The Renminbi: A Warrior for Competitiveness?

PEDRO BAÇÃO

CeBER and Faculty of Economics of the University of Coimbra

ANTÓNIO PORTUGAL DUARTE

CeBER and Faculty of Economics of the University of Coimbra

MATHEUS SANTOS

Faculty of Economics of the University of Coimbra

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Pedro Bação
(pmab@fe.uc.pt)

António Portugal Duarte
(portugal@fe.uc.pt)

Matheus Santos
(matheusamazonassantos@gmail.com)

GEMF, CeBER and Faculty of Economics, University of Coimbra

Av. Dias da Silva, 165
3004-512 Coimbra, Portugal
Tel. +351 239790500
Fax +351 239403511

Abstract

The purpose of this paper is to describe the evolution of China's exchange rate policy, relate it to the international competitiveness of the Chinese economy and assess the claims that China has been manipulating the exchange rate to foster its competitiveness. We begin by reviewing the historical evolution of China's exchange rate policy. We then describe the implications of the constraint represented by the "trilemma" (or "impossible trinity") of international economics for China's economic policy. We assess whether the Renminbi can meet the requirements to be considered an international reserve currency. We also propose to evaluate the degree of currency manipulation by looking at the magnitude of the exchange rate forecast errors. Our interpretation of the test is that currencies subject to higher degrees of manipulation should be easier to forecast. We find that the magnitude of the forecast errors associated with the Chinese currency's exchange rate is not noticeably smaller than the magnitudes observed for other currencies. This leads us to conclude that our test does not corroborate the view that China is a notorious currency manipulator. Countries wishing to improve their international competitiveness may therefore look to China's history for insights. However, it is unlikely that policies oriented to setting the exchange rate to artificial values will find support in China's exchange rate policy in recent years. Our conclusion runs counter the common view on China's exchange rate policy.

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1. Introduction

On October 1, 2016, the Chinese currency - the Renminbi (RMB) - was included in the Special Drawing Rights basket. This decision marked the international recognition of the importance that China has been assuming in the world economy. The new status of the Renminbi was made possible through a set of reforms implemented over the past decades by the Chinese government. Nevertheless, questions remain about China's exchange rate policy. The possible undervaluation of the Renminbi and its role in fostering China's exports has been at the centre of a bitter controversy. This paper sketches a profile of the renminbi with the emphasis on its role in enhancing China's international competitiveness.

The impact of exchange rate fluctuations on economic performance is a perennial hot topic in international economics - see Bação et al. (2015). When a country is viewed as influencing its exchange rate, it is subjected to criticism by countries that have companies competing in the same markets as the firms of the currency manipulator. In such a context, a currency war may be the outcome. China has been particularly targeted by leaders of other industrialized countries, namely in the USA. Understanding its exchange rate policy is therefore an important issue in international economics.

In this paper we describe the evolution of China's exchange rate policy (in section 2) and how it has been influenced by the constraints that the Chinese authorities face, namely the trilemma of international economics (section 3). We also evaluate the strength of the Renminbi's claim to become an international reserve currency (section 4). Finally, we propose (in section 5) and apply (in section 6) a test of the hypothesis that China has been manipulating the Renminbi's exchange rate.

2. China's Exchange Rate System

China has not always had the status of economic power that it enjoys today. Likewise, its currency has only recently acquired the status of international reserve currency. The second half of the 20th century was a time of enormous transformations for the Asian giant, be they economic, political or social. Therefore, it is inevitable to begin our analysis of the renminbi (RMB) with a historical overview. This will enable us to understand the current situation in China and why it invested in making the RMB an international reserve currency.

In 1949, the Communist Party of China took power and a new approach to economic growth was implemented. The new approach had a strong soviet influence, evident in the centralization of

the economy and in the role assigned to central planning. It was in this context that the Five-Year Plans appeared. Two decades passed under this regime until it began to become clear that the centralized system was not the most efficient for China. Thus, on the 22nd of December, 1978, in the Congress of the Communist Party, the Chinese leadership decided to initiate a process of economic reform. The goal was to modernize China, allowing it to compete with the most developed countries, namely the USA and Japan. It is important to stress that the communist ideology was not abandoned. Instead it was adapted, so as to allow decentralized markets to play a more important role in the economy. At the same time, international trade was being strongly supported. Until that time, due to nationalistic or even xenophobic feelings, imports were viewed with disapproval, even when necessary for the modernization of the country. However, after the implementation of reforms, it began to be understood that trade - and the exchange rate - would have to play a fundamental role in the development of China.

Figure 1 shows the bilateral nominal exchange rate of the RMB with respect to the United States Dollar (USD), between January 1981 and April 2017. Overall, there is a clear upward trend in the plot, i.e., a clear depreciation of the RMB. However, one can identify sub-periods with different characteristics. From 1981 until December 1993, the RMB steadily depreciated. In January 1994, there is a sharp depreciation, which is followed by a long period of stability until 2005. At that moment, the RMB entered an appreciation trend that lasted until 2014. Since then the RMB has been again depreciating steadily. What accounts for this behaviour of the RMB over the past 30 years?

Zhang (1996) and Xu (2000) give a detailed description of the Chinese policies that shaped the evolution of the RMB's exchange rate during the 1980s. In 1981, a dual currency system was introduced: one for foreigners and one for residents. Liberalization ensued and in 1986 "swap centres" were created, providing a location for currency exchange. Still in 1986, the official exchange rate of the RMB was pegged to the USD. That policy aimed at protecting the country from currency crises triggered by sharp depreciations.

