

Inclusion of the RMB in SDRs and the impossible trinity in China

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ABSTRACT

This paper explores the dynamics and features of the impossible trinity configuration in China, in the process of reforming the renminbi (RMB) exchange rate and inclusion in the currency basket of special drawing rights (SDR). By applying the synthetic model of Ito and Kawai (2014) and Aizenman et al. (2008) to Chinese data for the period between 2002 and 2019, we find structural breaks in China's exchange rate stability in 2005, when China started its market-oriented exchange rate reform, and 2016, when the RMB was included in the SDR. More importantly, we find that, in the process of RMB exchange rate reform and RMB's inclusion in the SDR, China has adopted a more flexible exchange rate regime, becoming more financially open, monetarily independent, and less reliant on international reserves hoarding.

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1. Introduction

International finance and macroeconomics research has devoted substantial attention to the impossible trinity theory—monetary policy autonomy, exchange rate stability, and financial market openness (Ito and Kawai, 2014)—and explored how a country can pursue a strategic policy to confront this trilemma. While a large group of literature uses data on the industrially developed countries,¹ a recent strand of the literature has explored this challenge in developing countries, particularly in the aftermath of the Asian financial crisis in 1997 and the global financial crisis in 2008 (Carton, 2011; Han et al., 2011; Patnaik and Shah, 2010; Sun and Payette, 2016).

In particular, a growing number of academic papers study the impossible trinity in emerging markets, represented by China (Aizenman et al., 2011; Han et al., 2011; Sun and Li, 2017; Sun and Payette, 2016). The linkage between the trilemma and currency internationalization in the process of exchange rate reform in the Chinese renminbi (RMB) is also explored (Anderson, 2016; Sun and Payette, 2016).

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¹ For instance, on the member countries of the Organization for Economic Cooperation and Development (OECD) (Rose, 1996) and European economies (Magas, 2018; Obstfeld et al., 2005).

China began its market-oriented exchange rate reform in 2005. According to Spiegel (2005), on July 21, 2005, after more than a decade of strictly pegging the RMB to the US dollar, the People's Bank of China (PBOC, China's central bank) announced a reform to incorporate a "reference basket" of currencies when choosing its target for the RMB. Another turning point came in 2016. On December 11, 2015, for the first time an RMB index was introduced to improve the market mechanism for determining the central parity of the RMB exchange rate.² On October 1, 2016, the RMB was officially included in the special drawing rights (SDR).

To be added to the SDR, a currency must satisfy the two prerequisite criteria by the International Monetary Fund (IMF): the issuer must be one of the top five global exporters, and the currency must be "freely usable." In order to make the RMB "freely usable," China has made aggressive efforts to internationalize it, especially since its unsuccessful first review in 2010. Now, the RMB is widely used in official foreign currency assets, international banking liabilities, and international debt issuance (Qiao and Ge, 2015).

In the process of the RMB exchange rate reforms and the RMB's inclusion in the SDR basket, China has gradually increased its exchange rate flexibility, and a substantial amount of capital flows into and out of China (Han et al., 2011). Theoretically, this implies a changed trinity configuration in China. As emphasized in Aizenman et al. (2008), increasing one trilemma variable induces a change in one or both of the other two variables. Specifically, in the process of increasing exchange rate flexibility, either financial market openness or monetary policy independence or both are expected to rise correspondingly. This implies that China would move closer to the economies with a floating exchange rate regime and perfect capital mobility to maintain monetary independence, such as the US, Japan, and Canada.

These changes have posed challenges in the management of the impossible trinity in China. Do Chinese policies regarding the degree of capital controls, the flexibility of exchange rates, and monetary autonomy behave differently in the process of RMB exchange rate reform and inclusion in the SDR basket? Does the impossible trinity theory restrict China's policy choices? If the trinity theory is valid, associated with rising flexibility of the RMB exchange rate and increased capital mobility, we would expect China to increase its monetary autonomy and behave similarly to the US and other economies with a floating exchange rate regime and perfect capital mobility to gain monetary independence. Is this what is happening in China? Has China increased its monetary independence as predicted by the impossible trinity theory?

Aizenman et al. (2008) also suggest that the accumulation of reserves might be closely related to changing patterns in the trilemma, because empirical evidence shows the increasing importance of financial integration as a determinant of international reserve hoarding (Aizenman and Lee, 2007). The traditional buffer stock model also suggests that China might increase its international reserve holdings to retain a degree of monetary policy autonomy at a time of growing financial integration but strong exchange rate stability. However, given the recent development of rising exchange rate flexibility and rising capital flows into and out of China, has China reduced its reliance on international reserve hoarding?

