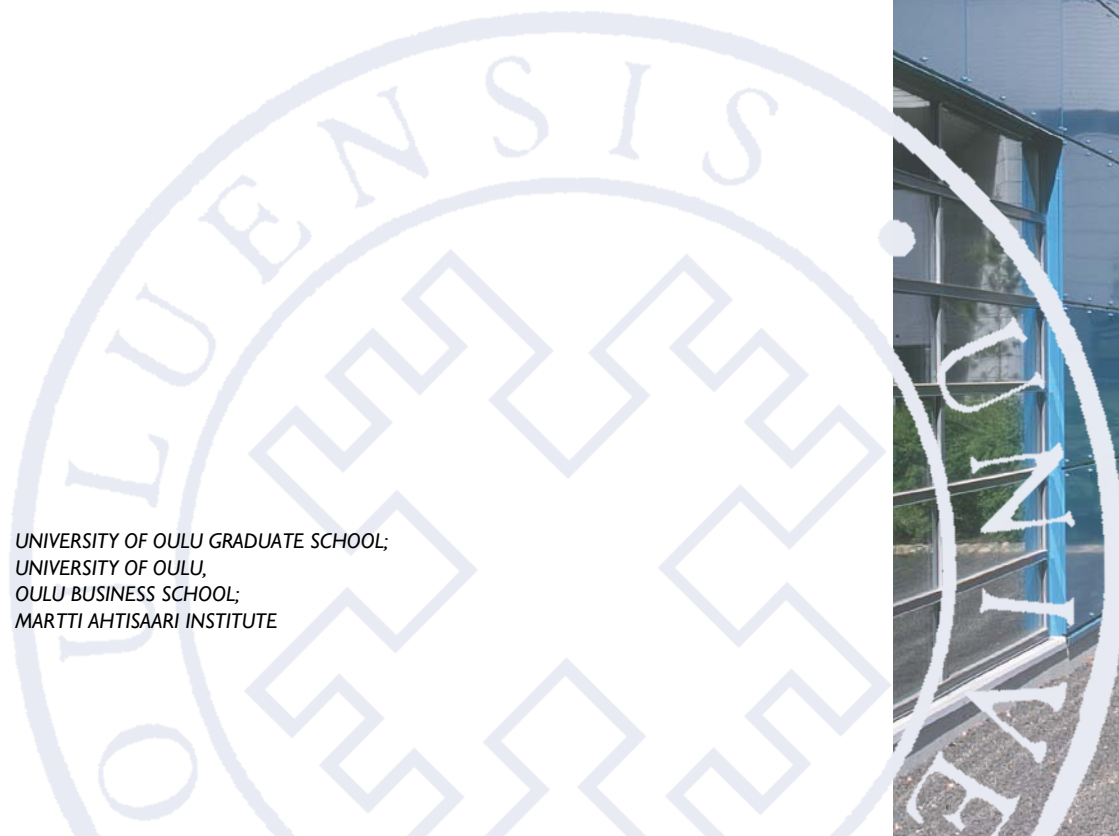


Riikka Nuutilainen

ESSAYS ON MONETARY
POLICY IN CHINA

UNIVERSITY OF OULU GRADUATE SCHOOL;
UNIVERSITY OF OULU,
OULU BUSINESS SCHOOL;
MARTTI AHTISAARI INSTITUTE

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Abstract

China's outstanding growth performance of recent years, the ongoing liberalisation of its capital market, and its deepening integration into the world economy provide ample motivation for a deeper understanding of the country's economic policy-making. This dissertation is an attempt to better understand monetary policy operations and transmission in this rapidly evolving situation. Monetary policy in China is unique compared to any other country in terms of both the available policy instruments and the policy environment. The policy regime is transitioning to a more market-orientated one, and presently the central bank uses a mixture of quantity-based and price-based instruments. These special features are addressed in this dissertation.

The dissertation is comprised of four independent but related essays that empirically evaluate monetary policy implementation and the policy environment in China. The first essay examines the relevance of a quantity-based McCallum-type policy rule in achieving price stability. The findings are that deviations in money supply from the rule help to forecast price developments and thus underline the relation between money supply and prices in China. The second essay considers a wider selection of possible policy rules and examines the monetary policy implementation and instruments used by the central bank. Money supply and interest rate instruments are found to react differently to price and output developments. The interest rate instrument is gaining weight over time, which highlights China's transition to a more market-based policy setting.

The third essay utilises bank-level data to study monetary policy transmission and the existence of the bank lending channel in China. Changes in the reserve requirement ratio are found to affect bank lending in China in a similar manner as changes in interest rates. Different types of banks (by ownership) react differently to these changes, but no robust evidence of a bank lending channel is found. The fourth essay compares the economic dynamics in a DSGE modelling framework under the assumption that China can successfully rebalance its economy and achieve a lower savings rate and higher level of domestic consumption. The rebalancing does not notably affect the transmission of monetary policy shocks, but it does render the economy more resilient to technology shocks.

Keywords: bank lending channel, China, Chinese banks, monetary policy, monetary policy rules, monetary policy transmission, rebalancing

Nuutilainen, Riikka, Esseitä Kiinan rahapolitiikasta.

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Tiivistelmä

Kiinan nopea talouskasvu, pääomamarkkinoiden avaaminen ja maan tiiviimpi kytkeytyminen maailmantalouteen ovat johtaneet siihen, että Kiinan talouspolitiikan ymmärtäminen on aiempaa tärkeämpää. Tämän väitöskirjan tavoitteena on perehtyä Kiinan rahapolitiikkatoimiin ja politiikan välittymiseen nopeasti muuttuvassa ympäristössä. Rahapolitiikka Kiinassa eroaa muiden maiden rahapolitiikasta niin käytössä olevien instrumenttien kuin politiikkaympäristönkin kannalta. Kiina on siirtymävaiheessa kohti markkinaperusteisempaa rahapolitiikkaa, ja tällä hetkellä maan keskuspankki käyttää sekä hinta- että määräperusteisia instrumentteja. Näitä erityispiirteitä tarkastellaan tähän väitöskirjaan sisältyvissä tutkimuksissa.

Väitöskirja koostuu neljästä yksittäisestä mutta toisiinsa liittyvästä esseestä, joissa tarkastellaan empiirisesti rahapolitiikan toteutusta sekä politiikkaympäristöä Kiinassa. Ensimmäisessä esseessä käsitellään määräperusteisen McCallum-rahapolitiikkasäännön käyttökelpoisuutta hintavakaustavoitteen saavuttamisessa. Havaitut poikkeamat säännön suosittelemasta rahamäärän kasvusta parantavat inflaatioennusteita, mikä korostaa rahan tarjonnan ja hintakehityksen välistä suhdetta. Toisessa esseessä hyödynnetään useampia mahdollisia rahapolitiikkasääntöjä ja tarkastellaan rahapolitiikan toteutusta ja keskuspankin käyttämiä politiikkainstrumentteja. Rahan tarjonnan ja korkoinstrumentin havaitaan reagoivan eri tavoin hintakehitykseen ja tuotannon kasvuun. Korkoinstrumentin painoarvo kasvaa ajan kuluessa, mikä osoittaa Kiinan olevan siirtymässä kohti markkinaperusteisempaa politiikkaa.

Kolmannessa esseessä hyödynnetään pankkikohtaista aineistoa ja tarkastellaan rahapolitiikan välittymistä ja pankkilainakanavan olemassaoloa. Keskuspankin varantovaatimusmuutosten havaitaan vaikuttavan pankkien lainanantoon samalla tavoin korkomuutosten kanssa. Omistustyypin mukaan jaoteltuna erilaiset pankit reagoivat eri tavoin rahapolitiikan muutoksiin. Tutkimuksessa ei kuitenkaan löydy vankkaa tukea pankkilainakanavan olemassaololle. Neljännessä esseessä tarkastellaan talouden dynamiikkaa DSGE-mallikehikossa olettaen, että Kiina onnistuu tasapainottamaan talouttaan niin, että säästämisaste laskee ja kotimaisen kulutuksen osuus taloudessa kasvaa. Tasapainottaminen ei merkittävästi vaikuta rahapolitiikkasokkien välittymiseen, mutta tekee taloudesta vähemmän herkän teknologiasokeille.

Asiasanat: Kiina, Kiinan pankkisektori, pankkilainakanava, rahapolitiikan välittyminen, rahapolitiikka, rahapolitiikkasäännöt, talouden tasapainottaminen

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I wish to express my sincere gratitude to my official examiners, Professor Yin-Wong Cheung and Professor Kari Heimonen, for carefully reviewing my doctoral dissertation and for their valuable comments and suggestions. I am most grateful to the excellent co-authors, Zuzana Fungáčová, Tuuli Koivu, Aaron Mehrotra, Jenni Pääkkönen and Laurent Weill, with whom I have had the privilege of working with. I have learned so much in the process of each paper. I would also like to thank all the people at BOFIT for providing endless inspiration, knowledge and support, as well as for the flexibility allowing me to finalise this dissertation.

On a final note, I want to thank all my family and friends for always being there for me.

Helsinki, April 2016

Riikka Nuutilainen

List of original articles

This dissertation is based on the introductory chapter and the following four essays:

- I Koivu T., Mehrotra A. & Nuutilainen R. (2009) An analysis of Chinese money and prices using a McCallum-type rule. *Journal of Chinese Economic and Business Studies* 7(2): 219–235.
- II Nuutilainen R. (2015) Contemporary monetary policy in China: An empirical assessment. *Pacific Economic Review* 20(3): 461–486.
- III Fungáčová Z., Nuutilainen R. & Weill L. (2015) Reserve requirements and the bank lending channel in China. BOFIT Discussion Paper 26/2015, Bank of Finland.
- IV Mehrotra A., Nuutilainen R. & Pääkkönen J. (2013) Changing economic structures and impacts of shocks: Evidence from a dynamic stochastic general equilibrium model for China. *Pacific Economic Review* 18: 92–107.

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1 Introduction

1.1 Background

In the twenty years covered by the analyses of this thesis China has grown enormously and has substantially increased its influence on the global economy. In the period from 1995 to 2014, China's average economic growth has been 10% per annum. In 1994 China accounted for 2% of world gross domestic product (GDP), and by 2014 the share had risen to over 13%. In the same period, China has risen to become the second largest country in the world in US dollar terms. Taking into account the price level differences between countries, in 2014 China became the world's largest economy in purchasing power parity (PPP) rates (IMF WEO).

This thesis aims to explain China's monetary policy in this period of favourable economic growth and to study changes in monetary policy implementation that have occurred over time. The time period covered also marks the period of accelerating market-based economic reforms that began in 1978. The Asian financial crisis of 1997 fundamentally impacted the economies and financial markets in East Asia. At the time, a largely closed capital account, non-convertible currency, underdeveloped financial markets and extensive policy support helped China to get through the crisis with little damage compared to the other countries in the region. After the Asian financial crisis, the pace of market-based reforms increased in China. For example, a more market-based monetary policy was adopted and the direct credit plans abandoned, the financial markets were reformed, the hard exchange rate peg was loosened, a more market-based interest rate setting was adopted, and foreign investment possibilities were expanded.

The exchange rate regime in China has also evolved over the same period. The Chinese yuan – or renminbi (RMB) – was tightly pegged to the US dollar from 1994 until 2005, at rates that were considered by many to be at odds with market fundamentals. China was accused of deliberate currency undervaluation designed to promote its export industries. Indeed, China's export performance during the time was beyond comparison. From 1994 to 2005, China recorded an 18% average annual export growth rate, and in 2009 it became the largest exporter in the world. China has repeatedly posted constant current account surpluses during the same period as well as steady additions to its foreign exchange reserves. Since 2005, the RMB has been allowed to gradually appreciate and greater volatility of the exchange rate has been permitted. From 2005 to 2014, the RMB appreciated 25%

against the dollar, and the debate on yuan undervaluation has largely faded. Recently, the International Monetary Fund (IMF), has also reassessed the situation and determined that the RMB is no longer undervalued.

Despite these developments, the transparency of monetary policy implementation in China is weak, and the roles of the different instruments utilised by the central bank remain unclear to outside policy observers. Therefore, we find that the general understanding of China's monetary policy is inadequate and that this results in wide speculation as to China's policy actions and objectives. Furthermore, the market environment in China remains profoundly different from that in advanced economies. This renders the analysis of China important in itself, as the models developed for advanced economies cannot be directly applied to China without taking into account the special characteristics of the economy. Given China's growth and opening up of the economy, a better understanding of monetary policy in China is important also in a global perspective, as China's policy decisions will affect also the rest of the world via trade and investment and increasingly via price linkages.

1.2 Aim of the thesis

The aim of the thesis is to study China's monetary policy in an evolving policy environment. China differs from the advanced economies in terms of both policy environment and use of policy instruments. The monetary policy goals are also harder to distinguish from other policy aims, as the central bank in China operates under government control. The essays of the thesis are an attempt to shed light on the opaque policy-making practises of the monetary authority and the chosen set of policy instruments. A further aim is to examine policy transmission in China, via the different instruments.

The main analysis is reported in the four essays of the thesis. The following three sections provide background that includes China's policy framework and the theoretical literature applied in the empirical analysis of this thesis. The following section describes the monetary policy environment in China. Section 3 discusses the monetary policy rules literature and section 4 the literature on monetary policy transmission. Section 5 provides brief summaries of the four essays.

