of which are highly leveraged (Gaulard 2014), but also through the extensive use of real estate as collateral for corporate sector borrowing (IMF 2014a). Local public finances are exposed through their reliance on land sales (35 percent of their revenues in 2013) and on fiscal revenues generated by related activities. This, added to the simple share of real estate and related activities in GDP, underlines the systemic nature of the sector. Adjustment begun in 2014; whether the authorities can keep control over the pace of adjustment remains however unclear. In any case, with urbanization bound to slow, residential construction should decline as a share of GDP, from 10 percent currently to around 3 percent in 2030 (Berkelmans & Wang 2012).

Excessive credit growth

The investment surge since 2008 has been financed by a sharp increase in overall debt, in contrast with the 2003-07 period where debt remained constant as a share of GDP (see figure B.8). In that sense, it can be argued that China switched from an investment- and export-led growth model before the crisis, to a credit-fuelled investment-led variant after the crisis. Whereas most of the initial credit surge was due to bank lending, shadow banking progressively took the lead as a way to circumvent the authorities' tougher controls on bank lending. Shadow banking also emerged as a consequence of distortions in the banking sector (see subsection 2.1). On one hand, private sector SMEs have been increasingly crowded

¹³According to the *International Cement Review*, China accounted for around 57 percent of cement's world production in 2010; there is little international trade in this sector (only 5 percent of world production is exported, and China was not even the first exporter in 2010). China's production is thus mainly used domestically.

¹⁴Reports based on electricity consumption suggested that back in 2010, there were as many as 65 million vacant apartments, supposedly bought for speculative purposes.

¹⁵Whereas local governments receive only slightly more than 40 percent of tax revenues, they are responsible for most of social expenditure and, especially since 2008, of the investment-based stimuli. They were until recently not allowed to borrow, and had to rely on Local Government Financing Vehicles.

out from bank credit due to accrued needs from local governments and SOEs to finance the infrastructure-based stimulus; SMEs (but also real estate developers and, to some extent, Local Government Financing Vehicles) thus had to rely on alternative funding sources. On the other hand, wealth management products offered through the shadow banking system were able to attract savings from households in search of higher returns than the capped-rate deposits.

While the shadow banking sector, which was until recently growing fast, entails its own risks, as argued by [Xiao \(2012\)](#), recent debt trends show that the current model is clearly unsustainable. Indeed total debt in China grew from 140 percent of GDP in 2008, to 230 percent in 2013 (see figure [B.8](#)). It has been argued that, since debt is essentially domestically held, risks are minimized: investment is financed through national savings and not through external funding, hence the economy is not at risk of a sudden-stop or reversal of capital flows. However, [Taylor \(2012\)](#) provides evidence that the current account balance does not matter much for predicting crises: surplus countries are nearly as much likely to experience a bust than deficit countries. In fact, according to [Drehmann et al. \(2011\)](#) the most powerful early warning signal for financial crises seems to be the credit-to-GDP gap¹⁶; by this metrics, China is well into the danger zone (see figure [B.9](#)).

In light of the rising vulnerabilities in recent years, the Chinese growth model is clearly reaching its limits, and rebalancing – from investment towards consumption – is urgent. The authorities are well aware of the risks and challenges,¹⁷ and President Xi's Administration has announced a comprehensive set of reforms following the Third Plenum in November 2013, aimed precisely at keeping the vulnerabilities under control and rebalancing the economy. Several expected measures would address the distortions mentioned above, in particular the hukou reform, the move towards a more flexible exchange rate, and the liberalization of interest rates. Our projections of potential growth (see sections [3](#) and [4](#)) will take into account the coming rebalancing process.

3 Methodology, data and assumptions

Traditional estimations of potential growth are essentially based on three approaches. A first – purely statistical – approach assimilates potential growth to average long term GDP growth, usually by applying a smoothing filter on aggregate GDP. A second approach, more structural and focusing on the supply side of the economy, decomposes growth through the components of a production function (which are filtered separately). Finally a third approach, relying on a demand-side perspective, interprets potential growth

¹⁶i.e., a significant upward deviation of credit-to-GDP from its historical trend.

¹⁷Since at least 2007 and Wen Jiabao's speech about the four "uns" (unsustainable, uncoordinated, unbalanced, and unstable).

as the GDP growth rate that is neutral to macroeconomic imbalances, usually identified through inflation and unemployment.¹⁸

Recent research by [Borio et al. \(2013\)](#) significantly improves this third approach, by integrating financial variables in estimations of potential growth. Taking the example of the United States, the United Kingdom and Spain, they argue that traditional methods had significantly overestimated potential output before the crisis, as low and stable inflation had actually co-existed with the build-up of financial imbalances. Their empirical methodology is based on a Hodrick-Prescott filter – applied to aggregate GDP –, augmented to include financial variables to the observation equation.¹⁹ They show that the introduction of financial variables (credit growth and real estate prices) would have resulted in larger "finance-neutral" output gaps, consistent with the financial market correction that accompanied the crisis.

While following the rationale developed by [Borio et al. \(2013\)](#), [Alberola et al. \(2013\)](#) adapt it to a production function framework (the second approach mentioned above). Focusing on five countries – US, UK, Spain, Germany and China –, they estimate a measure of "sustainable growth" by correcting each component of a production function for various measures of both internal and external imbalances;²⁰ in the case of China, they select the current account surplus and the fiscal deficit as the main imbalances. Focusing specifically on China, [Bailliu et al. \(2014\)](#) adopt a similar production function approach, where they only correct the capital stock, by (i) excluding housing investment, and (ii) accounting for overinvestment generated by excessive credit growth. Finally, [Maliszewski & Zhang \(2015\)](#) estimate finance-neutral measures of potential output by drawing on the methodology developed by [Borio et al. \(2013\)](#). Specifically, their approach is based on the intuition that positive output gaps are associated with positive deviations of real credit from its stochastic trend – the credit gap. Subsequently, the output gap is expected to close when deleveraging is completed.

Since the aim of our paper is to go beyond measures of potential output and identify growth factors and the implications of the rebalancing process away from overinvestment, we rely on a production function approach, as in [Alberola et al. \(2013\)](#) and [Bailliu et al. \(2014\)](#). In light of the recent developments in empirical research on one hand, and the strong credit growth observed in China (see subsection 2.2) on the other hand, taking into account financial imbalances to obtain a measure of sustainable output growth appears crucial. In addition, given the distortions in the Chinese economy highlighted in subsection 2.1 and in particular financial repression, credit in China essentially finances investment and very little consumption, households being significantly constrained in their access to credit. We thus assume that the imbalances related to the sharp rise in credit manifest themselves through overinvestment (and excessive

¹⁸See [Anand et al. \(2014\)](#) for a review of the different empirical methodologies used to estimate potential growth.

¹⁹The variances of the estimation equations are chosen so that the variability of the resulting potential output is similar to what would be obtained through an HP filter with a λ equal to 1600.

²⁰For each country, the relevant imbalances are chosen from a list including real estate investment, private and public financial balances, private and public debt, the current account, net foreign assets or the real effective exchange rate.

capital accumulation) and we seek to obtain a "sustainable" measure of investment by correcting it of credit dynamics. In that sense, our paper is closer to [Bailliu et al. \(2014\)](#) and [Maliszewski & Zhang \(2015\)](#); however, it differs from theirs in four important ways.

First, unlike [Maliszewski & Zhang \(2015\)](#), we do not rely directly on the BIS methodology, but rather adapt it to a production function framework. While they relate deviations in credit directly to the output gap, we specifically consider investment as the channel allowing credit to fuel GDP.

Second, we do not correct the capital stock by excluding housing investment, as done in [Bailliu et al. \(2014\)](#). Indeed a significant share of the recent credit surge was linked to the real estate boom, as developers increased their leverage by raising funds through traditional bank credit and – more and more – through the shadow banking system (see subsection 2.2). Thus correcting the capital stock for *both* housing investment *and* credit growth may result in some double counting.

Third, and most importantly, [Bailliu et al. \(2014\)](#) compute total factor productivity (TFP) as a residual of the production function equation incorporating the *corrected* capital stock; since capital stock growth has been corrected downwards, TFP growth is automatically corrected upwards to match observed GDP growth. In other words, a lower productive capital stock translates into higher productivity gains, leaving the estimated potential growth virtually unchanged. However, it is not clear why more unproductive capital should translate into higher TFP gains. Thus, in contrast to their methodological choice, we use the *observed* capital stock to derive the TFP residual: in our framework, a lower productive capital stock leaves TFP gains unchanged while potential growth is adjusted downwards. The intuition behind this is that realized investment, even if unproductive, does boost observed short term growth – through a keynesian effect –, and this additional growth should not be attributed to TFP; but unproductive investment fails to boost *potential* growth.

Fourth, unlike [Bailliu et al. \(2014\)](#) and [Maliszewski & Zhang \(2015\)](#), we attach special attention to the pattern of sectoral reallocations in driving TFP growth. This is particularly important in a rebalancing context: while labor shifts occurred from the agriculture to the manufacturing and services sector previously to the crisis, rebalancing is expected to be accompanied by a shift from manufacturing – and still agriculture – to services. Given that productivity levels are different among the three sectors, the changing pattern of sectoral reallocations should have an impact on TFP gains. [Bosworth & Collins \(2008\)](#) and [Haltmaier \(2013\)](#), among others, look at such effects by decomposing output into labor and labor productivity; we extend their analysis in a Cobb-Douglas production function framework, disentangling sectoral reallocations for both labor and capital from "pure" within-sector productivity gains.

3.1 A production function approach

We assume that the supply side of the economy can be reasonably described by a Cobb-Douglas production function. In this perspective, potential GDP can be interpreted as the output China is able to produce by using all of its available production factors (labor, capital, human capital). The production function can be written as follows:

$$Y_t = A_t \cdot K_t^\alpha \cdot (L_t \cdot h_t)^{(1-\alpha)} \quad (1)$$

where Y_t is gross domestic product at time t , A_t is total factor productivity (or TFP), K_t is the physical capital stock, L_t is total employment and h_t is human capital per inhabitant. α is the elasticity of output to capital, which is a parameter determined by technology. The growth rate of output can thus be written as:

$$\hat{Y}_t = \hat{A}_t + \alpha \hat{K}_t + (1 - \alpha) \hat{L}_t + (1 - \alpha) \hat{h}_t \quad (2)$$

with \hat{x} representing, for each variable x , the logarithmic derivative $\frac{dx}{x}$. Potential growth \hat{Y}^* is then defined by the following equation 3, based on the structural components of each production factor (\hat{K}^* , \hat{L} , \hat{h} , \hat{A}).

$$\hat{Y}_t^* = \hat{A}_t + \alpha \hat{K}_t^* + (1 - \alpha) \hat{L}_t + (1 - \alpha) \hat{h}_t \quad (3)$$

The structural components for labor \hat{L} and human capital \hat{h} are extracted through a Hodrick-Prescott filter. The component for capital stock \hat{K}^* is obtained through a structural approach seeking to correct for over-investment (described in subsection 3.2), and thus differs from the filtered capital stock based on *observed* investment, \hat{K} . Finally, total factor productivity \hat{A} is obtained as a residual of the estimation of production function equation 2, i.e. using the *observed* capital stock \hat{K} rather than the *corrected* capital stock \hat{K}^* , as explained above; it is further decomposed into two subcomponents, within-sector productivity and productivity due to sectoral reallocations (see subsection 3.3), both of which are then filtered to extract their respective structural components and derive \hat{A} .

Coefficients α and $(1 - \alpha)$ are traditionally proxied by the factor shares in income, based on the hypothesis of factors being paid their marginal productivity.²¹ However, Gollin (2002) argues that the compensation of employees may underestimate actual labor revenues in emerging economies, due to self-employed and informal labor, which would be falsely recorded as capital income. In addition, as argued in subsection 2.1, the atypical income distribution in China²² is mainly related to factor price distortions: in the labor market in particular, employees – especially migrant workers – are paid below their marginal productivity (Dollar &

²¹In a deterministic approach, factor shares are computed based on the decomposition of GDP in the revenue account, between compensation of employees and gross operating surplus.

²²The labor share in China, at 42% in 2011 (according to the Penn World Table 8.0), is well below the world average of 60-70% (Bernanke & Gürkaynak 2002) and levels recorded in other Asian countries with similar levels of development (60% in Japan in 1969, 55% in Taiwan in 1984 and 58% in South Korea in 1989).

Jones 2013); Hsieh & Klenow (2009) also document the extent of capital and labor misallocations in China. Thus, factor prices (wages and profits) do not effectively reflect the respective marginal productivities of labor and capital. Instead, we use the conventional labor and capital coefficients of 60% and 40%, respectively, in line with the literature; our choice is supported by studies showing that the labor and capital shares are rather constant in time and do not vary with the level of development (Bernanke & Gürkaynak 2002, Gollin 2002, Feenstra et al. 2013 and Penn World Table 8.0).

3.2 Capital stock: a correction of overinvestment based on the credit cycle

In addition to the supply-side approach within the Cobb-Douglas production function framework, we further rely on a demand-side approach in order to take into account overinvestment. We argue that excessive credit dynamics is largely responsible for overinvestment in China, artificially inflating GDP levels. In order to obtain a measure of sustainable capital stock, we seek to eliminate the part of investment that is due to the credit boom. To this end, we use the methodology and GAP software developed by Planas & Rossi (2010), adapted to isolate the component of investment that is compatible with a stable credit growth.

We set up a bivariate state-space model that extracts the unobservable structural component of investment by incorporating information about the financial cycle, namely credit growth. The rationale of such a model is that investment and credit have specific structural components, but common cyclical components. Thus, credit becomes a function of present and past values of investment. The model parameters are estimated by maximum likelihood, and a Kalman filter²³ is used to obtain the unobservable component (the investment cycle, and by differencing, the investment trend).