During this period, two exchange rates coexisted: the official (pegged to the USD) and the exchange rate in the swap centres. The two were unified in January 1994 and the certificates used by foreigners were abolished. At the same time, a small fluctuation band of 0.3% was established for the exchange rate. This change in the exchange rate policy accounts for the strong depreciation in 1994, noticed in Figure 1, and the stabilization that followed. During the 1997 Asian financial crisis, China was able to stabilize the RMB's exchange rate by means of central bank interventions. The interventions were made possible by the reserves that a succession of current account surpluses brought to the central bank's vaults.

Figure 1: Bilateral nominal exchange rate RMB/USD
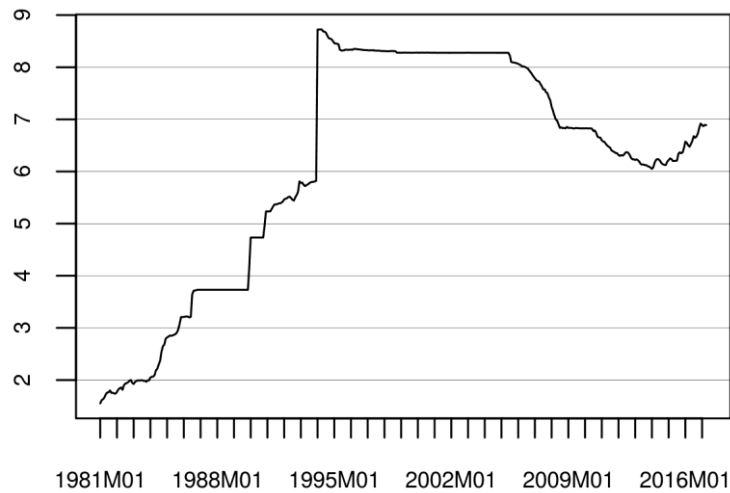
Source: St. Louis FRED.

In December 2001, China joined the World Trade Organization (WTO). China's accession to the WTO was contested because of the way that China, presumably, managed its international competitiveness. Accusations mentioned the deliberate undervaluation of the exchange rate with a view to promoting exports, a policy of low wages and underprotected workers. Nevertheless, accession to the WTO required a promise to change the orientation of the exchange rate policy, making the exchange rate regime more flexible.

In 2003, China's gross domestic product (GDP) accounted for 8.76% of the world's GDP. In 2002, counting the EU as a single trader, China became the fourth largest merchandise trader according to the WTO's International trade statistics 2003. By that time, China had already taken a leading role in the world economy. Naturally, the international pressure regarding China's exchange rate policy increased. In 2005, China announced the adoption of a managed floating exchange rate regime based on market supply and demand with reference to a basket of currencies. Therefore, the RMB was no longer strictly pegged to the USD. This represented a move of China's exchange rate regime towards a floating regime, where the exchange rate depends on market supply and demand, although within the 0.3% band. This band was widened to 0.5% in 2007. Nevertheless, in 2008, the RMB was once again pegged to the USD. This rollback was seen as a way of protecting China from the international financial crisis. The peg was temporary: in 2010 the peg was terminated and the liberalization process was back on track. In 2012 the fluctuation band was enlarged to 1%, and in 2014 it was again enlarged to 2%.

In 2014, the RMB's exchange rate hit a maximum of 6.0509 RMB to the USD. The following

two years were characterized by a slight depreciation, which may have resulted from capital outflows - more on this later. Finally, on October 1, 2016, the RMB was included in the Special Drawing Rights (SDR) basket. The SDR is a reserve asset created by the IMF in 1969. The basket that determines its value is composed of the most used currencies in international transactions. In fact, the goal of the SDR is to ensure liquidity for international transactions. Currently, the basket's composition is: the USD with a weight of 41.73%, the Euro (EUR) weighs 30.93%, the RMB has a share of 10.92%, the Japanese Yen (JPY) accounts for 8.33% and the British Pound (GBP) for 8.09%.

For a currency to be included in the SDR basket it must fulfill two requirements. First, it must be issued by countries with an important share of world exports. China is the largest exporter for several years now, so that this criterion has clearly been met. Second, the currency must be widely used international payments and widely traded in foreign exchange markets. This second criterion is harder to assess. It is important to stress that the criterion is not about the exchange rate regime - whether the exchange rate is freely floating or not - but rather about the utilization of the currency. It is a fact that the RMB has been increasingly used for settling international transactions - see Table 1.

Table 1: Share in international settlements

Period	RMB	USD	EUR	GPB	JPY	AUD	CAD
Nov.2012	0.56%	31.06%	40.89%	8.59%	2.44%	2.35%	1.86%
Oct.2013	0.84%	38.12%	34.69%	9.92%	2.56%	1.91%	1.89%
Oct.2014	1.59%	43.50%	29.38%	8.42%	2.91%	1.97%	1.76%
Oct.2015	1.92%	42.38%	29.89%	9.05%	3.00%	1.73%	1.13%
Oct.2016	1.67%	40.55%	32.26%	7.61%	3.38%	1.64%	1.82%

Source: Authors' computations base on data from SWIFT (www.swift.com).

In November 2012, the RMB was the 14th most used currency in SWIFT. In October 2013 it was the 12th. Between then and October 2014, its share almost double to 1.59%, moving up to the 7th position. In August 2015, the share of the BMB reached a maximum of 2.79%, surpassing the share of the JPY and reaching the fourth place. However, in October 2015, the RMB was down to the sixth position with a share of 1.67%. Throughout this period, the USD, the Euro, the GBP and the JPY, in this order, were the most popular currencies. Except in November 2012, the USD always had the largest share in international transactions. The RMB vies for the fifth place with the Australian Dollar (AUD) and with the Canadian Dollar (CAD). Therefore, the RMB appears to be a reasonably important currency in international payments, which helps to understand its inclusion in the SDR basket.

3. The Renminbi and the Trilemma

It is well-known in economics that a country cannot simultaneously have a fixed exchange rate, perfect capital mobility and an independent monetary policy - this is the "impossible trinity" or the "trilemma" of international economics. How does China deal with this trilemma?