2 Chinese monetary policy environment

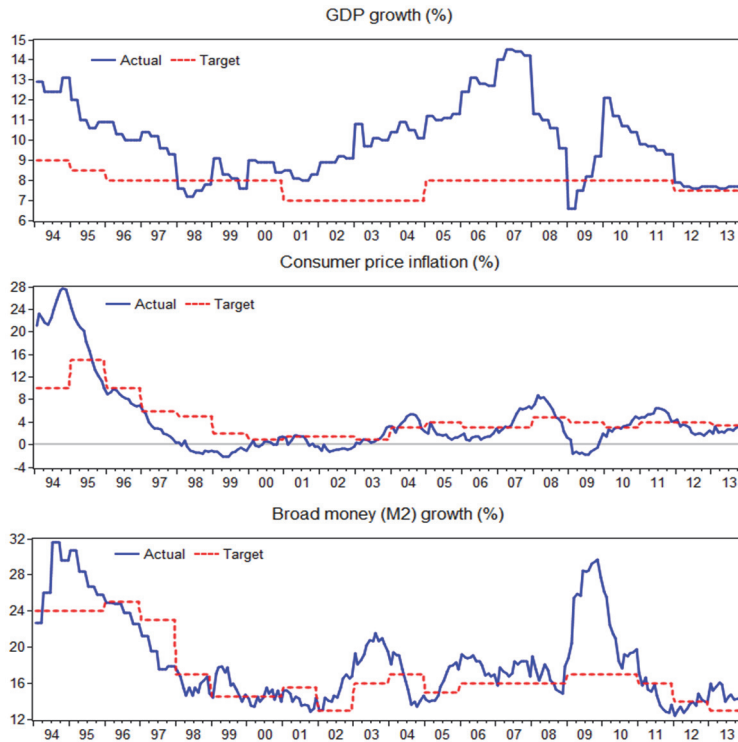
2.1 Characteristics of monetary policy in China

People's Bank of China

The People's Bank of China (PBC) was established in 1948. During 1950–1978 the PBC was the only bank in China performing the functions of a central bank as well as those of commercial banks (Libanio 2015). In 1984, the PBC began to operate exclusively as a central bank. Commercial banking activities were separated from the PBC and delegated to four state-owned commercial banks established for this purpose. The Law of the People's Republic of China on the People's Bank of China (PBC 2003), adopted in 1995, states that the PBC shall "formulate and implement monetary policy, prevent and mitigate financial risks, and maintain financial stability". According to the law, the PBC operates under the leadership of the State Council and so is not fully independent in making monetary policy decisions for China. The PBC is accountable to the State Council as to its money supply, interest rate and exchange rate decisions in that most policy changes have to be validated by the State Council before execution.

The final target of PBC policy is to "maintain the stability of the value of the currency and thereby promote economic growth" (PBC 2003). The latter objective can be seen as having two dimensions: domestic price stability and external currency stability (Leung & Lu 2011). At the end of each year the National Development and Reform Commission sets targets for economic performance in the coming year, specifically for annual GDP growth, annual consumer price (CPI) inflation and annual broad money (M2) growth (Fig. 1). The PBC's main task is to implement monetary policy in line with these targets. In addition to trying to hit these targets, the PBC has been active in carrying out monetary policy interventions to control the renminbi exchange rate.

The growth rates of monetary aggregates and total bank lending have served as nominal anchors for PBC policy. Since the abandonment of direct credit plans in 1998, broad money growth has been the most prominent intermediate policy target. The growth rate of base money is used as the operational target to achieve the preannounced broad money growth target as well as the other final targets set for price stability and economic growth.



Source: National People's Congress of the People's Republic of China, National Bureau of Statistics & People's Bank of China

Fig. 1. Outcomes for economic indicators compared to target values.

Main policy tools

From 1978 until the policy reform of 1998, PBC monetary policy was implemented through credit plans. The PBC set specific lending ceilings and provided the liquidity for individual financial institutions, which then provided funding for the government-favoured sectors. This policy impeded the effective allocation of credit. The policy also suffered from an inherent expansionary bias, as borrowers routinely overstated their financing needs (Leung & Lu 2011). The system was abandoned as the banking sector became more competitive and money market transactions were initiated. Since the reform, the implementation of monetary policy has formally shifted from direct credit controls to the use of indirect policy instruments.

The set of PBC policy instruments includes price-based tools, like central bank interest rate and open market operations, but as importantly also quantity-based tools, such as the reserve requirement ratio, window guidance and other administrative measures. In addition to the price and quantity based instruments, the exchange rate controls have been an important policy tool of the PBC. The main policy instruments of the PBC are discussed individually in the following subsections.

Required reserve ratio

The required reserve ratio (RRR) serves as an important instrument in China's monetary policy implementation. The RRR has gradually evolved into a monetary policy instrument. From its establishment in 1984 up until 2006, the RRR was adjusted only eleven times (Ma et al. 2013). Starting in 2007, the reserve requirement has evolved into an actively used policy tool (Fig. 2). In contrast to most other economies, RRRs are more frequently altered in China than are the policy interest rates.¹ Typically, the RRR is changed in conjunction with other policy actions, so as to reinforce the intended tightening/easing impact. The attractiveness of the RRR instrument is, according to Ma et al. (2013), explained by the fact that the PBC enjoys greater discretion in changing the ratio than in altering policy rates.

The RRR is the most important instrument for draining excess liquidity resulting from the large-scale foreign exchange sterilisations. In the absence of a fully-functioning price-based policy mechanism, manipulation of the RRR is preferred to open market operations and direct sales of bonds. The PBC claims that, for the purpose of withdrawing excess liquidity from the market, a hike in the RRR is a relatively light policy measure compared e.g. to the issuance of central bank bills. The latter would require high interest rates and hence would be more costly to commercial banks and so would have a more dramatic impact on the economy (Wu 2004).

China's reserve requirements are among the highest in the world relative to both GDP and the monetary-authority's balance sheet (Ma et al. 2013). The PBC argues that only after reserve requirements have reached a sufficient high level is an upward adjustment in RRR effective in draining all the excess liquidity from the

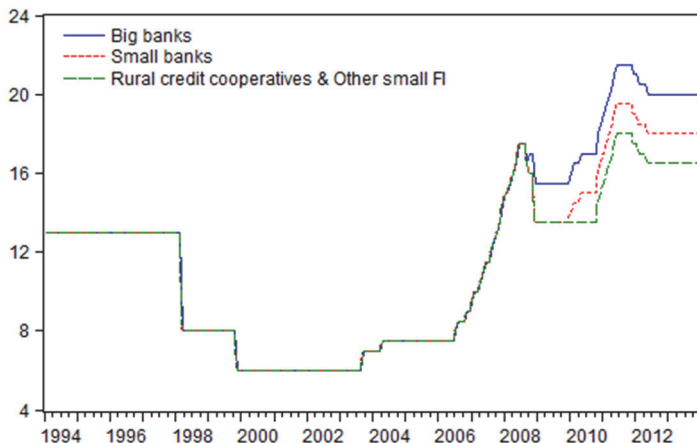
¹ For example, in 2010–2011 the RRRs were altered fourteen times, whereas the central bank benchmark rates were changed on just five occasions.

banking sector and in curbing credit expansion; at a relatively low level an increase in RRR serves only as a signalling device (PBC Annual report 2011).

All deposit-taking institutions are required to hold central bank reserves, but the required ratio is not the same for all institutions. In 2008 PBC adopted a required reserve system in which the RRR for the seven largest commercial banks is different from that for the smaller banks as well as from the rural credit cooperatives and other small financial institutions (Fig. 2).² The RRR system was revamped in 2004 so that banks with low capital adequacy ratios or poor asset quality had higher reserve ratios. The differentiated RRR scheme was used to control the risk-adjusted lending of financial institutions in the absence of a deposit insurance system and because of the poor capital adequacy ratios of financial institutions (Wu 2004). A dynamic differentiation-among-banks scheme was adopted in 2011 in which the RRR for an individual bank is related to its systemic importance and relative loan growth on a dynamic basis (Ma et al. 2013).

The PBC pays interest on both required and excess reserves (see Fig. 3). An increase in the required reserve ratio will reduce a bank's lending capacity only if the bank is not holding excess reserves. On the other hand, a reduction in the reserve requirement will boost bank lending only if the risk-adjusted return on lending is higher than the interest paid on excess reserves. The interest on excess reserves was drastically lowered in the beginning of 2004 to encourage interbank lending. Historically the banks have had abundant excess reserves, which has reduced the effectiveness of the RRR policy in China (see Nguyen & Boateng 2013). From the peak years in the 1990s, the excess reserves have declined considerably (Geiger 2008). Ljungwall et al. (2013) argue that the RRR in China remains a powerful policy tool because the majority of financing in China is still traditional deposit loans, and the deposit rates are depressed so that commercial banking business remains profitable with RRRs above 15%. Essay III studies the bank lending channel in China using the required reserve ratio as the policy instrument.

² Foreign currency deposits are subject to much lower reserve requirements than are domestic currency deposits. The foreign currency reserves held at the central bank, however, do not earn interest. (Ma et al. 2013.)



Source: People's Bank of China

Fig. 2. Required reserve ratios (%).

Central bank interest rates

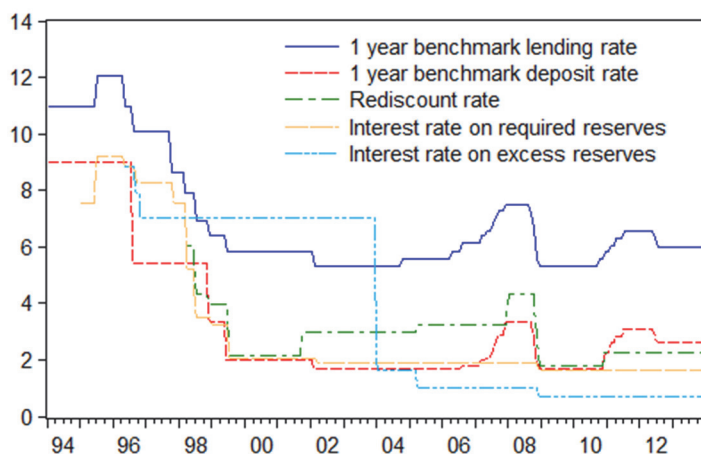
The PBC sets a series of benchmark interest rates, including interest rates on required and excess reserves, the rediscount rate, and the benchmark deposit and lending rates for commercial bank lending at different maturities.³ Fig. 3 displays the one-year benchmark lending and deposit rates. Benchmark rates for other maturities are usually changed correspondingly with the one-year rates. The PBC benchmark rates set the boundaries within which the commercial banks can set interest rates for their customers (see section 2.2).

The rediscount rate has served as the benchmark for central bank lending since 2004. Before the interest rate reform of 1998 the rediscount rate was subject to a floating range 5–10% below the PBC lending rate (Geiger 2008). Since the reform, the rediscount rate has been set in conjunction with the other PBC policy rates.

Changes in the PBC benchmark interest rate require the State Council's approval, which is considered a hindrance to the timely use of interest rates as policy instruments. Since 2004 the PBC has been allowed some discretion to add a surcharge onto the central bank lending rate (PBC 2005d).

³ The PBC quotes the following benchmark interest rates on deposits and loans of financial institutions: *i*) the interest rates on deposits (includes demand deposits and time deposits of maturities from 3 months to 5 years) and *ii*) the interest rates on loans (maturities from 6 months to over 5 years).

The interest rate liberalisation has proceeded gradually, which has affected the interest rate instrument's impact on the real economy. The interest rate liberalisation is discussed in section 2.2. For example, Koivu (2009) and Laurens and Maino (2007) argue that the role of the interest rate as a central bank monetary policy tool has been modest, and that the impact of the interest rate on the real economy was minor from the mid-1990s to 2008. The findings in Essay III suggest that since mid-2008 the policy interest rate has become more responsive to economic variables, especially to changes in real output.



Source: People's Bank of China

Fig. 3. Selected PBC benchmark interest rates (%).

Open market operations

Credit plans were officially abandoned and open market operations (OMOs) established in the 1998 policy reform.⁴ Open market operations in China include repurchase transactions, outright monetary transactions, and the issuance of central bank bills.

The PBC uses central bank bills of various maturities to conduct the OMOs. Supported by the RRR, the PBC bills are an important tool for draining excess liquidity from interbank market resulting, for example, from foreign currency

⁴ OMOs were initially introduced already in 1993 but were suspended in 1997 because of the very low volume of transactions (Geiger 2008).

purchases. The interbank markets for PBC bills has grown rapidly since the start of issuance in 2003.

The outright monetary transactions included trading in bonds, which was later replaced by repurchase transactions (repos) (Laurens & Maino 2007). The repo transactions were initiated in 2002 to cope with increasing foreign exchange inflows and were first carried out with treasury bonds. The PBC soon ran out of t-bonds and began to issue central bank bills. All outstanding repurchase agreements were converted into PBC bills in 2003. (Leung & Lu 2011). Nowadays the repo transactions are carried out with PBC bills.

Before the development of interbank markets in China, central bank re-lending was also considered an important policy instrument. The re-lending provided the majority of short-term financing for banks. The share of re-lending to banks in PBC's total assets has dropped from 43% to just 4% between 1999 and 2008, and re-lending is no longer viewed as an active monetary policy tool by the PBC (Leung & Lu 2011).

Window guidance

Window guidance is an administrative tool of moral suasion, where the PBC advises banks directly on the quantity and structure of their lending. The window guidance system was introduced in 1998, when the PBC abandoned its direct credit control regime. The function of window guidance is to allow specified credit supplies to flow to politically preferred sectors or regions. The PBC holds regular meetings with commercial bank representatives to discuss credit targeting.

Window guidance enables differentiated lending treatment for different sectors, and according to PBC (Annual report 2007), the policy is effective in “optimising the credit structure, exercising control over loans, restricting lending to the low-quality enterprises in sectors with excess capacity and enhancing credit support to socially preferable sectors”. The window guidance policy provides a powerful tool for directing bank lending to certain sectoral or geographic areas.

In recent years, the PBC's window guidance has been aimed at providing financial support to agriculture and rural areas, small-businesses, environmental protection, regional development, encouraging scientific and technological innovation, tourism, cultural industries, employment, and the alleviation of poverty, among other things (PBC Annual reports, various issues). Despite its pursuance of market-based-policy reform, the PBC has strengthened its window guidance in recent years.

The PBC window guidance advice is not legally binding. The governor of the PBC, however, is a higher-ranking official in the Communist Party than the leaders of the state-owned banks, which according to Geiger (2008) and Leung and Lu (2011), makes the bank officials likely to follow the guidance.

Exchange rate policy

A prominent feature of the Chinese monetary policy has been the exchange rate controls and the US dollar peg. The exchange rate reform has proceeded gradually. It was launched in 1994 with the unification of the then coexisting RMB official exchange rate and the swap market exchange rate into a single ‘managed floating exchange rate’. In practice, the currency was pegged to the US dollar. The strict dollar peg at 8.27 RMB to USD lasted nearly a decade (Fig. 4). During the Asian financial crisis in 1997–1998, the floating range was narrowed even further while the exchange rate against USD was kept unchanged.

In July 2005 China moved to a managed float exchange rate regime with reference to a ‘basket of currencies’ (PBC 2005a).⁵ The RMB/USD exchange rate was immediately allowed to appreciate to 8.11 and the daily trading price of the US dollar in the interbank markets was allowed to float within a band of $\pm 0.3\%$ per day. The non-USD currencies were initially allowed to fluctuate daily within a $\pm 1.5\%$ band, which was widened to $\pm 3\%$ in September 2005 (PBC 2005b).

