The Diseconomies Of Using The Policy Instruments To Control Inflation And In Particular Credit Growth In Beijing And Shanghai: Evidence On Shadow Banking

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Major Paper, ECO 6999

August 6, 2014

uOttawa

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ABSTRACT

The increasing credit growth is a source of deep concern to the Chinese economy and containing it has become the upmost priority for the People's Bank of China (PBC). The two main tools used by the Chinese authorities to control the liquidity, the credit growth and inflation are the reserve requirement ratio (RRR) and the policy interest rate. This paper's objective is to study the effectiveness of these policy changes in controlling inflation and in particular credit growth. Due to the important macroeconomic differences among Chinese cities, the paper will focus on two main cities: Beijing and Shanghai. The results show that the two policy tools are effective at containing the overall inflation in China. However, when it comes to credit growth containment, the results show that the use of the reserve requirement ratio tool is ineffective because it increases credit growth instead of contracting it.

I. Introduction

Inflation and credit growth are two chief sources of concern for the Chinese economy and controlling them is a major challenge for the Chinese policy makers and the central bank. On one hand, the People's Bank of China (PBC) uses the policy interest rate mainly to control inflation while it can also indirectly curb credit growth. On the other hand, the PBC uses the reserve requirement ratio (RRR) intensively with the objective of curbing the credit growth while it is also used to curb inflation.

The paper focuses on the how the use of the RRR curbs inflation successfully while having an adverse effect on credit growth and leading to increased lending through the shadow banking system.

1. Comparison between Beijing and Shanghai for the period 2000-2007

We start with a brief comparison between two representative cases in this study. Beijing and Shanghai are the two most prosperous cities in China and intensely promoted by the central government, and due to the availability of a comprehensive data set, the paper focuses only on these two cities.

	Beijing	Shanghai
Average GDP growth rate	1.4%	1.1%
Average GDP	298 billion RMB	359 billion RMB
Average GDP/capita growth rate	14.1%	11.0%
Average Population growth rate	0.6%	3.3%
# Of foreign direct investment contracts	1656	3513
Total capital invested by foreign direct investments	23 billion USD	45 billion USD
Average growth rate of wages	1.3%	1.1%
Average housing prices inflation	4.4%	2.5%
Average growth rate of credit	1.7%	1.2%
Average Inflation	1.7%	0.9%
Total exports	192 billion USD	555 billion USD

Total imports	601 billion USD	602 billion USD
Total trade	793	1,158 billion USD
Stoch exchange	No	Yes

The table above makes a simple macroeconomic and demographic comparison between the two cities. The most striking difference is that the total exports of Shanghai are almost three folds those of Beijing and the total capital invested by foreign direct investments in Shanghai is double that of Beijing. The average GDP in Shanghai for the studied period exceeds that of Beijing by 20% but with a lower GDP growth rate. However, the GDP growth in Shanghai accelerates and starts to grow faster past 2007. Shanghai has the Maglev train, the fastest train in the world in commercial operation and the state of the art world financial tower in Pudong distric (Xilin Lu, 2006), which has an unparalleled engineering construction in China. (Fulong Wu, 2000) elaborates how Shanghai is becoming a world city and how globalization is impacting Shanghai in particular compared to other cities in China.

The higher exports and foreign direct investment capital invested also give us a better sense why Shanghai is called a magnet for foreign companies. Fulong Wu also emphasizes that the Chinese authorities' more willingness to give more autonomy to Shanghai, along with greater changes in political economy contributed to the prosperity of Shanghai. This in turn attracts more foreign companies who are increasingly worried about local government hassle. Shanghai's solid economic formation, its geographical proximity to the booming cities in Zhejiang and Jiangsu, its relatively better trained labor force (Y. C. Richard Wong, 2002) and advanced infrastructure, all cause it to attract a larger number of joint ventures from a large number of countries.

2. The Reserve requirement ratio

The RRR is the minimum deposit percentage that banks should keep with the central bank. These deposits cannot be used to provide credit or buy securities (Christian Glocker & Pascal Towbin 2012). It is a policy tool aimed at curbing inflation and it is used in a number of countries, however the ratio is relatively very high in some countries such as Lebanon, Suriname, China, Tajikistan and Brazil.

The table below shows the latest data available on the reserve requirement ratio in the countries that employ it.

Country	RRR(%)	Country	RRR(%)
Eurozone	1	Zambia	8
Czech Republic	2	Burundi	8.5
Hungary	2	Turkey	8.5
South Africa	2.5	Ghana	9
Switzerland	2.5	Israel	9
Latvia	3	Bulgaria	10
Poland	3.5	Mexico	10.5
India	4	Croatia	14
Russia	4	Costa Rica	15
Chile	4.5	Malawi	15
Nepal	5	Romania	15
Pakistan	5	Hong Kong	18
Bangladesh	6	Brazil	20
Lithuania	6	Tajikistan	20
Taiwan	7	China	20.5
Jordan	8	Suriname	25
Sri Lanka	8	Lebanon	30

Table 1: Reserve requirement ratios of countries

In Lebanon, the reserve requirement is the highest. The reason is that banks attempt to keep a very solid status while withholding large amounts of liquidity because of the political instability in the region and its unfortunate geographical location. Brazil's high reserve requirement ratio is the subject of many papers and this matter will be elaborated further in the literature review section. Suriname goes hand in hand with Brazil due its geographical proximity.

The transmission mechanism of the RRR first takes its effect by forcing banks to withhold a fraction of their deposits and liabilities as liquid reserves in the central bank. By doing so, the RRR manages the credit cycle as follows: When lending is on the rise, an increase in the RRR slows credit growth and limits excess leverage of borrowers, thus acting as a speed limit and when the rate of lending is low, a decrease in the RRR stimulates credit growth since banks will have more access to liquidity to lend and make profit on (Camilo E. Tovar, Mercedes Garcia-Escribano, and Mercedes Vera Martin, 2012)

3. The policy interest rate

The PBC is committed to maintaining a stable inflation rate within the economy because an expectable inflation helps households and firms make their investment, saving and spending decisions. In other words, the PBC has the responsibility to anchor the expectations of individuals of firms to provide a healthy economic environment free of surprises. Christopher Ragan (2005) explains the transmission mechanism of the policy interest rate as follows: If the PBC sees a rapid economic expansion, it may want to tighten the monetary policy in order to slow the rapid growth and halt the aggregate demand. For this purpose, the PBC increases the policy interest rate thus slowing consumption and investment, which in turn slow the aggregate output and widen the output gap, the difference between the actual and potential output. This leads firms to produce below capacity and inflation decreases, however at the cost of decreasing wages.

On the other hand, the increase in the policy interest rate leads to an exchange rate appreciation, which in turn causes the price of imports to decrease, implying an increase in imports and a decrease in exports. The latter also causes a slowdown in the aggregate demand and thus a decrease in inflation.

The time required for the policy interest rate of the above-mentioned transmission mechanism to take effect varies between countries. In Canada, the lag between the change of the policy interest rate and that of the inflation may take over 18 months to take the full effect (Christopher Ragan, 2005). In Brazil, the raising the policy interest rate 1% causes the inflation to reach its minimum of around -0.2% after 6 months and stabilizes back to its original level in around 30 months (Christian Glocker & Pascal Towbin, 2011). In this paper, a lag of 6 months is used for the policy interest rate to take its full effect on inflation with significant results.

4. China's credit growth

In the aftermath of the global financial crisis, the Chinese government resorted to huge investments aimed at alleviating the expected economic downturn. The latter strategy effectively eased the output growth slowdown however, at the cost of a massive credit growth. This paper avoids the period of the global financial crisis.
One of the main destabilizing factors of the Chinese economy lies in the way infrastructure investments were carried out with a demand mismatch and a huge credit financing the developments.

The most notably inefficient channeling of investment manifests itself in the government's rapid urbanization plans through infrastructure investments, which have resulted in the famous "Ghost towns". Among the most significantly empty towns is "Tiandu" city in Hangzhou, which is a replica of Paris with a European style construction and a downsized Eiffel tower.
South China mall in Dongguan city is the biggest mall worldwide and a famous "Ghost town". Lanzhou new area is another example of wasteful infrastructure investment where over 700 mountains need to be leveled to make a city. Last but not least is a project in "Kangbashi" in Ordos, Inner Mongolia. This is a town full of business offices and governmental workplaces capable of accommodating over a million people.

In addition to the government's unjustified infrastructure spending, shadow banking was exacerbating the situation. The graph below clearly displays how credit grew considerably to 34% during the recession while the total output plummeted to around 5%.