Few papers have discussed the features and dynamics of the trinity configurations in China. This paper fills the gap by studying the dynamics of the triad policy choices in China. China makes an interesting case study of the impossible trinity theory for three reasons. First, China experienced phenomenal growth after the economic reforms in 1978. It is now an economic behemoth, increasing its involvement in the global economic system. Second, China is the only emerging market economy whose currency is included in the SDR basket. Its development and management of the trilemma might have a significant impact on other economies (Sun and Payette, 2016). Finally, China has implemented various reforms to liberalize its interest rates, exchange rates, and capital flows. China has increased its exchange rate flexibility and its financial openness, however, it is not clear what happened to its monetary independence.

To investigate the configuration of the triad policies in China, we first apply the metrics developed by Ito and Kawai (2014) and Aizenman et al. (2008) to construct trinity indexes, namely, exchange rate stability, monetary independence, and financial market openness. We also construct a measurement of international reserve hoarding, as Aizenman et al. (2008) suggests that reserve accumulation may be closely related to changing patterns in the trilemma. We then perform structural break tests of exchange rate stability to examine whether the exchange rate reforms and the RMB's inclusion in the SDR have brought breaks into exchange rate stability. Following these tests, we divide the sample into three periods: (1) the period from 2002 to 2005, when the RMB ended its strict peg to the US dollar in July, 2005; (2) the period from 2006 to 2016, when the RMB joined the SDR basket in October, 2016; and (3) the period from 2017 to 2019.

Two points should be noted. First, we find structural breaks in 2005 and 2016, which indicates that exchange rate flexibility has significantly increased since the market-oriented RMB exchange rate reforms in 2005 and the RMB's inclusion in the SDR in 2016. Additionally, we find that monetary policy independence, financial market openness, and international reserve hoarding in China have varied significantly over these sample periods. Second, we find that over the course of the RMB exchange rate reforms and the RMB's inclusion in the SDR, China has adopted a more flexible exchange rate regime and become more financially open. Consistent with the theoretical prediction, we find that, associated with the rising exchange rate flexibility and increased financial market openness, China has gained more control over its monetary autonomy and decreased its reliance on international reserve hoarding.

² Jermann et al. (2019) provides a background description of the RMB exchange rate reform at the end of 2015. To facilitate the internationalization of the RMB, on August 11, 2015, China reformed its procedure for setting the daily central parity of the RMB against the US dollar. Following the reform, the central parity of the RMB depreciated persistently against the dollar until the People's Bank of China (PBOC) intervened. To mitigate depreciation expectations, which was later strengthened by the slowing economy and the first possible interest rate hike by the US Federal Reserve and shift the focus away from the RMB's moves against the dollar, on December 11, 2015, the PBOC introduced the CFETS index as a measure of the RMB's performance against a basket of 13 currencies with the weight based mainly on international trade.

The paper contributes to the literature on the impossible trinity in emerging markets, such as China. We emphasize the changing patterns in the trinity configuration in China in the process of RMB exchange rate reforms and the RMB's participation in the SDR basket, which has been ignored in the literature on China's management of the trilemma. Our findings on the association of China's impossible trinity and the RMB exchange rate reforms and the SDR accession can help us understand the internationalization of the RMB and the management of the impossible trinity in emerging markets that face a trade-off between rising financial market openness and monetary independence.

The remainder of the paper is organized as follows. Section 2 reviews the impossible trinity theory, the RMB's market-oriented exchange rate reforms since 2005, and the RMB's accession to the SDR. We also analyze theoretically how the reforms and the accession would change the trinity pattern in China. Section 3 reviews the extant literature related to our study. The methodology and sample overview are discussed in Section 4. Empirical results are presented in Section 5. The study concludes in Section 6.

2. Background

2.1. The theory of the impossible trinity

The classical impossible trinity or trilemma theory, first introduced by Mundell (1963), posits that a country cannot simultaneously obtain three desirable policy goals: perfectly mobile capital flows, an autonomous monetary policy, and a fixed exchange rate regime. In Mundell's paper, with the simplifying assumption of the nonexistence of speculation and zero exchange rate margins, the perfect capital mobility condition is proxied by equal interest rates. That is, a small country "cannot maintain an interest rate different from the general level prevailing abroad" (Mundell, 1963). Additionally, he assumes equilibrium in three other markets: the market for goods, the money market, and the foreign exchange market. With a fixed exchange rate regime, a country's central bank loses control over monetary policy, as an increase/decrease in the domestic money supply arising from open market purchases/sales returns to the bank through its exchange stabilization operations.³

The impossible trinity is commonly illustrated by a trilemma equilateral triangle as shown in Fig. 1, in which the three equilateral sides measure the three indicators in the impossible trinity theory: monetary policy independence (MPI), exchange rate stability (ERS), and financial market openness (FMO) (Ito and Kawai, 2014). The vertical distance from any points to one side of the triangle represents the distance from the policy measure on that side of the triangle.

The figure illustrates that an economy can stand on at most two of the three sides simultaneously, in which case, the economy is on one corner and achieves the full extent of two of the goals but gives up the third one, which signifies the trilemma. Explicitly, we let each of the trilemma indicators take a value of between 0 and 1 to convey the varying degrees of policy management. For instance, Japan chooses MPI and FMO with a degree of one, respectively, but ERS with a degree of zero.