The deepening of the international financial crisis in 2008 forced China to shrink the RMB floating range to mitigate the impacts of the crisis (Hu 2010). This control was relaxed, and the exchange rate was given more flexibility starting in June 2010. Since then, the PBC has allowed for more adaptability in the exchange rate.⁶ The US dollar exchange rate band was widened to 0.5% in 2007 and to 1.0% in 2012. In 2014 the band has been further widened to 2.0%. From mid-2010 to end-2013 the renminbi appreciated 10% (Fig. 4).

⁵ The PBC has not officially revealed the composition of the RMB currency basket. Some information about the composition was given by Zhou Xiaochuan, governor of PBC, in a speech (PBC 2005c) in which he stated that the major currencies in the basket are those of China’s biggest trading partners: US dollar, euro, Japanese yen and Korean won. In addition, the other important reference currencies in the basket are Singaporean dollar, British pound, Malaysian ringgit, Russian rouble, Australian dollar, Thai bath and Canadian dollar. The relative weights of the component currencies, however, have not been revealed.

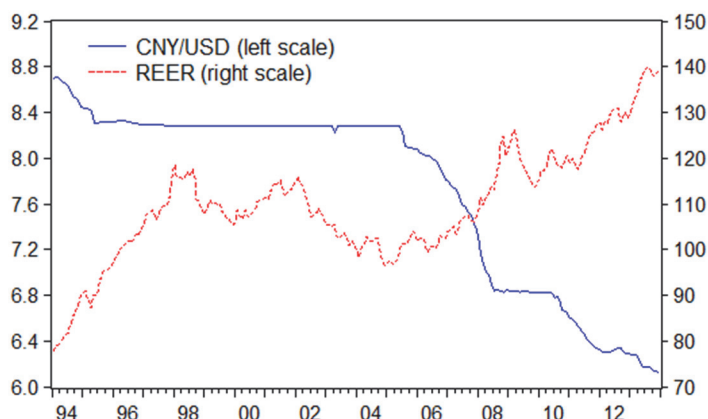
⁶ Despite the new exchange rate regime, studies find the US dollar still having a very large weight in the basket (see, for example, Fidrmuc 2010 and Oksanen 2012).

The exchange rate controls also have important implications for the effectiveness of other monetary policy instruments via the famous “impossible trinity” of Mundell (1960) and Fleming (1962). The capital controls are considered to be largely binding in China (see Ma & McCauley 2008), which enables monetary policy to be used for domestic purposes, although Wang (2010) finds that maintaining tight capital controls has become increasingly difficult in recent years.

Renminbi convertibility in the current account was established in 1996, whereas capital account convertibility has proceeded more slowly. Some liberalisation steps have been taken to open up the capital account for investment purposes. The liberalisation measures have mainly focused on encouraging capital outflows to ease the appreciation pressure of the renminbi but have restricted inward investments into the Chinese capital markets. A notable exception is the active promotion of foreign direct investment (FDI) inflows. Also since 2001, outward direct investments have been encouraged. The Qualified Investor schemes also enable a small number of qualified investors to make cross-border capital account transactions.⁷

PBC uses open market operations and RRRs to sterilise the effects of net capital inflows. It has been found that these sterilisation operations have been effective (see Wang 2010 and Ouyang et al. 2010). However, Tan and Yang (2012) find that in recent years the sterilisation has becoming increasingly difficult in the face of a rapid accumulation of foreign reserves.

⁷ The Qualified Foreign Institutional Investors (QFII) scheme, initiated in 2003, allowed foreign investors approved by the State Administration of Foreign Exchange (SAFE) to invest in China’s capital markets with an individual quota of USD 1 billion. A few years later a Qualified Domestic Institutional Investors (QDII) programme was also launched, allowing qualified Chinese investors to invest in the Hong Kong stock market. More recently, the Renminbi Qualified Foreign Institutional Investors (RQFII) programme was unveiled. (Bowles & Wang 2013.) By the end of 2013 SAFE had granted a total investment quota of USD 51 billion to 228 QFII institutions, a quota of USD 81 billion to 115 QDII institutions, and a quota of RMB 168 billion (USD 28 billion) to 52 RQFII institutions approved by the SAFE (SAFE Annual Report 2013).



Source: People's Bank of China & International Monetary Fund

Fig. 4. Renminbi exchange rate versus US dollar (CNY/USD) and the real effective exchange rate (REER).

Developments in the stance of PBC policy

This section gives a short overview of PBC policy during the research period, 1994–2013.

The relatively tight monetary policy carried out by the PBC from 1994 to 1996 was directed at curbing the high inflation rates of the early 1990s brought on by the robust economic growth (see Fig. 1). A variety of both standard and non-standard policy measures, including wage controls, were implemented to tame the price rise. The benchmark interest rate was raised in 1995, but at the time the RRR was not yet a PBC policy instrument. In the late 1990s, PBC policy was successful in stabilising prices and bringing inflation rates closer to target levels.

The period of high inflation quickly turned into deflation in 1997–1998, which is seen to reflect the limited fine-tuning ability of the policy instruments of that time (Geiger 2008). The deflation stemmed from over-supplies in the state-owned sector, and was more closely related to structural imbalances in the real economy than to monetary policy actions.

The Asian financial crisis in 1997–1998 led to turbulence in the East Asian financial markets and severely impacted the economies of the region.⁸ Chinese

⁸ The Asian financial crisis arose from attacks against the Thai Bath in June 1997 and triggered a large-scale financial crisis affecting most severely Thailand, Malaysia, Indonesia, Japan, Korea and China.

exports were especially affected by the crisis, and during the crisis years China implemented policies to boost domestic demand and stimulate growth. To prevent contagion of the crisis and to stabilise financial markets in the region, the Chinese government announced that it would not devalue the renminbi and kept the exchange rate stable at 8.28 RMB to USD.

The crisis years were followed by a period of weakening domestic demand and fears of deflation. The price rise turned negative in 1998–1999, and monetary policy was aimed at strengthening domestic demand. The years also witnessed severe problems in the banking sector and a high ratio of nonperforming loans. Massive policy measures were taken in order to help refinance the banking sector (see section 2.2).

The years following China's WTO accession in 2001 were characterised by expansionary monetary policy. A second minor deflationary period in 2001–2002 mainly resulted from overcapacity and excess supply in the agricultural sector. The expansionary policy was continued in 2003, in fear of the economic effects of the SARS epidemic, but the impact proved to be smaller than anticipated. This led to an inappropriately loose policy stance and attempts to restrict credit growth.

During the 2003–2004 period of economic expansion, China was faced with the problem of over-investment in certain sectors and increasing inflationary pressure mainly due to rising food prices. As inflation rose above the 3% target level, the PBC intensified window guidance to control credit growth and interest rates were raised for the first time in nine years.

These policy actions were successful in bringing down the inflation rates close to targets in 2005–2007. In 2007, however, rapid global price rises caused an acceleration of the price level in China. GDP growth reached a record-high 14.2% in annual terms. In late 2007 and in 2008 China tightened its policy by raising the interest rate and RRR and via OMOs and intensified window guidance, to prevent rapid growth from leading to overheating.

The onset of the sub-prime mortgage crisis in the US and the worldwide recessionary repercussions led swiftly to a reversal of monetary policy in mid-2008. External demand collapsed and the crisis had an adverse impact on the real economy via higher unemployment and excess production capacity in certain sectors. During the latter part of 2008 and throughout 2009, the PBC injected

The crisis had a serious effect on the economic growth of the region. In 1998 annual GDP growth was -13.1% in Indonesia, -10.5% in Thailand, -7.4% in Malaysia, -6.9% in South Korea and -2% in Japan (World Bank, WDI). Economic growth in China was largely unaffected: annual GDP growth remained at 7.8%, albeit failing to meet the 8% target.

money into the economy by making repeated cuts in the RRR and policy rates and by via open market purchases of PBC bills. In addition to the 4 trillion RMB stimulus package announced in 2008, the banking sector was encouraged to issue 9.5 and 7.95 trillion RMB of new loans in 2009 and 2010, respectively. This proved to be sufficient even to surpass the impressive 8% growth targets.

The economic recovery enabled a shift in the central bank policy stance, first to “appropriately accommodative” in 2010 and to “prudent” in 2011. Inflation controls were enhanced because of domestic price pressures and global instability. This included eleven RRR increases from June to November 2011, after which the RRR for big banks amounted to 21.5%. Moreover, central bank lending and deposit rates were raised.

Since the crisis, the outcomes for GDP growth, inflation and broad money growth have been remarkably close to target values in 2012–2013 (Fig. 1).

2.2 Financial sector developments

The financial sector plays an essential role in the transmission of monetary policy. This section runs briefly through the main features of the Chinese banking sector and financial markets. In section 4.2 the empirical findings of monetary policy transmission in China are discussed.

Banking sector

The Chinese banking sector is large by international standards, with assets amounting to over 200% of GDP. The high domestic saving rate (see sec. 2.3) and shortage of investment options in China have contributed to the high level of banking sector assets in the economy. RMB loan growth in the Chinese banking sector has developed in sync with the overall economy, whereas the growth of foreign exchange loans has been more rapid in recent times (IMF 2011). As a share of the total loan stock, however, the part attributable to foreign exchange loans is still small, at about 7% in 2013.

The banking sector is dominated by the four big state-majority-owned commercial banks.⁹ These enjoy oligopolistic market power and do not compete

⁹ The “Big Four” state owned banks, to which the commercial banking activities in China were delegated in the 1984 reform are: Agricultural Bank of China, Bank of China, Industrial and Commercial Bank of China and the People’s Construction Bank of China (later China Construction Bank). The Bank of Communications is often considered to be the fifth big state-owned bank.

with each other in all sectors or geographic areas. The primary function of the state-owned commercial banks is to provide financing to state-owned enterprises, largely leaving the private sector companies outside of the major financing of the Big Four.

In 2010 there were more than 3 600 banking institutions and almost 800 non-bank financial institutions – such as insurance companies, pension funds and asset management companies – in China. Banking institutions accounted for 88% of the total financial sector assets (IMF 2011). The 379 commercial banks accounted for 80% of the banking sector's total assets in 2010. Of the commercial banks' assets, the five biggest banks account for around two-thirds. Twelve joint stock commercial banks account for 16%, and the three policy banks for 8% of the total assets. The largest group of financial institutions comprises the urban and rural credit cooperatives and rural cooperative banks, with almost 2 900 entities. Nonetheless, together they account only 7% of total assets of the sector.

The banking system is divided into two segments by the 1995 Banking Law (PBC 1995). The commercial banks in China are subject to international portfolio risk standards and prudential ratios, whereas policy lending banks and other financial intermediates are not subject to similar regulations (Laurens & Maino 2007). The law also separated the activities of commercial banking from the securities industry in that commercial banks are not allowed to engage in securities investment, including e.g. investments in stock markets and real estate.

The Chinese banking reform began in 1984 with the establishment of the four state-owned banks. At that time the lending activities of these banks were not purely based on market fundamentals, and in the early-1990s their asset quality deteriorated, resulting in a mounting of nonperforming loans (NPLs). The restructuring of the banking sector and improvement of the asset quality of the banks was a costly operation, in which over two-thirds of the Chinese banking sector had to be recapitalised.¹⁰ For example, Luo and Yao (2010) estimate that the share of NPL of total loans was one-third in 1999, but after the sizable restructuring operations it was reduced to less than 3% by the end of 2008. The restructuring also included the establishment of three specialised policy banks in 1994, which took over the policy lending of the Big Four, which in turn were converted into state-owned commercial banks (SOCBs) focusing on commercial activities.

¹⁰ The NPLs totalled RMB 2.6 trillion. Four asset management companies were established to acquire the nonperforming loans, RMB 1.4 trillion (16% of GDP in 1999), and special government bonds worth RMB 280 billion were issued to recapitalise the four state-owned banks (PBC 2001).

Until 1998 the direct credit plans primarily served the large state-owned enterprises, whereas private enterprises or households had very limited access to bank finance. China's WTO accession in 2001 intensified the banking sector reforms and ownership diversification, with a view to providing competitive financing to export-oriented enterprises. All four major state-owned banks were transformed into joint-stock banks, where the government is still the majority owner. Three of the four state owned banks were listed on stock exchanges in 2005–2006. The Agricultural Bank of China was the last of the Big Four to go public in 2010. Since then, all four majority state-owned banks have been among the world's biggest banks. In 2012 the Industrial and Commercial Bank of China replaced Bank of America to become the world's biggest bank by Tier-1 capital.

Foreign-owned banks were allowed to carry out limited banking operations in China in 1997, and ten years later foreign bank operations were liberalised. The participation of foreign investors in Chinese banks is encouraged by allowing foreigners to have up to 25% ownership shares in the Chinese banks. Luo and Yao (2010) find that the banking sector reforms over the past decade have been effective in improving banks efficiency and resulting for example to the ability of Chinese banks to better protect themselves from the latest global financial crisis.

Shadow banking

The role of shadow banking in China has drawn attention in recent years. There are several estimates of the size and importance of China's informal financial system. For example, the BBVA (2013) analysis finds that in 2012 the shadow banking sector accounted over 50% of GDP and 20% of banking sector assets. The Financial Stability Board report (FSB 2014) finds the Chinese shadow banking sector to be the third largest in the world. The size of assets of 'other financial intermediaries' outside the regular banking sector was estimated to be 3 trillion USD (30 % of GDP) at the end of 2013, compared to the 31 trillion USD of assets of financial institutions in the formal sector. Li et al. (2014) note that while the shadow banking system in China is small relative to the rest of the financial system in terms of total assets, net financing via shadow banking instruments already exceeded financing by commercial bank loans in 2012. Funding in the informal shadow banking sector is

largely directed to SMEs and small investors that have difficulties in tapping formal finance.¹¹

Financial intermediation outside the regular banking system is a commonly observed phenomenon, especially in developing countries in which the banking sector is underdeveloped. In many cases the size of the shadow banking sector also reflects the sophistication of the financial system and the financial products available. For example, the US has by far the largest shadow banking sector (FSB 2014). However, the rapid rise of shadow financing in China can pose a threat to financial stability given the laxity of regulation of available investment products and poor supervision of financial intermediaries.

Interest rate reform

During most of the period 1994–2013, significant interest rate restrictions have been effective in China, and the gradual reform of the interest-rate regime has intensified only recently.