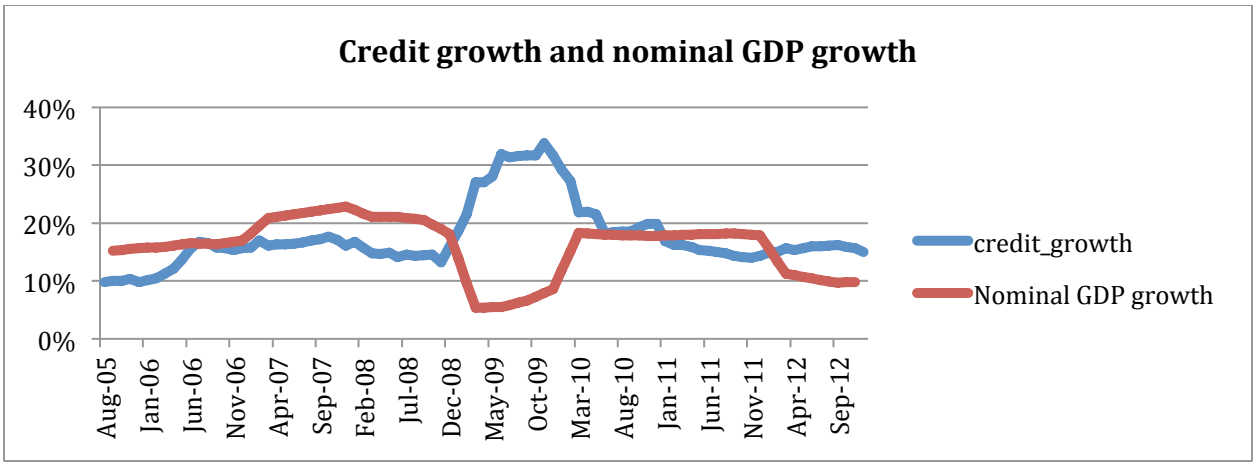

Figure 1: credit growth and nominal GDP

The government's actions were definitely creating jobs during hard economic times and preventing a deeper fall in the GDP but were not matching the demand. The credit surplus between late 2008 and mid 2010 was tremendous. The graph above shows that credit growth returned to its original level and that things are back to normal. The graph below shows a different angle of the additional credit that started floating around in late 2008 in the economy and was not "ingested". Shadow banking has been on the rise since the beginning of the global financial crisis. The snowball started when the Central bank imposed restrictions such as the RRR and the policy interest rate to fight rising inflation and credit growth. The latter restrictions further exacerbated the snowball effect by motivating banks to find ways around the restrictions to maximize their profit (Adrian, Tobias; Ashcraft, Adam B.; Cetorelli, Nicola, 2013).

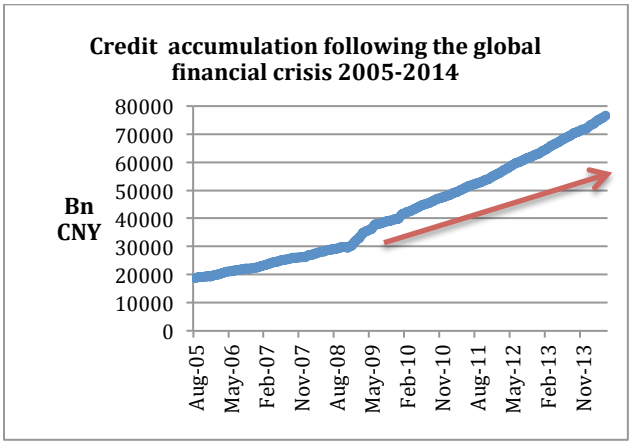

Figure 2: Credit accumulation 2005-2014

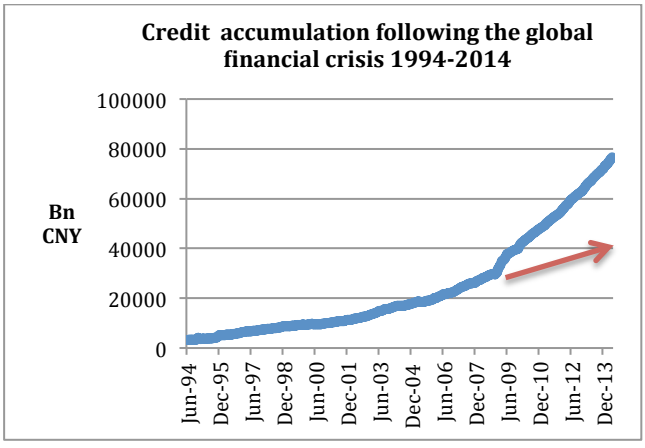

Figure 3: Credit accumulation 1994-2014

The arrows in red show the approximate projected normal trend and the blue line demonstrates the actual credit accumulated deviating from normal trend. Taking a time period extending beyond the scope of this study (from June 1995) demonstrates how aggravated the picture is (figure 3)

The area between the blue credit line and the red arrow is in big part the credit surplus floating in the economy and is the main source of concern to economists regarding the future of China's growth.

The role played by the shadow banking in aggravating the credit growth since late 2008 was very important. Credit growth from shadow banking is a different and relatively new form of credit in China that was not there a decade ago when most of the lending was through the state owned Chinese banks. Back then, lending was tightly monitored and controlled by the state owned banks and capital controls were controlled. Nowadays, with the Chinese government pursuing the RMB internationalization, the easing on cross border capital flows and the gradual opening and freeing of the financial system, lending by financial institutions has increased tremendously. The latter rate of credit increase hit a historic record high in China and the speed of credit growth matches that of the U.S. prior to the financial crisis. This is a major source of concern to the Chinese government and to the world.

Recently, more and more corporations and even industries have engaged in lending to generate revenues and diversify their business as a complimentary line to their industry. Acting as banks, these financial institutions and industries are motivated to engage in lending because many businesses are unable to secure loans from banks at fair rates. Offshore low rates of borrowing have attracted many firms in Mainland China. The Chinese government has been recently trying to curb down illegal lending. A famous recent form of illegal lending by a Chinese trading company in Qingdao was in the spotlight when it was providing multiple loans backed by the same collateral.

Chinese authorities have been trying hard to curb lending through tighter controls such as limiting borrowing with collateral in iron, ore and cupper. However investors

have always been successful to get around the regulations and finding alternative collateral to back up their loans. Today China is faced with an on-going historic challenge to setup a repertoire of successful macroprudential monetary policy to prevent a credit boom and bust that would put both the national and international economies on the line. Implementing a policy of "Laisser faire" with no capital flow restrictions, a complete financial system openness and a freely floating exchange rate is impossible at the present time because the Chinese financial markets need more reforms towards a better framework of transparency governing the lending to state owned enterprises.

5. A review of the changes in policy tools

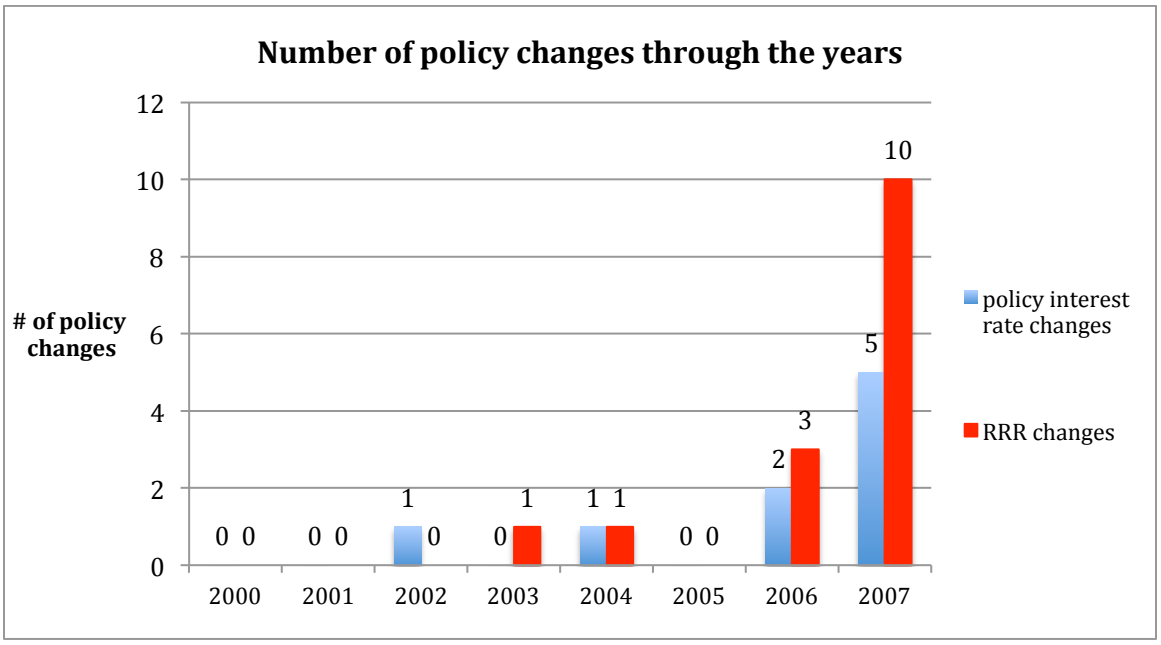

Figure 4: Number of policy changes 2005-2012

The Chinese central bank has stepped up its monetary policy interventions in 2007. A total of 15 reserve requirement changes and 9 policy interest rate changes were recorded by the central bank between 2000 and 2007.