In addition to the diagrammatic illustration, Feenstra and Taylor (2017, pp.145) present a simple system of equations to capture the idea of the impossible trinity. In particular, they construct three equations concerning desirable policy goals, as follows:

$$\text{fixed exchange rate: } \frac{E_{H/F}^e - E_{H/F}}{E_{H/F}} = 0, \quad (1)$$

$$\text{international capital mobility: } i_H = i_F + \frac{E_{H/F}^e - E_{H/F}}{E_{H/F}}, \quad (2)$$

$$\text{money policy autonomy: } i_H \neq i_F, \quad (3)$$

where $E_{H/F}^e$ is the expected exchange rate between the domestic currency and a foreign currency, and $E_{H/F}$ is the spot exchange rate between the domestic and foreign currency; and i_H and i_F are the domestic and foreign interest rates, respectively.

Eqs. (1) and (2) automatically lead to the following equation:

$$i_H = i_F \quad (4)$$

which is mutually incompatible with Eq. (3), the goal of autonomous monetary policy. Feenstra and Taylor (2017, pp.145) thus argue that "though governments may want to pursue all three of these policy goals. But in reality, they can't do this: ... it is a mathematical impossibility." Because these three policy goals are mutually incompatible, a country must drop one of the three. This implies that when an economy chooses ERS and FMO, it automatically gives up monetary independence, as happened in Greece, a euro-area member country, and in Hong Kong, China.

2.2. The RMB exchange rate reforms and its accession to the SDR

China initiated its market-oriented exchange rate reforms in 2005, when the People's Bank of China (PBOC) announced that it would incorporate a "reference basket" of currencies when choosing its target for the renminbi. Another turning point was reached in

³ In Mundell (1963), when the central bank adopts an expansionary monetary policy by purchasing securities on the open market, it puts downward pressure on the domestic interest rate, which drives further capital flight and worsens the balance of payments. To prevent the exchange rate from depreciating, the central bank sells foreign exchange and buys back domestic currency. The process continues until the cumulative foreign exchange deficits equal the open market purchases, and the money supply is restored to its original level.

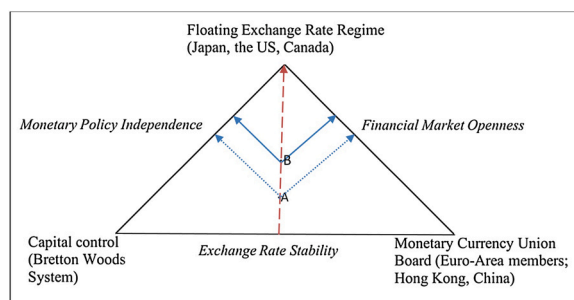


Fig. 1. The Trilemma Triangle.

Source: Ito and Kawai (2014).

Table 1

The weight of the SDR currencies (%).

Source: International Monetary Fund.

Currency	2001 – 2005	2006 – 2010	2011 – 2015	2016 – 2020
US dollar	45	44	41.9	41.73
Euro	29	34	37.4	30.93
Japanese yen	15	11	9.4	8.33
Pound sterling	11	11	11.3	8.09
Chinese renminbi				10.92

2016. On August 11, 2015, the PBOC liberalized the RMB exchange rate by improving the mechanism for determining the central parity of the RMB exchange rate. On August 30, 2015, the IMF added the RMB to the SDR basket of currencies. Under pressure due to tremendous depreciation in the RMB, on December 11, 2015, the PBOC introduced an RMB index for the first time to improve the market mechanism for determining the RMB exchange rate. On October 1, 2016, the RMB was officially included in the SDR, which was created by the IMF in 1969 as an international reserve asset to provide liquidity as well as augment its members' official reserves. The SDR is neither a currency nor a claim on the IMF but can be exchanged for the five freely usable currencies as determined by the IMF (US dollar, euro, RMB, Japanese yen, UK pound).

To be added to the SDR, a currency must satisfy the two prerequisites by the IMF, its issuer being an export leader and the currency being freely usable. The former requires a country to remain among the top five exporters for five years, and the latter means that its currency is widely used in international transactions as well as in foreign exchange markets.

The first review of the RMB by the IMF in 2010 shows that China has become one of the world's largest exporting countries (Qiao and Ge, 2015). However, the RMB could not join the basket based on the criterion of being "freely usable" (Anderson, 2016). To satisfy this requirement, the RMB would not need to be widely traded in all exchange markets, but it had to be traded in more than one principal exchange market. Sufficient liberalization within the market in China would also be necessary to ensure that members who receive financing from the IMF have adequate access to this market.