The broad feature of China's interest rate liberalisation has been to ease the controls on foreign currencies before those on the domestic currency and on loans before deposits and to liberalise long-term or large-value instruments before the short-term or small-value instruments (PBC 2005d). The deregulation started with interbank lending rates in 1996, followed by the liberalisation of bond market interest rates, repo rates and rates on outright cash transactions in 1997–1998.

Banks were allowed to adjust interest rates offered to their customers within a limited band around the PBC benchmark deposit and lending rates. The market-based reform of commercial banks' interest rates started with foreign currency-denominated loans in 2000–2004. The fluctuation bands for domestic currency loans and deposits have been gradually widened, with an important step taken in 2004, when the ceiling for commercial bank lending rates and the floor for deposit rates were abolished. In July 2013 the PBC further relaxed the controls by removing the floor for lending rates.¹² Until 2015, banks were free to set their lending rates, but deposit rates were still subject to central bank control. In 2015, the PBC

¹¹ Using survey data for 2 400 Chinese firms, Ayyagari et al. (2010) find that informal finance does not provide firms with an effective substitute for formal financing and that the shadow banking sector primarily has a role to play in serving only a fraction of very small firms that cannot access formal finance.

¹² The floor for mortgage lending, however, was maintained at 0.7 of the benchmark lending rate, to curb the abundant investment and speculative demand (PBC 2013b).

eliminated the last remaining interest rate limits. Interest rates are for the most part market-determined in the money and bond markets.

Interest rate controls have been imposed to ensure the profitability of banks and stability of the banking sector. Due to the controls on banks' loan and deposit rates, the commercial banks in China enjoy a wider net interest rate margin than banks in more competitive markets (Leung & Lu 2011).¹³ With the interest rate deregulation and increased competitiveness of the banking sector, the differences in net interest margins are expected to contract.

The full interest rate reform includes the launch of the Shanghai Interbank Offered Rate (SHIBOR) in January 2007, to replace the China Interbank Offered Rate (CHIBOR). The PBC has promoted the recognition of SHIBOR as a benchmark rate to replace the benchmark lending and deposit rates set by the central bank, claiming that this being achieved, the PBC could gradually withdraw from interest rate interventions (PBC 2008).

Financial markets

Financial markets in China have developed over the past 25 years from a very low initial level. In many aspects the financial markets are still underdeveloped, but the market reforms and opening up the market have been steadily progressing over the years. China's WTO accession in December 2001 can be seen as an important milestone after which the speed of the many financial market reforms has increased. Below is a brief discussion of the role of money and capital markets in China.

Money market

The unified national interbank market in China was established in 1996. Commercial banks and other financial institutions participate in the interbank money market. The money market was initially intended for financial institutions to trade short term liquidity among themselves, but it soon became an important platform for the PBC to conduct open market operations (Chen et al. 2013).

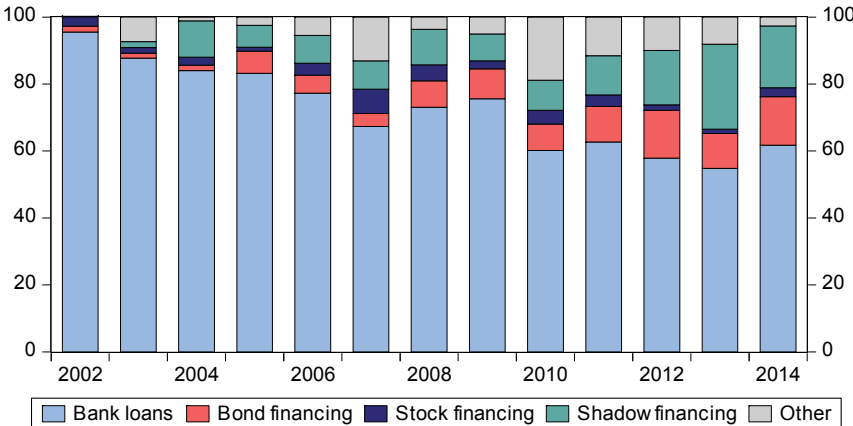
Money markets in China comprise three submarkets: *i*) interbank market, where banks lend and borrow among themselves, *ii*) interbank bond market, where PBC bills, fiscal bonds and commercial and policy bank bonds are issued, and *iii*)

¹³ For example, in 2008 the commercial banks in Hong Kong had a net interest rate margin of 1.8%, whereas big Chinese banks reported an average interest rate net margin of over 3% (Leung & Lu 2011).

bond repo market for short term borrowing (Laurens & Maino 2007). Interest rates in the interbank and bond markets are market-determined. The majority of the short-term money market transactions take place in the repurchase agreement (repo) markets. In the repo market the five largest state owned banks are generally net providers of funds, and smaller banks and foreign banks net borrowers.

In 2012, the turnover in the interbank market was RMB 47 trillion and in the bond repo market RMB 142 trillion (PBC 2013a). Bond issuance in 2012 totalled RMB 8 trillion, of which RMB 7.5 trillion was issued in the interbank bond market.

In addition to the domestic money markets, currencies are traded in the foreign exchange market. The China Foreign Exchange Trade System, operating under the direct control of the PBC, provides the interbank foreign exchange trading facilities in China. The interbank forex market has developed since the exchange rate reform in 2005. Prior to 2014, four currency pairs (US and Australian dollar, Japanese yen and Russian rouble against the RMB) were traded in the foreign exchange market. In 2014 the direct trading of four new currency pairs was started (New Zealand and Singapore dollar, British pound and the euro). The market exchange rates are determined in the foreign exchange trading, but are subject to the daily trading band imposed by the authorities (see section 2.2). In 2014 the total trading volume in the interbank forex market was USD 9 trillion.



Source: People’s Bank of China

Fig. 5. Share of different financing sources by non-financial enterprises (% of total financing).

Capital market

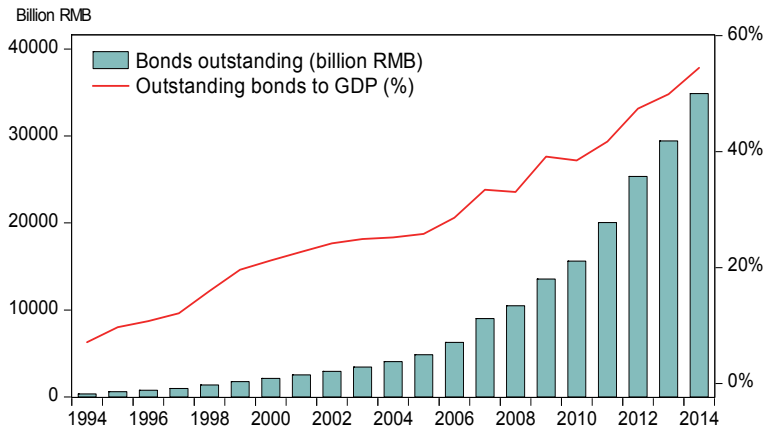
The nationwide corporate bond and stock markets in China were introduced in the beginning of the 1990s. Bank lending was long the main source of funding for Chinese enterprises (Fig. 5). In early 2000 bank loans constituted more than 90% of such funding. The share declined to around 50% in 2013. At the same time financing via corporate bonds increased from less than 2% in 2002 to 14% in 2012.

Bond markets were first established on the Shanghai and Shenzhen stock exchanges in the early 1990s. A separate interbank bond market in China was created in 1997 to enable trading by commercial banks that had been prohibited from trading on the exchanges (Porter & Xu 2009). Nowadays, the vast majority of bond trading is carried out in the interbank bond market. There is also an exchange bond market in China, where individual and small investors can trade bonds.

Bond markets in China have in recent years expanded their role in providing equity financing for firms (Fig. 6). In general, all companies in China can issue bonds. Corporate bonds usually provide cheaper financing for enterprises than direct borrowing from banks. The rapid growth of bond markets is also partly a result of the obstacles to listing on a stock exchange in China. Stock listing is a cumbersome process, and the China Securities Regulatory Commission, an institution controlled by the State Council, tightly controls IPOs. In many instances IPOs have been halted altogether for a long period. In an effort to liberalise lending rates for enterprises the PBC has since 2005 actively promoted corporate bond trading in the interbank market (Leung & Lu 2011).

Government bonds, central bank notes, financial institution bills and other corporate bonds are traded in the bond markets. Despite the rapid rise of bond financing in China, the markets remain relatively shallow, over half of the outstanding bonds having been issued by the government and majority of the rest by partially state-owned banks (IMF 2011).

In 2013 the amount of bonds outstanding in the domestic markets reached RMB 29 trillion (50% of GDP). This makes China's bond markets the third largest in the world according to BIS statistics.



Sources: China Securities Regulatory Commission & National Bureau of Statistics

Fig. 6. Bonds outstanding.

Stock markets were first established in China in the early 1990s, but at that time they were supporting only a few big state owned companies with relatively few tradable shares. There are two stock markets in mainland China. The present stock exchanges in Shanghai and Shenzhen were both formally established in 1990 and operate under the supervision of the China Securities Regulatory Commission. Generally speaking, the difference between the two exchanges is that the big state owned firms are listed in Shanghai and the smaller growth enterprises in Shenzhen.

The mainland stock markets are dominated by small retail investors. The absence of long term investors, and big institutional and foreign investors is often seen as hampering the sophistication of stock market trading in China. Stock markets in China are found to be less efficient compared to the developed markets (see Morck et al. 2000 and Luo et al. 2015). The efficiency is hindered, for example, by daily price fluctuation limits, large amount of non-tradable shares and frequent regulatory changes and interventions by the government.

In 2013 the combined market capitalisation of the Shanghai and Shenzhen stock exchanges was RMB 24 trillion or 42% of GDP (with a tradable market capitalisation of RMB 20 trillion), and the number of listed companies had reached 2 500. Still, the stock markets play a fairly small role in enterprises' total financing (Fig. 5).

Foreign investments in China's capital markets are still restricted. Qualified institutional investors in the QFII and RQFII programs can access China's stock and bond markets. In addition, since 2010, the central bank has granted access to

the domestic interbank bond market to some foreign financial institutions. These include, for example, overseas RMB clearing banks, foreign central banks and international financial institutions, and recently the access to the interbank bond market for foreign institutional investors has been further opened. Majority of the foreign investments are still restricted by pre-specified quotas, but the quotas for the different investment programs have been extended at an increasing rate in recent years.

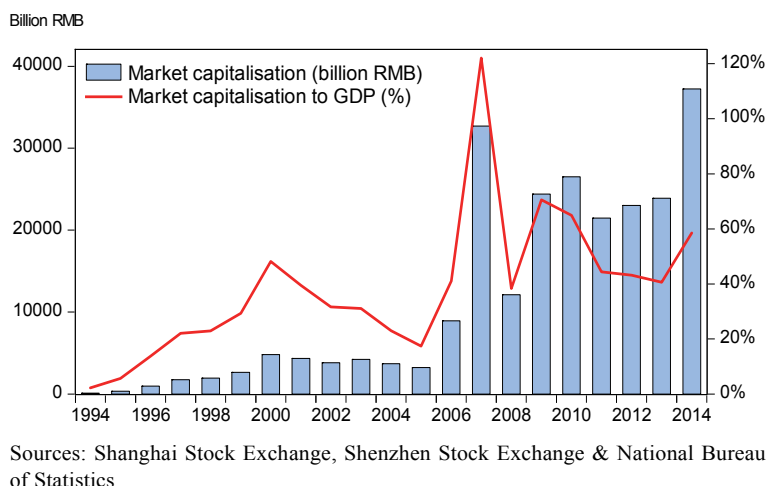


Fig. 7. Mainland stock market capitalisation.

2.3 Rebalancing of the Chinese economy

Rebalancing in the Chinese context refers to moving from a high investment (and savings) rate to higher domestic consumption. The rapid growth of the Chinese economy in recent years has rested heavily on investments. In many cases the local governments have been responsible for the massive infrastructure investments, made to raise their growth rates to targeted levels. In addition, a large share of investment has been financed by bank loans, mainly issued by the large state owned banks, which has exacerbated the local government debt problem. The big state companies have also invested heavily in infrastructure and production capacity.

The investments have been largely financed using domestic savings deposited in the Chinese banks. The savings rate in China has been remarkably high; the gross domestic savings rate in 2013 was 50% of GDP (Fig. 8). This can be compared to

the saving rates in United States (16% in 2013), euro area (23%) and Japan (18%) (World Bank, WDI). The Chinese saving rate is still higher than those in other developing countries, for example in India (30% in 2013), Indonesia (33%), Brazil (18%), and Mexico (21%) (World Bank, WDI).

The need for high domestic household savings is explained by the low level of social security in China. Also family structure, consumption habits and possibilities, as well as cultural factors may encourage the Chinese to save. The savings' share of household income climbed as high as 30% in 2013. Due to the lack of other investment possibilities – underdeveloped financial markets and mainly closed capital account – the majority of household savings is deposited in domestic banks.

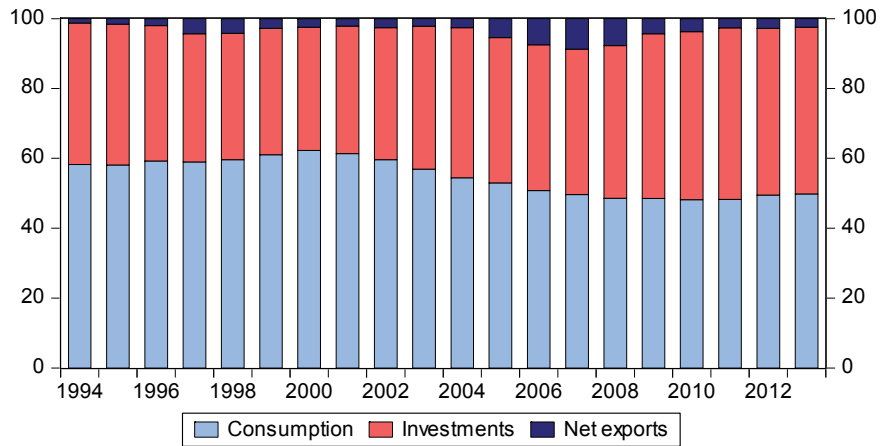
Following many years of rapid investment growth, new investments have become less profitable. Especially the big state-owned firms can access the cheap capital provided by state-owned banks. Interest controls have kept the lending rates artificially low for big companies. The controls have also kept deposit rates low, which has affected the interest payments that savers receive from banks. The rebalancing should reduce the misallocation of capital and increase its productivity in China.