The reserve requirement ratio is a widely used tool by the Chinese central bank to control liquidity in the markets and thus fight inflation. This tool is rarely used by other countries due to the disturbing effects it can have on the financial markets.

Between January 2001 and December 2007, the PBC raised the RRR 15 times and policy interest rate 9 times.

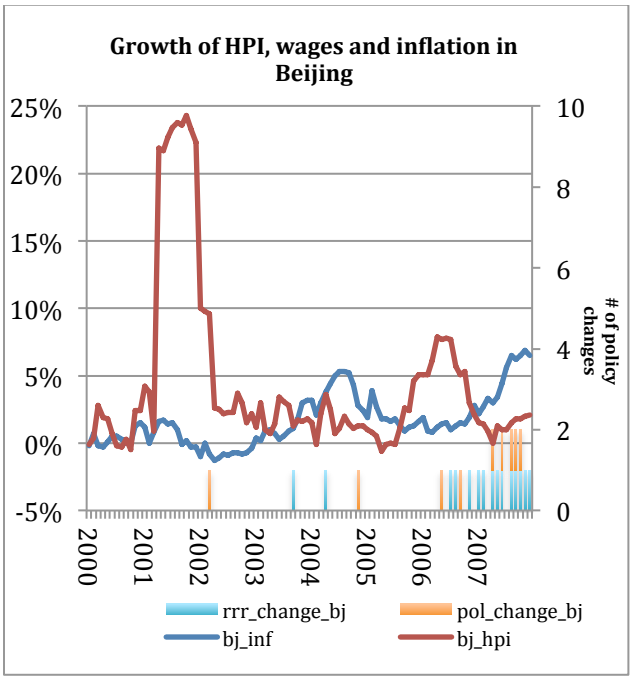

Figure 5: Policy changes vs inflation and HPI in Beijing

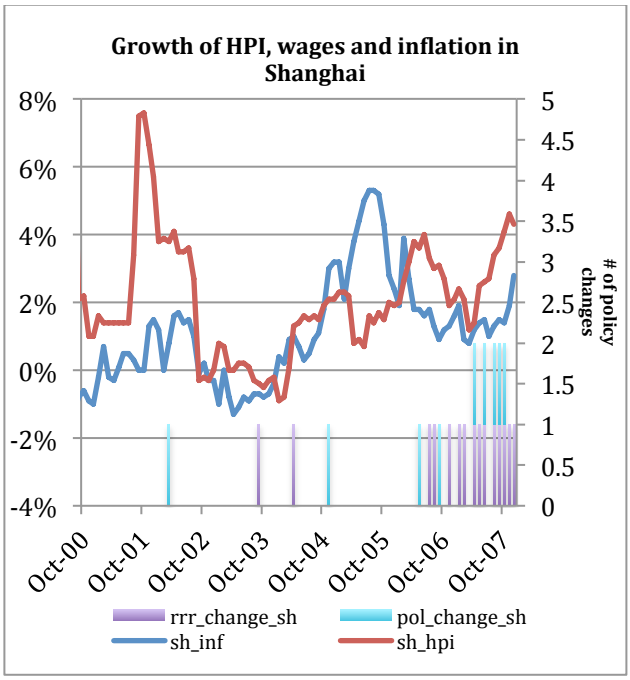

Figure 6: Policy changes vs inflation and HPI in Shanghai

The stacked columns on bottom of the graph above illustrate the number of policy changes between 2000 and 2007. It is clear how the policy interventions intensified in 2006 and 2007. The regression analysis will study in detail the effect of policy changes on inflation and in particular on the credit growth.

6. The housing prices

The booming real estate market in China is of major concern for the Chinese authorities and the well being and stability of the real estate market has an important effect on the overall Chinese economy.

The housing price volatilities in 2001 in Beijing and Shanghai in figures 5 and 6 are huge. These upsurges in the housing prices are not accompanied with any increase in inflation. In an attempt to understand the determinants of the housing price increases during

2001 and 2002 while there were no policy changes preceding them, we try to retrieve any possible special events that may have caused these changes. In July 2001 Beijing was awarded the 2008 summer Olympics games. In consequence, the Chinese government invested heavily in infrastructure projects, in particular in the transportation systems. For the sole purpose of preparing for the Beijing Olympics 7 years ahead of time, the Chinese government renovated the Beijing airport and added a state of the art third terminal. On the other hand, the network length of Beijing's subway was doubled and became capable of accommodating the double capacity. Various measures were taken to lessen the pollution externalities in Beijing. These measures included restrictions on construction of gas stations and the limiting of commercial vehicles off the streets of the capital.

All these measures have inflated the housing prices as seen in figure 5 in 2001. It is believed that the building of metro lines and the extension of Beijing airport's terminal 3 may have played a leading role in increasing the future price expectations of the Chinese. The expectation of the housing price increase has driven residents and firms to further invest in the real estate sector.

In Shanghai, a different trigger drove the 2001 housing price increase. Shanghai successfully won the 2010 world Expo in 2001. This was the main driver of the housing price increase (Wu Gongliang and Long Fenjie, 2012). Shanghai was viewed as a spotlight for the world economy and a global financial hub. The promising future of Shanghai increased investors' expectations and the real estate market boomed. The 2001 housing price boom in Shanghai may also have been fueled partly by the awarding of the 2008 world Olympics to Beijing in 2001 since some of the games such as football were going to be held in Shanghai.

It should be noted that both booms, in Shanghai and Beijing, lasted for almost a year and stabilized immediately after that. Whether such big events have only around a single year temporary effect on the housing prices is not within the scope of this paper but is an interesting and important research topic question to explore.

7. Money supply and inflation behavior in China

M2 and the inflation are more or less procyclical. The inflation in China, unlike in Canada, is not positively correlated to money supply M2. The red line in figure 9 below depicts a 1:1 relation between inflation and money supply M2 while the black line depicts the trend of the actual data with a slope of negative 1. Hence, inflation and money supply are inversely correlated or countercyclical, however this information doesn't give any information on causality between the two. Rises in inflation coincides with falls in M2 growth. This is also the case in several other countries, including the US. Since money supply, in particular M2, is strongly believed to affect inflation, the paper adds M2 as a control variable in the regression.

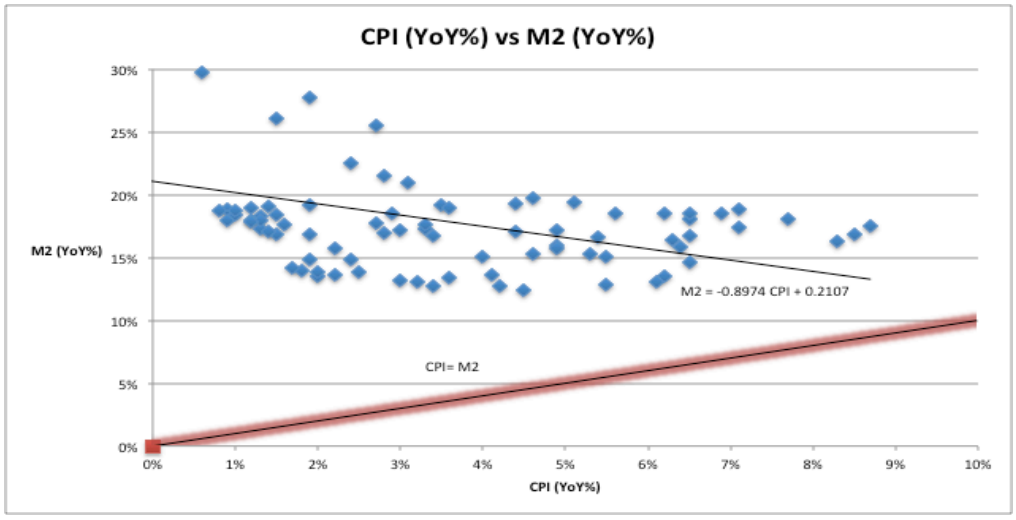

Figure 7: Inflation vs year on year money supply M2

The rest of the paper is organized as follows: In the coming section we review other empirical studies and compare some of the results with the current paper. Section three discusses the paper data, the regressions and the different tests including Granger tests and autocorrelation tests. Section four discusses the empirical results and section five offers conclusions and recommendations.

II. Literature review

China's monetary policy approach is the subject of many research papers however, the majority of the papers present unique approaches and different views on China's monetary policy. The reason is simply because there is no single unique monetary policy used in China and the latter is constantly evolving over time to adapt to the changing reforms, the opening of the financial system to the world and the development of both national and international economies.

Before exploring the approaches of previous research papers and the contribution brought forward by this paper, it is necessary to step back and understand how China's shadow banking is evolving in China and present some instances of it.

i. Shadow banking in China

Before the year 2000, almost all lending in China was through state owned commercial banks. After the Asian financial crisis, lending in China started to become available from trusts, money market mutual funds, leasing companies and other forms of alternative institutions. These financial institutions are acting as shadow banks.