Since then, China has made aggressive efforts to internationalize the RMB and to satisfy the SDR "freely usable" criterion. These efforts include reducing interest rate controls and opening the domestic bond market to foreign central banks and sovereign wealth funds (Das, 2019); encouraging the lines of the RMB swap to central banks on all continents as well as relaxing restrictions on financial flows between China and other economies (Eichengreen and Xia, 2019); promoting a flexible exchange rate regime and liberal interest rate policy (Kwan, 2018); improving data reporting standards and enhancing data transparency by joining the Data Release Special Standard (SDDS) (International Monetary Fund, 2015); and cooperating with investigations by the Currency Composition of Official Foreign Exchange Reserves COFER (International Monetary Fund, 2016) and the Bank for International Settlements (BIS) (Upper and Valli, 2016).

Over the next five years, the RMB developed greatly in both quality and quantity. As a result of these efforts, the RMB is widely used as part of official foreign currency assets, international banking liabilities, and international debt (Qiao and Ge, 2015). Consequently, the RMB was formally included in the SDR basket on December 1, 2015, and this took effect on October 1, 2016.

The SDR's review is performed every five years. Before the addition of the RMB to the basket, the SDR basket consisted of four major currencies: the US dollar, the euro, the Japanese yen, and the British pound sterling; the addition of the RMB increases that number to five. The weight of each of the SDR currencies is reported in Table 1.

The addition of the RMB to the SDR has certain positive aspects for both China and the SDR. On the one hand, it benefits the world reputation of RMB from globalization proceeds (Qiao and Ge, 2015) and reinforces confidence in China in the international market and otherwise (Anderson, 2016). It also enhances bulk commodity pricing (Wang, 2018), which is the foundation of Chinese development. On the other hand, the RMB's inclusion contributes to the stability and representativeness of the SDR basket (Qiao and Ge, 2015), because its managed exchange rate mechanism can mitigate the high volatility of the other currencies.

2.3. The changed trinity configuration and international reserves in China

Associated with the RMB exchange rate reforms and the efforts toward RMB internationalization are rising exchange rate flexibility and large capital inflows to and outflows from China (Han et al., 2011). According to the Viviani's theorem⁴, in Fig. 1, the sum of a point's vertical distance to the three sides of an equilateral triangle is a constant (Ito and Kawai, 2014). This suggests that, after China moves farther away from one policy goal (ERS), it simultaneously moves closer to another one or two policy goals (FMO and MPI).

Theoretically, this implies a different trinity configuration in China. In particular, in Fig. 1 the three policies move from point A to point B. In the process of the attainment of increased exchange rate flexibility and rising FMO, we would expect MPI in China to rise correspondingly. The figure shows that exchange rate reforms and rising FMO moved China closer to the economies with floating exchange rate regimes and perfect capital mobility which help to maintain monetary independence, as seen in the US and Japan.

Aizenman et al. (2008) also suggests that reserve accumulation might be closely related to changing patterns in the trilemma because empirical evidence demonstrates the increasing importance of financial integration as a determinant of international reserve hoarding. This evidence suggests that emerging economies would hoard international reserves because these reserves can reduce the probability of sudden stop in capital inflows and the depth of the resulting output collapse when the sudden stop occurs. For instance, Aizenman and Lee (2007) find evidence that international reserve hoarding serves as a means of self-insurance against exposure to sudden stop by linking a large increase in reserve holdings to deepening financial integration in developing countries.

At the same time, the traditional buffer stock model suggests that China would increase its international reserve holdings to retain a degree of monetary policy autonomy at a time of growing financial integration but strong ERS. For instance, Chinese monetary authorities have implemented open market operations and the reserve requirement ratio as sterilization tools to keep the exchange rate relatively stable and manage domestic liquidity issues (Han et al., 2011). However, given the recent rising exchange rate flexibility and rising capital flows into and out of China, it is possible that China will reduce its reliance on international reserve hoarding to maintain an independent monetary policy.

3. Literature review

Since the impossible trinity was first introduced by Mundell (1963), numerous papers have studied its multifaceted aspects, its validity, its correlation with macroeconomic factors, and its policy implications.

Rose (1996) is among the first to examine the historical trade-offs among fixed exchange rates, monetary policy independence, and capital mobility; though he finds little evidence of a trade-off, several papers confirm the existence of the trilemma. In particular, Obstfeld et al. (2004, 2005) document the logic of the trilemma and consider it a guiding policy in macroeconomic management. Aizenman et al. (2008, 2011) also confirm the trilemma theory by pointing out that an increase in one of the three variables leads to a decline in the other two variables. This evidence is again confirmed by Aizenman et al. (2016) using policy interest rates and real effective exchange rate movements.

Other research in mainstream international finance and economics sheds light on the linkage between the trilemma and macroeconomic factors. Aizenman et al. (2008, 2011) document that if an economy pursues a more stable exchange rate regime, it faces more volatile output and inflation. Aizenman and Sengupta (2013) obtain the same results, validating the trade-off between a fixed exchange rate policy and inflation but note that the latter is not statistically affected by monetary policy autonomy. In addition to output and inflation, Beckman et al. (2017) takes government ideology into account to test the trilemma. As a result, their paper shows that political concerns affect a country's trilemma management because left-leaning governments prefer ERS over monetary independence if a negative output gap emerges.