It has been common to say that the RMB is undervalued. In 2016, this proposition was one of the cornerstones of Donald Trump's presidential campaign. It was argued that China was a currency manipulator, which allowed it to unfairly gain a competitive advantage for its exports, at the expense of the American economy, namely through the destruction of jobs in America. China's President reacted shortly afterwards, in January 2017, during the annual meeting of the World Economic Forum in Davos, stating that no one will win from a trade war and that China maintains a positive view on globalization. Critics will argue that it is easy to speak well of globalization when you have a current account surplus. Current account surpluses allow the accumulation of reserves, which can be used to sustain intervention in foreign exchange markets. But countries such as the USA have been pursuing policies that other commentators also argue that could affect the exchange rate, namely the policy of Quantitative Easing (QE). By expanding domestic liquidity, QE may lead to a depreciation of the currency; thus some of the effects of QE may work through "disguised devaluations" - see Bação et al. (2013).

The issue is then whether the RMB is undervalued. Cardoso and Duarte (2015) analyzed 25 papers about the undervaluation of the RMB between 1995 and 2011. They concluded, on average, the RMB was undervalued by around 20% relatively to the USD. Cardoso and Duarte also concluded that an appreciation of the RMB to eliminate the undervaluation would have a detrimental impact on Chinese exports to the EU. On the other hand, Shi (2006) shows that RMB's appreciations have had a negative effect on China's GDP. Thus, given the role that exports had in the Chinese growth model in the past few decades, it is clear that there are few incentives for the Chinese authorities to deliberately appreciate the RMB.

The international pressure for the appreciation of the RMB is not new. Step by step, the Chinese authorities have been giving the market a bigger role in the determination of the exchange rate, letting it float more and managing it less. The RMB was undervalued for a considerable period and that had beneficial effects for China's economy. But today that is not so obvious. In fact, more recently the trend has the opposite - see Prasad (2016). This may be related to the changes that have been occurring in the Chinese economy. Figure 2 shows the evolution of the growth rate of China's GDP.

Figure 2: Growth rate of China's GDP (%)
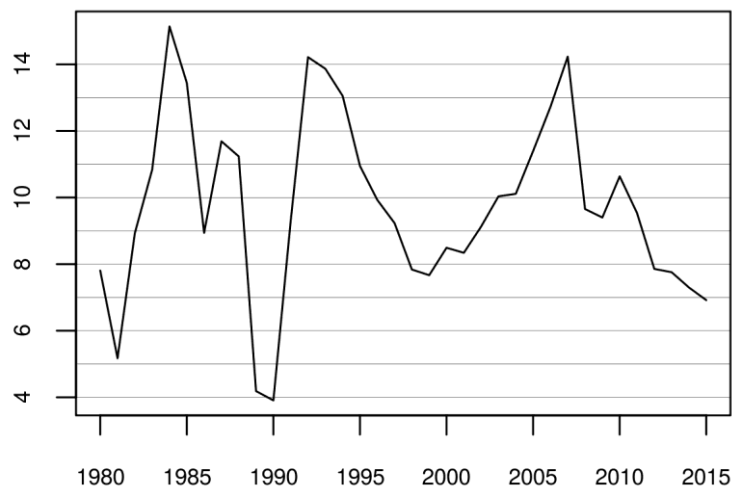
Source: World Development Indicators, The World Bank.

The Chinese GDP growth rates are extremely high. Nevertheless, the growth rate in 2015, 6.9%, was the lowest for over 20 years. In fact, there is a clear deceleration of growth since 2007. On the other hand, decelerations have occurred before and still strong growth resumed. (When analyzing Chinese data one should be ware of the quality of the statistics. According to Clark et al. (2017), China's GDP growth is likely to be understated. Given our needs in this paper, we will take the available data as a good indicator of the Chinese economic reality.)

Lardy (2006) argues that decelerations are caused by changes in the growth model, and that these changes are required to assure the sustainability of growth itself. Eichengreen et al. (2011), based on evidence gathered from a panel of high-growth countries, predicted a growth deceleration in China. They also show that the deceleration is more likely to happen when the exchange rate is undervalued and consumption is low relative to GDP. Therefore, one can say that the slowdown of Chinese GDP growth was expected. The Chinese authorities prepared for it, aiming for a soft landing, namely through the management of monetary policy by the Chinese central bank, the People's Bank of China (PBC).

The Chinese economy is going through a transition, moving from an export-led economy to an economy where consumption is increasingly more important. Naturally, the transition entails costs and a lower growth rate may be one of those costs. Bernanke (2016) identified this situation and related it to the trilemma. According to Bernanke, China is attempting to maintain all the three incompatible elements: a somewhat managed exchange rate, capital mobility and an independent

monetary policy. This is where the PBC comes to the fore. In order for the slowdown to be less steep, the PBC adopted a more flexible stance, injecting liquidity in the economy. The consequence was a lower interest rate on Chinese savings, which, together with higher capital mobility, led to flows of savings in search of higher yields. Capital mobility, albeit imperfect, allows part of the savings to be invested in foreign assets. In that process, the RMB is used to buy foreign currency, thus putting pressure on the exchange rate, in this case towards depreciation of the RMB. To prevent the depreciation, the PBC intervenes to shore up the RMB. This can only continue for as long as the foreign exchange reserves allow it. Figure 3 shows the evolution of China's foreign exchange reserves (gold is excluded). As a percentage of GDP, China's foreign reserves - accumulated mainly in the first decade of the 21st century - are on a declining trend since the 2010 peak.