The high reserve requirement ratio imposed on banks makes the spread between the lending rate and deposit rate larger which increases the cost of lending to banks (Montoro, 2011), lowers the Chinese banks' profitability from the commercial sector and drives them to find alternative sources of profit. Hence banks resort to repackaging of loans and selling them to other financial institutions that in turn sell them to investors. On the other hand, the increased restrictions imposed by the central bank on the banks give non-bank financial institutions the opportunity to make lucrative businesses by acting as banks and offering higher returns to investors than the returns offered by the banks.

Yangzijiang Shipbuilding is a famous example of shadow banking emergence in China. One third of Yangzijiang Shipbuilding's profit is made from lending money to other companies and the other two thirds are from shipbuilding.

Institutions acting as banks provide credit with high interest rate (20% and more) to customers with bad credit who are not able to get loans from the banks and who in turn make risky investments.

Underground lending in Wenzhou is another known instance of shadow banking in China. In the early 2000s, the shadow lending activity was on the rise in Wenzhou. Thousands of firms benefited from the shadow lending to boost their investments and exports. However, in 2006, the shadow banks went out of control as borrowers increasingly used the borrowed funds to invest in stocks with the aim of becoming rich overnight (Article from the "South China morning post", 2012).

The high deposit rates provided by the shadow banking lead thousands of entrepreneurs to borrow money from the commercial banks and invest them in the shadow banking to secure higher returns. Eventually in 2008, the shadow banks became insolvent and the burden fell on the firms and lenders.

ii. Previous literature on the use of policy instruments to control credit growth and inflation

A paper titled " Has the Chinese economy become more sensitive to interest rates? Studying credit demand in China" (Tuuli Koivu, 2007) shows that the four months lagged policy interest rate does not have a significant effect on credit growth however, for the period 2001-2006, a 1% increase in the eight-month lagged policy interest rate curbs credit growth by 0.19% with a significant t-statistic. The approach used in the paper by Tuuli uses a vector autoregression model and a different approach including a different set of independent variables such as the lagged credit growth and lagged output.

A paper titled "China's evolving reserve requirement" (Guonan Ma, Yan Xiandong and Liu Xi, 2011) pinpoints to the fact that the reliance of the PBC on the RRR to drain liquidity acts as a distortionary tax on banks and thus puts them at a competitive disadvantage (Robitaille, 2011). The paper emphasizes that the excessive application of the RRR gives rise to regulatory arbitrage. Regulatory arbitrage involves banks and financial institution to find ways around the regulations to maximize their profit, hence

banks increase their off balance sheet credit provisions. Guonan Ma in his paper performs a Granger causality test to check whether the use of the RRR causes credit growth to increase. His results indicate that a three months lagged RRR and a six months lagged one both cause credit to increase at 5% significance level. A twelve months lagged RRR causes credit growth only at 10% significance level.

Christian Glocker and Pascal Towbin (2011), analyze the macroeconomic effects of using the RRR in Brazil. The author uses a Bayesian vector autoregressive model (BVAR). The paper shows that a an increase in the RRR leads to a credit contraction but at the cost of an increased unemployment and an exchange rate depreciation, a trade surplus and an increase in inflation. The paper however doubts that the simultaneous use of both policies, the RRR and the policy interest rate, can help achieve price stability. One advantage of using the RRR is that it curbs credit without attracting capital inflows and appreciating the exchange rate. The paper finds that a 1% contraction in the loans in Brazil can be achieved by increasing the policy interest rate by 0.42% while a 1% contraction in the loans can be alternatively achieved by increasing the RRR by only 0.29% however at the cost of an increase in unemployment. This implies that the RRR is more effective at curbing credit growth than the policy interest rate in Brazil. Regarding the policy interest rate, the paper concludes that it is consistent with the traditional macroeconomic theory, that is an increase in the interest rate leads to a credit contraction, an exchange rate appreciation, an increase in unemployment and a decline in inflation.

Another research paper examining the effectiveness of the reserve requirement ratio in Latin America and more specifically on Brazil where the reserve requirement is around 20% (Camilo E. Tovar, Mercedes Garcia-Escribano, and Mercedes Vera Martin, 2012) shows that the Brazilian authorities increase the RRR when the credit growth is beyond what they think it should be and reduce it whenever there are increased pressures on liquidity. The RRR used in this way resembles the way it is used in China. The RRR is used in both countries to address systemic risk. However in China, the RRR is in big part used to sterilize the increasing foreign exchange reserves.

The empirical results show that the use of the RRR doesn't provide long-term effects on credit growth. The paper also suggests that the monetary policies in addition to the RRR and other macroprudential policy tools play a complimentary role but not a substitutionary one. The results show that countries use the RRR when credit is growing at rates exceeding 20% and increasing. These policies have an immediate but moderate decrease in credit growth, however, the effects on credit growth are short lived since the credit growth returns after 4 months to its pre-crisis level.

According to a paper titled "The use of reserve requirements as a policy instrument in Latin America" (Carlos Montoro and Ramon Moreno, 2011), using the RRR makes banks lose competitiveness against financial institutions. The imposition of the reserve requirement ratio on banks by the central bank pushes the former to increase the gap between the lending and deposit rate, which in turn creates an incentive for borrowers to fetch substitute sources of funds. This in turn increases the credit from other financial institutions, a sign of shadow banking.

In the BIS Quarterly Review (March 2011), an article titled "International banking and financial markets developments" explains the side effects of the reserve requirements. RRR's impose significant costs on banks, since they force banks to deposit a portion of their assets in the central bank thus earning low yield compared to other investments. Therefore, the RRR acts as a tax on banks and makes it the costly for banks to lend due to the larger spread between the lending and deposit rates. The paper then mentions that the RRR's in particular create an incentive for borrowers to look for other sources of funding such as an unregulated financial institution. Hence, using RRR leads to credit growth when borrowing financial institutions resort to the shadow banking system.

Regarding the effect of money supply on inflation, According to a paper titled "Navigating the trilemma: Capital flows and monetary policy in China" (Reuven Glick and Michael Hutchison, 2008) a 1% increase in a two period (six months) lagged reserve money causes inflation to decrease by 0.001%. The data in the paper are quarterly; hence a single period represents a three months period. The paper also finds that

increasing the RRR has a temporary effect in dampening inflationary pressures.
Jianjun Li and Sara Hsu (2012) explain one essential determinant of credit growth: The tightening of monetary policy makes the activity of the shadow banking to rise.
(In big part, tightening of monetary policy is carried out through an increase in RRR or in policy interest rates) The paper describes how commercial banks in China engage in the shadow banking system by cooperating with trust and investment companies or by transferring deposits into financial management products and lending to investors in short-term projects.

The RRR also causes the banking system to resort to the shadow banking as explained in the "Shadow bank monitoring" paper (Adrian, Tobias; Ashcraft, Adam B.; Cetorelli, Nicola, 2013). The paper explains that the Chinese authorities use a number of policy instruments to combat the rising credit growth. Among these instruments, are the RRR, the policy interest rates and the maximum permitted loan to value ratio on second home purchases. These policies were initially successful to curb the credit growth on banks' balance sheets. Nevertheless, banks found ways to get around the regulations and secure loans.

A newsletter issued by the federal reserve of San Francisco (April 2013) "Asia Focus" also highlights that China's shadow banking rise is a consequence of tightened regulation and supervision of commercial banks.

A paper published in the Levy Economics Institute (Nersisyan, Yeva; Wray, L.Randall, 2010) focuses on how commercial banks are avoiding reserve requirements and increasing leverage and their return on equity by engaging in asset backed securities business (ABS). Banks setup ABS issuers to move securitized assets from their balance sheets. The ABS issuers, in turn, issue bonds and commercial paper.
James A. Dorn (2013) explains one of the most important reasons for which the Chinese government uses the reserve requirements. The paper explains that the need to boost exports requires a weaker currency; the latter can be achieved when the Chinese government buys foreign exchange reserves using the Chinese RMB. This in turn leads to

inflationary pressures that require the central bank to raise the RRR to sterilize the liquidity.

Several articles emphasize Chinese bank's access to the shadow banking. An article in The Economist titled "The lure of shadow banking" (Mark Carney, 2014) mentions that the increased banning of banks from expanding lending to certain industries (such as increasing the RRR to banks lending to specific sectors) are motivating banks to secure loans from the shadow banking (which in turn would further raise credit growth).

Another article from the international finance magazine titled "Chinese banks resort to shadow banking" (2013) is also emphasizing a similar point: Chinese banks are pressing customers to shift their money from their highly regulated savings deposits with low yields to investing in the highly unregulated repackaged loans with high yields by banks selling them to their customers as bonds. By doing so, the banks circumnavigate government interest rates.