Questions are also posed as to whether the trilemma lead to a choice between monetary autonomy and ERS (Han et al., 2011) or become quadrilemma, with the addition of financial stability and international reserves (Kaur, 2019) as economic policy goals. Although some scholars recommend that countries asymptotically reach the vertexes in the diamond trilemma chart, the implications for policy makers are mixed in the literature. Some suggest that developing countries converge in the middle of the chart, such as setting an intermediate extent of monetary independence and financial integration but controlled exchange rate flexibility (Aizenman et al., 2011) or choosing a combination of macroprudential management of capital flows and flexible exchange rates, with international monetary policy coordination (Sun and Li, 2017) or even to give up on one factor to attain the other two (Klein and Shambaugh, 2015; Kaltenbrunner and Paineira, 2017).

Some papers are studying this issue with regard to China's impossible trinity. Han et al. (2011) show that the trilemma also occurs in China, and to deal with the impossible trinity, China could employ a "macroprudential" regulation in terms of capital flows or accumulate official reserves (Carton, 2011) whereas Aizenman and Sengupta (2013) indicate that ERS is a weighted tool in China's macroeconomic management of the impossible trinity. The latter result is also consistent with Kawai and Liu (2015), who argue that China still has a tight exchange rate regime to reduce monetary independence and capital market controls. Sun and Payette (2016) offer new insights into the research on the trilemma in China by taking RMB internationalization into account. Their paper proposes

⁴ <https://mathworld.wolfram.com/VivianisTheorem.html>.

Table 2
Descriptive Statistics of Exchange Rates.

Variable	No. of Obs.	Mean	Std. Dev.	Min	Max
ΔRMB	213	-0.000263	0.0134	-0.0442	0.0500
ΔUSD	213	0.000460	0.0130	-0.0453	0.0374
ΔGBP	213	0.00101	0.0183	-0.0529	0.0852
ΔJPY	213	-0.000502	0.0240	-0.105	0.0684
ΔEUR	213	-0.000696	0.0161	-0.0548	0.0691

Notes: ΔRMB , ΔUSD , ΔGBP , ΔJPY , and ΔEUR are the first difference in the natural logarithm of monthly exchange rates of the RMB, US dollar, British pound, Japanese yen, and euro against the numéraire currency, that is, the SDR. Data are gathered from the IFS, ranging from January 2002 to October 2019.

that, to maximize the internationalization of the RMB, China should liberalize monetary and capital controls but accept a more flexible exchange rate policy and currency basket pegging on SDR.

4. Methodology and sample overview

4.1. Data

The data used in this study were obtained and merged from different data sources, including the International Financial Statistics (IFS), the China Economic Information Network Statistics Database (CEInet Statistics), and the World Development Indicators of the World Bank.

The frequency of the data to construct ERS and MPI is monthly, and for FMO and international reserve hoarding (INRE) it is annual. As we use the exchange rates of the other four major currencies included in the SDR (USD, GBP, JPY, and EURO) to construct China's exchange rate stability, and the EURO officially began to circulate in January 2002, our data for constructing ERS and MPI range from January 2002 to October 2019. As we use China's International Investment Position (IIP) to construct FMO and INRE, and China first officially published its IIP in 2004, our data used for them range from 2004 to 2019.

To study whether significant differences arise in the ERS in the process of the exchange rate reforms, we perform structural break tests of the monthly ERS. As FMO and INRE have an annual frequency, we take the annual averages of ERS and MPI and divide the sample into different subperiods based on the results of the structural break tests. Finally, we study the annual dynamics and trinity configurations of the trinity measures and international reserve hoarding over time.

4.2. Methodology

To examine what has happened to the trilemma in China in the process of the RMB's exchange rate reforms and inclusion in SDR, we follow the methodology of [Ito and Kawai \(2014\)](#) and [Aizenman et al. \(2008\)](#) to construct the measures of ERS, MPI, and FMO in China.

4.2.1. Measuring exchange rate stability (ERS)

We construct the ERS index based on the idea of [Ito and Kawai \(2014\)](#).⁵ We postulate that the PBOC can use one currency or an implicit basket of currencies to manage the pricing of RMB, and the currency weights in this basket might vary over time. We consider the major currencies in the basket are the USD, GBP, JPY, and EUR, all of which are included in the SDR basket. Hence, to measure the ERS, we run the following model.⁶

$$\Delta RMB_t = \alpha_t + \beta_{USD,t} \Delta USD_t + \beta_{GBP,t} \Delta GBP_t + \beta_{JPY,t} \Delta JPY_t + \beta_{EUR,t} \Delta EUR_t + \varepsilon_t \quad (5)$$

where ΔRMB_t is the first difference of the natural logarithm of monthly exchange rates of the RMB against the numéraire currency—that is, the SDR. ΔUSD_t , ΔGBP_t , ΔJPY_t , and ΔEUR_t are the first difference in the natural logarithm of monthly exchange rates of the US dollar, British pound, Japanese yen, and the euro against the SDR. $\hat{\beta}_{k,t}$ and $k = USD, GBP, JPY, EURO$ are the weights of each currency in the basket of the four currencies. ε_t is the error term.