More precisely, we decompose investment I_t into a trend and a cyclical component:

$$I_t = I_t^{trend} + I_t^{cycle} \quad (4)$$

The trend of investment is then modeled as a second order random walk:

$$(1 - L)I_t^{trend} = \mu_{t-1} + e_t \quad (5)$$

$$(1 - L)\mu_t = \nu_t \quad (6)$$

²³The Kalman filter assigns values to the unobserved variable and makes predictions of the observed variable, so that the prediction errors are minimized.

while the cycle of investment follows a second order auto-regressive process:

$$(1 - \rho_1 L - \rho_2 L^2)I_t^{cycle} = \varepsilon_t^{cycle} \quad (7)$$

where L is the lag operator, and μ_t , e_t , ν_t and ε_t^{cycle} are white noise innovations. The relationship between investment and financial imbalances, as proxied by credit growth, is then given by the following equation:

$$\Delta Credit_t = \varphi + \gamma(1 - L)^2 I_{t-1} + \sum_{i=0}^r \beta_i I_{t-i}^{cycle} + \phi_1 \Delta Credit_{t-1} + \phi_2 \Delta Credit_{t-2} + v_t \quad (8)$$

where φ is a constant, r is the number of lags for which investment is supposed to influence credit, γ , β_i and ϕ_i are parameter to be estimated and v_t is a white noise.

Once we obtain the sustainable component of investment I_t^{trend} , we use it to construct our series of "sustainable" capital stock K^* with the perpetual inventory method:

$$K_t^* = (1 - \delta)K_{t-1}^* + I_t^{trend} \quad (9)$$

We choose a constant 6% depreciation rate δ , which affects the level of the capital stock but not its dynamics.²⁴ For the initial capital stock, following the usual convention in the literature (Zhu 2012, Bailliu et al. 2014) we use $K_0^* = \frac{I_1}{\delta + g}$, where g is the average growth rate of investment during the first five years of our sample. We do not take into account in the remainder of the analysis the first 12 years of the capital stock series, in order to allow for the capital stock to converge to a level that is independent of the choice of the first point.

Finally, we also construct a series of "observed" capital stock K , using the same perpetual inventory method with realized investment I ; we will rely on this non-corrected measure of the capital stock to derive total factor productivity (see subsection 3.3). The difference $K - K^*$ can be thought of as a measure of "excessive", or unproductive capital, linked to excess capacities (see subsection 2.2).

$$K_t = (1 - \delta)K_{t-1} + I_t \quad (10)$$

3.3 Total factor productivity: disentangling the role of sectoral reallocations

As argued earlier, we derive total factor productivity as the residual from equation 2 rather than from equation 3, i.e. using the "observed" capital stock K_t rather than the "corrected" capital stock K_t^* : indeed

²⁴Depreciation rates in the literature vary between 5 and 12%. Bosworth & Collins (2008) and Zhu (2012) use 6%, Dragonomics (2011) choose 7%, while Wu (2009) and Haltmaier (2013) use different depreciation rates for the three sectors of the economy (1.6% for agriculture, 5.2% for industry and 4% for services). Finally, higher depreciation rates are used by Bai et al. (2006), between 10 and 12%.

realized investment, even if unproductive, does boost observed short term growth – through a keynesian effect –, and this additional growth should not be attributed to TFP.

In addition, in the 2003-07 period total factor productivity has been significantly boosted by sectoral reallocations of labor, from low-productivity agriculture to the higher-productivity manufacturing sector. However, as rebalancing is expected to gather pace going forward, the pattern of sectoral reallocations will change, from the manufacturing to the service sector. To take into account this changing pattern, it is important to disentangle the effects on TFP of sectoral reallocations from "pure" within-sector productivity. To this purpose, we consider three sectors (agriculture, manufacturing, services) and we assume that each of these sectors $i = 1, 2, 3$ is described by a Cobb-Douglas production function, similar to equation 1:

$$Y_{i,t} = A_{i,t} \cdot K_{i,t}^\alpha \cdot (L_{i,t} \cdot h_{i,t})^{(1-\alpha)} \quad (11)$$

We assume that the elasticity of output to capital α is the same for the three sectors; Brandt & Zhu (2010) make a similar assumption when decomposing the Chinese economy into three sectors (agriculture, and non-agricultural state and non-state sectors). We also assume that human capital per capita grows at the same pace in all sectors (i.e., $\hat{h}_i = \hat{h}$ for each sector i). Since the total output of the economy is given by $Y = \sum_{i=1}^3 Y_i$, we have (dropping time index t for simplicity):

$$\hat{Y} = \sum_{i=1}^3 \left(\frac{Y_i}{Y} \right) \hat{Y}_i \quad (12)$$

with \hat{x} representing, for each variable x , the logarithmic derivative $\frac{dx}{x}$. Using equations 11 and the fact that $K = \sum_{i=1}^3 K_i$ and $L = \sum_{i=1}^3 L_i$, equation 12 can be re-written as:

$$\begin{aligned} \hat{Y} = & \sum_{i=1}^3 \left(\frac{Y_i}{Y} \right) \hat{A}_i + \alpha \sum_{i=1}^3 \left(\frac{Y_i/K_i}{Y/K} - 1 \right) \frac{dK_i}{K} + (1-\alpha) \sum_{i=1}^3 \left(\frac{Y_i/L_i}{Y/L} - 1 \right) \frac{dL_i}{L} \\ & + \alpha \hat{K} + (1-\alpha) \hat{L} + (1-\alpha) \hat{h} \end{aligned} \quad (13)$$

Comparing with equation 2, total factor productivity gains for the whole economy \hat{A} are thus given by:

$$\hat{A} = \sum_{i=1}^3 \left(\frac{Y_i}{Y} \right) \hat{A}_i + \alpha \sum_{i=1}^3 \left(\frac{Y_i/K_i}{Y/K} - 1 \right) \frac{dK_i}{K} + (1-\alpha) \sum_{i=1}^3 \left(\frac{Y_i/L_i}{Y/L} - 1 \right) \frac{dL_i}{L} \quad (14)$$

The first element of the above decomposition is within-sector productivity, i.e. a weighted average of productivity gains within each sector. The third element represents the impact on TFP of labor reallocations across sectors: a reallocation of labor towards sector i ($\frac{dL_i}{L} > 0$) will have a positive [resp. negative] impact on TFP if the apparent productivity of labor in this sector is higher [resp. lower] than the average

for the whole economy. Similarly, the second element can be interpreted as the impact on TFP of capital "reallocations" across sectors; in fact, rather than "reallocation" it represents the impact on TFP of diverging paces of capital accumulation across sectors: faster capital accumulation in sector i ($\frac{dK_i}{K} > \frac{dK_j}{K}$) will have a positive [resp. negative] impact on TFP if the apparent productivity of capital in this sector is higher [resp. lower] than the average for the whole economy.

In practice, we calculate the impact on TFP of labor reallocation across all three sectors (agriculture, industry, services), but we only calculate the impact on TFP of capital "reallocations" between industry and services. This is because we rely on urban FAI data to derive capital stocks per sector (see Appendix A): the "agricultural" component of urban FAI data misses most of the investment directed towards agriculture.²⁵

Finally, we obtain a measure of within-sector productivity gains by subtracting the labor and capital reallocation terms to the global TFP gains \hat{A} (given by equation 2, as argued before). The structural components of within-sector productivity on one side, and the reallocation term on the other side, are extracted through a Hodrick-Prescott filter.

3.4 Assumptions for long term projections on production factors

Besides analyzing past growth trends and the respective contributions of production factors, we also seek to provide an assessment of China's growth prospects within the next fifteen years, and give some insights on the way rebalancing may affect potential growth. The historical data we use are presented in Appendix A; as for projections, we have to rely on several assumptions. In a nutshell, our main assumption is that the Chinese authorities will implement the reforms they announced at the Third Plenum, which will progressively lead to a significant rebalancing (i) away from investment and towards consumption, (ii) away from manufacturing and towards services, and (iii) from an extensive to a more intensive growth model. We detail below the implications for the assumptions relative to each production factor – in particular for capital accumulation and TFP –, over the period 2014-2030. Finally, an important point is that we apply Hodrick-Prescott filters to the whole series (1978-2030) to avoid the end-point bias.

Capital stock

Rebalancing is essentially a way to achieve more sustainable growth and to reduce the vulnerabilities that have been mounting recently (see subsection 2.2). Overinvestment, as indicated by rising excess capacities, suggest the need to slow down investment growth; the rising capital-output ratio should imply a decline in the marginal return on capital, thus reducing incentives to invest. Moreover, a further correction in the

²⁵ An attempt to incorporate all three sectors leads to absurdly high values of the apparent productivity of capital in the agricultural sector.

real estate market would weight on investment. Several measures could also produce that outcome: *first*, bringing down excessive credit growth would reduce financing available for investment; *second*, financial liberalization, by ending financial repression – especially the cap on the remuneration of deposits – would induce a rise in the cost of capital. Over the longer run, an ageing population but also the elimination of distortions²⁶ should lead to a decline in savings, further increasing the cost of capital.

*We thus assume a gradual (linear) decline in the investment-to-GDP ratio, from 47% in 2013 to 34% in 2030.*²⁷ Accordingly, capital accumulation would progressively slow down (see subsection 4.1.1). This hypothesis is in line with Haltmaier (2013), Nabar & N'Diaye (2013) and World Bank (2013), and is consistent with a rebalancing scenario: since public consumption and net exports are very unlikely to compensate such a decrease in the investment ratio, this implicitly implies a strong increase in the consumption-to-GDP ratio, making consumption the main growth engine.

Labor

Due to the one-child policy and rapid ageing, China is expected to face significant demographic challenges in the coming decades, with a declining labor force that will weight on potential growth. *We assume that labor will evolve in line with the labor force, as given by CEPII projections, which are themselves based on the working age population projections by the United Nations (medium fertility growth scenario) and calculations on participation rates from the International Labor Organization.* We thus implicitly assume a constant structural unemployment rate, consistent with the long term scenario of the OECD (constant 2.2% unemployment rate from 2013 to 2030). As a result, labor growth should decrease from +0.4% in 2013 to -0.7% in 2030.

Human capital

Progress in terms of education should persist in the coming years, in line with the Chinese economy climbing up the value chain and the increasing demand for skilled labor. *Over the forecast horizon, we assume that human capital will keep growing at the average rate observed during the period 2008-2011, i.e. at +0.9% per year.* This implies an overall 17% increase of the human capital stock during 2011-2030, somewhat higher than in Bailliu et al. (2014) (12%) but lower than in Tsounta (2014) (who chooses the average growth rate over the 2005-2010 period, i.e. +1.0% per year for China).

Total factor productivity

Consistently with our decomposition of total factor productivity presented in equation 14, we make separate assumptions to project each component.

²⁶Eliminating distortions is necessary to rebalance the economy, as distortions are at the heart of imbalances; however, distortions were also one of the reasons of the particularly high saving rate (see subsection 2.1).

²⁷From a technical point of view, we proceed as follows: we set an arbitrary trajectory for investment (or for the capital stock, which is equivalent) and estimate potential growth; we then compare the investment-to-GDP ratio in 2030 to its desired target of 34%, and adjust the investment / capital stock trajectory in an iterative process.

As regards sectoral reallocations (of both labor and capital), equation 14 shows that projections require assumptions on sectoral GDP, sectoral employment and sectoral capital stock. This is equivalent to having hypotheses on the *level* of global GDP, employment and capital stock, and on the respective *shares* of each sector in GDP, employment and capital stock. *We thus assume, following World Bank (2013), that (i) the sectoral decomposition of employment in 2030 will be 12.5% for agriculture (31.4% in 2013), 28.5% for industry (30.1% in 2013) and 59.0% for services (38.5% in 2013) – see figure B.10; and that (ii) the sectoral decomposition of GDP in 2030 will be 4.3% for agriculture (10.0% in 2013), 34.6% for industry (43.9% in 2013) and 61.1% for services (46.1% in 2013). We also assume that the service share of the capital stock will increase to 70% by 2030 (from 55.5% in 2013), with the industry share of the capital stock following the opposite trend.*²⁸ Finally, total employment and capital stock are given by our previous assumptions (see above) while total GDP is taken from the outcome of our potential growth estimates.²⁹

Within-sector productivity slowed markedly in recent years, to around 1% in 2013. We expect the reforms launched at the Third Plenum of the Communist Party in late 2013 to have a progressive impact on within-sector TFP, starting already from 2016. *Therefore, we assume "pure" within-sector productivity to accelerate progressively to 2.1% a year by 2025.* We rely on Nabar & N'Diaye (2013), who provided an indication as to the expected gains due to structural reforms, based on provincial data regressions. They argue that service sector deregulation, improvement in the contestability of markets and reform of the hukou system, so as to reach the levels observed in Shanghai, should lead to productivity gains of respectively 1.1, 0.6 and 0.3 percentage points a year. While we think the structural reforms laid out in the Third Plenum will be gradually put into place, our scenario is more cautious regarding the expected outcome from these reforms: within-sector productivity gains would amount to roughly 1 percentage point, materializing progressively over the 2016-2025 period³⁰. This seems more in line (albeit on the lower side) with a recent paper by Lam & Maliszewski (2015), who conclude that the full implementation of the Third Plenum reform agenda would yield gains in TFP growth in the range of 1 to 1.5 percentage points per year (keeping in mind that their estimate refers to global TFP growth, while our "reform scenario" focuses on "pure" within-sector TFP growth).

²⁸The latter assumption has little impact on the reallocation term. More generally, the "reallocation" term for capital is lower and smoother than that for labor: first, capital "reallocations" are only considered between industry and services; second, capital stock data are smoother because of the way they are calculated (Perpetual Inventory Method).