In regards to the housing price index, Gerlach and Peng (2005) investigate the relationship between the housing prices and the credit growth. They find that lending has no influence on the housing prices and that the direction of influence is from the housing prices to bank lending in the short run and in the long run. Oikarinen (2009) also studies the relation between household borrowing and housing prices in Helsinki. The results suggest that there is a significant two-way interaction between housing prices and household borrowing.

iii. Conundrum of the literature and contribution of the paper's empirical study

There are conflicting results in the literature related to the effectiveness of the policy instruments, in particular the RRR, on curbing the credit growth. This paper fills the gap in the literature by providing empirical evidence on the inefficiency of the RRR in containing credit growth. Many articles emphasize that the use of the RRR causes credit to grow however no paper has provided any concrete evidence on

this issue in China. On the other hand, some papers mentioned in section "i" of the literature review, provide evidence on the effectiveness of the RRR in Brazil where the reserve ratio is used frequently. Our paper focused on the fact that the use of RRR in Shanghai and Beijing bolsters the shadow banking lending.

The paper addresses another gap in the literature by providing empirical evidence on the fact that the effect of the foreign exchange reserves may have varying effects on credit growth in various regions whereas the growth rate of the housing price index has a negative impact on credit growth.

III. DATA

1. Description

During the 2008 global financial crisis, the Chinese government implemented a stimulus package of $586 billion to relieve the effects of the crisis. The latter stimulus was injected over a period of 27 months and was assumed to be successful by many economists. The latter period witnessed a credit surge that worried the Chinese authorities and the world.

To avoid the economic complications associated with the global financial crises, this paper studies the period 2000-2007. This period is between two financial crises: the 2008 global financial crisis and the Asian financial crisis of 1997-1998. This would help avoid any economic shocks and abnormalities that may have happened as a byproduct of the crises.

One of the challenges for analyzing the impact of the policy instruments on inflation and credit growth is to specify the time horizon necessary for the policy tool to take its effect. China and Brazil are among the few countries in the world having a very high reserve requirement ratio of around 20% and both countries are struggling with increasing credit growth. China like Brazil uses the reserve requirement ratio and the policy interest rate as a way to contain credit growth and fight the rising inflation. The time lag it takes these two policy tools in Brazil to take effect is of six months (Christian Glocker & Pascal Towbin, 2011). In this paper several lags will be tried to try to find out

the most significant one. Six lags are computed in the regressions ranging from 3 through 8.

The data comprises 96 observations and the analysis in this paper focuses on China's monthly data from January 2000 to December 2007. Data were retrieved from Bloomberg and from Haver Analytics. The dependent variables in this paper are the inflation and the credit growth, however the focus of the paper will be more on the credit growth. The independent variables include the wages, the reserve requirement ratio, the policy interest rate, the money supply M2, the inflation, GDP and the housing price index.

Since monthly data for the credit growth are only available on yearly data, a monthly credit growth data was approximated using the following formula:

$$\text{credit\_growth}_{\text{current month}} = \left[\frac{current\_credit}{previous\_credit}\right]^{1/12} - 1 \quad \left[\frac{current\_credit}{previous\_credit}\right]^{1/12} - 1$$

where current credit is the credit of the current year and previous credit is the credit of the previous year.

2. The regressions:

The two dependent variables are regressed over the independent variables as follows:

$$Cpi_t = \beta_0 + \beta_1 lrrr_{t-6} + \beta_2 lpolicy\_rate_{t-6} + \beta_3 M2_{t-12} + \beta_4 lwages +$$
$$B_5 mixed\_tool_{t-6} + \beta_6 oil\_prices_t + \varepsilon_t \qquad (1)$$

$$cg\_fi_{t,j} = \beta_0 + \beta_1 lrrr_{t-i} + \beta_2 lpolicy\_rate_{t-i} + \beta_3 M2_t + \beta_4 \ HPI_j + \beta_5 lwages_j +$$
$$\beta_6 GDP_j + \beta_7 Inflation + \varepsilon_t \qquad (2)$$

Where "i" stands for the lags 3 through 8 and j stands for cities Beijing and Shanghai. The table in appendix 4 summarizes the data as they are in STATA.

The data for inflation covers all of China and no city specific data on inflation are retrieved. The first regression is rather a general one. It studies the effect of the policy

instruments on inflation in All China while taking into consideration the oil prices, a crucial source of shock to the inflation. The second regression is a city specific one and it measures the effectiveness of the policy instruments in curbing the credit growth in Shanghai and Beijing while taking the city specific data for the wages, the housing price index, the credit growth and the GDP. Since no city-specific inflation data are retrieved for China, the first regression studies the overall impact of the policy tools on the overall inflation level in China while taking into consideration the average wage level of all Chinese cities.

Regarding the money supply M2, an established lag of 12 months in China is necessary for M2 to take its effect on inflation. The paper's results reinforce the literature where the p-value of 0.000 is on the 12 months lagged M2's coefficient with an overall significant regression. In China the money supply takes its effect on inflation starting 5 months and the effect disappears after 18 months (Huan Chen, 2009). Reuven Glick and Michael Hutchison (2008) use the money base M0 to study its effect on inflation. Our study in contrast focuses on the M2 instead of the M0 since the effect of the broad money is considered to have a stronger association with inflation in the economic literature (Huan Chen, 2009).

Regarding the lag on the RRR and the policy interest rate, multiple regressions were carried out using equation (2) for Beijing and Shanghai. The results in appendices 1 and 2, show that the most significant lags on the policy interest rate and RRR in Beijing and Shanghai are 3 months and 4 months respectively.

Regarding the lag on the policy interest rate in equation (1) that applies to China, the regression results show that the most significant results are those with a lag of 6 months on the policy instruments (Appendix 3).

IV. Methodology

1. Correlation matrix

Checking for highly correlated independent variables is essential to make sure that no multicollinearity exits between the independent variables. Appendices 1 and 2 show that there are no multicollinearities among the independent variables.

2. Granger causality tests:

Appendixes 1 and 2 display the results of the Granger causality tests. The lags in the Granger causality test is calculated using the Schwarz information criterion (SIC) and is determined as follows:

Lag=(Number of observations)$^{1/4}$ = 96$^{1/4}$ ≈ 3

This is the optimal number of lags to be used in the granger causality equation that minimizes the SIC.

The results of the Granger causality tests in Appendix 1 and 2 show that all of the p-values in Shanghai and Beijing, are above 0.05 which means that we fail to reject the null hypothesis H0 that the dependent variable does not Granger cause the independent one. These results are essential for the study to filter out the possibility of endogeneity whereby a causality loop exists between the dependent variable and the independent variable.

The p-values of the lagged policy instruments are not shown in the appendixes because the policies are assumed to have a six months lag on inflation and credit growth. Hence, it would be impossible for inflation and credit growth at time t to have any effect of a variable 6 months in the past (the 6 months lag was found optimal for the regression in equation 2, see Appendix 3). Therefore the reverse causality cannot be examined in this context. It is possible and interesting however to examine the effect of the credit growth and inflation at time t on the policy instrument in several months in the future. This however is beyond the context of this paper.

3. The Durbin-Watson test for autocorrelation

Due to uncertainty on the presence of any autocorrelation between the dependent and independent variables, the Durbin-Watson test is performed to find out if any autocorrelation exists. The Durbin-Watson test for autocorrelation for the first regression in Appendix 3 (cpi regression over the independent variables) has a d value of 0.757 with 77 observations and 7 degrees of freedom. The lower and upper bounds for the critical values of this test, dL and dU, are 1.284 and 1.682 respectively. Since our d value of 0.757 is below dL, we reject H0 in favor of the alternative of a positive autocorrelation.

In Shanghai and Beijing the Durbin-Watson test showed signs of a positive autocorrelation and all the d values were below dL.

a. The Newey and West's consistent estimator

Because of the Durbin-Watson autocorrelation test, the presence of a positive autocorrelation is evident, however, the nature of the autocorrelation is not clear. Using the Newey and West's consistent estimator is a suitable choice in this case. The Newey and West's methodology has become popular recently since it corrects for both autocorrelation and heteroskedasticity and makes hypothesis tests for the estimators valid.

The results of the Newey and West's consistent estimator show no important change in significance compared to the original model. The p-values have changed but still hold he same significance. This implies that the p-values of the estimators in the original regressions are robust. The analysis part will be based on the Newey-West test results.

V. Results of the regressions and analysis:

1. The effect of the policy tools on inflation

Our results show that in China, a 1% increase in the six months lagged policy interest rate curbed inflation by 0.72%, while a 1% increase in the reserve requirement ratio curbed inflation by 1.3%. Hence the RRR is a more effective tool to curb inflation however, this paper does not study the side effects of using the RRR on other macroeconomic variables. The only established side effect of using the RRR in this paper is that it increases credit growth. Hence, while the government uses the RRR to curb inflation, it would simultaneously be exacerbating the effect of credit growth.

2. The effect of the policy tools and other variables on credit growth

2.1. The effect of the housing prices on credit growth

The causal relationship between the housing prices and the credit growth changes significantly between different economies. In Shanghai and Beijing, the causality is unidirectional. The Grangrer causality tests in appendices 1 and 2 reveal that credit growth does not have any significant effect on the housing prices. The Newey-West tests on the other hand reveal that the coefficients on the housing price indices are significant. Our results are in line with that of Gerlach and Peng (2005) and that of Charles Goodhart and Boris Hofmann (2008) which suggest that the housing prices influence the credit growth and not the other way around.