Then, we extract the adjusted R^2 , which, according to [Ito and Kawai \(2014\)](#), is defined as a proxy for ERS. It ranges from zero to one, with higher values indicating a more stable exchange rate regime. [Ito and Kawai \(2014\)](#) argue that if the RMB is pegged to a major currency or a basket of major currencies, it must be either $\hat{\beta}_{k,t} = 1$ or $\sum_{k=1}^K \hat{\beta}_{k,t} = 1$. In that case, the goodness of fit of the estimation of Eq. (5) must be high.

⁵ We do not use the measure developed by [Aizenman et al. \(2008\)](#) to construct exchange rate stability (ERS). The reason is that in [Aizenman et al. \(2016\)](#), the ERS index is an version of exchange rate volatility, in which the exchange rate is a bilateral concept, defined between the home and the base country. Given that China has pegged the value of its currency to a basket of currencies, not to the currency of a particular country, since 2005, the standard deviations of the bilateral exchange rate might not reflect the reality of the exchange rate arrangement.

⁶ We also construct the ERS index using the US exchange rate alone in the regression. The results are similar to those based on Eq. (5), in that the exchange rate flexibility has persistently risen.

Table 3
Correlation Matrix of Exchange Rates.

	1. ΔRMB	2. ΔUSD	3. ΔGBP	4. ΔJPY	5. ΔEUR
1. ΔRMB	1.000				
2. ΔUSD	0.822	1.000			
3. ΔGBP	-0.195	-0.289	1.000		
4. ΔJPY	0.092	0.133	-0.381	1.000	
5. ΔEUR	-0.767	-0.884	0.150	-0.420	1.000

Notes: The table provides information on the correlation matrix of the ERS variables. ΔRMB , ΔUSD , ΔGBP , ΔJPY , and ΔEUR are the first difference in the natural logarithm of monthly exchange rates of the RMB, US dollar, British pound, Japanese yen, and euro against the numéraire currency, that is, SDR. Data are gathered from the IFS, ranging from January 2002 to October 2019.

Table 4
Descriptive Statistics of Variables Used to Construct MPI.

Variable	No. of Obs.	Mean	Std. Dev.	Min	Max
i_{cn}	214	2.241	0.716	0.81	6.43
i_{us}	214	1.419	1.588	0.07	5.26

Notes: The table briefly reports information on variables used to construct the MPI. i_{cn} is the monthly average of overnight interbank bank interest rate of China, i_{us} is the monthly overnight federal funds rate. These data are extracted from CEInet Statistics. Both range from January 2002 to October 2019.

To have a better understanding of the dynamics of ERS, we estimate Eq. (5) over a rolling window of 36 months. Additionally, to obtain precise estimates, we conduct the estimation in two steps. We first run Eq. (5) and then rerun it after dropping the variables with p -values larger than 20 percent. Using the rolling-window estimation, we obtain the time-varying goodness of fit or the adjusted R^2 . We average these monthly R^2 over a year horizon to determine the annual R^2 . The annual adjusted R^2 s are the measures of annual ERS.

The descriptive statistics for the monthly raw data are reported in Table 2. It shows that the five currencies are very stable against the SDR, with a minimum standard deviation of 1.3 percent for the RMB and the USD, and a maximum standard deviation of 2.4 percent for the JPY.

The correlation matrix among the five currencies is in Table 3. It shows that the RMB exchange rate against the SDR has a highly positive correlation with the USD exchange rate (0.82) and a highly negative correlation with the EUR exchange rate (-0.767). The correlations of RMB with the GBP and the JPY are much smaller.

4.2.2. Measuring monetary policy independence (MPI)

We follow Aizenman et al. (2008) in constructing the MPI index, which is developed based on the correlation between a country's interest rates and the base country's interest rate, given by:⁷

$$MPI = 1 - \frac{\text{corr}(i, i^*) - (-1)}{1 - (-1)}. \quad (6)$$

The higher the annual correlation of the monthly interest rates between the home country and the base country is, the less monetary independence the home country has. In general, the base country is defined as the one with which the home economy is most closely linked, as in Obstfeld et al. (2004). Following the literature, when studying the trinity in China, we choose the base country as the US (see Han et al., 2011). We choose the monthly average of overnight interbank bank interest rates and the monthly overnight federal funds rate as China and the US money market rates respectively.

The descriptive statistics for the monthly raw data are reported in Table 4, showing that on average interest rates are higher in China than in the US and have less volatility.

To get a better understanding of the dynamics of China's MPI, we implement Eq. (6) over a rolling window of 36 months as we use in the ERS index.