Rebalancing of the economy is widely seen as perhaps the most important obstacle to China's continued robust economic growth. For example the IMF has for years stressed the importance of rebalancing and moving to a more sustainable growth paradigm. These recommendations are discussed for example in IMF's annual Article IV Consultation staff reports for China. Also other influential observers, such as the World Bank and Asian Development Bank, have stressed the need for economic rebalancing in order to sustain growth.

The Chinese authorities have also recognised the need for rebalancing. In a speech, PBC Governor Zhou Xiaochuan said that China has had a clear policy aim to reduce the savings ratio already since 2005 (Zhou 2009). Sustainable growth and promotion of domestic consumption were selected as the key themes of the 12th Five-Year Plan approved by National People's Congress in 2011. In recent years, domestic consumption has picked up, and in 2013 growth of domestic consumption already accounted half of total GDP growth.

Essay IV deals with the rebalancing of the Chinese economy. In a new Keynesian DSGE framework, we develop a model for the Chinese economy and study the effects of rebalancing. The paper finds that the rebalancing would also be favourable for the economy's resistance to the effects of shocks. Reducing the investment share from the current 45% to the 25% levels of advanced economies

and raising the consumption share accordingly would reduce the volatility of the real economy in the presence of technology shocks.



Source: National Bureau of Statistics

Fig. 8. Structure of Chinese GDP (% of GDP).

3 Monetary policy rules

3.1 Theoretical background

The idea of using normative rules to guide central bank monetary policy decision-making is not new to the economics literature. In the early literature, authors such as Henry Thornton, David Ricardo, Irving Fisher and Knut Wicksell stressed the importance of rule-guided monetary policy. Rules were seen as a good way to avoid the inflationary money growth that would lead to economic instability (Taylor & Williams 2011). Nowadays ‘rule-based policy’ typically refers to a policy regime in which the central bank announces in advance how the policy instrument will be adjusted to respond to changes in the economy. Thus the monetary policy rule describes a contingency plan for the setting of monetary policy instruments. In order to compute the optimal rates for the policy instruments and use the rules in economic analysis, the policy rules need explicit mathematical expression.

In the literature, monetary policy rules are studied by evaluating their historical performance. Another approach is to try to find optimal policy rules by building a structural model describing the features of the economy and evaluating the performance of different policy rules via simulations. The performance of the rules is usually evaluated on their ability to provide economic stability, i.e., small inflation or output fluctuations. The underlying assumption is that economic performance could be improved if monetary policy followed a rule rather than being totally discretionary.

In the 1970s and 1980s, the empirical models with rational expectations and sticky prices were developed, and the monetary policy rules literature was advanced on the basis of the Lucas critique. In recent years the literature has contributed to adjusting the simple rules to take into account, for example, measurement errors and expectations. Contemporary monetary policy focuses on price stability, which is the main objective for most central banks. This development has intensified the search in the monetary policy rules literature for the optimal way to conduct price-stabilising policy in various environments.

In this section we discuss the most popular policy rules and the optimality of the rules. The following sections discuss some issues in the design of such rules and give a short overview of the rules versus discretion discussion. Section 3.4 reviews the previous literature on monetary policy rules estimation for China.

Money supply rules

Milton Friedman was among the first to propose an explicitly defined rule to guide monetary policy actions. Friedman (1960) argued that the previous attempts to conduct countercyclical monetary policy had performed so poorly that the best way to conduct stabilising policy is to prevent policy changes altogether and simply keep the money stock constant. The money stock should be allowed to grow only at a constant rate k , corresponding to the growth rate of the economy. More important than the precise growth rate, however, was the advocacy of a steady growth policy (Friedman 1968). Friedman (1960) argued that a rule-based policy would be easy to understand and would eliminate instability and uncertainty regarding the policy.

Subsequent to Friedman's introduction of k -percent rule, contemporary monetary policy literature had taken the view that the central bank should play a role in smoothing economic fluctuations via counter-cyclical measures. Taylor (1981) proposed one alternative to the Friedman rule in which the monetary aggregate should respond counter-cyclically to changes in real output, but should not accommodate price changes. McCallum (1984) argues that the Friedman constant growth rule can be improved with an adjustable growth rate rule, where the money supply growth rate is adjusted for changes in output and corrected for the irregular changes in the velocity of money. Such a rule would have stronger, and automatic, countercyclical effects on aggregate demand.

The properties of the adjustable growth rate rule are explicitly formulated by McCallum (1988), and can be written as

$$\Delta b_t = g - \Delta v_{t-1}^a + \lambda(x_{t-1}^* - x_{t-1}). \quad (1)$$

In (1) the policy instrument Δb is the change in monetary base in response to the nominal output deviation from the target path ($x^* - x$). Parameter $\lambda > 0$ is a measure of the strength of policy adjustment. The term Δv^a is the average growth rate of base money velocity over the past four years. With nominal output at its target level and velocity of money constant, the money supply should grow at rate g , which is the long run average growth rate of the economy (3% in annual terms in McCallum 1988).

The nominal output measure x in the original model is the nominal gross national product (GNP). The rule specifies nominal GNP growing along a steady, pre-specified target path x^* . This growth rate should equal the prevailed long-term

average real output growth. Keeping the nominal output growth at the target rate should, over the long-run, provide approximately zero inflation (McCallum 1988).

In McCallum (2000) the nominal output target is expressed in terms of growth rates rather than levels:

$$\Delta b_t = \Delta x^* - \Delta v_{t-1}^a + \lambda(\Delta x^* - \Delta x_{t-1}). \quad (2)$$

McCallum argues that the parameter λ should be large enough to provide adequate responsiveness in the monetary instrument to target misses but small enough to avoid dynamic instability. In McCallum (1988) the values $0 \leq \lambda \leq 0.5$ are tested. McCallum (2000) suggests a value 0.5 for the growth rate type rules (2).

The average velocity term Δv^a is added to the rule to reflect long-lasting changes in the demand for money. Examples of these are regulatory changes and technological progress in the payment system, which had produced turmoil especially in the late 1970s to mid-1980s in the US, during which time the original rule was designed (McCallum 1984, McCallum 1988). This shields the policy from exogenous developments that alter the velocity of money.

The consideration of a nominal rule is reasonable in that the dynamic interactions between nominal and real variables remains largely unknown. Therefore, it is not known how the observed changes in nominal GNP will be divided between output and prices – the ultimate concerns of policy. The rule should not be dependent on some arbitrary division method. (McCallum 1984, McCallum 1988.) In McCallum (1990) the nominal policy target was replaced by a direct price level target that proved to be less satisfactory, as it increased the likelihood of dynamic instability.

McCallum stresses that the policy rule is fully operational, in that it reacts to the last period changes, observable at the time of policy decision. The instrument variable, the monetary base, is a good tool because the central bank can fully control it.

The McCallum (1988) rule was originally designed for the US for the period 1954–1985. McCallum (1993) shows that the rule would have performed well also in Japan in 1972–1992. Taylor (2001b) suggests that for emerging market economies, where there can be big shocks to investment and net exports or measuring the real or equilibrium interest rate can be difficult, the money supply would be a preferable instrument. In Essay I, it is shown that the McCallum rule (2) can be utilised to describe the Chinese monetary policy in 1994–2007.

Interest rate rules

Almost all central banks use interest rate as the operational policy instrument. This has shifted the focus from money supply rules to interest rate rules. The interest rate rules applied in the literature are usually variations of the rule proposed by Taylor (1993).

The Taylor rule (1993) can be expressed as:

$$r = \pi + g\hat{y} + h(\pi - \pi^*) + r^f, \quad (3)$$

where r is the federal funds rate, π is the rate of inflation over the previous four quarters and \hat{y} is the deviation of real GDP from its trend level. The price level and real output variables in the rule are made stationary by considering the deviation of real output from trend and using first differences in the price level term, i.e. the inflation rate.

Originally in Taylor (1993) the parameters g and h were both set at 0.5 and the target rate for inflation π^* and the target equilibrium real interest rate r^f were both set at 2 percent. The Taylor rule is designed to describe monetary policy in the US in 1987–1992 and has been shown to do this surprisingly well. Other weights for the reaction parameters g and h have often been tested in the literature.

The reaction coefficient for inflation h and output gap g describe the central bank's relative preferences for stabilising inflation versus output. With parameter value $h < 0$ an increase in inflation induces a decrease in the real interest rate, which in turn increases demand and puts additional upward pressure on the price level (Taylor 1999a). With $h > 0$ the interest rate response to an increase in inflation is stabilising. This idea is called the 'Taylor principle'.

Having the output stabilisation coefficient $g > 0$ is commonly referred to in the literature as "leaning against the wind", meaning that monetary policy is tightened when real output rises above its potential level (measured by the long run trend) and becomes more accommodative when output trails its potential level. When output or inflation deviates respectively from the potential level or target rate, monetary policy serves to facilitate the economy's return to the equilibrium steady state.

Taylor (1999a) analyses variations in the rules' parameters (g , h and r^f) over time in the US. He shows that interest rate reactions have increased gradually over time from the 1870s to the 1990s. In the international gold standard era before the First World War, the estimated parameter coefficients were less than one-tenth of their values during the Bretton Woods era and thereafter. The study arrives at the

conclusion that the periods of the most responsive policy rules are also those marked by the greatest economic stability.

A characteristic of the interest rate rules is the presence of the zero lower bound for nominal rates. At the zero lower bound, the interest rate rule may not be very effective in stabilising the economy. Developments in Japan in the 1990s as well as in other advanced economies after the recent financial crises have increased the attention paid to this issue.¹⁴

McCallum (1990) experimented with a nominal policy rule similar to (1), but with the interest rate as the policy instrument variable. He also studied explicit price level targeting via a money supply rule. McCallum (2000) argued that there is no apparent reason why the policy instruments and targets should be paired in any particular combination, and he specified an interest rate rule with nominal variables and a money supply rule in terms of real variables. Essay II estimates different types of monetary policy rules, both money supply rules and interest rate rules, for China. The paper focuses on how the central bank reaction parameters for inflation and output have evolved over time.

Optimality of policy rules

Both the Taylor-type interest rate rules and the McCallum-type money supply rules have their origins in the famous quantity-of-money equation of Friedman and Schwartz (1963). This identity states that when the real output of the economy (Y) and the velocity of money (V) are constant, an increase in the money stock (M) leads to a higher price level (P):

$$MV = PY. \quad (4)$$

The relationship between the variables in the McCallum rule (1) is easy to observe from the quantity equation. In log-difference form this relationship can be expressed as

$$\Delta m = \pi + \Delta y - \Delta v = \Delta x - \Delta v, \quad (5)$$

where the variable Δx denotes a logarithmic change in nominal output, similar to the McCallum rule (2).

¹⁴ For example, Reifschneider and Williams (2000) suggest that in the presence of a zero lower bound limit for the nominal interest rate, the policy rule should be modelled as a max function: $r_t = \max[0, \{\pi_t + g\hat{y}_t + h(\pi_t - \pi^*) + r^f\}]$.

In deriving the Taylor rule, one can use the idea that the velocity of money (V) depends on the interest rate (r) and real output (Y). In addition, the money supply can be assumed to respond in a systematic way to either the interest rate or real output (Taylor 1999a). Hence, we are left with a function expressing the relationship between the policy interest rate (r), real output (Y) and price level (P). Alternatively, the nominal interest rate rules can be derived by replacing real output and prices by a measure of nominal output.

In deriving a specific functional form for a policy rule, one must assume some type of central bank loss function. The usual assumption is that the central bank tries to minimise the loss due to deviations in the actual inflation rate from the target rate ($\pi - \pi^*$) and output deviation from either potential output or long-run equilibrium output (\hat{y}). Using a quadratic form for the loss function, the central bank decision problem can be written as

$$\min L = E\{(\pi - \pi^*)^2 + \beta \hat{y}^2\}. \quad (6)$$

In (6) parameter β is assumed to be positive and to measure the preference for output stabilisation over inflation stabilisation. E is the expectations operator. The policy problem is to choose the policy-rule parameters so as to minimise (6), i.e. the optimal policy rule is that which minimises the central bank loss function. The optimal policy depends on the economic model in which it is evaluated. In small models, the optimal policy can be shown to equal the Taylor rule (see e.g. Ball 1999b, Svensson 1997 and Taylor 1994).

Estrella and Mishkin (1997) formulate a theoretical model that establishes conditions under which the McCallum rule (1) is optimal. Using the quantity theory of money identity (4) and a central bank loss function in which the policy objective is to minimise the mean squared deviation of nominal income from a pre-specified target path, the authors show that the policy optimum can be achieved via the McCallum rule (1).

3.2 Issues in the design of monetary policy rules

In addition to the original rules described in the previous section, a substantial body of literature has investigated the properties of the rules and suggested improvements. The commonly applied modifications to the rules are the inclusion of policy smoothing behaviour and the use of forward-looking specifications. The potential roles of other variables in the policy rule, such as the exchange rate or asset prices, have also been widely examined. These enhancements are usually

found to improve the empirical fit of the rules. Another strand of literature addresses the question of how the policy target variables should be measured in the context of the rules.

The measurement of variables of interest is crucial in the empirical estimation of the policy rules. Macroeconomic data are subject to measurement errors and revisions, and so only estimates of the values of current-period variables are available. The output gap is unobservable in reality, and the outcomes of policy rules are dependent on how the trend or potential level of output is constructed. In addition, the equilibrium real interest rate and the target growth rate for output in the Taylor rule are also unobservable variables that have to be estimated.

A number of papers have examined the implications of potential measurement errors in the output gap for the monetary policy rules (see, for example, Smets 2002, McCallum 2001, Orphanides et al. 2000 and Orphanides & van Norden 2002). The general finding in the literature is that measurement errors in the output gap reduce the estimated policy coefficients by increasing the estimation errors for the rule. Consequently, in the presence of errors in the output gap term, the estimated policy coefficient for inflation may be overstated.¹⁵

In practice, the conduct of monetary policy is highly persistent. Therefore, in many of the empirical evaluations of policy rules, inertia is included in the rule. Comparing different policy rules in a variety of macroeconomic models, Taylor (1999b), however, finds that rules without the lagged interest rate are robust and that the addition of inertia to the rule may cause instability or large variance in the rule. Orphanides and Williams (2002) propose an interest rate rule in first differences that includes the lagged policy variable as an additional variable in the target equation. The advantage of such a model, over the original formulation of the Taylor rule, is that it can overcome the measurement error problem, since the rule does not require knowledge of the natural rates of interest or output. The monetary policy rules estimated in Essay II are expressed in difference-form and include policy smoothing behaviour in the rules.