²⁹Again, as for capital stock above, this is done through an iterative process: we first set an arbitrary trajectory for GDP (this is just to calculate the sectoral reallocation term); once we get from the whole methodology our estimates for potential growth up to 2030, we adjust the previously postulated trajectory of GDP until it is fully consistent with our potential growth estimates.

³⁰There are several reasons for adopting a more cautious scenario than in Nabar & N'Diaye (2013). First, their estimates rely on correlations at the provincial level between TFP growth on one side, and the service sector share of employment, FDI share of FAI, and non-agricultural hukou share of population on the other side. However, the direction of causality (if any) is far from established; as an illustration, it is unclear why raising the service sector share of employment would per se lead to higher overall TFP gains (given that the service sector is on average less productive than the manufacturing sector in China, reallocation effects would suggest the opposite). Second, the ability of reforms to raise the provincial average to the level observed in Shanghai in 2010 seems questionable; for example, because of their geographical location, the FDI share of FAI in inland provinces may remain durably below the levels observed in coastal provinces, despite progress in the contestability of markets.

4 Results, policy implications and discussion

4.1 Components of potential growth

4.1.1 A progressive slowdown in capital accumulation

In order to extract the sustainable component of investment, as detailed in subsection 3.2, we take into account its interaction with credit growth through a bivariate state-space model, following Planas & Rossi (2010). Parameters are estimated through maximum likelihood and a Kalman filter is used to generate the sustainable component of investment by incorporating information on credit growth. The conditions to be met for the model to be valid are the stationarity of the observable variable (credit growth) and a sufficiently lower variance of the investment slope compared to the variance of the investment cycle.

The estimation results of this model are presented in table C.1. The investment equation is correctly specified as a second order random walk, while the slope variance appears considerably smaller than the cycle variance. The significance of the beta coefficients in the credit equation confirms our hypothesis that investment is a significant determinant of credit growth (both contemporaneously and with one lag).³¹ Credit growth thus allows the cyclical component of investment to be identified, and by differencing, we get the structural or sustainable component of investment.

A graphical representation of the fitted values based on this correction is presented in figure B.11: we compare the initial investment series with our "sustainable" investment, as well as with a series smoothed by a simple Hodrick Prescott filter. As expected, our results point to overinvestment due to excessive credit growth between 2009 and 2011. Our correction implies a downward revision of 3 to 6% of the volume of investment over the period 2009-2011 (equivalent to 1.5 – 3% of GDP). The effect of this correction on the capital stock is represented in figure B.12: "sustainable" capital accumulation would have been slower by about 0.5 to 1.1% per year between 2009 and 2011, compared to effective capital accumulation.

Overall, our estimations highlight the role of capital accumulation as the main determinant of potential growth in China during the last two decades. Distortions have been pushing up investment (see subsection 2.1), resulting in strong growth of the capital stock at more than 13% a year during the 1990s and 2000s, and still 10.9% in 2013 (HP-filtered "sustainable" capital stock). Going forward, as distortions are removed to rebalance growth, capital accumulation should slow down, due to lower returns, a higher cost of capital, the gradual reduction of overcapacity, the need to keep credit growth at a sustainable pace and a possible further correction in the real estate market (see subsection 3.4 for more details). From around 11% currently, the pace of capital accumulation would progressively moderate towards 4% in 2030 (see figure B.13). Given the elasticity of output to capital accumulation (α), this would result in a loss of

³¹Further lags of investment have been tested but they are not significant in explaining credit.

potential growth of around 3 percentage points by the end of our forecast horizon: the contribution of capital accumulation to potential growth would decrease from 4.5 percentage points in 2011-2013 to 1.6 percentage point in 2030 (see table C.2).³²

4.1.2 Declining demographics

Between 1950 and 1980, China's population has risen sharply, due to the baby boom and the improvement in health conditions, thus increasing the labor supply. However, following the birth control policy and the "one-child" policy – set up respectively in the early 1970s and in 1979 –, labor growth declined from an average of 3% a year in the 1980s, to 1.2% in the 1990s and 0.6% after 2000: indeed, while the working-age population slowed down markedly, the participation rate also decreased (from 76% in 1995 to 63% in 2009 in urban areas, according to World Bank (2013)). The evolution of employment (comprising both employees and self-employed) has been rather similar (see figure B.14), decreasing from an average of 3.5% a year during the eighties, to 2% a year in the nineties and 0.5% a year in the years 2000s.

Slowing population dynamics imply that its effects on potential growth are about to reverse: employment increased by only 0.4% in 2012-2013, and should turn negative from 2018 onwards (see figure B.14). In addition, the lack of comprehensive statistics on the Chinese labor market may hide a somewhat more pessimistic picture of current trends in labor input: in particular the unemployment rate may be higher than officially reported, since migrant workers are not included in official statistics.

In line with population dynamics, our estimates point to a declining impact of labor on potential growth: its contribution decreased from 1.2 percentage point in the 1990s, to 0.3 in the 2000s and 0.1 currently; going forward, our projections suggest that population dynamics would eventually result in a negative contribution of labor input to potential growth, at -0.3 percentage point in 2030 (see table C.2).³³

4.1.3 Progress in terms of human capital

During the last decades, China has achieved significant progress in terms of education, as illustrated by the Barro and Lee human capital index: the number of years of schooling increased from an average of 5.6 years in 1990 to 7.5 years in 2010 (Barro & Lee 2013). However progress has been slowing over time; while gains in the index averaged 1.4% per year during the 1990s, they moderated to 1% during the 2000s and to 0.7% in 2010 (see figure B.15). Accordingly, the contribution of human capital to potential growth has steadily declined, from 0.8 percentage point in the 1990s to 0.6 pp in the 2000s and 0.5 pp currently.

³²In relative terms, capital accumulation would explain 37% of potential growth in 2030 compared to 55% in 2011-2013.

³³In relative terms, labor would explain -9% of potential growth in 2030 compared to +2.2% in 2011-2013 and +12% during the nineties.

Going forward, to the extent that the economy will climb up the value chain and generate more skilled jobs, incentives to accumulate human capital should be stimulated. Indeed, some employers are already facing shortages of skilled labor and progress in terms of human capital will be needed in order to ensure competitiveness gains. Therefore, in line with expected further progress in terms of education (see subsection 3.4), the contribution of human capital to potential growth would stay at its current level of 0.5 percentage point over the forecast period (see table C.2).³⁴

4.1.4 Diverging trends in total factor productivity subcomponents

As described in subsection 3.2, we compute TFP as the residual of the Cobb-Douglas production function, after subtracting the contributions of *observed* capital accumulation, labor and human capital. We then decompose TFP into within-sector productivity and the effects of sectoral reallocation (subsection 3.3); each component is projected according to the assumptions presented in subsection 3.4, and smoothed with a Hodrick Prescott filter. The results are presented in figure B.16.

First, within-sector productivity gains were already strong in the 1990s, averaging 1.7% per year: in particular, the public sector reform led to productivity gains and an expansion of the private sector. After 2001 and trade liberalization reforms following China's accession to the World Trade Organization, within-sector productivity gains were reinforced and averaged 2.7% per year in the 2000s: China's integration into global value chains was accompanied by massive inflows of foreign direct investment, leading to technology transfer and productivity spillovers; moreover, returns to scale and "learning by exporting" also amplified productivity gains. Finally, the share of revenue devoted to research & development activities has consistently increased from 0.9% in 2000 to almost 2% in 2012, a level similar to developed economies. However, within-sector productivity gains slowed sharply following the crisis, to around 2% in 2011-2013 and further to 1.5% in 2014-2015;³⁵ this drop is consistent with the diagnosis of overinvestment discussed previously, when post-crisis strong capital accumulation mechanically squeezed TFP. Going forward, within-sector TFP would gradually rebound, reaching 2.1% in 2030: implementation of the reforms announced by the Chinese authorities in late 2013 should progressively lead to productivity gains, especially in services, and domestic innovation efforts.

Second, sectoral reallocation effects varied significantly over the past period. They were relatively low between 1998 and 2002 – around 0.8% a year on average, following the Asian crisis and banking problems within China. However, they rebounded from 2003 onwards, and averaged 1.2% per year between 2004 and 2007: indeed China's accession to the World Trade Organization, in the context of an undervalued

³⁴This means that *in relative terms*, human capital accumulation would explain 12% of potential growth in 2030 compared to 6% in 2011-2013.

³⁵These results are in line with those of Hoffman & Polk (2014), while Bulman & Kraay (2013) find lower within-sector productivity gains already in the 2000s.

currency and other factor price distortions (see subsection 2.1), led to strong market share gains at the global level, fostering a rapid expansion of the manufacturing sector which was thus able to absorb large internal migrations from rural to urban areas.³⁶ As a result, labor reallocation from agriculture to the more productive manufacturing sector led to a strong increase in productivity. However, in the aftermath of the crisis, productivity gains due to sectoral reallocation moderated to around 1% a year, since labor growth in the manufacturing sector slowed due to sluggish growth in external markets. Going forward, economic rebalancing will imply a further shift in the pattern of sectoral allocations: factor reallocation is expected to occur increasingly towards the service sector, which is less productive than manufacturing (see subsection 3.4). As a result, the component of TFP due to sectoral reallocation would slow further, averaging 0.4% a year over 2020-2030.

Overall, the aggregation of the two components shows strong TFP gains, averaging 2.5% a year in the 1990s, subsequently accelerating to 3.9% a year in the 2000s following China's accession to the World Trade Organization; however, in the wake of the crisis, TFP gains slowed to 3.1% a year over 2011-2013, and around 2.4% in 2014-2015. Going forward, the expected improvement in within-sector TFP would compensate the shift in sectoral reallocations, resulting in stable TFP gains averaging 2.4-2.5% during the period 2020-2030 (see table C.2).³⁷

4.2 Potential growth, output gap and policy implications

Our results for potential growth, aggregating the structural components of the different production factors, are presented in figure B.17 and table C.2. According to our estimates, China's potential growth during the past two decades (1990s and 2000s) was relatively stable and close to 10%. However, in the aftermath of the economic crisis, potential growth has been on a downward trend, reaching around 7.3% in 2014. Therefore, the Chinese economic slowdown since 2011 appears mainly structural, and accompanied by unsustainable investment and a slowdown in TFP. Going forward, in our projection scenario, potential growth is expected to continue its gradual decline to around 5.1% in 2020 and 4.1% in 2030.

Turning to China's growth drivers, potential growth was in the past essentially driven by capital accumulation and, to a lesser extent, total factor productivity: over the 2001-2010 period, capital accumulation contributed by 5.1 percentage points (51% of total growth), and TFP by 3.9 percentage points (39% of total growth). Conversely, labor and human capital had relatively small contributions to potential growth (respectively 0.3 and 0.6 percentage points, or 3 and 6% of total growth). This is expected to change

³⁶Rural population accounted for 47% of total population in 2013, against 74% in 1990. The share of employment in agriculture also dropped, from 60% in 1990 to 34% in 2012, while employment in industry increased from 19 to 36%. Migrants workers (living in cities, although with a rural hukou) are estimated at more than 200 million people.

³⁷In relative terms, TFP gains would explain 60% of potential growth in 2030 compared to 37% in 2011-2013, thus becoming progressively the main driver of growth.

gradually in the future, as rebalancing proceeds: capital accumulation would contribute by 1.6 percentage points to growth in 2030, less than TFP at 2.5 points. TFP will thus become the main driver of growth (60% of total growth, against 37% for capital); progress in human capital would be enough to compensate the drag on potential growth represented by unfavorable demographics.

Looking at the output gap, China's growth acceleration in the 2000s peaked at 14.2% in 2007, corresponding to an overheating phase and resulting in a positive output gap (1 percentage point, as shown in figure B.18).³⁸ In the aftermath of the crisis, as cyclical factors were pushing on the downside, the Chinese authorities launched a massive stimulus package to offset the drag from lower external demand. Therefore, to the extent that actual growth in the post-crisis period was sometimes faster than potential growth, the positive output gap was maintained and even increased, to reach a peak of +1.2% in 2011. According to our estimates, despite the economic slowdown registered since 2012, the output gap was still positive in 2014, at roughly 0.6 percentage points.³⁹

The finding that the output gap may currently still be positive has important policy implications for China. Indeed, since growth began to slow in 2011, the authorities have regularly relied on "mini-stimuli" measures including an acceleration of investment projects to prevent growth from slowing too much – and, especially, from slowing *below* the growth target –. However, by doing this, China maintained a highly accommodative quasi-fiscal stance: according to IMF (2014a), the "augmented" fiscal deficit – including off-budget Local Government Financing Vehicles' infrastructure spending, and land sales revenues – has been hovering around 7 to 8% of GDP since 2009. Our finding that the growth slowdown may be mainly structural, with a persistent positive output gap, casts doubts on the rationale behind repeated stimuli measures as a way to maintain high growth. In addition, the fact that potential growth may be slowing relatively quickly (to 6.8% in 2015, according to our estimates) lends support to the authorities' decision to lower the growth target for 2015 to 7%. In this vein, IMF (2014a) suggested switching priorities to keeping vulnerabilities under control and rebalancing the economy, instead of reaching a specific growth target.

4.3 Discussion of the results

Our estimates are of course sensitive to our methodology and projection assumptions, and especially to three elements: (i) the extent of our correction for overinvestment, (ii) the timing of rebalancing, and (iii) the pace of rebalancing. Regarding the first point, our measure of potential growth can be interpreted as the GDP growth rate that does not widen financial imbalances, defined here as "excessive" credit growth.

³⁸The Chinese authorities restrained access to credit, especially for the real estate sector, in December 2007 in response to overheating concerns.