⁷ Ito and Kawai (2014) argued that the "trilemma indexes" developed by Aizenman et al. (2008) might fail to depict the subtlety of the policy arrangements. They proposed another measure of MPI based on the regressions on a set of variables including the world interest rate, output gap, inflation gap, the world industrial production growth rates, and the changing rate of world crude oil prices. However, as we only have quarterly data on industrial production in China and in the world, we would have too few observations in the sample periods before the 2005 exchange rate reform and after the RMB was added to the SDR, which deteriorates the adjusted R^2 and makes the regression results less reliable. So we follow Aizenman et al. (2008) in calculating MPI.

Table 5
Descriptive Statistics of Variables Used to Construct FMO.

Variable	No. of Obs.	Mean	Std. Dev.	Min	Max
$ta_{cn,t}$	16	4,571,814.2	2,251,100.1	920,420.44	7,599,449.8
$tl_{cn,t}$	16	3,203,424.9	1,702,886.9	692,856.78	5,590,463.3
$ra_{cn,t}$	16	2,578,332.8	1,055,449.5	614,496	3,859,161.3
$gdp_{cn,t}$	16	7,382,730.1	3,667,258.2	2,309,825	13,558,662
$ex_{cn,t}$	16	1,738,346.7	633,725.85	590,485.6	2,512,763
$im_{cn,t}$	16	1,458,757.3	531,376.72	559,385.4	,2142,487.8

Notes: The table briefly reports information on FMO variables in China. $ta_{cn,t}$ is total assets. $tl_{cn,t}$ is total liabilities. $ra_{cn,t}$ is official reserve assets excluding gold. $gdp_{cn,t}$ is GDP. $ex_{cn,t}$ is the value of exports. $im_{cn,t}$ is the value of imports. Data on $ta_{cn,t}$, $tl_{cn,t}$, and $ra_{cn,t}$ are extracted from the International Financial Statistics (IFS) and the People's Bank of China. Data on $gdp_{cn,t}$, $ex_{cn,t}$, and $im_{cn,t}$ are retrieved from CEInet Statistics. Data on FMO measures have an annual frequency from 2004 to 2019. All measurements are in millions of dollars.

4.2.3. Measuring financial market openness (FMO)

We construct the de facto measure of FMO developed by Lane and Milesi-Ferretti (2001, 2007), which is given by the following equation:⁸

$$FMO_t = \frac{1}{2} \left(\frac{ta_{cn,t} + tl_{cn,t} - ra_{cn,t}}{gdp_{cn,t}} + \frac{ta_{cn,t} + tl_{cn,t} - ra_{cn,t}}{ex_{cn,t} + im_{cn,t}} \right) \quad (7)$$

where $ta_{cn,t}$ is China's total assets, which is the sum of foreign direct investment assets, portfolio equity assets, debt assets, financial derivatives assets, and foreign exchange reserve. $tl_{cn,t}$ is China's total liabilities, which is the sum of foreign direct investment liabilities, portfolio equity liabilities, debt liabilities, and financial derivative liabilities. $ra_{cn,t}$ is official reserve assets, which exclude gold because gold reserves do not reflect financial claims on another economy (Lane and Milesi-Ferretti, 2017). $gdp_{cn,t}$ is China's GDP, and $ex_{cn,t}$ and $im_{cn,t}$ are the value of China's exports and imports, respectively. The FMO index ranges from zero to one, and a higher value indicates a more open capital market. Table 5 lists the descriptive statistics for the variables used in Eq. (7). We have only 16 observations as the data frequency is annual. To gain a better understanding of the magnitude of China's financial market openness relative to the world level, we normalize China's FMO by that of the US in terms of the average over the sample period 2004 to 2019. In addition, the US FMO is calculated based on Eq. (7) using total assets, total liabilities, and official reserve assets excluding gold. US GDP and the value of exports and imports are in the World Development Indicators of the World Bank.

4.2.4. Measuring international reserves (INRE)

International reserve accumulation plays a crucial role in macroeconomic management because it is viewed as a way to cover fiscal liabilities or as a self-insurance mechanism against output volatility (Aizenman and Lee, 2007) as well as financial turbulence (Aizenman and Sengupta, 2013) caused by capital flight shocks. Han et al. (2011) document that Chinese authorities have adopted open market operations and the reserve requirement ratio as sterilization tools to retain a degree of monetary autonomy.

Papers such as Aizenman et al. (2008, 2011) add the ratio of international reserves to GDP (INRE) as the fourth index in determining whether a trilemma or quadrilemma exists. They argue that a country confronts a trade-off in a quadrilemma among monetary independent policy, a fixed exchange rate regime, a liberal financial market, and a large share of international reserve hoarding as a policy that a country applies to deal with the impossible trinity, rather than a trilemma. Following the literature, we consider this measure as well.