Figure 3: China's foreign reserves excluding gold (% of GDP)
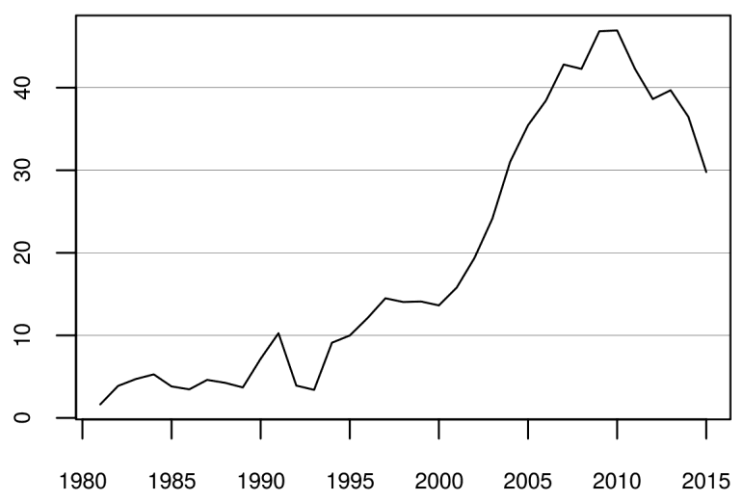
Source: Authors' computations based on data from the International Financial Statistics, International Monetary Fund.

The third vertex of the trilemma is the exchange rate. In 1986, the RMB was linked to the USD and during some time the exchange rate regime was effectively a peg. However, the Chinese authorities have gradually allowed the exchange rate to fluctuate inside wider bands, as we mentioned in the previous section. Nowadays, the Chinese exchange rate regime definitely cannot be considered a perfect peg.

In view of the trilemma, China must choose on of three possible combinations. Most developed countries opt for a liberalized capital market and an independent monetary policy, and let the exchange rate float.

However, China is still a developing country, for which the best option may be different. One

option would be to let the RMB float - something that is viewed with suspicion in China, given the possibility that wild swings might occur and might destabilize the Chinese economy. Such instability might also jeopardize the rise of the RMB to the status of international reserve currency.

The second option would be to restrict capital mobility. This would mean stepping back from the defense of globalization that has sustained the drive towards greater openness of the economy since 2001. Another hypothesis would be to use monetary policy to raise the interest rate, to counteract the outflow of capital, in effect losing control of monetary policy for domestic goals. Thus, the disadvantage would be that credit would become more expensive, harming investment and economic growth.

Of the three alternatives, China opted for capital controls. This appears somewhat surprising, given Xi Jinping's statement at the Davos 2017 meeting of the World Economic Forum, mentioned in the beginning of this section. Nevertheless, it is understandable given the importance that economic growth has for the legitimacy of the path that recent leaderships haven chosen for China, deviating it from orientation imposed on the Chinese economy until the 1970s.

## 4. The Renminbi as an International Reserve Currency

Whether a currency should be classified as an international reserve currency depends on the criteria chosen for that classification. Tavlas (1991) addressed the case of the German Mark and highlighted three characteristics usually attached to international currencies: (i) low inflation and credible monetary policy; (ii) a developed financial system; (iii) the size of the economy. Prasad (2016) added a few more criteria: (i) the size of the economy; (ii) macroeconomic policies (low inflation and sustainable public debt); (iii) capital mobility and currency convertibility; (iv) floating exchange rate; (v) developed financial system.

Let us go through Prasad's criteria, starting with the size of the economy. In this case, we are interested in the weight of China in the world economy, with respect to both output and trade.

Figure 4 shows the evolution of the share in the World GDP (measured in USD) of China, the USA, the Euro Area, Japan and the UK. In 1990, China's share of World GDP was less than 2%. By 2006, China's share was 5.4%, slightly above the UK's share. In 2010, China's share was 9.3%, above Japan's 8.7%. In 2015, China's share was 14.9%, not far behind the share of the Euro Area (15.6%), although still clearly below the USA's share (24.3%). The importance of China's economy in the World is undeniable. Besides accounting for a large part of World output, it leads the exporters ranking and occupies the second position in the top importers, according to the WTO. Therefore, as

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concerns the size of the economy, China clearly meets the requirement for the RMB to be an international reserve currency.

Figure 4: Shares in World GDP (%)
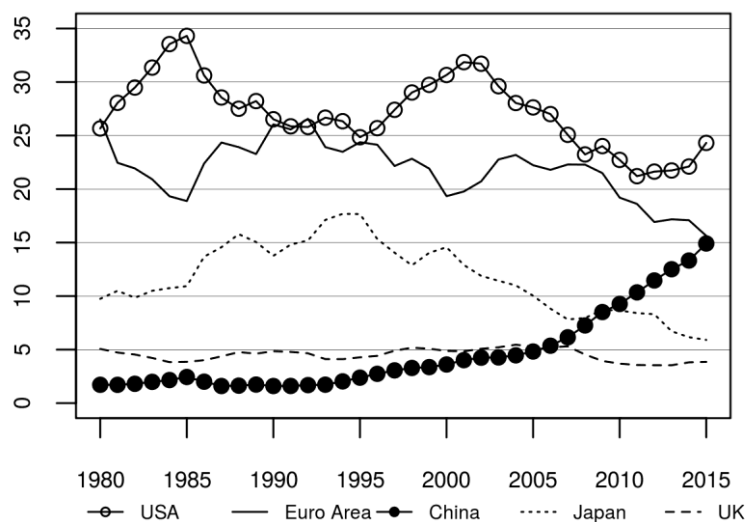
Source: World Development Indicators, The World Bank.

The second criterion, macroeconomic policies, is to be assessed in terms of inflation and public debt. Low inflation and credible monetary policy help sustain the value of a currency and thus make it more useful as a reserve asset - see Dobson and Masson (2009).