³⁹Going forward, we expect the output gap to progressively close by 2018-2019, as shown in figure B.18.

Absent this correction (and given the value retained for the capital share α in the production function), potential growth could have been overestimated by about 0.2 to 0.5 percentage points a year during 2009-2011. However, our estimate for overinvestment is much smaller than in [Lee et al. \(2012\)](#), suggesting that we may still overestimate actual potential growth in China. Regarding the timing of rebalancing, a delay⁴⁰ could modify upwards the time profile of potential growth, *at the risk however of a much more abrupt adjustment further down the road*: indeed, if left unaddressed, currently unsustainable debt trends would sooner or later force rebalancing. Finally, we assume a large but gradual rebalancing, so that the investment-to-GDP ratio gets back in line with emerging economies' average by 2030; it could however be argued that a somewhat smaller rebalancing may be enough to contain vulnerabilities.

With these elements in mind, we now compare our results to the existing literature; an overview of the main results in recent works is presented in table C.3. By and large, all studies on future potential growth in China predict a gradual decline on account of slower capital accumulation. However, *in the short to medium term*, our estimates for potential growth are significantly lower than usually found in most other existing papers in the literature. This is due to our correction of overinvestment, and the fact that we take into account the negative impact of rebalancing on total factor productivity via a shift in sectoral reallocation patterns.

More precisely, [Alberola et al. \(2013\)](#) estimate potential growth in China at 9.9% in 2011: while they do include corrections for potential imbalances, they focus on the current account and official public balance which may give an incomplete picture of imbalances in China.⁴¹ [ECB \(2013\)](#) also reports relatively high figures, at 9% in 2012. [Bailliu et al. \(2014\)](#) estimate potential growth at 8.3% in 2014, significantly higher than our 7.3% figure: although they take into account overinvestment and also exclude housing, this downward revision on the capital stock is passed onto higher TFP. A similar credit-neutral measure of potential growth is provided by [Maliszewski & Zhang \(2015\)](#), who find potential growth to reach around 7.7% in 2013. This is more in line with our own estimate, as well as results from [Anand et al. \(2014\)](#) and [IMF \(2014a\)](#). Similar discrepancies can be observed with respect to the output gap: [Alberola et al. \(2013\)](#) find a negative output gap for the period 2008-2011; estimates from [IMF \(2014a\)](#) also point to a small negative output gap in 2013.⁴² Conversely, [Maliszewski & Zhang \(2015\)](#) highlight the existence of a positive output gap in 2013, however higher than our estimate (at around 2%).

Discrepancies over potential growth estimates persist in the medium term. According to our results, potential growth would average 5.6% per year over the 2016-2020 period, significantly lower than in most

⁴⁰We assume that rebalancing started already in 2015.

⁴¹The current account had already dropped significantly by 2011, and the official public balance figures give a very incomplete picture of the situation ([IMF \(2014a\)](#) provides "augmented" fiscal data to take into account local governments' public finances).

⁴²However, aside from its baseline scenario, [IMF \(2014a\)](#) also provides alternative estimates based on the methodology in [Borio et al. \(2013\)](#), resulting in a large 4% positive output gap in 2013, well above our estimates.

other work in the existing literature:⁴³ [World Bank \(2013\)](#) expects growth to average 6.9% over this period, close to the 7% from [ECB \(2013\)](#) and [Kuijs \(2009\)](#). Thus, our results casts doubts on the so far rather consensual "soft landing" scenario; on the contrary, a gradual but nevertheless significant rebalancing implies that China's growth slowdown may be faster than anticipated, leading to some sort of "long landing" scenario ([Pettis 2014](#)).

4.4 Convergence or middle-income trap?

While generally lower than most existing estimates in the literature on potential growth in China, our results are nonetheless consistent with a number of recent cross-country studies. *First*, based on cross-country regressions over extended periods of time, [Pritchett & Summers \(2014\)](#) argue that abnormally rapid growth is rarely persistent, and that reversion to the mean is an empirically robust feature of economic growth; they conclude that forecasts for Chinese growth should encompass a wider range of scenarios than the currently consensual "soft landing" scenario. *Second*, looking for some common characteristics among countries that experienced a sharp growth slowdown, [Eichengreen et al. \(2012\)](#) find that China shares many of these characteristics, such as a high investment-to-GDP ratio, an undervalued currency, an ageing population. They also point to the existence of thresholds for GDP per capita, beyond which growth is more likely to slow,⁴⁴ and underline the role played by slower productivity growth (due to slower labor reallocation from agriculture to industry, and lower imports of foreign technology). *Third*, noting that many countries in the past adopted a growth model similar to the Chinese one, [RGE \(2013\)](#) look at how these countries rebalanced to shed some light on China's growth prospects. Based on 47 episodes of rebalancing following investment-led growth in a large sample of countries, they find that, on average, growth in the five years following the investment peak was 3.5 percent lower than growth in the five years preceding the peak. Our results for the Chinese growth slowdown around the 2013 investment peak – assuming that rebalancing starts effectively in 2014 – are actually somewhat lower, with a 2.9 percent growth loss, although imbalances are much more acute in China than in the average country of [RGE's](#) sample;⁴⁵ if anything, if China were to follow the average rebalancing pattern, our lower-than-consensus projections may still underestimate the impact of rebalancing on China's medium-term growth.

Finally, our results imply that, by 2030, China would still be far away from the high-income status – with GDP per capita at roughly one third or one quarter of the US level –. Most importantly, the convergence process, which had been very quick thus far, would slow significantly, raising the risk of falling into the middle-income trap. Indeed, as argued by [World Bank \(2013\)](#), few countries so far have managed

⁴³With the notable exception of [Hoffman & Polk \(2014\)](#), who anticipate 5.5% over 2015-2019; [Haltmaier \(2013\)](#) presents different scenarios, with growth in 2020 ranging from 8.7 to 4.7%.

⁴⁴China is about to cross one of these thresholds.

⁴⁵In [RGE's](#) sample, investment peaked at 36 percent of GDP on average, whereas China's investment-to-GDP ratio reached 47 percent in 2013.

to converge: out of 101 middle-income countries in 1960, only 13 had achieved a high-income level of development in 2008. Moreover, among these 13 countries, few can be considered as possible "models" for China's development: Greece, Portugal, Spain and Ireland likely benefited from their accession to the European Union, while Puerto Rico has been part of the United States since the beginning of the past century; Equatorial Guinea, as an oil producer, enjoyed exceptional windfalls from the surge in oil prices during the 2000s; Mauritius is a small island whose economy is based on tourism; and Hong Kong and Singapore are city-states as well as major international financial centers. Finally, Japan, Korea, Taiwan and Israel are the only countries in the recent history that succeeded to converge, and whose development model may be to some extent replicated by China.

As a matter of fact, it is often argued that China's development is on track to follow the Japanese, Korean and Taiwanese precedents of successful development and convergence (Lin 2011, World Bank 2013, Zhang et al. 2015 among others). These studies point to the similarities in the development model adopted by East-Asian countries, in particular export-led growth supported by strong investment. However, some differences are worth highlighting as well. *First*, their convergence occurred in a favorable external context (the "Thirty Glorious"), quite different from current times. *Second*, the geopolitical context was also very different, as the United States adopted a Containment strategy to prevent the spread of communism. This had far reaching consequences for both Korea and Taiwan – and, to a lesser extent, Japan –: Berger & Borer (1997) highlight the role played by US Cold War efforts in industrializing these countries, through massive aid inflows,⁴⁶ assistance during land reforms, privileged access to the North American market while tolerating Taiwan and South Korea's protected markets. Woo (1991) emphasizes that the amount of US economic grants and loans to Korea between 1946 and 1978 was equivalent to the amount for all Africa, and close to half the amount for Latin America. Indeed, Korea and Taiwan – but also, interestingly, Israel, one of the few other countries to have reached a high-income level of development – were among the top beneficiaries of US aid between 1946 and 1985⁴⁷. Of course, foreign aid is not sufficient to explain the success stories of Korea and Taiwan, but it highlights a key difference between their development trajectory and the one currently followed by China: Korea and Taiwan had access to a stable source of foreign capital to finance high levels of investment, while China relies on its own savings to finance investment. This helps explain why domestic imbalances are far more acute in China than they have ever been in Korea, Taiwan or even Japan – high savings being the obvious reverse side of low consumption –. Comparisons between China and other East-Asian countries thus need to take into account the fact that rebalancing is more urgently needed now in China than it was in Korea and Taiwan when these countries were at similar stages of development.

⁴⁶According to Berger & Borer (1997), in the 1950s 75 percent of Taiwan's infrastructure investment came from US aid, while more than 80 percent of South Korean imports were financed by US economic assistance.

⁴⁷Based on data from the Statistical abstract of the United States (1995), our calculations indicate that Korea and Taiwan received each the equivalent of ten Marshall Plans over the period 1946-1985, reported to their GDP.

Overall, our projections for future potential growth in China are consistent with the Japanese precedent. China is now at a similar stage of development than Japan in 1970; and Japanese growth decelerated from an average of 10% per year in the 1960s, to around 5% in the following decade. However, China’s current economic situation also bears some similarities with Japan at the end of the 1980s: unfavorable demographics; a previous phase of strong export-led growth, interrupted by an external factor – global financial crisis, Plaza Agreement –; a subsequent strong surge in investment to maintain high growth, accompanied by rising vulnerabilities – real estate bubble in Japan, but also probably in China–. Whether China will follow Japan’s 1970 or 1990 precedent remains to be seen⁴⁸, but avoiding the middle-income trap will certainly be a challenge.

5 Conclusion

In light of increasing imbalances during the previous period of sustained growth, and rising vulnerabilities since the global crisis, China’s current growth model has reached its limits and needs to evolve towards a more sustainable and more balanced growth framework. Assuming gradual rebalancing away from capital accumulation and towards consumption, potential growth should further weaken: to the extent that the strong pre-crisis growth was partly due to factor price distortions, also responsible for the current imbalances, economic rebalancing requires the elimination of these distortions and should naturally lead to slower growth.

In the present paper we provide estimates of Chinese potential growth and an assessment of its future growth prospects in the next fifteen years. Our contribution to the literature is twofold. *First*, we augment the traditional production function approach by including a measure of credit-neutral capital stock, thus extending recent works by [Borio et al. \(2013\)](#). *Second*, we disentangle the effects of sectoral reallocations of production factors from within-sector productivity gains, allowing for a better estimation of the impact of rebalancing through the expected shift in sectoral reallocation patterns.

Our results provide evidence of significant over-investment during the period 2009-2011, in line with excessive credit growth. Moreover, our estimates confirm that fast TFP growth during the pre-crisis period was partially achieved through labor shifting from agriculture to manufacturing. While China’s economic growth appears today broadly in line with potential, we nevertheless find a positive output gap in 2013-2014. This weakens the rationale behind repeated economic stimulus measures, since extended policy easing – as evidenced by large quasi-fiscal deficits – may perpetuate or even exacerbate existing imbalances, increasing the risk of a hard landing. In the short and medium term, our estimates point to a more pronounced slowdown in potential growth than in the so far consensual soft landing scenario: as rebalancing

⁴⁸For further details, [Fracasso \(2015\)](#) provides a thorough assessment of the similarities between China and Japan.

proceeds, slower investment would weight on capital accumulation while the expected structural shift in the allocation of production factors towards the service sector would erase much of the gains expected from the reforms; unfavorable demographics would represent a further drag. Finally, potential growth would slow to close to 5% by 2020, and 4% by 2030, thus significantly hampering the convergence process; growth would however become more sustainable and reliant on within-sector productivity gains.

Bibliography

- Ahuja, A., Cheung, L., Han, G., Porter, N., & Zhang, W. (2010). *Are House Prices Rising Too Fast in China?* Working Papers 1008, Hong Kong Monetary Authority.
- Ahuja, A. & Nabar, M. (2012). *Investment-Led Growth in China: Global Spillovers*. IMF Working Papers 12/267, International Monetary Fund.
- Alberola, E., Estrada, A., & Santab rbara, D. (2013). *Growth beyond imbalances. Sustainable growth rates and output gap reassessment*. Banco de Espa a Working Papers 1313, Banco de Espa a.
- Allen, F., Qian, J., & Qian, M. (2005). Law, finance, and economic growth in china. *Journal of Financial Economics*, 77(1), 57 – 116.
- Anand, R., Cheng, K. C., Rehman, S., & Zhang, L. (2014). *Potential Growth in Emerging Asia*. IMF Working Papers 14/02, International Monetary Fund.
- Aziz, J. & Cui, L. (2007). *Explaining China’s Low Consumption: The Neglected Role of Household Income*. IMF Working Papers 07/181, International Monetary Fund.
- Bai, C.-E., Hsieh, C.-T., & Qian, Y. (2006). The Return to Capital in China. *Brookings Papers on Economic Activity*, 37(2), 61–102.
- Bailliu, J., Kruger, M., Toktamyssov, A., & Welbourn, W. (2014). *What’s Driving Economic Growth in China? Accounting for Overinvestment, Housing and Human Capital*. Mimeo, Bank of Canada.
- Barro, R. J. & Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, 104(C), 184–198.
- Berger, M. T. & Borer, D. A. (1997). *The Rise of East Asia: Critical Visions of the Pacific Century*. London: Routledge.
- Berkelmans, L. & Wang, H. (2012). *Chinese Urban Residential Construction to 2040*. RBA Research Discussion Papers rdp2012-04, Reserve Bank of Australia.
- Bernanke, B. S. & G rkaynak, R. S. (2002). Is Growth Exogenous? Taking Mankiw, Romer, and Weil Seriously. In *NBER Macroeconomics Annual 2001, Volume 16*, NBER Chapters (pp. 11–72). National Bureau of Economic Research, Inc.
- Blanchard, O. & Giavazzi, F. (2006). Rebalancing growth in china: A three-handed approach. *China & World Economy*, 14(4), 1–20.
- Borio, C., Disyatat, F. P., & Juselius, M. (2013). *Rethinking potential output: Embedding information about the financial cycle*. BIS Working Papers 404, Bank for International Settlements.
- Bosworth, B. & Collins, S. M. (2008). Accounting for Growth: Comparing China and India. *Journal of Economic Perspectives*, 22(1), 45–66.
- Brandt, L. & Zhu, X. (2010). *Accounting for China’s Growth*. IZA Discussion Papers 4764, Institute for the Study of Labor (IZA).
- Bulman, D. & Kraay, A. (2013). *Thirty years of Growth in China: Accumulation, Reallocation, and TFP Growth*. Unpublished working paper, World Bank.
- Bussiere, M., Kalantzis, Y., Lafarguette, R., & Sicular, T. (2013). *Understanding household savings in China: the role of the housing market and borrowing constraints*. MPRA Paper 44611, University Library of Munich, Germany.
- Bussiere, M. & Mehl, A. (2008). *China’s and India’s roles in global trade and finance - twin titans for the new millennium?* Occasional Paper Series 80, European Central Bank.
- Canning, D. & Pedroni, P. (2008). Infrastructure, Long-Run Economic Growth And Causality Tests For Cointegrated Panels. *Manchester School*, 76(5), 504–527.