In practice, central banks take into account expectations about the future when making policy decisions, and therefore it is suggested that monetary policy rules should also be forward looking. Batini and Haldane (1999) argued that the rules

¹⁵ Discussion concerning the policy target variables extends also to the discussion of whether or not the target variables should be measured in levels or in difference-form. This discussion is often referred to as inflation vs. price level targeting, but it also applies to other target variables. In most of the literature, the targets are expressed as growth rates. But, for example, Hall and Mankiw (1994) and Svensson (1999a) take an opposing view.

should be forward looking because of the presence of lags in policy transmission, and because forward-looking rules can be designed to automatically embody transmission of lags. Clarida, Galí and Gertler (1998) show that the forward-looking version of the Taylor rule, where the central bank reacts to the expected future inflation and the output gap, works well in comparison to the backward-looking alternative for the US, Germany and Japan in 1979–1993. In Clarida Galí and Gertler (2000) the forward-looking interest rate rule is employed to study pre- and post-1979 monetary policy in the US. In addition, for example, Batini and Haldane (1999), Levin et al. (2003), and Rudebusch and Svensson (1999) have studied interest rate rules in which the central bank reacts to forecasts of future inflation.

Several studies also assess the role of different asset prices, such as exchange rates, or financial market information in the monetary policy rule. Theoretically, asset prices can be seen as indicators of future developments in the target variables (inflation and output gap). A different view is to assume that the central bank includes asset prices directly in its objective function. Ball (1999a) finds that in an open economy model, the addition of the exchange rate to the policy rule can improve the rule's macroeconomic performance. Interest rate rules with an exchange rate for open economies have also been studied by Clarida (2001), Taylor (1999b) and Taylor (2001a), among others.

Bernanke and Gertler (1999, 2001) examine the role of asset prices in monetary policy rules, and find that changes in asset prices should affect monetary policy only to the extent that they have an impact on the future policy instruments. An opposing view is proposed by Goodhart and Hofmann (2002). In Essay I, we analyse whether 'monetary excess' (measured in terms of money supply over the values given by the McCallum rule) can provide information about future asset price movements China. It is found, however, that asset prices in China are driven by their own shocks rather than excess liquidity.

In the literature, much effort has been devoted to studying the robustness properties of monetary policy rules. The robustness of different rules can be studied by analysing their stabilisation properties across different macroeconomic models. Levin et al. (2003) analyse different interest rate rules and find that, while the more complicated rules can be fine-tuned to the dynamics of a specific model, the simple rules are more robust to model uncertainty. Rudebusch and Svensson (1999) also find similar results.

Bryant, Hooper and Mann (1993) provide a comparative analysis of four different monetary-policy regimes (money targeting, nominal income targeting,

real GNP and inflation targeting, and exchange rate targeting) using a variety of macroeconomic models. While the comparison does not come up with a ‘best policy rule’, the regimes that target nominal output or the sum of real output and inflation are shown to outperform the money targeting and exchange rate targeting regimes. In addition, within the selected models, the rules with an interest rate instrument performed better than the money supply rules.¹⁶

A common criticism of policy rules is that they are too simple and that they ignore much of the valuable information about the economy. Levin et al. (2003), Levin et al. (2005) and Williams (2003), for example, conclude in favour of simple rules. Williams (2003) shows that a Taylor rule including inflation, output gap and a lagged interest rate suffices for a monetary-policy guideline and that rules containing these three variables perform nearly as well, in terms of economic stabilisation, as the fully optimal policies that respond to hundreds of variables.

3.3 Rules versus discretion

The rules versus discretion debate hinges on the question of whether policy rules should be used merely as guidelines for the central banks’ policy-making or should be strictly followed without discretion. Adherence to a rule clearly increases the transparency of policy actions and may also contribute to policy credibility. Both of these are considered highly desirable. In the literature, discretion implies period-by-period re-optimisation by the central bank, whereas following a rule means period-by-period implementation of the contingency formula (McCallum 1999).

Taylor and Williams (2011) argue that in the early monetary policy literature it was believed that that a simple rule that allows the money supply to grow smoothly would contribute to avoiding monetary shocks and thus help tame the gyrations of recession, inflation, and deflation. The authors state that the issue was “rules versus a chaotic monetary policy” rather than rules versus discretion. Starting in the 1980s, the rules versus discretion debate has intensified with the emergence of empirical dynamic stochastic models that can be employed to study the policy performance of the rules in practise.

¹⁶ McCallum (1994, 1999) criticises the operability of the selected rules in Bryant et al. (1993). The rules are formulated so as to use the current period realisations of the target variables as well as the baseline values for policy instruments and targets. He argues that these type of rules are not operational, as in practice policymakers cannot respond to the true value of current period target variables. It then follows that the simulated performance of selected rules appears to be better than what can be achieved in reality.

The fundamental reasoning in favour of rule-based policy over discretion is that adherence to a rule in setting monetary policy enables one to avoid the time inconsistency problem. The seminal papers by Kydland and Prescott (1977), followed by Barro and Cordon (1983) have greatly advanced the use of policy rules as optimal guides to central banks in the literature. Time inconsistency arises in the context of policy decisions when policymakers have an incentive to deviate from the previously announced policy in order to improve the economic outcome. Without a commitment, the optimal policy for the monetary authority is to create more inflation than the public expects. But in the presence of rational expectations, surprise inflation cannot happen systematically, since the public understands policymakers' incentives, and can correctly anticipate such policy changes. The only optimal policy is to credibly constrain the monetary authority so that the future policy accords with economic agents' expectations.

The rules versus discretion debate has also evolved into a discussion of instrument rules versus targeting rules (see, for example, Svensson 2002, Svensson 2003, McCallum & Nelson 2005 and Svensson 2005). Targeting rules refer to rules that are designed to achieve some monetary policy target (usually a certain inflation rate), rather than controlling only the monetary policy instrument (interest rate or money supply) itself. Svensson (2002, 2003) argues that commitment to a simple instrument rule is not an adequate description of monetary policy in an inflation targeting framework. The targeting rules, proposed for example by Svensson (1997, 1999b, 2003) and Giannoni and Woodford (2004), are much more complicated than the simple instrument rules. Simplicity is a desirable property of a policy rule because the rule can then be easily verified by outside observers, and it can be used to explain the monetary policy stance to the general public.

Chari, Kehoe and Prescott (1989) state that the rules versus discretion discussion – where rules are seen as commitment to certain policies and discretion as policies without a commitment – is misguided in that societies cannot choose between commitment and non-commitment. In their interpretation, commitment technologies do or do not exist in a given society. Therefore, rather than rules versus discretion, the debate should focus more on how much authority should be delegated to central banks. McCallum (1999) also stresses that neither of the central bank behaviour types – rule-based or discretionary – has yet been firmly established as empirically relevant.

Taylor (1993) emphasises that no real-life central banker is likely to rigidly follow a simple rule, but nonetheless systematic “rule-like” behaviour is advisable. His policy recommendation is that rules should be used to make policy decisions

more predictable and to serve as rough benchmarks for making decisions, but should not be used as mechanical formulae. In this vein, policy rules are often employed in macroeconomic models to justify a particular description of central bank policy. This usage does not entail a stand on whether or not there is a commitment to a rule. Empirical findings support the view that policy rules provide a good estimate of actual policies of discretionary central banks. In this vein, Essay IV utilises a version of the Taylor interest rate rule to describe monetary policy in China.

3.4 Application of rules in the China context

In recent years a few papers have presented estimations of monetary policy rules for China. The papers can be divided broadly into two categories: those that analyse the properties of different types of rules on the basis of their ability to deliver desired macroeconomic outcomes for China and those that focus on estimating monetary policy reaction functions for China on the basis of the monetary policy rules literature. In the China context, compared with the advanced economies, the availability of different policy instruments, various administrative measures as well as the policy environment (all discussed in section 2) naturally affect the application of policy rules and the analysis based on them.

In the first category, Burdekin and Siklos (2008) develop an augmented McCallum rule for China in order to study PBC monetary policy in 1990–2005. They also estimate the parameters of the rule and find PBC policy to be responsive to the nominal output gap and that deviations from the rule correspond to inflationary pressures in China. Utilising the findings of Burdekin and Siklos (2008), Essay I estimates money growth rates suggested by the McCallum rule for China and finds the rule to be useful as a monetary policy guideline, as upward deviations from the rule are followed by higher inflation rates in the future.

He et al. (2011) estimate a structural vector autoregressive model for China that has monetary policy reacting via a money supply rule. They find that the PBC responds to inflation and output fluctuations but not to asset price fluctuations. In Essay I, it is also found that the McCallum rule does not contain information that would help to predict asset price inflation.

Zhang (2009) develops a new Keynesian dynamic stochastic general equilibrium (DSGE) model for China and studies the properties of a money supply rule and an interest rate rule. The results indicate that the interest rate rule is more effective in managing the macroeconomy and that shocks cause less economic

instability if the PBC uses an interest rate rule rather than a money supply rule. In line with Zhang (2009), Essay IV develops a DSGE model for China in which an interest rate rule is used to describe PBC monetary policy.

Zheng and Guo (2013) also estimate a small open economy DSGE model for China and find that the interest rate reacts to inflation changes, the output gap and changes in the exchange rate. Monetary policy shocks are found to have a significant influence on the economic dynamics in the short run but no real effects in the longer run. Liu and Zhang (2010) estimate a small new Keynesian model to assess the Chinese monetary policy framework, where quantity and price instruments are used simultaneously. The authors find that the use of both interest rate and money supply instruments simultaneously is optimal for the PBC and that a monetary policy rule combining both instruments is more effective in stabilising inflation and output than are single-instrument versions of Taylor or McCallum rules.

Papers in the second category include Fan et al. (2011), Jawadi et al. (2014), Mehrotra and Sánchez-Fung (2010) and Zheng et al. (2012).

Fan et al. (2011) assess monetary policy responsiveness in China by estimating Taylor and McCallum rules for 1992–2009. The policy rules are estimated with both fixed and time-varying coefficients. The policy instruments are found to respond to inflation and output gap, and the reactions are better captured by time-varying coefficient models. The reactions, however, are smaller than those observed for advanced economies. The effectiveness of the policy instruments is also analysed using a vector autoregressive (VAR) model for the economy. Here, neither of the policy instruments is found to have an effect on future inflation or output.

Using a somewhat similar approach, Mehrotra and Sánchez-Fung (2010) estimate a hybrid McCallum-Taylor reaction function (in a VAR model) for China in 1994–2008. Policy reactions are found to be countercyclical with respect to the output gap but procyclical with respect to the inflation gap. The authors also estimate a Taylor rule for China, but find that it does not provide an adequate description of China's monetary policy over the estimation period.

Jawadi et al. (2014) estimate nonlinear monetary policy reaction functions for China utilising Taylor and McCallum rules and taking into account reactions to financial markets, commodity prices and the exchange rate. Zheng et al. (2012) introduce a regime-switching forward-looking Taylor rule for China. The PBC's interest rate responses to inflation and output deviations are found to be asymmetric and the policy to be well characterized by a two-regime rule.

Essay II contributes to the analysis of PBC's policy reactions by estimating different monetary policy rules for China for the period 1998–2014. The time-varying analysis shows that China's monetary policy has become more responsive over time and suggests that in recent years the central bank policy actions have begun to rely also on the interest rate instrument.

4 Monetary policy transmission

Monetary policy transmission refers to the process by which monetary policy actions affect the economy via the financial markets. The transmission is far from immediate, and usually the precise effects of monetary policy actions on the economy are difficult to assess. Poor monetary transmission hinders the effectiveness of monetary policy in that changes in monetary policy do not fully impact aggregate demand and prices. In developing countries the main factor hampering policy transmission is the underdevelopment and segmentation of financial markets. The next section discusses the different monetary policy transmission channels, and section 4.2 reviews the previous literature on identifying the different channels for China.

4.1 Transmission channels

The economic literature specifies several possible monetary transmission channels. The traditional channels, classified by Boivin et al. (2011), are the interest rate channel for investment, the wealth channel for consumption, and the exchange rate channel for trade. There are other channels relating to market imperfections, such as the agency problems in credit markets. These are the credit channel and the bank lending channel.¹⁷

The direct *interest rate channel*, which is the most traditional mechanism of monetary policy transmission, refers to policy transmission via the user cost of capital in accordance with the Keynesian IS-LM model. When monetary policy is tightened, real interest rates rise, which adds to the cost of capital. Firms and consumers then demand less capital and so reduce their investment spending. This leads to a fall in aggregate demand. The opposite is true in the case of monetary policy loosening, which induces an increase in aggregate demand and output. In the new Keynesian framework, sticky prices and rational expectations make the change in the short-term nominal interest rate cause a corresponding change in the long-term real rates (Mishkin 1995).

The *wealth channel*, (or intertemporal substitution channel) describes how interest rates affect the consumption profile over time. The life-cycle hypothesis of

¹⁷ In addition, the “expectations channel” of monetary policy has been discussed in the literature. The central bank can, through its communication policy, alter the expectations of economic agents and thus affect economic outcomes. See e.g. Evans and Honkapohja (2001), Geraats (2009) and Woodford (2005).

saving and consumption (by Ando & Modigliani 1963) assumes that households consume their lifetime wealth and income and that all increases in wealth also increase consumption. The monetary authority can boost household consumption by pursuing expansionary monetary policy. Lowering the interest rate increases the returns on alternative assets, such as stocks or property, as an increase in money supply increases the propensity to invest in alternative assets. Hence, households' wealth increases. The intertemporal substitution effect assumes that lower interest rates today bring about higher consumption today (Boivin et al. 2011). The higher equity prices in response to lower interest rates also affect firms' investment according to Tobin's q theory (Tobin 1969). Higher equity prices lead to a higher q and thus to higher investment spending, which leads to a higher output (Mishkin 1995).

The *exchange rate channel* transmits monetary policy changes in open economies to changes in the exchange rate. Monetary policy loosening and lower interest rates in the home economy lower the relative return on domestic assets and make deposits in the home country less attractive. This causes the currency to depreciate. The cheaper currency in the home country makes export goods relatively cheaper and import goods more expensive, which increases aggregate demand by increasing the net exports. Monetary policy tightening works in reverse, so that aggregate demand declines.