Figure 5 shows the evolution of China's inflation rate between 1987 and 2016. In the early part of the sample, inflation was very volatile, frequently in the two-digit zone. In 1994, the inflation rate reached 24%. In the following years, inflation dropped precipitously. Since then, inflation has become more stable, usually falling in the range 0%-5%. Thus, the requirement appears to be fulfilled.

Figure 5: China's inflation rate (%, Consumer Price Index).
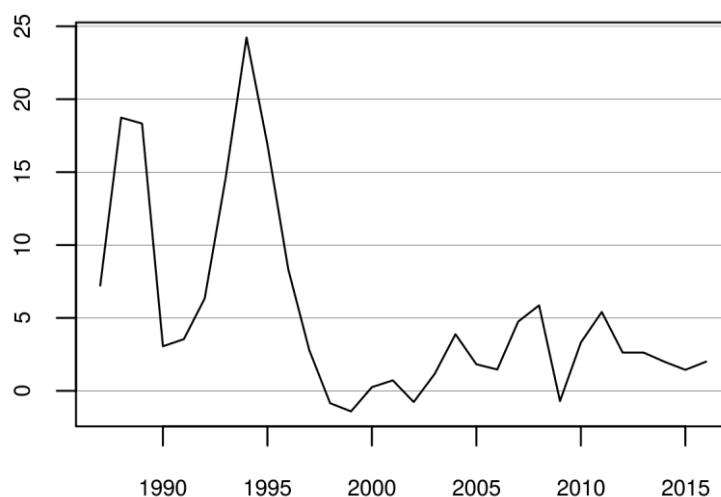
Source: World Development Indicators, The World Bank.

As for public debt, Table 2 shows how it has evolved over the last decade as a percentage of GDP. Chinese public debt has been on a clear increasing trend. Nevertheless, it remains well below the levels observed in developed countries. It appears that in this respect as well, the requirement is satisfied.

Table 2: General government gross debt (% of GDP)

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
China	29	27	34	34	34	34	37	40	43	46
USA	65	74	87	96	100	103	105	105	106	107
UK	42	50	64	76	82	85	86	88	89	89
Japan	183	191	209	216	231	237	240	242	238	239
EuroArea	65	69	78	84	87	91	94	94	93	91

Source: World Economic Outlook, International Monetary Fund.

The third item is capital mobility. As we mentioned in the previous section, China has put in place capital controls. But how strict are those controls? Chinn and Ito (2006) have introduced an index based on information provided by the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAR). This index attempts to measure de jure capital mobility; the higher the index, the higher is capital mobility. The Chinn-Ito index for China, in 2014, takes the value -1.19. For countries that do not restrict capital flows, such as the USA, the UK, Japan, Germany, Switzerland and Canada, the index takes the value 2.39. Thus, China's capital controls appear to be strict from the de jure perspective.

An alternative way of evaluating the economy's openness is by looking at measures related to actual capital flows - the de facto degree of capital mobility. One such measure is the international investment position and the associated measures of external assets and liabilities. The IMF's data shows that China's external assets and liabilities together sum to just about China's GDP. This suggests that capital mobility in and out of China is de facto high. Therefore, China's standing regarding the capital mobility requirement is unclear - see also Prasad and Ye (2012). The de jure analysis suggests little capital mobility. The de facto analysis points to the opposite conclusion. And probably greater liberalization is to be expected.

The fourth criterion is a floating exchange rate regime. As we remarked above, the Chinese exchange rate regime is not a purely floating regime. Although the pegging to the USD was terminated in 2005, still the RMB is only allowed to fluctuate inside a plus or minus 2% band. Figure 6 shows the evolution of the RMB's exchange rates vis-à-vis the USD, the Euro, the JPY and the GBP, between 2005 and 2016. In since the beginning of the international financial crisis, there is a tendency for the RMB to appreciate relatively to the other currencies, although the trend may have changed in the end of the sample. Still, the RMB's exchange rate appears to have been influenced by market forces, despite the controls imposed by the Chinese authorities. Thus, perhaps the RMB is in fact not too far from fulfilling this fourth requirement.

Figure 6: Renminbi's bilateral exchange rates (base January 1999 = 100)
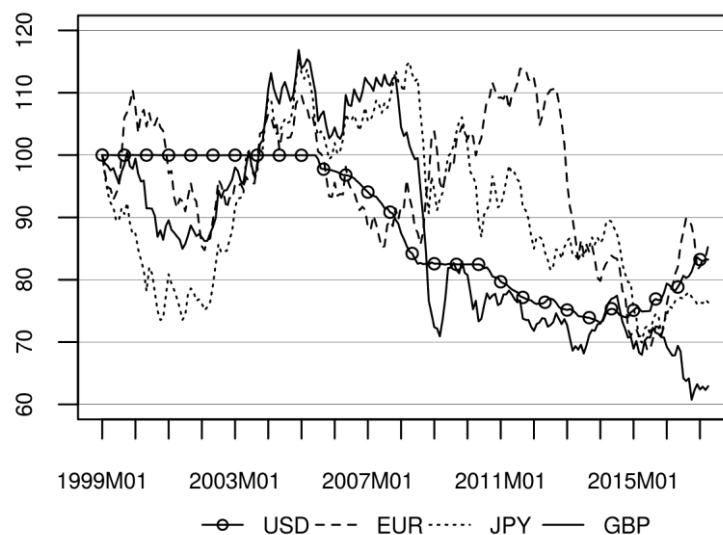
Source: St. Louis FRED.

The fifth and final criterion is the development of the financial markets. In other words, is the financial system sophisticated, are there varied financial markets, and is there ample liquidity in the

financial markets? Dobson and Masson (2009) argued that the Chinese financial system is underdeveloped. According to the data reported in Prasad (2016), the debt market appears to be insufficiently dense to support an international reserve currency - see also Chen and Peng (2007), Eichengreen (2011) and especially Elliot and Yan (2013).