- Chamon, M. D. & Prasad, E. S. (2010). Why are saving rates of urban households in China rising? *American Economic Journal: Macroeconomics*, (pp. 93–130).
- Deloizier, B. & Rebillard, C. (2010). Le rééquilibrage de la croissance chinoise : enjeux et perspectives. *Économie et Prévision*, 194(3), 119–127.
- Dollar, D. & Jones, B. F. (2013). *China: An Institutional View of an Unusual Macroeconomy*. NBER Working Papers 19662, National Bureau of Economic Research, Inc.
- Dollar, D. & Wei, S.-J. (2007). *Das (Wasted) Kapital: Firm Ownership and Investment Efficiency in China*. IMF Working Papers 07/9, International Monetary Fund.
- Dorrucci, E., Pula, G., & Santabárbara, D. (2013). *China's economic growth and rebalancing*. Occasional Paper Series 142, European Central Bank.
- Dragonomics (2011). *The great rebalancing (I) - does China invest too much?* China Insight Economics, September.
- Drehmann, M., Borio, C., & Tsatsaronis, K. (2011). Anchoring countercyclical capital buffers: The role of credit aggregates. *International Journal of Central Banking*, 7(4), 189–240.
- ECB (2013). Factors underlying China's growth performance and prospects. *European Central Bank, Monthly Bulletin*, December, Box 1, 16–19.
- Eichengreen, B., Park, D., & Shin, K. (2012). When fast-growing economies slow down: International evidence and implications for china. *Asian Economic Papers*, 11(1), 42–87.
- Feenstra, R. C., Inklaar, R., & Timmer, M. (2013). *The Next Generation of the Penn World Table*. Working Paper 19255, National Bureau of Economic Research.
- Feyzioglu, T., Porter, N., & Takáts, E. (2009). *Interest Rate Liberalization in China*. IMF Working Papers 09/171, International Monetary Fund.
- Fracasso, A. (2015). *Economic Rebalancing and Growth: the Japanese experience and China's prospects*. DEM Discussion Papers 2015/07, Department of Economics and Management.
- Gaulard, M. (2014). La burbuja inmobiliaria en China. *Problemas del desarrollo*, 45(178), 63–88.
- Gauvin, L. & Rebillard, C. (2013). *Towards Recoupling? Assessing the Impact of a Chinese Hard Landing on Commodity Exporters: Results from Conditional Forecast in a GVAR Model*. Mimeo, 9th CERDI-IDREC International Conference on the Chinese Economy.
- Geng, N. & N'Diaye, P. (2012). *Determinants of Corporate Investment in China: Evidence From Cross-Country Firm Level Data*. IMF Working Papers 12/80, International Monetary Fund.
- Goldstein, M. & Lardy, N. R. (2009). *The Future of China's Exchange Rate Policy*. Number pa87 in Peterson Institute Press: All Books. Peterson Institute for International Economics.
- Gollin, D. (2002). Getting Income Shares Right. *Journal of Political Economy*, 110(2), 458–474.
- Haltmaier, J. (2013). *Challenges for the Future of Chinese Economic Growth*. International Finance Discussion Papers 1072, Board of Governors of the Federal Reserve System.
- Hoffman, D. & Polk, A. (2014). *The Long Soft Fall in Chinese Growth: Business Realities, Risks and Opportunities*. Research report 1563/14, Conference Board.
- Hsieh, C.-T. & Klenow, P. J. (2009). Misallocation and Manufacturing TFP in China and India. *The Quarterly Journal of Economics*, 124(4), 1403–1448.
- Huang, Y. & Tao, K. (2011). *Causes of and Remedies for the People's Republic of China's External Imbalances: The Role of Factor Market Distortion*. ADBI Working Papers 279, Asian Development Bank Institute.
- Huang, Y. & Wang, B. (2010). Cost distortions and structural imbalances in china. *China & World Economy*, 18(s1), 1–17.

- IMF (2012). *People's Republic of China: Staff Report for the 2012 Article IV Consultation*. Country report 12/195, International Monetary Fund.
- IMF (2014a). *People's Republic of China: 2014 Article IV Consultation – Staff Report*. Country report 14/235, International Monetary Fund.
- IMF (2014b). *World Economic Outlook, October 2014: Legacies, Clouds, Uncertainties*. International Monetary Fund.
- Johansson, A. C. (2012). *Financial Repression and China's Economic Imbalances*. Working Paper Series 2012-22, China Economic Research Center, Stockholm School of Economics.
- Knight, J. & Ding, S. (2010). Why Does China Invest So Much? *Asian Economic Papers*, 9(3), 87–117.
- Kuijs, L. (2009). *China through 2020: a macroeconomic scenario*. Research working paper 9, World Bank China Office.
- Lam, W. R. & Maliszewski, W. (2015). *Giving Credit to China's Slowdown*. IMF Working Papers (forthcoming), International Monetary Fund.
- Lardy, N. R. (2008). *Financial Repression in China*. Policy Brief PB08-8, Peterson Institute for International Economics.
- Lee, I. H., Syed, M. H., & Xueyan, L. (2012). *Is China Over-Investing and Does it Matter?* IMF Working Papers 12/277, International Monetary Fund.
- Lee, I. H., Syed, M. H., & Xueyan, L. (2013). *China's Path to Consumer-Based Growth: Reorienting Investment and Enhancing Efficiency*. IMF Working Papers 13/83, International Monetary Fund.
- Li, H. & Zhou, L.-A. (2005). Political turnover and economic performance: the incentive role of personnel control in China. *Journal of Public Economics*, 89(9-10), 1743–1762.
- Lin, J. Y. (2011). China and the global economy. Remarks at the 20th Anniversary of the Hong Kong University of Science and Technology, March 23.
- Ma, G. & Wang, Y. (2010). China's High Saving Rate: Myth and Reality. *Economie Internationale*, (122), 5–40.
- Maliszewski, W. & Zhang, L. (2015). *China's Growth: Can Goldilocks Outgrow Bears?* IMF Working Papers 15/113, International Monetary Fund.
- Meng, X. (2003). Unemployment, consumption smoothing, and precautionary saving in urban China. *Journal of Comparative Economics*, 31(3), 465–485.
- Modigliani, F. & Cao, S. L. (2004). The Chinese Saving Puzzle and the Life-Cycle Hypothesis. *Journal of Economic Literature*, 42(1), 145–170.
- Nabar, M. (2011). *Targets, Interest Rates, and Household Saving in Urban China*. IMF Working Papers 11/223, International Monetary Fund.
- Nabar, M. & N'Diaye, P. (2013). *Enhancing China's Medium-Term Growth Prospects: The Path to a High-Income Economy*. IMF Working Papers 13/204, International Monetary Fund.
- OECD (2013). *OECD Economic Surveys: China 2013*. Organisation for Economic Cooperation and Development.
- OECD (2015). *OECD Economic Surveys: China 2015*. Organisation for Economic Cooperation and Development.
- Pettis, M. (2014). The impact of reform on growth. Blog post, available at <http://blog.mpettis.com/2014/01/the-impact-of-reform-on-growth>.
- Planas, C. & Rossi, A. (2010). *Program GAP: Technical description and user manual, Version 4.2*. Jrc scientific and technical report, Joint Research Centre of the European Commission.

- Poncet, S. & Starosta de Waldemar, F. (2013). Export Upgrading and Growth: The Prerequisite of Domestic Embeddedness. *World Development*, 51(C), 104–118.
- Pritchett, L. & Summers, L. H. (2014). *Asiaphoria Meets Regression to the Mean*. NBER Working Papers 20573, National Bureau of Economic Research, Inc.
- Psacharopoulos, G. (1994). Returns to investment in education: A global update. *World Development*, 22(9), 1325–1343.
- RGE (2013). *The Myth of a Gradual Rebalancing and Soft Landing for China*. Asia-Pacific report, Roubini Global Economics.
- Rodrik, D. (2008). The real exchange rate and economic growth. *Brookings Papers on Economic Activity*, 39(2 (Fall)), 365–439.
- Shi, H. & Huang, S. (2014). How Much Infrastructure Is Too Much? A New Approach and Evidence from China. *World Development*, 56(C), 272–286.
- Song, M. & Yang, D. T. (2010). *Life cycle earnings and the household saving puzzle in a fast-growing economy*. Mimeo, Chinese University of Hong Kong.
- Song, Z., Storesletten, K., & Zilibotti, F. (2011). Growing Like China. *American Economic Review*, 101(1), 196–233.
- Standard & Poor's (2013). *The Investment Overhang: High For China; Intermediate for Australia, Canada, France And Most BRICS*. Analysis report, Standard & Poor's.
- Taylor, A. M. (2012). *The great leveraging*. BIS Working Papers 398, Bank for International Settlements.
- Tsounta, E. (2014). *Slowdown in Emerging Markets: Sign of a Bumpy Road Ahead?* IMF Working Papers 14/205, International Monetary Fund.
- Walter, C. E. & Howie, F. J. (2011). *Red capitalism: the fragile financial foundation of China's extraordinary rise*. John Wiley & Sons.
- Wei, S.-J. & Wang, T. (1997). The siamese twins: Do state-owned banks favor state-owned enterprises in china? *China Economic Review*, 8(1), 19 – 29.
- Wei, S.-J. & Zhang, X. (2011). The Competitive Saving Motive: Evidence from Rising Sex Ratios and Savings Rates in China. *Journal of Political Economy*, 119(3), 511 – 564.
- Wen, Y. (2009). *Saving and growth under borrowing constraints explaining the "high saving rate" puzzle*. Working Papers 2009-045, Federal Reserve Bank of St. Louis.
- Woo, J.-E. (1991). *Race to the Swift: State and Finance in Korean Industrialization*. New York: Columbia University Press.
- World Bank (2013). *China 2030: Building a Modern, Harmonious, and Creative High-Income Society*. Washington, DC.
- Wu, J., Gyourko, J., & Deng, Y. (2012). Evaluating conditions in major chinese housing markets. *Regional Science and Urban Economics*, 42(3), 531–543.
- Wu, Y. (2009). *China's Capital Stock Series By Region and Sector*. Economics Discussion / Working Papers 09-02, The University of Western Australia, Department of Economics.
- Xiao, G. (2012). Regulating shadow banking. *China Daily*, October 12th.
- Xing, Y. (2006). Why is China so attractive for FDI? The role of exchange rates. *China Economic Review*, 17(2), 198–209.
- Yao, S. & Wei, K. (2007). Economic growth in the presence of FDI: The perspective of newly industrialising economies. *Journal of Comparative Economics*, 35(1), 211 – 234.

- Zhang, J., Xu, L., & Liu, F. (2015). The Future is in the Past: Projecting and Plotting the Potential Rate of Growth and Trajectory of the Structural Change of the Chinese Economy for the Next 20 Years. *China & World Economy*, 23(1), 21–46.
- Zhu, X. (2012). Understanding China's Growth: Past, Present, and Future. *Journal of Economic Perspectives*, 26(4), 103–24.

Appendix

A Data sources

This appendix describes the data sources used to estimate the different components of potential growth. Our data come mainly from Chinese national sources and from international organizations. These historical series are available over the time period 1952-2013 or, for some of them, over a shorter sub-period (this is the case in particular for credit). Assumptions used to make projections over the forecast horizon (2014-2030) are detailed in subsection 3.4.

A.1 Capital stock

Capital stock data are not officially reported by the National Bureau of Statistics of China (NBS). We thus construct our own capital stock series by using the standard Perpetual Inventory Method, with a 6 percent depreciation rate (see subsection 3.2).

The available series for investment (from the NBS) are:

1. *Fixed Asset Investment* (FAI): this series is often used in empirical research, as it starts in 1952 and is available in real terms since 1991. However, FAI includes the value of purchased land and expenditure on existing assets,⁴⁹ which leads to an overestimation of the productive capital stock (land sales have been very dynamic in recent years, in particular in the run-up to the crisis).
2. *Gross Capital Formation* (GCF) and *Gross Fixed Capital Formation* (GFCF): these series present the advantage of being consistent with national accounts concepts. However, the NBS only reports nominal series of GFC and GFCF, while the World Bank provides both real and nominal series for GCF.

We choose to rely on GFCF data for nominal investment, as it is the closest measure to the concept of productive investment. In order to get real investment, we use the implicit deflator for GCF from the World Bank (based on real and nominal series of GCF): we thus assume that price deflators for investment and inventories are identical.