In Beijing, a 1% increase in the housing prices causes the credit growth to contract by 6.56% while the p-value is very significant at 0.001. On the other hand, a 1% increase in the housing prices in Shanghai causes the credit growth to contract by 6.59% with a significant p-value of 0.012.

An analysis by Chamon, Marcos; Prasad, Eswar (2007) pinpoints to the fact that when it comes to durable purchases (House and car), the Chinese have a preference to

rely on savings rather than on borrowing against future income. According to the paper, a 1% increase in inflation causes savings to increase by 0.24%. During an increase in the housing prices, savings is preferred because most housing purchases are financed by withdrawal from past savings. An increase in the property prices will hence curb the demand on the real estate sector since the Chinese decide to save more, which in turn would curb the credit growth.

Guonan Ma (2011) emphasizes how central banks use the RRR to curb a sector specific credit growth. That is to say that if the housing prices increase significantly, the central bank increases the RRR on banks that provide credit to house purchasers. This in turn would curb credit growth. However, the time lag between the increase in the housing purchase and the use of the RRR to curb lending in the real estate sector is beyond the scope of our study.

The housing price index data are retrieved from HAVER Analytics. They housing price index in HAVER represents the average price index reported by China's national bureau of statistics. The index is however not reliable and heavily criticized. Many papers have built alternative housing price indices for China however it is not possible to retrieve the related data for this paper's time window period. Another housing price index in China is the "70 cities index" calculated by the same agency and its data conflict the average housing price index (Jing Wu, 2012). Several other papers highlight the misalignment in the housing prices in China stressing that the housing price index is mispriced and undervalued. The undervaluation of the housing prices data in China may be a tool to contain speculations revolving around a booming housing sector, which may increase investors' expectations, thus further fueling a bubble in the real estate business. However at the same time, the Chinese government took some measures to boost the housing sector in China by enacting the Land public building system" in 2002. Since then the housing prices increased and in 2005 the Chinese government took measures to curb the housing sector expansion by enacting a set of "Eight rules". According to China's national bureau of statistics, the housing prices in most costal cities in China are

almost flat, except for Beijing, which is increasing at a very low rate. However, according to several studies the costal cities' housing prices increased at a very high rate.
Had the housing price data used in this study been closer to reality, the analysis results are expected to exacerbate the effect of the housing price increase on the overall credit growth.

2.2. The effect of the GDP and the wages on credit growth

Schnabel and Garcia-Luna (2006) analyzed the relationship between bank's credit and the GDP and found that credit extension to the private sector moves procyclically with output. Aysan, Dalgic and Demirci (2010) mentions that higher GDP per capita translates into higher consumption and investment, which can translate to higher demand for credit by both firms and households. Higher GDP per capita, which implies higher wages or higher revenues for firms and may entitle agents to acquire, loans immediately.

The GDP coefficients in Shanghai and Beijing are both insignificant with p-values of 0.198 and 0.559 respectively. On the other hand, the wages in Shanghai and Beijing are also insignificant with p-value of 0.676 and 0.899 respectively. An increase in wage or in the income per capita is likely to increase the capability of households to get mortgages however the results show that these two variables are insignificant. The reason may lie in the fact that a wage increase is a more complex process since many other factors are taken into consideration by households such as the stability of the job, the overall economic uncertainty of the institutions they work for, the type of the business which may be seasonal and dependent on other factors, and others…

2.3. The effect of the RRR on credit growth

Regarding the policy instruments' lagging period, it was found that the Newey-West regressions with a 4 months lag on the RRR and the policy interest rate in Shanghai gave the most significant results with an overall p-value significance of 0.0000.

In Beijing, the most significant Newey-West regressions showed that the policy instruments are most significant with a 3 months lag and with an overall regression significance of 0.0000. The overall significance of the regressions implies that the coefficients are significantly different than zero.

In Beijing, the coefficient on the RRR is not significant at 5% confidence interval, however it is significant at 10%. At 10% significance level, a 1% increase in the three months lagged reserve requirement ratio increased the credit growth by 0.0454%. On the other hand, a 1% increase in the four months lagged RRR in Shanghai, increased credit growth by 0.047% with a significant p-value of 0.003.

These results indicate that the use of the RRR to contain credit growth is not successful. The externalities associated with imposing higher reserve requirement ratios on banks outweigh the benefits of reducing credit. Instead of curbing credit, imposing higher reserves on banks is pushing banks to resort to the shadow banking to secure loans for refinancing. The papers mentioned in the literature review section reinforce this result.

The use of the RRR in Shanghai is prompting a more significant effect than in Beijing. That is using the RRR in Shanghai is pushing credit growth significantly further up compared to Beijing. Since the p-value of 0.003 in Shanghai is more significant that that of Beijing with a p-value of 0.064 we conclude that the RRR is causing banks and financial institutions to resort more to the shadow banking. One possible reason may be that Shanghai is more financially interconnected with the world and it is a financial hub connecting with many of the stock markets around the globe. This may make it easier for the Shanghai banks and financial institutions to access the shadow banking through its improved interconnectedness. Another reason is that the number of state owned enterprises in Beijing are far more than those in Shanghai and these SOE's are more tightly monitored and regulated hence it is very hard if not impossible for these SOE to secure loans from the shadow banking system.

Our results are not in line with the findings of Christian Glocker & Pascal Towbin (2012), with opposite results on the effect of the RRR on credit growth. Possible explanations for this difference may lie in the increased exposure of Shanghai and

Beijing to the international financial markets compared to Brazil and the increased and ease of access to the shadow banking system. Shadow banking is a more evident problem in China and the results in China are not expected to follow similar trends to those of Brazil. One major difference in the way the RRR is used in China and in Brazil lies in the fact that China uses the RRR to sterilize the increasingly growing foreign exchange reserves while it is not the case in Brazil. Also Glocker & Pascal take into consideration in their paper the effect of the RRR on unemployment which is not considered in our paper due to the uncertainty surrounding the data of unemployment in China.

2.4. The effect of the policy interest rates on credit growth

In Beijing, a 1% increase in the policy interest rate by the central bank decreases the credit growth by 0.03% with a very significant value of 0.003. In Shanghai, the corresponding coefficient is also very significant with a p-value of 0.001 and a 1% increase in the policy interest rate decreases the credit growth by 0.0217%.
The results indicate that the policy interest rate is an effective measure in both Shanghai and Beijing in curbing credit growth. Our results are in line with that of (Tuuli Koivu, 2007). Tuuli reveals that for the period 2001-2006, a 1% increase in the eight-month lagged policy interest rate curbs credit growth by 0.19% with a significant t-statistic. An increase in the four-months lag in Tuuli's analysis for the period of 1998-2002 increased credit by 0.46%. However, It is hard to compare the magnitude of the effect of the policy interest rates of our paper with that of Tuuli's since our paper applies to Shanghai and Beijing only while Tuuli's applies to all China. Also Tuuli finds different results with same lags in different periods.

2.5. The effect of the foreign exchange reserves on credit growth

Since 2012, China holds the world's largest foreign exchange reserves worth over 3.9 trillion USD. Heavy capital inflow into China helps the buildup of the foreign exchange reserves, which plays a crucial role in the Chinese economy. The excessive growth of the

foreign exchange reserves is a deep source of concern for the Chinese economy and China's government have been attempting to make a positive use of this excess by investing abroad. For this purpose the state administration of foreign exchange (SAFE) created a new investment body in 2013 named SAFE Co-financing to use the foreign reserves to provide loans to Chinese companies to invest abroad thus channeling the foreign reserves overseas.

In Beijing, a 1% increase in the foreign exchange reserves decreases the credit growth by 0.033% with a significant value of 0.000. In Shanghai on the contrary, a 1% increase in the foreign exchange reserves increases the credit growth by 0.035% with a significant value of 0.000.

Figure 8: International trade in Beijing and Shanghai

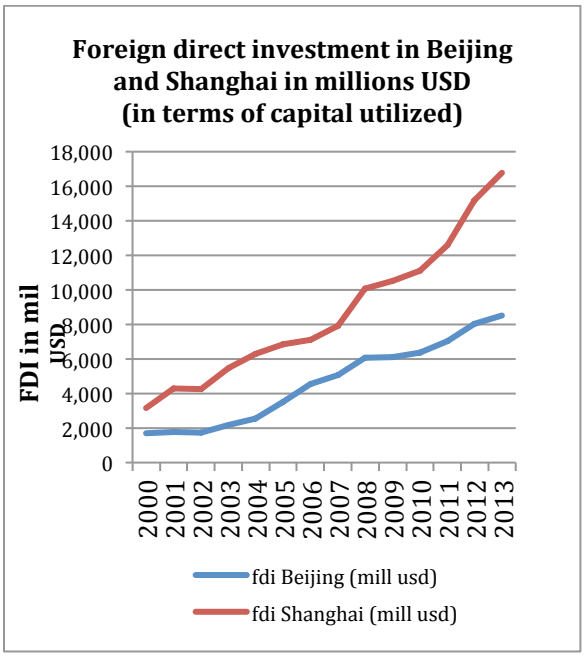

Figure 9: Foreign direct investment in Beijing and Shanghai in terms of capital utilized.