In conclusion, it appears that the RMB's aspiration to become an international reserve currency has some strength, but also some shortcomings. The shortcomings are related to the financial markets in a broad sense. First, the financial system is still in a development stage. The standards of the Chinese financial system still lag behind those observed in leading economies. Second, capital mobility is still curtailed by the Chinese authorities. That has not prevented significant capital flows, as reflected in China's international investment position statistics. But the fact is that Chinese authorities frown upon liberalized capital flows. In fairness, given the recent past of financial crises, that stance is not difficult to understand. Third, China's exchange rate regime is still not a fully floating regime. This has prompted strong accusations against China. As we discussed earlier, China's exchange rate policy is often seen as a means to gain unfair competitiveness in international markets, destroying jobs in the rest of the world. We now turn to an evaluation of these accusations against China.

5. Empirical Model: Forecasting Exchange Rates

The starting point for our empirical model is the following. If China's has been manipulating the exchange rate, then possibly the evolution of the RMB's exchange rate will be easier to forecast than the exchange rate of freely floating exchange rates. Naturally, when thinking about exchange rate forecasts, one is instantly reminded of the Meese and Rogoff (1983) conclusion that exchange rates are basically a random walk - theoretical models are not helpful for exchange rate forecasting. Cheung et al. (2017) provide a modern treatment of the issues involved in exchange rate forecasting. Even if that is the case, we still want to know whether fluctuations of the RMB's exchange rate are similar to that of other currencies. If the magnitude of the RMB's exchange rate fluctuations is lower than that of other currencies, then perhaps that is the result of the intervention in foreign exchange markets by the PBC.

Nevertheless, we will not attempt to forecast bilateral nominal exchange rates. After all, there is only one bilateral exchange rate of the RMB to the USD: we could not use it to compare the volatility of the RMB and the volatility of the USD. Instead we will work with effective exchange rates. Effective exchange rates compute a weighted average of the bilateral exchange rates of one

currency (the currency of the "home country") against a set of other currencies. The loads given to the other currencies are related to the importance (in the home country's trade) of the trade between the home country and the country that issues the other currency. A higher value of the effective exchange rate means that the home country's currency has depreciated.

Effective exchange rates come in two flavours: nominal and real. The nominal effective exchange rate is a weighted average of the bilateral nominal exchange rates, whereas the real effective exchange rate is a weighted average of the bilateral real exchange rates. The real exchange rate compares the price of the goods in the home country and the price of those goods in the foreign country, after converting the foreign price of the goods to the home country's currency (using the bilateral nominal exchange rate).

We will therefore construct forecasts of the nominal and real effective exchange rates for China and a collection of other countries that issue currencies with some importance in international financial markets. Those countries are the USA, the Euro Area, Japan, the UK and Switzerland. The choice of Switzerland may be surprising to some readers. However, Switzerland's exchange rate policy made the headlines recently, when it abandoned a peg against the Euro that had been in place since 2011 - see Berhold and Stadtmann (2017). Switzerland can therefore provide a useful benchmark in our analysis.

The next step is to choose the forecasting methods. We will be working with monthly data and construct forecasts for a forecast horizon ranging from one month to twelve months. For that sort of data and forecast horizon, simple methods should perform adequately. We will employ two such forecasting methods: exponential smoothing - to be exact, Holt's linear trend method - and ARMA models - see, e.g., Hyndman and Athanasopoulos (2013) for an accessible introduction to these methods. Holt's linear trend model was chosen because it allows for a changing trend over time. Given the behaviour of exchange rates - recall Figures 1 and 6 - this feature of Holt's linear trend method may prove useful for forecasting exchange rates. As for ARMA models, they provide a simple characterization of the dynamics of the time series, which has been very popular in the context of forecasting. We allowed for up to four lags in both the autoregressive and the moving average components of the ARMA model. These limits stem from the difficulties that are associated with the estimation of ARMA models with many lags. Nevertheless, we believe that four lags should be enough to capture the essential characteristics of the time series.

We will not impose unit roots, i.e., we will not be using ARIMA models. There are several reasons for this choice. One is that we do not want to impose restrictions that might not be correct. A second reason is that, given the uncertainty about whether the restrictions are correct, the analysis should be repeated every period, to update the information available regarding the behaviour of the

time series. Doing so would require either introducing arbitrary judgment in every period concerning whether to impose or not the unit root, or just make the decision automatic on the basis of a threshold for the p-value associated to a certain test of the restriction - which also amounts to using a set of arbitrary choices. All that to impose a restriction that, if it is in fact valid, should be reflected in the estimates of the ARMA model - the impact of imposing the restriction should only become more important in the case of long-run forecasts. Therefore, for our present purposes, we believe it is unnecessary to deal explicitly with the issue of unit roots.

Our approach to the issue of quantifying the uncertainty surrounding exchange rate forecasts will therefore be the following. We will compute forecasts for the (nominal or real) effective exchange rate of each currency. The forecasts will have a certain forecast horizon, which will vary between one and twelve months. For each forecast horizon, we will compute forecasts spanning the period beginning in January 2002 and ending in April 2017. Thus, for currency i and forecast horizon h we will have the forecasts $f_{i,h,2002M01}$, $f_{i,h,2002M02}$, ..., $f_{i,h,2017M03}$, $f_{i,h,2017M04}$. We can then compute the root mean squared error (RMSE) of the h-step-ahead forecasts for currency i:

$$RMSE_{i,h} = \sqrt{\frac{\sum_{t=1}^{T}(y_{i,t} - f_{i,h,t})^2}{T}},$$

where $y_{i,t}$ is the actual value of the (logarithm of the) effective exchange rate of currency i in period t, $t = 1$ corresponds to January 2002 and $t = T$ corresponds to April 2017. Note that the forecasts will be computed recursively. In other words, to forecast h months ahead the effective exchange rate of currency i in period t we will use the data available until the period $t - h$. For example, to forecast four months ahead the effective exchange rate in January 2002, we will use the data available until September 2001; when forecasting the effective exchange rate in February 2002, we will use the data available until October 2001, and so on. The parameters implicit in the forecasting methods will be re-estimated (or re-optimized) every period, mimicking the actual behaviour of forecasters that might be using these methods for forecasting exchange rates.