A.2 Credit

In order to correct investment and hence capital stock for "excessive" credit growth (see subsection 3.2), we use credit data from the People's Bank of China (PBoC). Given the recent development of shadow banking (see subsection 2.2), bank credit gives an increasingly incomplete picture of overall debt growth in the Chinese economy; we thus rely on the Total Social Financing measure (excluding equity) published by the PBoC. This measure includes:

1. *Bank credit*: series of outstanding bank credit are available from 1977 (RMB denominated and foreign currency denominated).
2. *Shadow banking / Corporate bond market*: we use series for Entrusted (intercorporate) loans, Trust loans, Banks' acceptance bills, Corporate bonds, Other TSF; since these series are only available as net flows, we compute the corresponding outstanding figures by cumulating the nets flows, starting from zero at end 2001 (and we assume that these items were negligible prior to 2001, which seems plausible since net flows for the first years are very low).⁵⁰

A.3 Labor

We proxy labor input by total employment, comprising both employees and self-employed. Data comes from the Penn World Table 8.0. Indeed hours worked are not available, and the unemployment rate gives

⁴⁹See Bai et al. (2006).

⁵⁰IMF (2014a) makes similar calculations.

an incomplete picture of actual labor resources as it only relates to urban residents (migrant workers are not included). By doing this, we implicitly assume that average hours worked and the structural unemployment rate (NAIRU) are constant over the whole period.

A.4 Human capital

We proxy human capital by the Human capital index from the PWT 8.0 (Penn World Table), which relies on the average years of schooling from the [Barro & Lee \(2013\)](#) database and a rate of return on education based on [Psacharopoulos \(1994\)](#).

A.5 TFP: Sectoral reallocations

The TFP component that is due to sectoral reallocations is calculated using the second and third terms of equation 14. Thus GDP, labor and capital stock need to be decomposed by sector:

1. *Labor*: data on the sectorial labor force are available from the Ministry of Human Resources and Social Security, starting in 1952.
2. *GDP*: nominal GDP data by sector are available from 1952, while indexes of real GDP growth per sector are available from 1978 (both are from the NBS); we use these series to reconstruct GDP series per sector in volume terms.
3. *Capital stock*: since a decomposition of GFCF data per sector is not available, we have to rely on Fixed Asset Investment per sector (available since 1996 from the NBS) for the relative shares of investment in each sector (assuming these shares were constant prior to 1996)⁵¹; we then apply these shares to the total GFCF series calculated above to get sectorial investment series consistent with national accounts. Finally we derive capital stocks per sector through the Perpetual Inventory Method, with the same 6 percent depreciation rate for all sectors.

⁵¹This assumption is rather strong but, since our paper focuses primarily on current and future potential growth in China, approximations on earlier data are less of an issue.

B Figures

B.1 Stylized facts

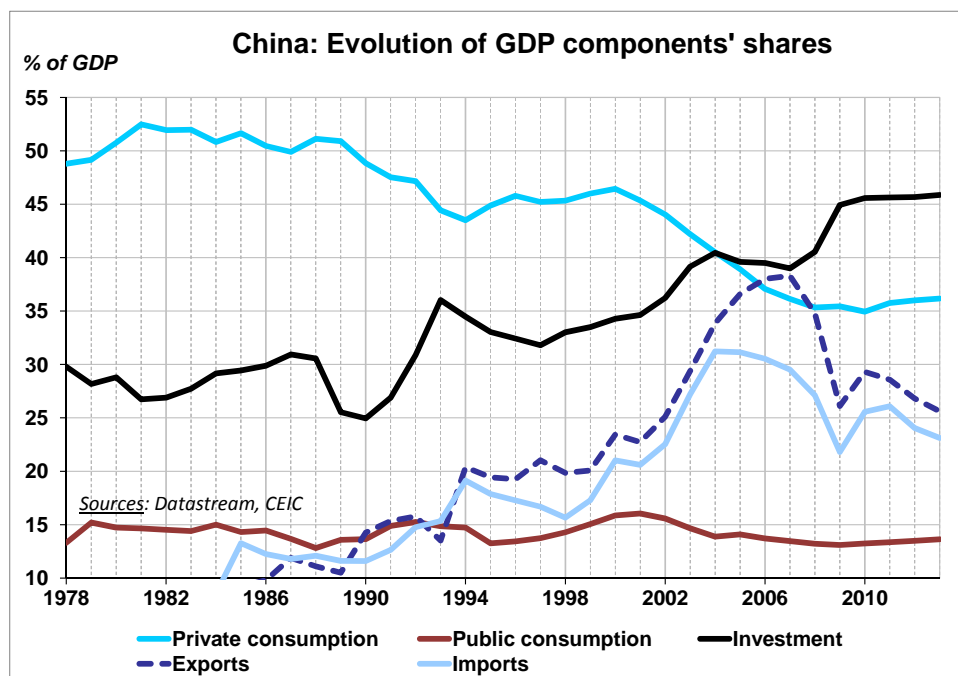


Figure B.1: China's internal imbalances.

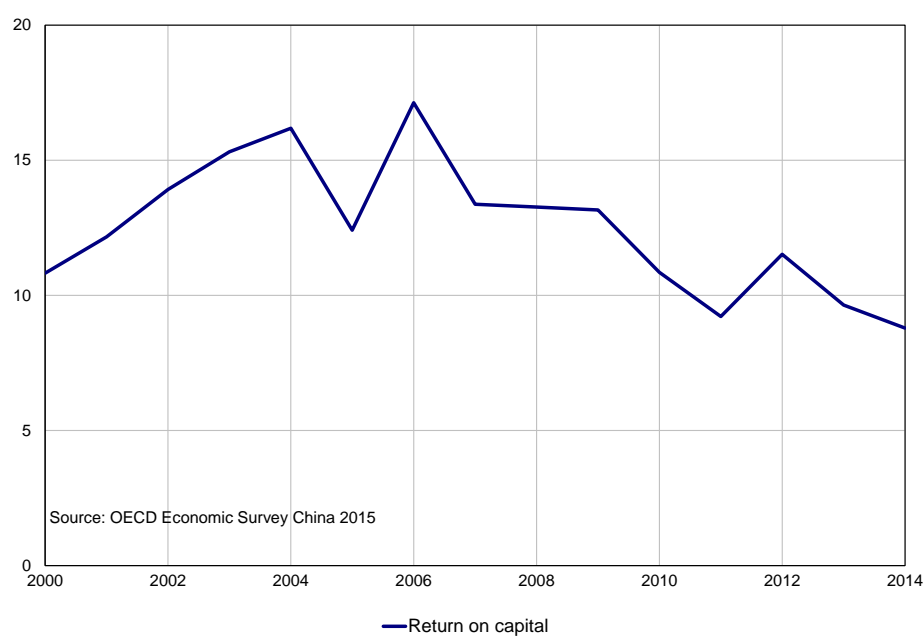


Figure B.2: Return on capital.

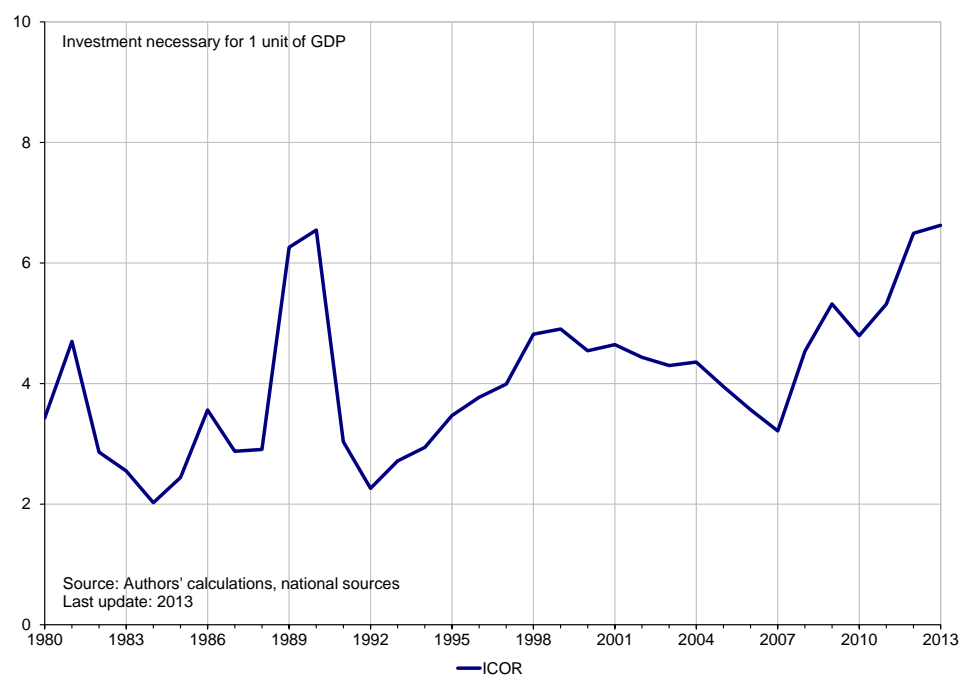


Figure B.3: China's Incremental Capital-Output Ratio.



Figure B.4: Price-to-rent ratios in China's ten largest cities.

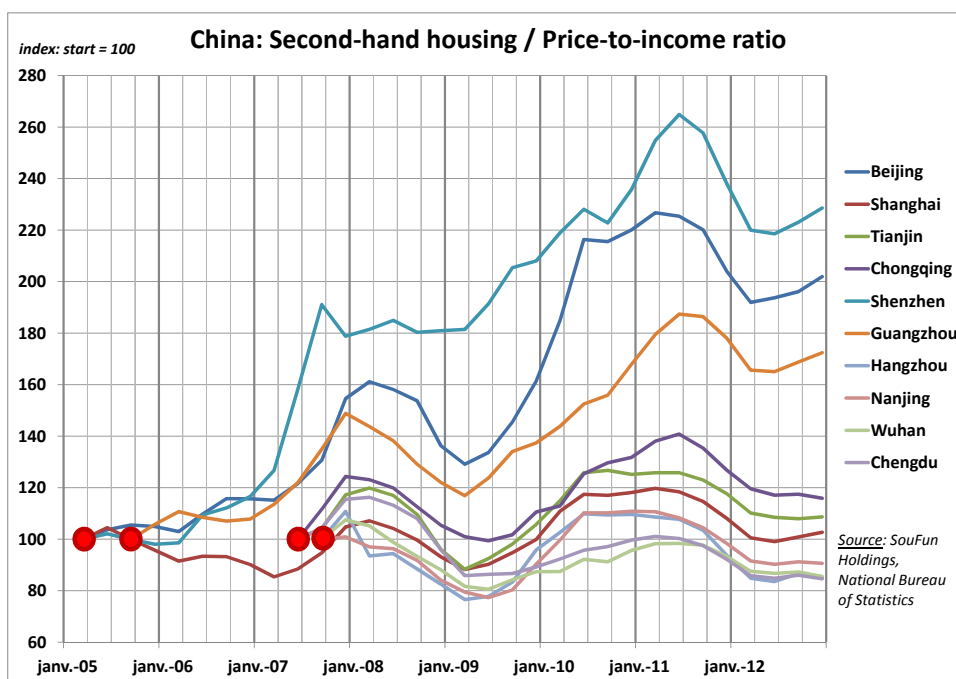


Figure B.5: Price-to-income ratios in China's ten largest cities.

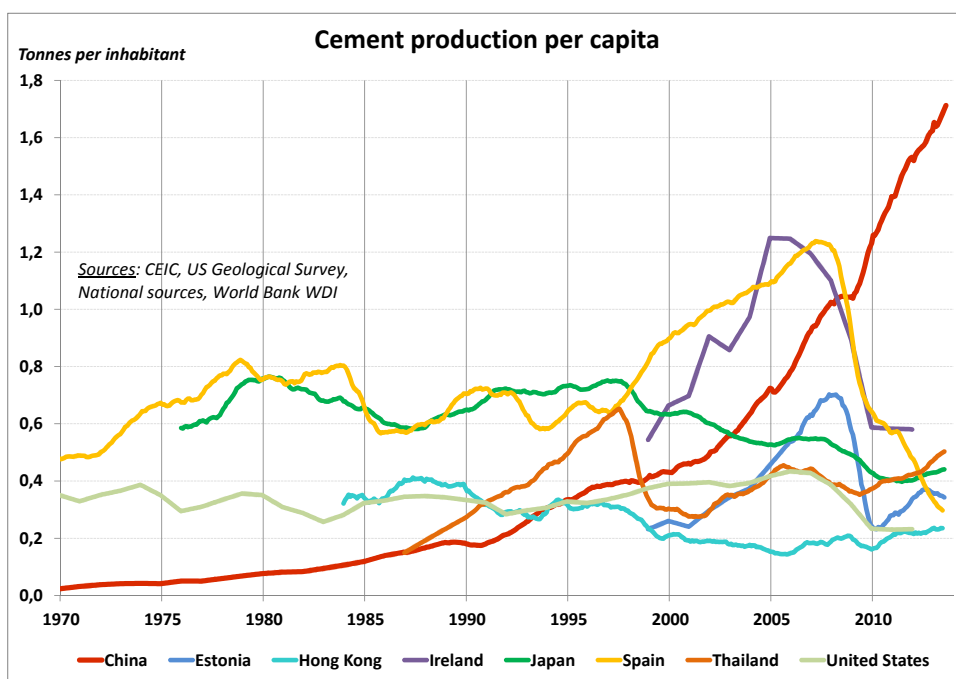


Figure B.6: Cement production in China compared to past real estate bubbles.