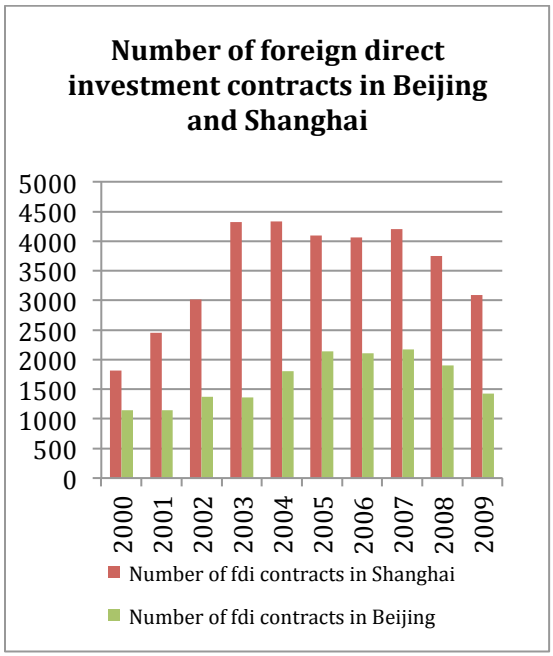

Figure 10: Number of foreign direct investment contracts in Beijing and Shanghai.

To explain the discrepancy in the opposite effect of the foreign exchange reserves on credit growth in Beijing and Shanghai, we first examine the above figures of international trade, foreign direct investment capital and number of foreign direct contracts in Beijing and Shanghai.

Figure 9 above shows that Shanghai's international trade exceeds by far that of Beijing's. Shanghai's exports excess of Beijing is also highlighted in the graph. In 2004 for instance, Shanghai's international trade exceeded that of Beijing's by 69%!

Figure 10 shows Shanghai's far exceeding foreign direct investment in terms of capital utilized and figure 11 shows Shanghai's exceeding number of foreign direct investment contracts compared to that of Beijing's.

The increase in foreign exchange reserves causes the currency to depreciate. This in turn boosts exports and the production increases thus increasing the credit growth since firms take more loans to invest more in capital in order to catch up with the increasing demand. This explains the positive sign on the foreign exchange reserves' coefficient in Shanghai. The latter scenario is very evident in Shanghai where the exports exceed those of Beijing's and the number of foreign direct investment capital and contracts are much higher.

In Beijing on the other side, the scenario explained above may be overridden by another: Foreign firms may decide to invest less and hence takes less loans because their future return over their investment will be in Chinese currency which is depreciating and will have less worth in the future (Investopedia, definition of currency depreciation). This makes investing in Beijing during a Chinese currency depreciation less attractive to foreign investors.

A main reason for the difference of signs on the foreign exchange reserve coefficient in Beijing and Shanghai is that the effect of currency devaluation might differ between regions (B. Kamin and Marc Klau, 1997).

Pierre-Richard Agénor (1991) explains that sometimes, contrary to the traditional view, currency devaluation can have a negative impact of output. The demand function plays an important role in this (Diaz Alejandro 1963). Bruno (1979) discusses a number of supply channels through which devaluations can be contradictory.

Another reason for Beijing's negative sign on the coefficient of the foreign exchange reserves may lie in the fact that Beijing has a greater number of state owned enterprises (SOE) with less access to the shadow banking due to the stricter control over them.

SOE's are tightly regulated in Beijing, so when the currency depreciates, firms find it harder to secure loans to expand their production and exports. However, according to an article "China's Shadow Banking is More Symptom than Disease" (Pui Chau, 2014) mentions that more recently, SOE's retain an enormous influence over Chinese bankers, which can facilitate lending.

In conclusion, changes in foreign exchange reserves affect the exchange rate, which may have different effects in different regions. Other factors play a role as well in the effect of the devaluation on output and lending such as the demand function and the level of restrictions on the state owned enterprises, which is varying through time in China.

VI. Conclusion

The first purpose of this paper is to examine efficacy of the two policy instruments, the reserve requirement ratio RRR and the policy interest rate, in controlling inflation and in particular credit growth.

The results of the first regression in this paper shows that the policy interest rate and the RRR are both successful tools in curbing inflationary pressures in China. The latter results are in line with the economic literature. The coefficients on the policy tools reveal that increasing the reserve requirement ratio to banks by the central bank is a more effective measure to curb inflation than using the policy interest rate, however our paper does not investigate how such a use of the RRR influences unemployment and other macroeconomic variables. Other literature reviews emphasize that using the RRR is disruptive to several macroeconomic data. However, this paper finds that while the RRR is successfully used to curb inflation, its use is motivating the banks to acquire off balance sheet loans and some non-bank financial institutions to act as vehicles for banks to facilitate and extend lending.

The paper shows that the increased use of the RRR leads to an increased credit growth in Shanghai and Beijing, a sign of shadow banking. By squeezing liquidity out of the banks and storing money more idly in the hands of the central banks, the former lose competitiveness to other financial institutions. As a result,

banks and other financial institutions find it harder to secure loans, banks increasingly hesitate to lend to businesses and in particular to startup companies.

To get around the RRR restrictions, bank loans are sold to trust companies that sell wealth management products to depositors. The banks receive fees for making these loans and managing them. This is a lucrative way for banks to escape the strict Chinese regulations. The paper stresses that the increase in credit from the shadow banking is hence the result of the heightening regulatory restrictions, in particular the RRR, and not of financial innovation as in the west. The use of the RRR leads non-bank financial lending institutions to attract a large share of savings with higher yield to be offered to investors.

The government took several measures to crackdown on unregulated lending however the crackdown only reinforced the dependency of China's non state backed enterprises on the shadow banking system (Shadow banking bolsters China Inc as Beijing tightens credit, Reuters). Disguised as "Wealth management companies", unofficial credit providers such as pawn shops and trust firms are booming in China and seizing the banks' profit share of lending.

Using the policy interest rate instrument on the other hand is by far a more effective way in containing credit growth since this approach does not harm banks' profitability. The regression results demonstrate that the optimal lag for the policy interest rate in Beijing to take its optimal effect is of three months, while the optimal lag for it to take effect in Shanghai is of four months. The use of the policy tool encourages households and firms to save more thus curbing credit growth while it does not put banks at a competitive disadvantage with other financial institutions. As households and firms decide to save more, less liquidity will be floating around and the interest rate revenue compensates the agents thus there would be fewer urges to resort to the shadow banking. In comparison with the use of the policy interest rate, the RRR has a more choking effect on the economy since households and firms are deprived from any extra interest rate revenue and banks' profits from commercial lending are squeezed. These factors push non-bank financial institutions to benefit from the heightened

restrictions on banks to lend at high interest rates and generate profits and push banks to find alternative ways to sell loans and engage more with the shadow banking system.

The paper hence suggests using the policy interest rate instead of the RRR to curb inflation and credit growth. Using the RRR may be more efficient when the government more tightly monitors banks' off balance sheet loan provisions, when there are more restrictions on shadow banking, more reforms, a more flexible exchange rate, and a more reasonable accumulation rate of the foreign exchange reserves.

Regarding the real estate market in China, the paper's findings show that the increasing housing prices cause a significant decrease in the credit growth in Beijing and Shanghai. An increase in the housing prices encourages the Chinese to save more and postpone the purchase of a house. The housing price index in China plays a very essential role in anchoring the expectations of households and an instable growth in the real estate sector may be a serious threat to the entire economy. Although the housing price indicator in China is not reliable, the sign of the coefficient on the housing price index in China and Beijing and the p-values show that they significantly reduce the credit growth. Had the housing price indices been more accurate, the magnitude of these coefficients would be substantially higher and would more significantly reflect how important the housing prices drive the credit growth in China.

Finally, the paper shows opposite effects resulting from increasing the foreign exchange reserves in Shanghai and Beijing. Previous literature emphasize that the currency devaluation may have different effects in different regions. Due to the increased involvement of Shanghai in the international trade, the increased number of foreign direct investment contracts and the larger amount of capital invested by foreign firms, increasing the foreign exchange reserves in Shanghai may cause a currency devaluation and an increase in exports and production, which drives credit growth.

On the other hand, Beijing's relatively less involvement in the international trade, its greater number of state owned enterprises that are tightly regulated against accessing the shadow banking system and the smaller number of foreign direct investment contracts, are all reasons for it to be less sensitive to a considerable increase

in exports resulting from an increase in foreign exchange reserves and a currency devaluation. In fact, an increase in the foreign exchange reserves in Beijing turns out to curb credit growth. Previous literature emphasizes that currency devaluations may have different effects in different regions and the demand function plays a key role.