The choice to begin the forecasts in January 2002 is related to the fact that China joined the WTO in December 2001. We wanted to analyze the behaviour of the RMB's exchange rate in the period where China's role in the world economy became more important, and concerns about its exchange rate policy became more acute. The data on effective exchange rates were collected from the Federal Reserve Bank of St. Louis (Federal Reserve Economic Data - FRED, web address: https://fred.stlouisfed.org/), although the series were computed by the Bank for International Settlements. All computations were performed with the econometrics software Gretl, version 2016d.

6. Results

Application of the procedure described in the previous section yielded root mean squared errors for forecasts of the nominal and the real effective exchange rates of the RMB, the USD, the EUR, the JPY, the GBP and the CHF (Swiss Franc), for forecasting horizons from one to twelve months. We organized these results in four tables (Tables 3 to 6), each corresponding to one of the possible combinations between nominal/real effective exchange rates and exponential smoothing/ARMA models.

The results suggest that exponential smoothing (in this case, Holt's linear trend model) is almost always the best option for very short term forecasts (up to three or four months ahead). ARMA models usually perform better on longer horizons, but exponential smoothing do better for the GBP exchange rate (nominal and real), for the CHF (nominal) and the USD (real). As one would expect, the quality of the forecasts declines (the RMSE increases) as the forecast horizon increases. We will make reference to the results for the best forecasting method for each exchange rate, i.e., for example, for the RMB we will use exponential smoothing forecasts for horizons up to three months and ARMA forecasts for horizons longer than three months.

For both the nominal and the real effective exchange rate, except for one-month-ahead forecasts, the lowest values of the RMSE are always observed for the CHF. This result is likely to be a reflection of the peg that the Switzerland adopted between 2011 and 2015. If we ignore Switzerland, then of the remaining currencies, the one with the lowest RMSE will be, for most of the cases, the Euro. This is especially so at longer forecast horizons. For short horizons, the RMB will be easier to forecast when the nominal rate is considered, and the USD will be easier to forecast when the focus is on the real rate. Therefore, the results presented in this paper do not support the view that China has been notoriously manipulating the exchange rate anymore than other countries have. It should be noticed that alternative explanations for these results could be devised. We leave investigation of that possibility to future research.

Table 3: RMSE of ARMA forecasts of the nominal effective exchange rate

horizon	RMB	USD	EUR	GBP	JPY	CHF
1	0.022	0.014	0.016	0.017	0.033	0.015
2	0.022	0.023	0.024	0.027	0.056	0.023
3	0.033	0.030	0.029	0.039	0.070	0.029
4	0.035	0.035	0.035	0.048	0.077	0.035
5	0.041	0.040	0.039	0.059	0.080	0.039
6	0.046	0.045	0.043	0.068	0.084	0.044
7	0.050	0.049	0.047	0.077	0.088	0.048
8	0.055	0.053	0.050	0.084	0.093	0.052
9	0.057	0.056	0.054	0.090	0.097	0.056
10	0.061	0.059	0.057	0.094	0.101	0.060
11	0.063	0.062	0.060	0.099	0.105	0.064
12	0.066	0.065	0.062	0.103	0.108	0.068

Source: Authors' computations.

Table 4: RMSE of exponential smoothing forecasts of the nominal effective exchange rate

horizon	RMB	USD	EUR	GBP	JPY	CHF
1	0.012	0.013	0.014	0.016	0.024	0.015
2	0.022	0.023	0.022	0.026	0.041	0.022
3	0.030	0.030	0.029	0.034	0.057	0.027
4	0.037	0.036	0.035	0.042	0.072	0.033
5	0.046	0.043	0.040	0.049	0.085	0.037
6	0.055	0.049	0.046	0.056	0.095	0.040
7	0.064	0.055	0.051	0.062	0.103	0.044
8	0.072	0.060	0.055	0.068	0.109	0.047
9	0.080	0.064	0.060	0.074	0.116	0.050
10	0.087	0.068	0.066	0.079	0.123	0.053
11	0.095	0.072	0.071	0.086	0.132	0.057
12	0.103	0.076	0.077	0.092	0.144	0.061

Source: Authors' computations.

Table 5: RMSE of ARMA forecasts of the real effective exchange rate

horizon	RMB	USD	EUR	GBP	JPY	CHF
1	0.018	0.023	0.018	0.019	0.042	0.015
2	0.033	0.044	0.025	0.032	0.074	0.021
3	0.037	0.072	0.031	0.045	0.089	0.026
4	0.038	0.098	0.035	0.055	0.094	0.030
5	0.045	0.118	0.039	0.070	0.091	0.033
6	0.054	0.134	0.043	0.081	0.091	0.036
7	0.056	0.148	0.047	0.093	0.093	0.038
8	0.057	0.159	0.050	0.102	0.097	0.040
9	0.061	0.167	0.053	0.109	0.103	0.043
10	0.067	0.172	0.056	0.115	0.111	0.045
11	0.069	0.176	0.060	0.121	0.117	0.047
12	0.070	0.183	0.062	0.127	0.123	0.049

Source: Authors' computations.