The *credit channel* theory of policy transmission assumes that changes in the external finance premium amplify the direct effects of monetary policy on interest rates (Bernanke & Gertler 1995). The finance premium is the difference between the cost of funds raised externally – via equity issuance or bank loans – versus funds raised internally – via retained earnings. In the presence of financial market imperfections, the cost of external credit rises when the firm's balance sheet deteriorates, and this adds to the adverse selection and moral hazard problems (Boivin et al. 2011). Monetary policy can affect firms' balance sheets directly by affecting their debt service burdens via interest rates and indirectly by affecting their values via asset prices. Thus, monetary policy has an additional impact on the external finance premium: by affecting the interest rate it tends to change the finance premium in the same direction (Bernanke & Gertler 1995). Thus the real economy effects of a policy change are magnified.

Lastly, the *bank lending channel* is based on the assumption that retail bank deposits and other sources of funds are not perfectly substitutable. Banks have a special role in the financial markets, because they are well suited to deal with the asymmetric information problems of borrowers (Mishkin 1995). Expansionary

monetary policy that increases bank deposits increases the loanable funds available. As many lenders are dependent on bank loans as a source of financing, an increase in the amount borrowed from banks will boost consumption and investment in the economy. In their studies, Kashyap and Stein (1995, 2000) assume that banks do not have unlimited frictionless access to funds other than deposits. Thus the effect of a monetary policy change should have different effects on bank lending depending on the strength of banks' balance sheets. The bank lending channel is highlighted when banks with weaker access to external funding (proxied by small capitalization, liquidity, and size) react more strongly to policy changes.

4.2 Analysis for China

The characteristics of the Chinese monetary policy environment, discussed in section 2, have an impact on the monetary policy transmission that renders the transmission channels different from those of advanced economies. In general, there are only a few papers that attempt to identify the different monetary policy channels discussed in the previous section for China.

The interest rate channel is traditionally found to be weak in China. For example, Koivu (2009), Laurens and Maino (2007) and Mehrotra (2007) find that the interest rate channel does not function properly in China and that the influence of interest rate on the real economy is weak. Possible explanations are that in China the small enterprises are still lacking in access to financing, whereas the big state-owned companies have virtually unlimited access to cheap bank credit, making both of these groups less dependent on monetary policy conditions. The large informal shadow banking sector also limits the transmission and effectiveness of monetary policy.¹⁸

It is often found that the quantity-based policy instruments are more effective in adjusting the real economy and prices in China (see e.g. Fan et al. 2011, He et al. 2013, and Zhang 2011). This finding is in line with the result in Essay I that the level of money supply influences price developments in China. In recent years, however, the interest rate liberalisation and implementation of other market based reforms has intensified, making the economic agents more sensitive to the interest rates. Fernald et al. (2014) find that interest rate changes have considerable impacts

¹⁸ Even with a weak link between interest rates and economic activity in China, Koivu (2009) finds that the credit demand has become more dependent on interest rates, and thus the interest rate policy has gained some power along with the developments in the financial sector.

on economic activity and inflation in China. Therefore, the authors view the monetary policy transmission channel in China is moving closer to those in the advanced economies.

Consumers' saving and consumption habits are not very sensitive to interest rate changes, because of the extremely high domestic savings rate in China (see section 2.3). This may affect the wealth channel. Koivu (2012) studies the wealth channel in China by first examining the link between monetary policy and asset prices and then the link from asset prices to consumption. The first link from monetary policy to asset and housing prices is found to exist, but the study fails to find a clear link from assets prices to consumption. Koivu (2012) concludes that the wealth channel in China remains weak. In addition, the exchange rate channel in China is restrained by the largely binding capital controls and a nearly fixed exchange rate.

There are few papers that study the bank lending channel in China. Essay III extends the analysis of the two previous papers by Gunji and Yuan (2010) and Hou and Wang (2013) by examining the transmission of monetary policy via the bank lending channel in China. In Essay III, using the methodology of Kashyap and Stein (1995, 2000), we generally find no support for the existence of a bank lending channel. The results are robust to the monetary policy instrument: the reserve requirement ratio versus the interest rate. Results in Essay III are broadly in line with Gunji and Yuan (2010) who find limited evidence of differences in monetary policy responses depending on banks' capitalisation, liquidity and size. Hou and Wang (2013), on the other hand, find that as the marketization of the Chinese banking sector increases, monetary policy transmission via the bank lending channel weakens. Nguyen and Boateng (2013) study the bank lending channel in the case of involuntary excess reserves in China and find that banks with larger amounts of involuntary excess reserves appear to be less responsive to changes in monetary policy, which then makes monetary policy less effective.

5 Summary of Essays

5.1 Essay I: An analysis of Chinese money and prices using a McCallum-type rule

Essay I utilises the McCallum rule to study the interdependence of monetary policy and price developments in China. The hypothesis of the paper is that assuming the McCallum rule can deliver an optimal amount of money supply that keeps inflation at the desired level, deviations from the rule then should result in inflationary or deflationary pressures. The paper confirms this hypothesis in that the ‘monetary excess’, defined as the actual money supply in excess to the rule-amount, is useful in forecasting future consumer and producer prices. However, the stance of the money supply in China relative to the McCallum rule does not affect share prices or land prices, which are probably driven by their own shocks rather than by ‘monetary excess’.

The analysis is further extended to study whether the deviations from the rule have dynamic impacts on the overall economy in a structural vector autoregressive framework. Two findings arise from this analysis. First, money supply in excess vis-a-vis the McCallum rule leads to a permanent increase in nominal output in China, which stabilises only after a long lag. Second, as money is generally assumed to be neutral in the long run, the permanent increase in nominal output results from a permanent increase in the price level. Therefore, maintaining money supply close to the level generated by the McCallum rule can be seen as crucial to maintaining price stability in China also over the longer run.

5.2 Essay II: Contemporary monetary policy in China: An empirical assessment

Essay II broadens the analysis of monetary policy rules for China. Four different types of monetary policy rules are analysed to study the PBC’s policy responses in 1998–2014: the Taylor rule, the McCallum rule, and two hybrid rules that combine the features of both. The primary focus is on detecting changes in policy reactions over time, given that the monetary policy environment has become remarkably more market-based over the estimation period.

The results show that the approaches based on the literature on monetary policy rules can be utilised to study PBC policy. Monetary policy in China is conducted

more or less in line with the advanced economy counterparts, where the policy instruments respond to changes in macroeconomic variables in a countercyclical fashion. In China, the money supply instrument is found to react more strongly to price developments and to a lesser extent to output changes. The interest rate reactions also become statistically significant after 2008. The interest rate, however, mainly responds to the output gap. The general finding in the earlier literature is that interest rate rules do not well describe the PBC monetary policy. The results of this paper offer the opposite view. The findings support the perception that PBC policy is placing increasingly more weight also on the interest rate instrument.

5.3 Essay III: Reserve requirements and the bank lending channel in China

In Essay III the focus shifts from monetary policy rules to monetary policy transmission in China. The paper analyses the presence of a bank lending channel in China, and examines the reactions of banks' loan supply to changes in monetary policy using the methodology of Kashyap and Stein (1995, 2000).

Compared to the advanced economies, the unique feature of Chinese monetary policy is the active use of the required reserve ratio (RRR) as a policy tool. Changes in RRR work much like policy interest rate changes, in that both affect how much the banks are willing to lend to their customers. The difference is that the RRR directly changes the quantity of money available for lending, whereas the interest rate instrument produces a price incentive to alter the level of lending. While changes in RRR are found to affect bank lending in China, we generally find that they do not influence the transmission of monetary policy via the bank lending channel.

Our sample of 170 Chinese banks is exceptionally large in comparison to the existing literature. The comprehensive sample of banks also enables us to study whether policy transmission in China differs according to bank type. In general, we find that different types of banks react differently to changes in monetary policy. In this way, changes in the ownership structure of banks can also affect monetary policy effectiveness in China.

The paper also contributes to the discussion of the preferred monetary policy instruments in China. The bank lending channel is further analysed with the interest rate as the monetary policy instrument. The results show that the interest rate is an effective monetary policy instrument and that it can be used as well to alter bank

lending. However, no bank lending channel is identified with the interest rate as the policy instrument either.

5.4 Essay IV: Changing economic structures and impacts of shocks: Evidence from a dynamic stochastic general equilibrium model for China

In the last Essay the focus is extended to study the overall economic dynamics and monetary policy transmission in China. To do this we develop a dynamic stochastic general equilibrium model that is calibrated for the Chinese economy. The paper studies the economy-wide effects of the rebalancing away from the investment-led growth, which is universally viewed as essential for China. The aggregate economy effects of the desired rebalancing are not widely analysed in the previous literature.

The paper studies how the economy would respond to shocks arising from monetary policy or technological innovations in the rebalanced economy, compared to the economy as it is now structured. Monetary policy in the model follows the Taylor rule. The results show that the rebalancing will not have a large impact on the transmission of monetary policy shocks in the economy.

On the other hand, when facing a technology shock the economy, having a lower investment share and a higher consumption share, will be better able to bear the effects of a shock. In the rebalanced economy, the responses of the real economy will be shorter-lived and will be smaller in the long run. Further, monetary policy will play a role in stabilising the economy in the presence of technology shocks. If the monetary authority changes its reaction function so as to place more weight on reducing output fluctuations in the Taylor rule, in line with the higher consumption share, the overall impacts of technology shocks are further reduced.

References

- Ando, A. & Modigliani, F. (1963). The "life cycle" hypothesis of saving: Aggregate implications and tests. *The American Economic Review* 53: 55–84.
- Ayyagari, M., Demirgüç-Kunt, A. & Maksimovic, V. (2010). Formal versus informal finance: Evidence from China. *The Review of Financial Studies* 23(8): 3048–3097.
- Barro, R.I. & Gordon, D.B. (1983). Rules, discretion and reputation in a model of monetary policy. *Journal of Monetary Economics* 12: 101–121.
- Ball, L. (1999a). Policy rules for open economies. In: Taylor, J.B. (ed) *Monetary Policy Rules*. Chicago, University of Chicago Press: 127–156.
- Ball, L. (1999b). Efficient rules for monetary policy. *International Finance* 2: 63–83.
- Batini, N. & Haldane, A. (1999). Forward-looking rules for monetary policy. In: Taylor, J.B. (ed) *Monetary Policy Rules*. Chicago, University of Chicago Press: 57–92.
- BBVA (2013). *Banking Watch China*, 8 March 2013. Hong Kong, BBVA Research.
- Bernanke, B. & Gertler, M. (1995). Inside the black box: The credit channel of monetary policy transmission. *Journal of Economic Perspectives* 9(4): 27–48.
- Bernanke, B. & Gertler, M. (1999). Monetary policy and asset price volatility. *Proceedings, Federal Reserve Bank of Kansas City*: 77–128.
- Bernanke, B. & Gertler, M. (2001). Should central banks respond to movements in asset prices? *American Economic Review* 91(2): 253–257.
- Boivin, J., Kiley, M.T. & Mishkin, F.S. (2011). How has the monetary transmission mechanism evolved over time? In: Friedman, B.M. & Woodford, M. (eds) *Handbook of Monetary Economics*. Amsterdam, Elsevier: 369–422.
- Bowles, P. & Wang, B. (2013). Renminbi internationalization: A journey to where? *Development and Change* 44(6): 1363–1385.
- Bryant, R.C., Hooper, P. & Mann, C.L. (eds) (1993). *Evaluating Policy Regimes: New Research in Empirical Macroeconomics*. Washington DC, Brookings Institution.
- Burdekin, R.C.K. & Siklos, P.L. (2008). What has driven Chinese monetary policy since 1990? Investigating the People's bank's policy rule. *Journal of International Money and Finance* 27: 847–859.
- Chari, V.V., Kehoe, P.J. & Prescott, E.C. (1989). Time consistency and policy. In: Barro, R.J. (ed) *Modern Business Cycle Theory*. Cambridge, Harvard University Press: 265–305.
- Chen, H., Chen, Q. & Gerlach, S. (2013). The implementation of monetary policy in China: The interbank market and bank lending. In: Bang, N.J. & Olivero, M.P. (eds) *Global Banking, Financial Markets and Crises*. Bingley, Emerald Publishing: 31–69.
- Clarida, R. (2001). The empirics of monetary policy rules in open economies. *International Journal of Finance and Economics* 6(4): 315–323.
- Clarida, R., Galí, J. & Gertler, M. (1998). Monetary policy rules in practice - Some international evidence. *European Economic Review* 42: 1033–1067.
- Clarida, R., Galí, J. & Gertler, M. (2000). Monetary policy rules and macroeconomic stability: Evidence and some theory. *Quarterly Journal of Economics* 115: 147–180.

- Estrella, A. & Mishkin, F. S. (1997). Is there a role for monetary aggregates in the conduct of monetary policy? *Journal of Monetary Economics* 40: 279–304.
- Evans, G.W. & Honkapohja, S. (2001). *Learning and Expectations in Macroeconomics*. Princeton: Princeton University Press.
- Fan, L., Yu, Y. & Zhang, C. (2011). An empirical evaluation of China's monetary policies. *Journal of Macroeconomics* 33: 358–371.
- Fernald, J.G, Spiegel, M.M. & Swanson, E.T. (2014). Monetary policy effectiveness in China: Evidence from a FAVAR model. *Journal of International Money and Finance* 49: 83–103.
- Fidrmuc, J. (2010). Time-varying exchange rate basket in China from 2005 to 2009. *Comparative Economic Studies* 52: 515–529.
- Fleming, J.M. (1962). Domestic financial policies under fixed and under floating exchange rates. *IMF Staff Papers* 9: 369–379.
- Friedman, M. (1960). *A Program for Monetary Stability*. New York, Fordham University Press.
- Friedman, M. (1968). The role of monetary policy. *The American Economic Review* 58: 1–17.
- Friedman, M. & Schwartz, A. (1963). *A Monetary History of the United States 1867–1960*. Princeton, Princeton University Press.
- FSB (2014). *Global Shadow Banking Monitoring Report 2014*. Financial Stability Board.
- Geiger, M. (2008). Instruments of monetary policy in China and their effectiveness: 1994–2006. United Nations Conference on Trade and Development, Discussion Papers No. 187.
- Geraats, P.M. (2009). Trends in monetary policy transparency. *International Finance* 12: 235–268.
- Giannoni, M.P. & Woodford, M. (2004). Optimal inflation-targeting rules. In: Bernanke, B.S. & Woodford, M. (eds) *The Inflation-Targeting Debate*. Chicago, University of Chicago Press: 93–172.
- Goodhart, C. & Hofmann, B. (2002). Asset prices and the conduct of monetary policy. Royal Economic Society Annual Conference 88.
- Gunji, H. & Yuan, Y. (2010). Bank profitability and the bank lending channel: Evidence from China. *Journal of Asian Economics* 21: 129–141.
- Hall, R.E. & Mankiw, N.G. (1994). Nominal income targeting. In: Mankiw, N.G. (ed) *Monetary Policy*. Chicago, University of Chicago Press: 71–94.
- He, P., Nie, G., Wang, G. & Zhang, X. (2011). Optimal monetary policy in China. *China & World Economy* 19: 83–105.
- He, Q., Leung, P-H. Chong, T.T-L. (2013). Factor-augmented VAR analysis of the monetary policy in China. *China Economic Review* 25: 88–104.
- Hou, X. & Wang, Q. (2013). Implications of banking marketization for the lending channel of monetary policy transmission: Evidence from China. *Journal of Macroeconomics* 38: 442–451.
- Hu, X. (2010). Successful experiences of further reforming the RMB exchange rate regime. URI: <http://www.bis.org/review/r100812d.pdf>. Cited 2015/10/14.