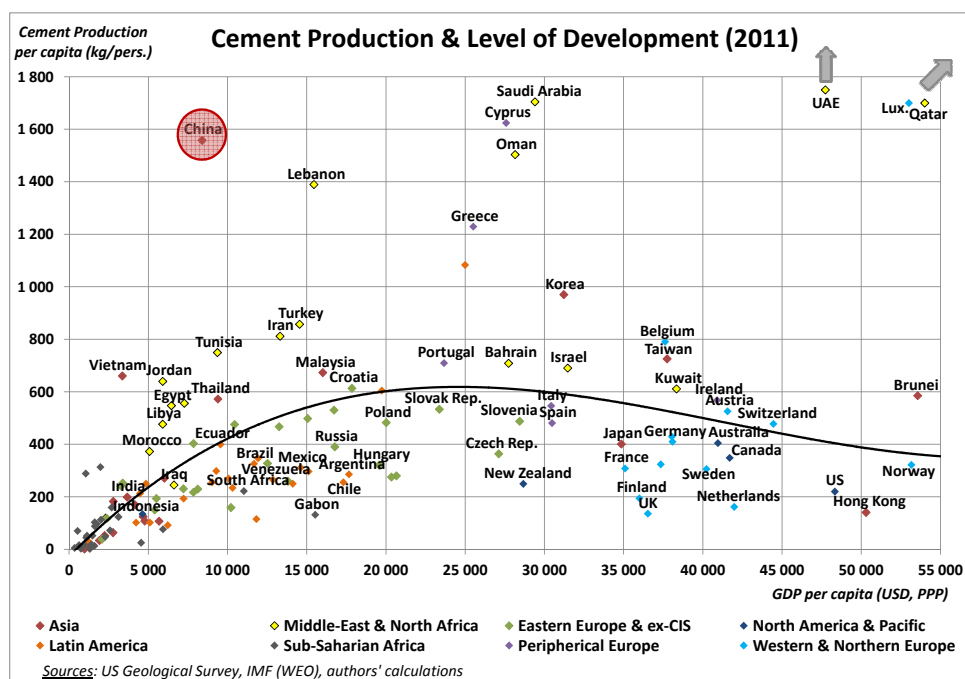


Figure B.7: Cement production and level of development.

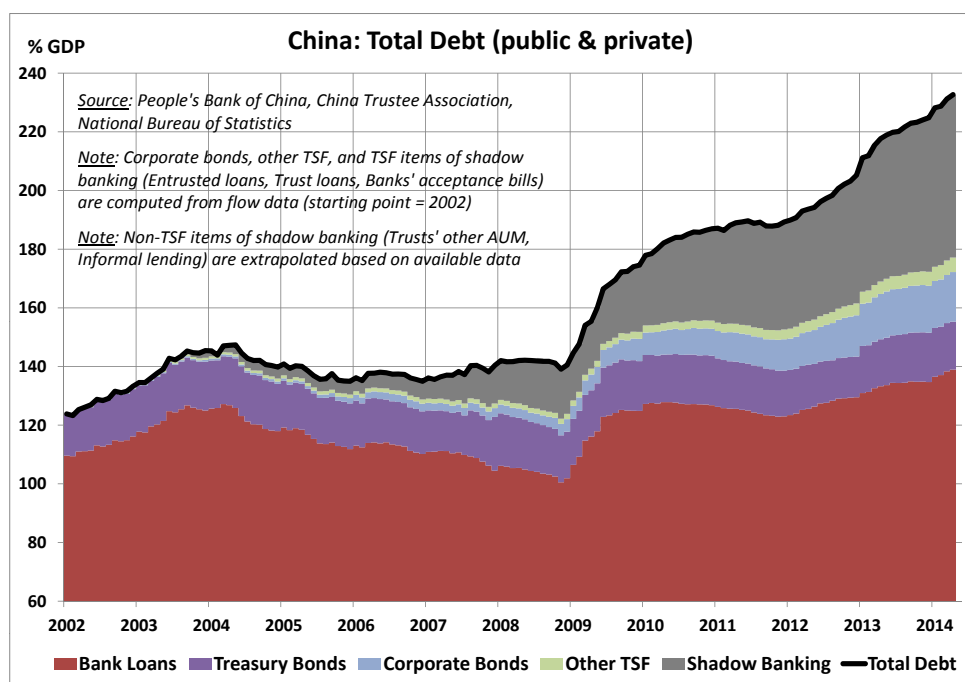


Figure B.8: China's total debt surge.

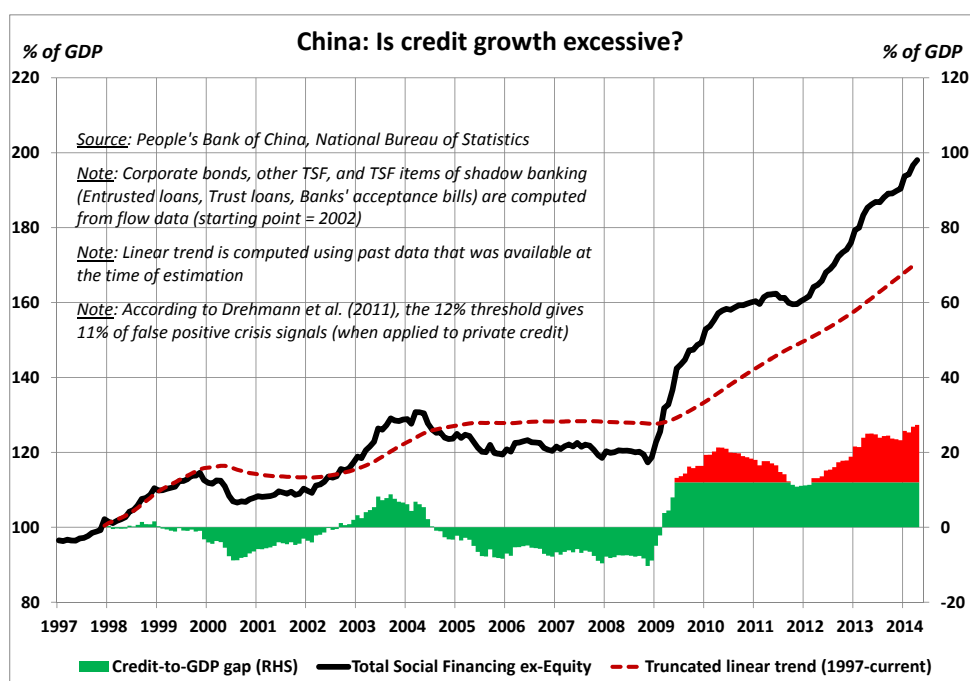


Figure B.9: China's credit-to-GDP gap.

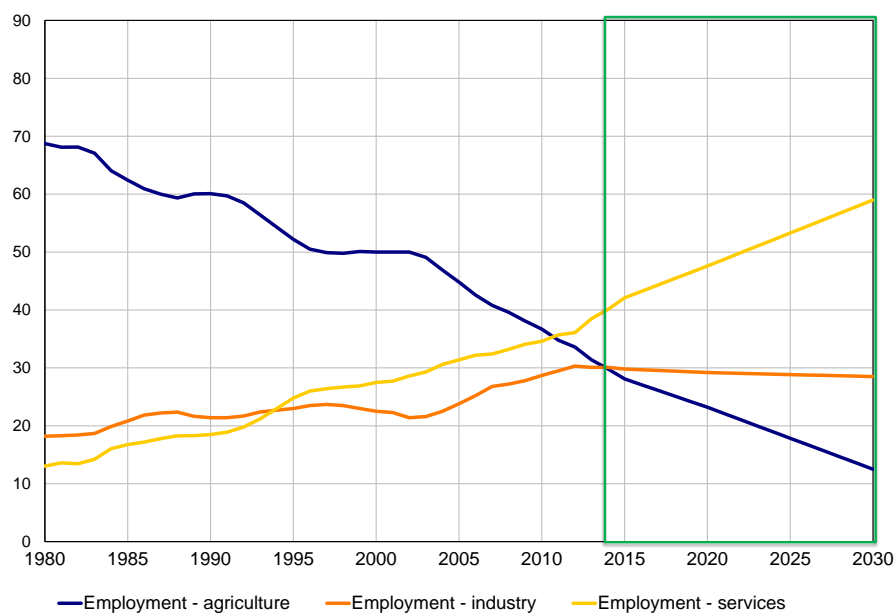


Figure B.10: Projections of employment by sectors (World Bank, 2013).

B.2 Results

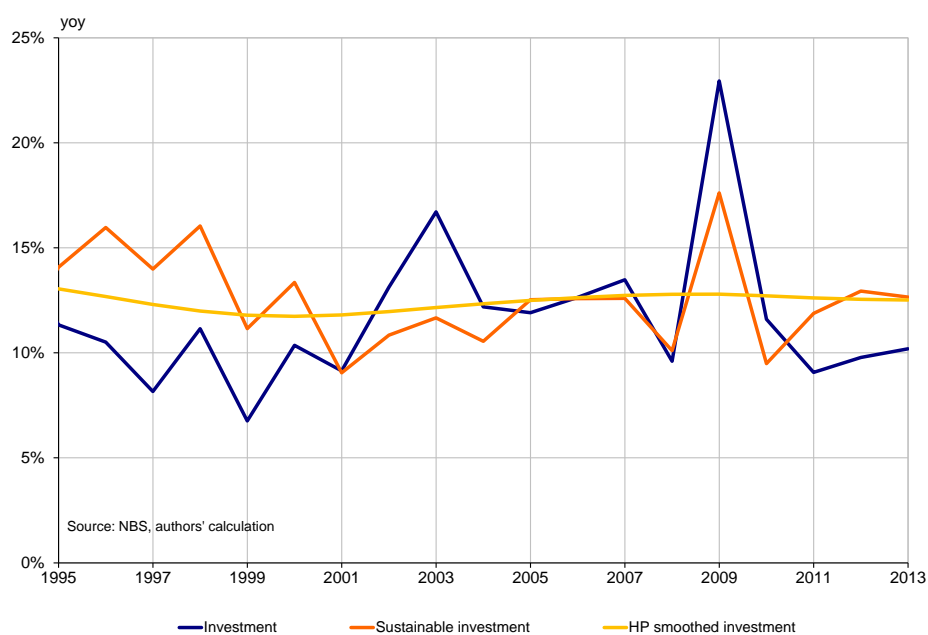


Figure B.11: Correction of investment due to "excessive" credit growth.

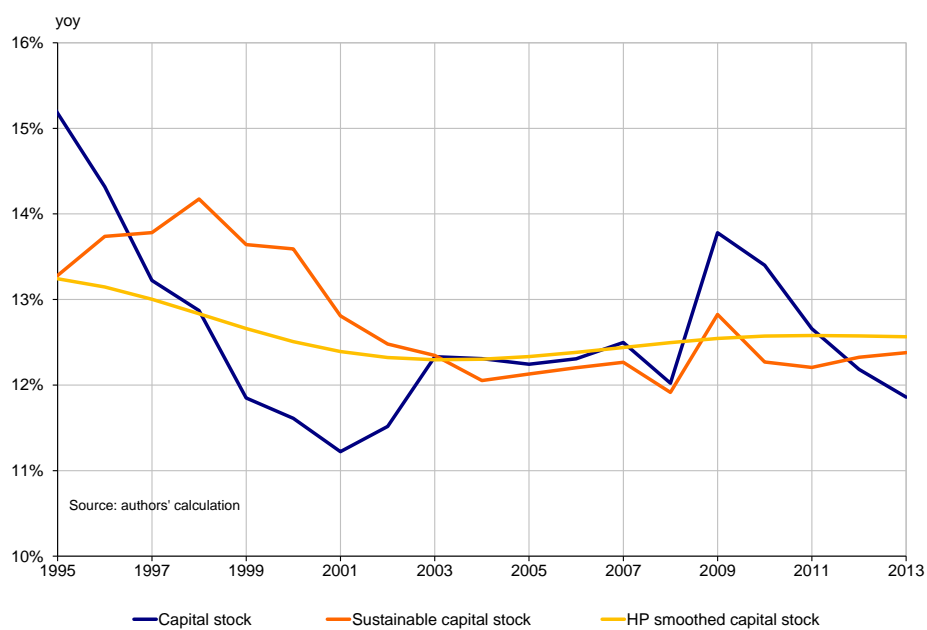


Figure B.12: Correction of capital stock due to "excessive" credit growth.

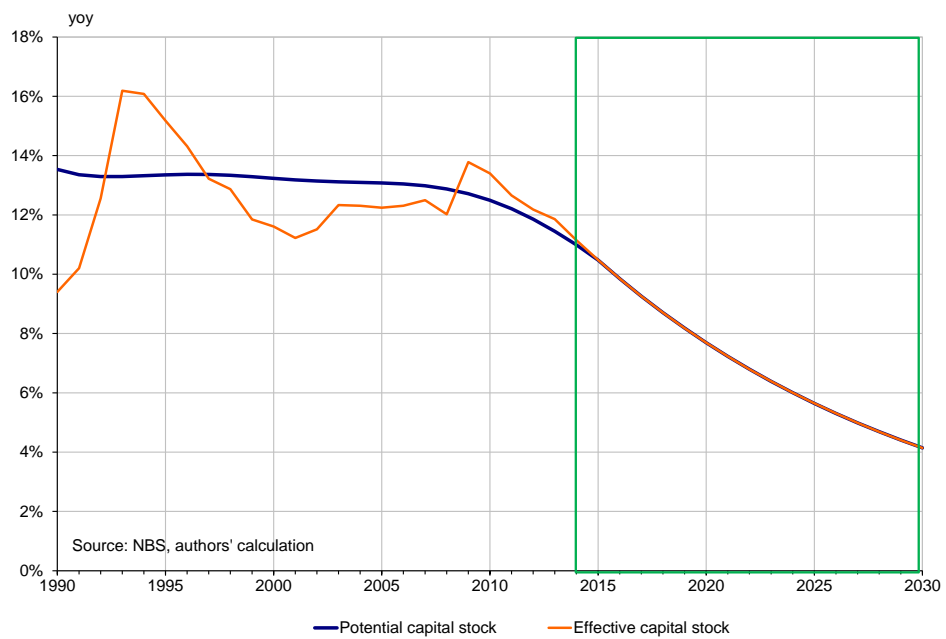


Figure B.13: Effective and potential capital accumulation.