Table 6: RMSE of exponential smoothing forecasts of the real effective exchange rate

horizon	RMB	USD	EUR	GBP	JPY	CHF
1	0.014	0.013	0.015	0.017	0.024	0.015
2	0.025	0.021	0.023	0.026	0.041	0.022
3	0.034	0.027	0.029	0.034	0.057	0.027
4	0.041	0.032	0.034	0.042	0.072	0.031
5	0.050	0.038	0.039	0.049	0.085	0.035
6	0.057	0.043	0.043	0.055	0.095	0.038
7	0.065	0.048	0.048	0.061	0.103	0.041
8	0.071	0.053	0.053	0.067	0.109	0.044
9	0.076	0.056	0.058	0.072	0.116	0.047
10	0.081	0.059	0.063	0.078	0.123	0.050
11	0.086	0.063	0.067	0.084	0.132	0.053
12	0.091	0.067	0.072	0.089	0.143	0.057

Source: Authors' computations.

7. Conclusion

This paper analyzed the behaviour of the RMB with a focus on its use for influencing the international competitiveness of Chinese producers. With that in mind, we discussed the RMB's role in the world economy and its potential for becoming an international reserve currency. We therefore conducted a review of the historical evolution of China's exchange rate policy, highlighting the economic and political factors that shaped the path of the RMB. Namely, we discussed the undervaluation that gave an initial spur to Chinese exports. We also discussed the ensuing liberalization movement and the internationalization of the RMB.

We also analyzed the recent evolution of China's economy, characterized by a growth slowdown. This discussion was framed in the context of the trilemma of international economics, which places severe restrictions on the options available to policymakers. The discussion made clear the importance of the foreign exchange reserves for the sustainability of China's monetary policy, under pressure from the threat of capital outflows.

The position of the RMB in the international context was discussed with reference to the usual criteria for a currency to be considered an international reserve currency. It was argued that the RMB fails in some of the criteria, most clearly in those related to capital mobility and development of the financial system.

Finally, we undertook an empirical analysis of the level of currency manipulation in China, the USA, the Euro Area, Japan, the UK and Switzerland. The indicator for currency manipulation was the forecast error of the effective exchange rate. Unsurprisingly, the CHF appeared to be the easiest to forecast, which we interpreted as indicating a higher level of central bank intervention. On this indicator and under our interpretation of it, China does not appear to be a serious offender with regard to the exchange rate.

References

Bação, P., Duarte, A. P., Machado, D. (2015), "Exchange rates, the competitiveness of nations and unemployment", In Krstic, B., Paszek, Z (eds.), *Competitiveness of enterprises and national economies*, Nis: University of Nis, Faculty of Economics, pp. 147-166.

Bação, P., Duarte, A. P., Simões, M. (2013), "The International Monetary System in Flux: Overview and Prospects", In Mirdala, R. (ed.), *Financial Aspects of Recent Trends in the Global Economy*, ASERS Publishing, Vol. I, Ch. 10, pp. 191-206.

Bernanke, B. (2016), "China's trilemma-and a possible solution". https://www.brookings.edu/blog/ben-bernanke/2016/03/09/chinas-trilemma-and-a-possible-solution/ (10/12/2016).

Berhold, K., Stadtmann, G. (2017), "Who put the holes in the Swiss cheese? Currency crisis under appreciation pressure", European University Viadrina Frankfurt (Oder), Department of Business Administration and Economics, Discussion Paper No. 391.

Cardoso, A., Duarte, A. P. (2015), "The Impact of the Undervaluation of the Chinese Currency", Estudos do GEMF No. 9, University of Coimbra, Faculty of Economics.

Chen, H., Peng, W. (2007), "The Potential of the Renminbi as an International Currency", *China Economic Issues*, 7.

Cheung, Y.-W., Chinn, M.D., Pascual, A.G., Zhang, Y. (2017), "Exchange rate prediction redux: new models, new data, new currencies", ECB Working Paper Series No. 2018.

Chinn, M., Ito, H. (2006), "What Matters for Financial Development? Capital Controls, Institutions, and Interactions", *Journal of Development Economics*, 81 (1), pp. 163-192.

Clark, H., Pinkovskiy, M., Sala-i-Martin, X. (2017), "China's GDP Growth May be Understated", NBER Working Paper, 23323.

Dobson, W., Masson, P.R. (2009), "Will the renminbi become a world currency?", *China Economic Review*, 20 (1), pp. 124-135.

Eichengreen, B. (2011), "The renminbi as an international currency", *Journal of Policy Modeling*, 33 (5), pp. 723-730.

Eichengreen, B., Shin, K., Park, D. (2011), "When Fast Growing Economies Slow Down: International Evidence and Implications for China", NBER Working Paper Series, 16919.

Elliott, D., Yan, K. (2013), "The Chinese Financial System", John L. Thornton China Center at Brookings Monograph Series, 6.

Hyndman, R.J., Athanasopoulos, G. (2013), Forecasting: principles and practice, OTexts.

Lardy, N. (2006), "China: Toward a Consumption-Driven Path", Policy Briefs in International Economics.

Meese, R., Rogoff, K. (1983), "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?", *Journal of International Economics*, 14 (1-2), pp. 3-24.

Prasad, E. (2016), "China's Efforts to Expand the International Use of the Renminbi", U.S.-China Economic and Security Review Commission.

Prasad, E., Ye, L. (2012), "The Renminbi's Role in the Global Monetary System", IZA Discussion Paper, 6335.

Shi, J. (2006), "Are Currency Appreciations Contractionary in China?", NBER Working Paper Series, 12551.

Tavlas, G.S. (1991), "On the international use of currencies: the case of the deutsche mark", *Essays in International Finance*, 181.

Xu, Y. (2000), "China's exchange rate policy", *China Economic Review*, 11 (3), pp. 262-277.

Zhang, Z. (1996), "The exchange value of the Renminbi and China's balance of trade: an empirical study", NBER Working Paper Series, 5771.

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