Appendix 1: Beijing's results:

1. Durbin-Watson Autocorrelation Test results:

Ho: No Autocorrelation - Ha: Autocorrelation

Durbin-Watson Test	AR(1) =	0.7037	df: (7 , 88)	8 Lags
Durbin-Watson Test	AR(1) =	0.6722	df: (7 , 89)	7 Lags
Durbin-Watson Test	AR(1) =	0.6644	df: (7 , 90)	6 Lags
Durbin-Watson Test	AR(1) =	0.6559	df: (7 , 91)	5 Lags
Durbin-Watson Test	AR(1) =	0.6539	df: (7 , 92)	4 Lags
Durbin-Watson Test	AR(1) =	0.6662	df: (7 , 93)	3 Lags

2. The Newey-West regression results:

The independent variable in the table boxes below are the Beijing loan denoted "bj_loan" and the independent variables are listed below it. Appendix 4 summarizes the variable names.

bj_loan	Coef.	P>|t|
bj_hpi	-0.045719	0.034
bj_gdp	-1.326513	0.017
bj_wage	-0.6552934	0.679
lrrr8	0.0264909	0.323
lpol_rate8	-0.0204304	0.014
fx_res	-0.0303114	0.035
_cons	0.0471691	0.317

bj_loan	Coef.	P>|t|
bj_hpi	-0.0487703	0.017
bj_gdp	-1.166756	0.02
bj_wage	-0.8446521	0.547
lrrr7	0.0247461	0.29
lpol_rate7	-0.0202362	0.012
fx_res	-0.0339013	0.01
_cons	0.0516093	0.198

bj_loan	Coef.	P>|t|
bj_hpi	-0.0522818	0.007
bj_gdp	-0.9978309	0.036
bj_wage	-0.8949607	0.492
lrrr6	0.0266323	0.226
lpol_rate6	-0.0214415	0.008
fx_res	-0.0354353	0.003
_cons	0.0499084	0.172

bj_loan	Coef.	P>|t|
bj_hpi	-0.0573394	0.003
bj_gdp	-0.8294459	0.073
bj_wage	-0.7480995	0.567
lrrr5	0.0329706	0.156
lpol_rate5	-0.0245155	0.004
fx_res	-0.0349116	0.001
_cons	0.0410345	0.268

bj_loan	Coef.	P>|t|
bj_hpi	-0.0621172	0.002
bj_gdp	-0.6654861	0.14
bj_wage	-0.5502802	0.688
lrrr4	0.0399962	0.115
lpol_rate4	-0.0279493	0.004
fx_res	-0.0337458	0
_cons	0.0308712	0.432

bj_loan	**Coef.**	**P>|t|**
bj_hpi	**-0.0656193**	**0.001**
bj_gdp	**-0.5535656**	**0.198**
bj_wage	**-0.5526401**	**0.676**
lrrr3	**0.0454307**	**0.064**
lpol_rate3	**-0.0300858**	**0.003**
fx_res	**-0.033403**	**0**
_cons	**0.024382**	**0.508**

3. Correlation matrix:

	bj_inf12	bj_hpi	bj_gdp	bj_wage	lrrr8	lpol_r~8	fx_res
bj_inf12	1						
bj_hpi	-0.1916	1					
bj_gdp	-0.0658	-0.1536	1				
bj_wage	-0.0914	0.3157	0.3377	1			
lrrr8	0.0568	0.3364	0.3066	-0.1225	1		
lpol_rate8	0.5527	-0.3348	0.4507	0.1089	0.3462	1	
fx_res	0.3614	-0.6313	0.0147	-0.3294	-0.3819	0.4013	1

4. Granger causality test results:

Granger Causality test results				
bj_loan	Granger causes	bj_inf	0.0931	No causality
		bj_hpi	0.6969	No causality
		bj_gdp	0.9922	No causality
		bj_wage	0.9457	No causality
		fx_res	0.1053	No causality

Appendix 2: Shanghai's results:

1. Durbin-Watson Autocorrelation Test results:

Ho: No Autocorrelation - Ha: Autocorrelation

Durbin-Watson Test	AR(1) =	0.5403	df: (7 , 88)	8 Lags
Durbin-Watson Test	AR(1) =	0.5403	df: (7 , 88)	7 Lags
Durbin-Watson Test	AR(1) =	0.5303	df: (7 , 89)	6 Lags
Durbin-Watson Test	AR(1) =	0.4796	df: (7 , 90)	5 Lags
Durbin-Watson Test	AR(1) =	0.4463	df: (7 , 91)	4 Lags
Durbin-Watson Test	AR(1) =	0.3293	df: (7 , 92)	3 Lags

5. The Newey-West regression results:

The independent variable in the table boxes below are the Shanghai loan denoted "sh_loan" and the independent variables are listed below it. Appendix 4 summarizes the variable names.

sh_loan	Coef.	P>|t|
sh_hpi	-0.0256952	0.294
sh_gdp	-0.0072545	0.981
sh_wage	0.2662199	0.23
lrrr8	0.0556846	0
lpol_rate8	-0.0304484	0
fx_res	0.033723	0
_cons	-0.0390895	0.03

sh_loan	Coef.	P>|t|
sh_hpi	-0.0379174	0.116
sh_gdp	-0.0708661	0.836
sh_wage	0.1952042	0.393
lrrr7	0.0524365	0
lpol_rate7	-0.02729	0
fx_res	0.0326362	0
_cons	-0.0372718	0.062

sh_loan	Coef.	P>|t|
sh_hpi	-0.0503123	0.057
sh_gdp	-0.130037	0.721
sh_wage	0.1273768	0.591
lrrr6	0.0502889	0
lpol_rate6	-0.0246553	0
fx_res	0.0316348	0
_cons	-0.0364867	0.075

sh_loan	Coef.	P>|t|
sh_hpi	-0.0582629	0.025
sh_gdp	-0.1838963	0.619
sh_wage	0.0753097	0.757
lrrr5	0.0476707	0.002
lpol_rate5	-0.0226589	0
fx_res	0.0308606	0
_cons	-0.0340904	0.112

sh_loan	**Coef.**	**P>|t|**
sh_hpi	**-0.0659543**	**0.012**
sh_gdp	**-0.2192292**	**0.559**
sh_wage	**0.0311991**	**0.899**
lrrr4	**0.0469748**	**0.003**
lpol_rate4	**-0.0217373**	**0.001**
fx_res	**0.0305756**	**0**
_cons	**-0.0334329**	**0.128**

sh_loan	Coef.	P>|t|
sh_hpi	-0.0696528	0.01
sh_gdp	-0.3465199	0.356
sh_wage	-0.0116681	0.964
lrrr3	0.0385617	0.021
lpol_rate3	-0.0179148	0.006
fx_res	0.0286528	0
_cons	-0.0235577	0.283

6. Correlation matrix:

	sh_inf12	sh_hpi	sh_gdp	sh_wage	lrrr8	lpol_r~8	fx_res
sh_inf12	1						
sh_hpi	0.125	1					
sh_gdp	0.1577	-0.332	1				
sh_wage	0.4989	0.3674	-0.0666	1			
lrrr8	0.0334	0.5909	-0.3791	0.4814	1		
lpol_rate8	0.4984	0.2729	0.456	0.5405	0.3462	1	
fx_res	0.2279	-0.2753	0.6021	-0.1715	-0.3819	0.4013	1

7. Granger causality test results:

Granger Causality test results				
sh_loan	Granger causes	sh_inf	0.3792	No causality
		sh_hpi	0.6304	No causality
		sh_gdp	0.3553	No causality
		sh_wage	0.4855	No causality
		fx_res	0.416	No causality

Appendix 3: China's overall regression results on inflation

cpi	Coef.	P>|t|
lrrr6	-1.305566	0.000
lpolicy_rate6	-0.7264918	0.000
m212	0.2473622	0.000
lwages	0.0171161	0.181
mixed_tool6	-0.4460943	0.000
oil_price	0.0006951	0.000
_cons	-2.368128	0.000

Granger Causality test results				
cpi	Granger causes	lwages	0.9492	No causality
		m212	0.5111	No causality
		oil_price	0.4331	No causality

Appendix 4: The variables

lrrr	log of reserve requirement ratio
lrrrx	X months lagged log of reserve requirement ratio
lpolicy_rate	lagged log of policy interest rate tool
lpolicy_ratex	X months lagged log of policy interest rate tool
M2	money supply growth rate year on year
M212	12 months lagged money supply M2 year on year
oil_price	Growth rate of oil price year on year
lwages	Log of monthly wages year on year
mixed_toolx	X months lagged mixed policy tool. This is the product of lrrrx and lpolicy_ratex
_cons	Constant variable
sh_inf	Inflation in Shanghai year on year
sh_hpi	Shanghai's housing price index year on year
sh_gdp	Shanghai's nominal GDP year on year
Sh_wage	Shanghai's monthly wages year on year
fx_res	Foreign exchange reserves year on year
bj_inf	Beijing's inflation year on year
bj_hpi	Beijing's housing price index year on year
bj_gdp	Beijing's nominal GDP year on year
bj_wage	Beijing's monthly wages year on year
sh_loan	Shanghai's year on year credit growth where credit represents the total loans from all financial institutions in Beijing year on year
bj_loan	Beijing's year on year wages where credit represents the total loans from all domestic financial institutions in Shanghai year on year
HPI	Housing price index

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