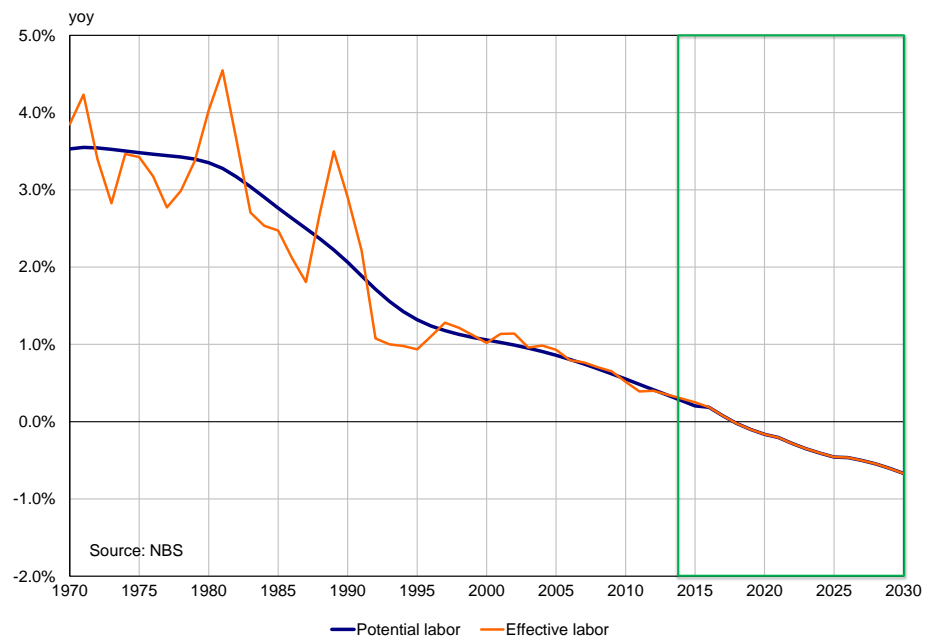


Figure B.14: Effective and potential labor growth.

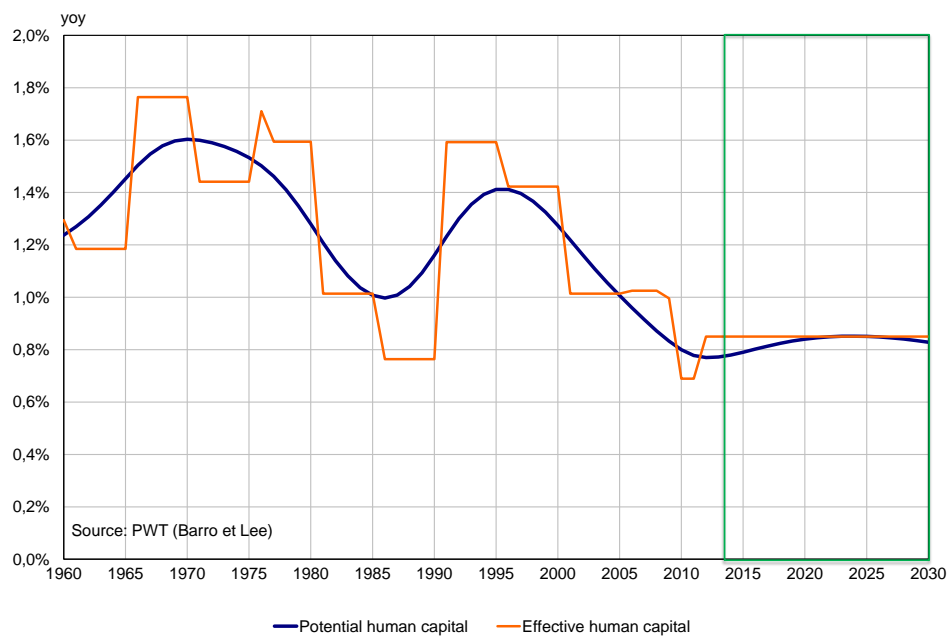


Figure B.15: Effective and potential human capital accumulation.

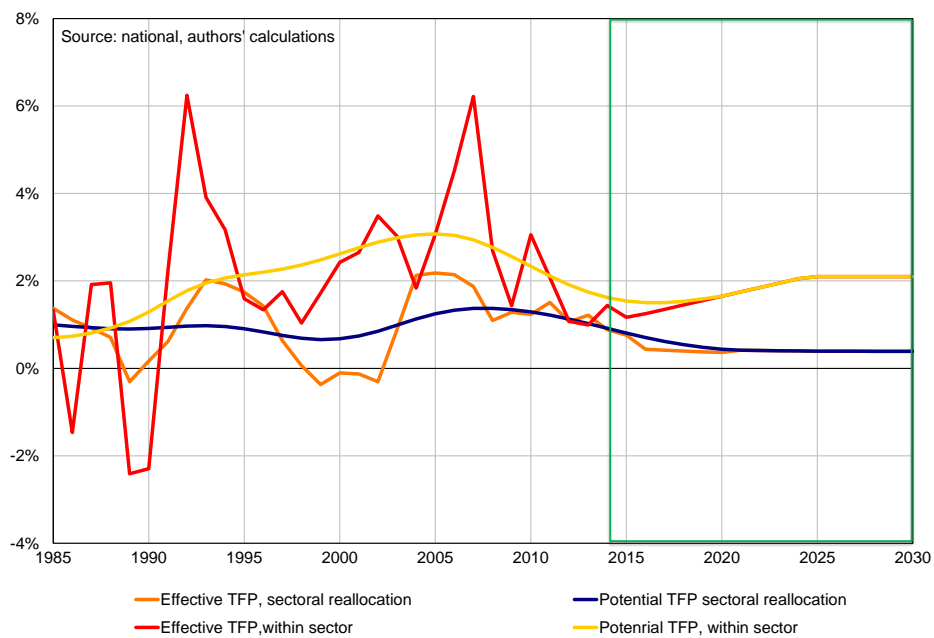


Figure B.16: Effective and potential Total Factor Productivity by subcomponent.

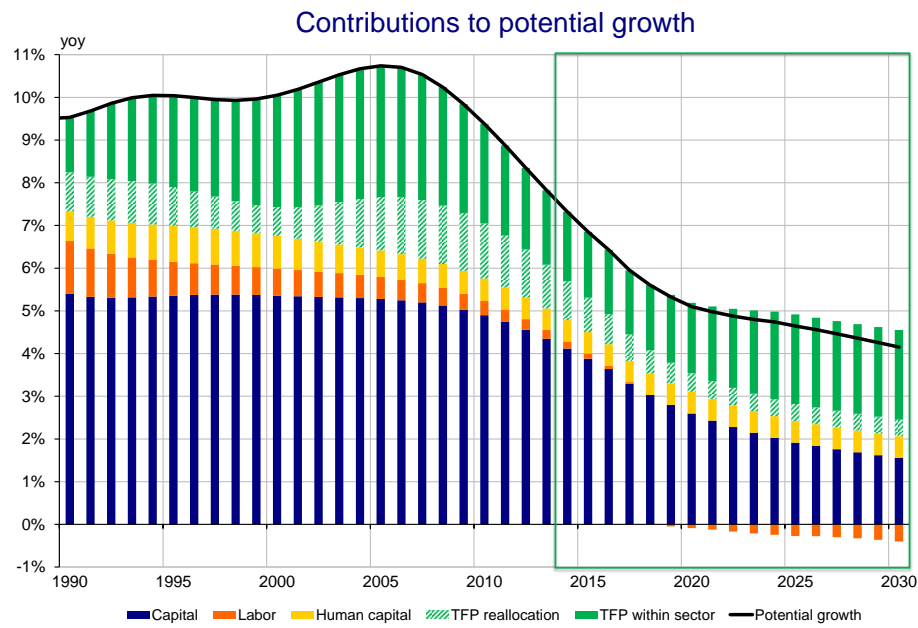


Figure B.17: Potential growth and contributions from production factors.

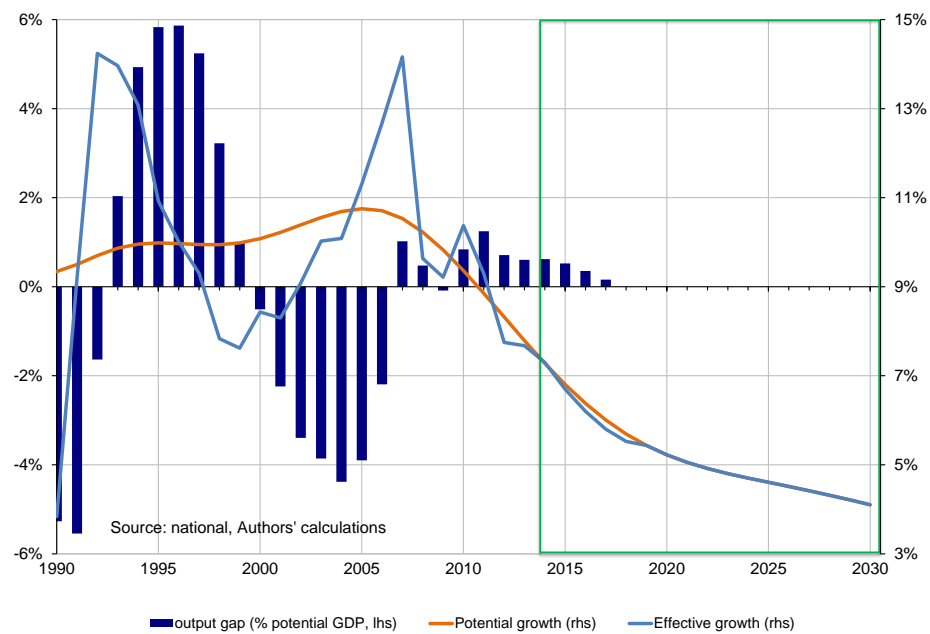


Figure B.18: Output gap.

C Tables

	Coefficient	Standard error	t-stat
Investment equation			
AR1	1.321 ***	0.120	11.040
AR2	-0.763 ***	0.103	-7.382
Trend variance	1.608E-03		
Slope variance	2.557E-15		
Cycle variance	1.147E-03		
Credit equation			
Constant	0.167 ***	0.035	4.804
AR1	0.193	0.154	0.154
beta - lag 0	0.661 ***	0.249	2.652
beta - lag 1	-0.464 ***	0.229	-2.027
Credit cycle variance	4.488E-03		
-2*log-Maximum Likelihood	-177.234		

Table C.1: Maximum likelihood estimations of the state-space model of investment and credit growth.

	Potential Growth	Contributions to potential growth					
		Capital	Labor	Human capital	Total Factor Productivity		
					Total	within-sector	reallocations
1991-2000	9.8	5.4	1.2	0.8	2.5	1.7	0.8
2001-2010	9.9	5.1	0.3	0.6	3.9	2.7	1.2
2011-2013	8.3	4.5	0.2	0.5	3.1	2.0	1.1
2014	7.3	4.1	0.1	0.5	2.5	1.6	0.9
2015	6.8	3.9	0.1	0.5	2.3	1.5	0.8
2016-2020	5.6	3.1	0.0	0.5	2.1	1.5	0.6
2021-2025	4.5	2.2	-0.2	0.5	2.4	2.0	0.4
2026-2030	4.3	1.7	-0.3	0.5	2.5	2.1	0.4
2030	4.1	1.6	-0.3	0.5	2.5	2.1	0.4

Table C.2: Contributions to potential growth and their evolution over time.

	Period	Potential Growth	Contributions to potential growth			
			Capital	Labor	Human capital	TFP
Bailliu et al. (2014)*	1997-2001	8.6	4.0	0.7	0.9	2.9
	2002-2011	11.0	5.0	0.7	0.7	4.6
	2013	8.3	4.6	0.1	0.7	2.9
	2014-2018	7.2	4.2	0.0	0.6	2.5
	2019-2023	5.8	3.5	0.0	0.5	1.9
	2024-2030	4.2	2.7	-0.1	0.6	1.1
ECB (2013)**	2013-2015	8.0	-	-	-	-
	2016-2020	7.0	-	-	-	-
Alberola et al. (2013)	1992-1997	9.8	4.9	0.8	-	4.1
	1998-2002	9.3	4.5	0.7	-	4.1
	2003-2011	9.9	5.3	0.4	-	4.2
	2011	9.9	-	-	-	-
Haltmaier (2013)***	2010	9.9	-	0.4	-	9.5
	2020	8.2	-	-0.2	-	8.4
	2030	5.4	-	-0.4	-	5.8
World Bank (2013)	2011-2015	8.6	-	0.3	-	8.3
	2016-2020	6.9	-	-0.2	-	7.1
	2021-2025	6.0	-	-0.2	-	6.2
	2026-2030	5.1	-	-0.4	-	5.5
Kuijs (2009)	2010-2015	8.4	5.4	0.2	0.5	2.3
	2016-2020	7.0	4.6	-0.5	0.6	2.3

* Capital stock excluding housing investment and corrected for overinvestment.

** Gradual rebalancing scenario.

*** Lower investment scenario.

Table C.3: Comparison of Chinese potential growth estimates in the recent literature.

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