- IMF (2011). People's Republic of China: Financial System Stability Assessment. IMF Country Report No. 11/321. Washington DC, International Monetary Fund.
- Jawadi, F., Mallick, S.K. & Sousa, R.M. (2014). Nonlinear monetary policy reaction functions in large emerging economies: the case of Brazil and China. *Applied Economics* 46: 973–984.
- Kashyap, A. & Stein, J. (1995). The impact of monetary policy on bank balance sheets. *Carnegie-Rochester Conference Series on Public Policy* 42: 151–195.
- Kashyap, A. & Stein, J. (2000). What do a million observations in banks say about the transmission of monetary policy? *American Economic Review* 90: 407–428.
- Koivu, T. (2009). Has the Chinese economy become more sensitive to interest rates? Studying credit demand in China. *China Economic Review* 20: 455–470.
- Koivu, T. (2012). Monetary policy, asset prices and consumption in China. *Economic Systems* 36: 307–325.
- Kydland, F. & Prescott, E. (1977). Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy* 85(3): 473–492.
- Laurens, B.J. & Maino, R. (2007). China: Strengthening monetary policy implementation. IMF Working Paper WP/07/14.
- Leung, M-K. & Lu, Q. (2011). Changing money market and monetary policy operations in China: An institutional perspective. *Journal of Contemporary China* 20: 287–305.
- Levin, A.T., Onatski, A., Williams, J.C. & Williams, N. (2005). Monetary policy under uncertainty in micro-founded macroeconomic models. NBER Macroeconomics Annual 20: 229–312.
- Levin, A., Wieland, V. & Williams, J.C. (2003). The performance of forecast-based monetary policy rules under model uncertainty. *American Economic Review* 93(3): 622–645.
- Li, J., Hsu, S. & Qin, Y. (2014). Shadow banking in China: Institutional risks. *China Economic Review* 31: 119–129.
- Libanio, G. (2015). People's bank of China. In: Rochon, L.-P. & Rossi, S. (eds). *The Encyclopedia of Central Banking*. Cheltenham, Edward Elgar Publishing: 403–405.
- Liu, L-g. & Zhang, W. (2010). A New-Keynesian model for analysing monetary policy in Mainland China. *Journal of Asian Economics* 21: 540–551.
- Ljungwall, C., Xiong, Y. & Yutong, Z. (2013). Central bank financial strength and the cost of sterilization in China. *China Economic Review* 25: 105–116.
- Luo, D. & Yao, S. (2010). World financial crisis and the rise of Chinese commercial banks: An efficiency analysis using DEA. *Applied Financial Economics* 20: 1515–1530.
- Luo, Y., Ren, J. & Wang, Y. (2015). Misvaluation comovement, market efficiency and the cross-section of stock returns: evidence from China. *Economic systems* 39: 390–412.
- Ma, G., Xiandong, Y. & Xi, L. (2013). China's evolving reserve requirements. *Journal of Chinese Economic and Business Studies* 11(2): 117–137.
- Ma, G. & McCauley, R.N. (2008). Efficacy of China's capital controls: Evidence from price and flow data. *Pacific Economic Review* 13: 104–123.
- McCallum, B.T. (1984). Monetarist rules in the Light of Recent Experience. *American Economic Review* 74: 388–391.

- McCallum, B.T. (1988). Robustness properties of a rule for monetary policy. *Carnegie-Rochester Conference Series on Public Policy* 29(Autumn): 173–203.
- McCallum, B.T. (1990). Targets, indicators, and instruments of monetary policy. In: Haraf, W.S. & Cagan, P. (eds) *Monetary Policy for a Changing Financial Environment*. Washington DC, the AEI Press: 44–70 and 193–197.
- McCallum, B.T. (1993). Specification and analysis of a monetary policy rule for Japan. *Bank of Japan Monetary and Economic Studies* 11: 1–45.
- McCallum, B.T. (1994). Specification of policy rules and performance measures in multicountry simulation studies. *Journal of International Money and Finance* 13(3): 259–275.
- McCallum, B.T. (1999). Issues in the design of monetary policy rules. In: Taylor, J.B. & Woodford, M. (eds) *Handbook of Macroeconomics*. Amsterdam, North-Holland: 1483–1530.
- McCallum, B.T. (2000). Alternative monetary policy rules: A comparison with historical settings for the United States, the United Kingdom, and Japan. *Federal Reserve Bank of Richmond Economic Quarterly* 86: 49–79.
- McCallum, B.T. (2001). Should monetary policy respond strongly to output gaps? *American Economic Review* 91(2): 258–262.
- McCallum, B.T. & Nelson, E. (2005). Targeting versus instrument rules for monetary policy. *Federal Reserve Bank of St. Louis Review* 87(5): 597–611.
- Mehrotra, A.N. (2007). Exchange and interest rate channels during a deflationary era – evidence from Japan, Hong Kong and China. *Journal of Comparative Economics* 35: 188–210.
- Mehrotra, A. & Sánchez-Fung, J. (2010). China’s monetary policy and the exchange rate. *Comparative Economic Studies* 52: 497–514.
- Mishkin, F.S. (1995). Symposium on the monetary transmission mechanism. *Journal of Economic Perspectives* 9(4): 3–10.
- Morck, R., Yeung, B. & Yu, W. (2000). The information content of stock markets: why do emerging markets have synchronous stock price movements? *Journal of Financial Economics* 58: 210–260.
- Mundell, R.A. (1960). The monetary dynamics of international adjustment under fixed and flexible exchange rates. *Quarterly Journal of Economics* 74: 227–257.
- Nguyen, V.H.T. & Boateng, A. (2013). The impact of excess reserves beyond precautionary levels on bank lending channels in China. *Journal of International Financial Markets, Institutions and Money* 26: 358–377.
- Oksanen, H. (2012). Re-pegging the renminbi to a basket: Issues and implications. *Asian-Pacific Economic Literature* 26: 18–33.
- Orphanides, A., Porter, R.D., Reifschneider, D., Tetlow, R. & Finan, F. (2000). Errors in the measurement of the output gap and the design of monetary policy. *Journal of Economics and Business* 52: 117–141.
- Orphanides, A. & van Norden, S. (2002). The unreliability of output-gap estimates in real time. *The Review of Economics and Statistics* 84(4): 569–583.

- Orphanides, A. & Williams, J.C. (2002). Robust monetary policy rules with unknown natural rates. *Brookings Papers on Economic Activity* 2: 63–118.
- Ouyang, Y.A., Rajan, S.R., & Willet, T.D. (2010). China as a reserve sink: The evidence from offset and sterilization coefficients. *Journal of International Money and Finance* 29(10): 951–972.
- PBC Annual reports 2007–2013. URI: <http://www.pbc.gov.cn/english/130739/index.html>. Cited 2015/10/14.
- PBC (1995). Law of the People's Republic of China on commercial banks. URI: http://www.pbc.gov.cn/publish/english/964/1952/19526/19526_.html. Cited: 2014/04/09.
- PBC (2001). Continuing sound monetary policy and sustaining strong economic growth. URI: http://www.pbc.gov.cn/publish/english/956/1938/19381/19381_.html. Cited 2014/04/09.
- PBC (2003). Law of the People's Republic of China on the People's Bank of China. URI: <http://www.pbc.gov.cn/english/130721/2831163/index.html>. Cited 2015/10/14.
- PBC (2005a). Public announcement of the People's Bank of China on reforming the RMB exchange rate regime. URI: <http://www.pbc.gov.cn/english/130721/2831438/index.html>. Cited 2015/10/14.
- PBC (2005b). Circular on further improving the management of the trading prices in the inter-bank foreign exchange market and the quoted exchange rates of the foreign exchange-designated banks. URI: <http://www.pbc.gov.cn/english/130721/2873884/index.html>. Cited 2015/10/14.
- PBC (2005c). Speech of governor Zhou Xiaochuan. URI: <http://www.pbc.gov.cn/english/130724/2829809/index.html>. Cited 2015/10/14.
- PBC (2005d). Supplement to the China monetary policy report – report on steady progress in market-based interest rate reform. URI: <http://www.pbc.gov.cn/english/130721/2831321/index.html>. Cited 2015/10/14.
- PBC (2008). Speech by deputy governor Mr. Yi Gang in the 2008 Shibor work conference. URI: <http://www.pbc.gov.cn/english/130724/2829954/index.html>. Cited 2015/10/14.
- PBC (2013a). China financial stability report 2013. URI: <http://www.pbc.gov.cn/english/130736/2869239/index.html>. Cited 2015/10/14.
- PBC (2013b). PBC official answers press questions on furthering market-based interest rate reform. URI: <http://www.pbc.gov.cn/english/130721/2868795/index.html>. Cited 2015/10/14.
- Porter, N. & Xu, T. (2009). What drives China's interbank market? IMF Working Paper WP/09/189.
- Reifschneider, D. & Williams, J. C. (2000). Three lessons for monetary policy in a low-inflation era. *Journal of Money, Credit and Banking* 32(4): 936–966.
- Rudebusch, G. & Svensson, L.E.O (1999). Policy rules for inflation targeting. In: Taylor, J.B. (ed) *Monetary Policy Rules*. Chicago, University of Chicago Press: 203–262.
- SAFE (2013). Annual report of the State Administration of Foreign Exchange. URI: <http://www.safe.gov.cn/wps/portal/english/AnnualReport>. Cited 2014/29/09.

- Smets, F. (2002). Output gap uncertainty: Does it matter for the Taylor rule? *Empirical Economics* 27: 113–129.
- Svensson, L.E.O. (1997). Inflation forecast targeting: Implementing and monitoring inflation targets. *European Economic Review* 41: 1111–1146.
- Svensson, L.E.O. (1999a). Price level targeting vs. inflation targeting: A free lunch? *Journal of Money, Credit and Banking* 31: 277–295.
- Svensson, L.E.O. (1999b). Inflation targeting as a monetary policy rule. *Journal of Monetary Economics* 43: 607–654.
- Svensson, L.E.O. (2002). Inflation targeting: should it be modelled as an instrument rule or a targeting rule? *European Economic Review* 46: 771–780.
- Svensson, L.E.O. (2003). What is wrong with Taylor rules? Using judgment in monetary policy through targeting rules. *Journal of Economic Literature* 41: 426–477.
- Svensson, L.E.O. (2005). Targeting versus instrument rules for monetary policy: What is wrong with McCallum and Nelson? *Federal Reserve Bank of St. Louis Review*, 87(5): 613–625.
- Tan, Z. & Yang, S. (2012). Neutralization in China: Evidence from the balance sheet of the People's Bank of China. *Journal of Economic Policy Reform* 15: 25–31.
- Taylor, J.B. (1981). Stabilization, accommodation, and monetary rules. *American Economic Review* 71: 145–149.
- Taylor, J.B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy* 39: 195–214.
- Taylor, J.B. (1994). The inflation / output variability trade-off revisited. In: Fuhrer, J.C. (ed) *Goals, Guidelines, and Constraints Facing Monetary Policymakers*. Boston, Federal Reserve Bank of Boston: 21–38.
- Taylor, J.B. (1999a). A historical analysis of monetary policy rules. In: Taylor, J.B. (ed) *Monetary Policy Rules*. Chicago, University of Chicago Press: 319–341.
- Taylor, J.B. (1999b). The robustness and efficiency of monetary policy rules as guidelines for interest rate setting by the European Central Bank. *Journal of Monetary Economics* 43: 655–679.
- Taylor, J.B. (2001a). The role of the exchange rate in monetary-policy rules. *American Economic Review* 91(2): 263–267.
- Taylor, J.B. (2001b). Using monetary policy rules in emerging market economies. *Stabilization and Monetary Policy: The International Experience*, proceedings of a conference at the Bank of Mexico.
- Taylor, J.B. & Williams, J.C. (2011). Simple and robust rules for monetary policy. In: Friedman, B.M. & Woodford, M. (eds) *Handbook of Monetary Economics, Volume 3B*. Saint Louis, North-Holland: 829–859.
- Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of Money, Credit and Banking* 1: 15–29.
- Wang, Y. (2010). Effectiveness of capital controls and sterilizations in China. *China and World Economy* 18(3): 106–124.
- Williams, J.C. (2003). Simple rules for monetary policy. *Federal Reserve Bank of San Francisco Economic Review*: 1–12.

- Woodford, M. (2005). Central bank communication and policy effectiveness. Proceedings of the Federal Reserve Bank of Kansas City Economic Symposium at Jackson Hole.
- Wu, X. (2004). China's monetary and interest rate policy in year 2004. URI: <http://www.bis.org/review/r040528g.pdf>. Cited 2015/10/14.
- Zhang, C. (2011). Why is inflation in China a monetary phenomenon? *China & World Economy* 19: 1–17.
- Zhang, W. (2009). China's monetary policy: Quantity versus price rules. *Journal of Macroeconomics* 31: 473–484.
- Zheng, T. & Guo, H. (2013). Estimating a small open economy DSGE model with indeterminacy: Evidence from China. *Economic Modelling* 31: 642–652.
- Zheng, T., Wang, X. & Guo, H. (2012). Estimating forward-looking rules for China's monetary policy: A regime-switching perspective. *China Economic Review* 23: 47–59.
- Zhou, X. (2009). On savings ratio. URI: <http://www.bis.org/review/r090327b.pdf>. Cited 2015/10/14.

Original publications

- I Koivu T., Mehrotra A. & Nuutilainen R. (2009) An analysis of Chinese money and prices using a McCallum-type rule. *Journal of Chinese Economic and Business Studies* 7(2): 219–235.
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