5. Empirical results

5.1. The structural breaks

As stated earlier, on July 21, 2005, China initiated its market-oriented RMB exchange rate reform, de-pegging the RMB from the US dollar but incorporating a "reference basket" of currencies when choosing its target for the RMB. On December 11, 2015, the RMB index was introduced for the first time to improve the market mechanism for determining the RMB exchange rate. On October 1, 2016, the Chinese RMB was officially included in the SDR.

In the course of the exchange rate reforms, ERS might vary across sample periods. To account for this possibility, we perform Chow tests to identify the structural breaks in the series of the ERS index. In particular, we identify July 2005 and October 2016 as potential structural breakpoints and test the equality of the group means of the indexes for these breakpoints. The results are reported

⁸ We do not use the de jure measure of capital control to reflect FMO, as in Aizenman et al. (2008), because in China this measure barely changes. Obviously, it does not reflect the fact that China has opened its capital market substantially due to efforts by Chinese authorities and pressure from large foreign capital inflows. However, as a robustness check, we report the ACI indexes to compare the two methods that quantify the trilemma hypothesis in China.

Table 6
Structural Break Tests for ERS and MPI.

Potential Breakpoint	(1) ERS		(2) MPI	
	Prob. F(2,210)	Prob. Chi-Square(2)	Prob. F(2,210)	Prob. Chi-Square(2)
July 2005	0.0025***	0.0022***	0.0000***	0.0000***
October 2016	0.0000***	0.0000***	0.0000***	0.0000***

Note: The null hypothesis is no structural break at the selected time points. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7
China's Impossible Trinity in Numbers.

Period	Exchange Rate Stability (ERS)		Monetary Policy Independence (MPI)		Financial Market Openness (FMO)		International Reserves (INRE)	
	Value	Percentage Change (%)	Value	Percentage Change (%)	Value	Percentage Change (%)	–	Percentage Change (%)
2002–2005	0.93	–	0.65	–	0.10	–	0.29	–
2006–2016	0.78	–16.3	0.53	–18.69	0.16	57.64	0.41	43.86
2017–2019	0.69	–11.28	0.73	39.24	0.22	38.58	0.25	–40.11

Note: The table presents the dynamics of China's trilemma indexes (ERS, MPI, and FMO) and international reserve hoarding (INRE) during different periods. The percentage change (%) is the rate of change relative to the previous period.

in Table 6, Column (1). We also test whether the MPI series has structural breaks at these two points in time, and the results are reported in Table 6, Column (2).⁹

The Chow tests reject the null hypothesis at the 1 percent significance level that the selected time points have no structural breaks. Thus, after looking at the annual sequences of these variables, we divide the sample period into the following three subsamples: 2002–2005, 2006–2016, and 2017–2019.

Table 7 displays the detailed mean values of these variables in these different sample periods. They indicate that after the market-oriented RMB exchange rate reform in 2005, the mean of the ERS index and the mean of the MPI index fell statistically significantly from 0.93 to 0.78 and 0.65 to 0.53, respectively, whereas the mean of FMO and international reserve hoarding increased from 0.1 to 0.16 and 0.29 to 0.41, respectively. In addition, they show that after the RMB's inclusion in the SDR, the mean of the ERS index and international reserve hoarding fell statistically significantly from 0.78 to 0.69 and 0.41 to 0.25, respectively, while the mean of MPI and FMO increased from 0.53 to 0.73 and 0.16 to 0.22, respectively.

On average, ERS has fallen and FMO has risen. This suggests rising exchange rate flexibility and increased FMO since the market-oriented exchange rate reform in 2005 and as the RMB has become “freely usable.”

MPI fell in the second period, then rose again in the third period after the RMB's accession to the SDR. In contrast, international reserve hoarding rose in the second period but fell in the third period. This suggests that in recent years China has come to rely less on international reserves so as to maintain a more independent monetary policy.

We concluded that, in the process of the RMB exchange rate reforms, China has adopted a more flexible exchange rate regime and become more monetarily independent and more financially open and less reliant on hoarding international reserves.

5.2. The dynamics of trinity indexes

Fig. 2 plots the time series of the indexes for ERS, FMO, MPI, and INRE. It shows that ERS falls over time, which is consistent with Jermann et al. (2019). In particular, it dropped quickly between 2012 and 2015. Despite a rise in recent years, the overall level is lower than it was before 2012. This suggests that, along with the RMB exchange rate reforms, exchange rate flexibility in China has risen over time. The increasing flexibility of the exchange rate is even greater when we look at the ERS index in the regression based on the US dollar alone (ERS_USalone). This is consistent with the fact that the PBOC reformed the RMB's central parity formation mechanism on December 11, 2015, by explicitly introducing a basket of currencies into RMB exchange rate pricing, which has significantly loosened the relationship between the RMB and the US dollar.

Another important feature is rising FMO, which suggests that China has gradually and persistently engaged in deeper financial integration with the rest of the world. Compared to the falling trend in ERS and the rising trend of FMO, MPI shows a more volatile and ambiguous pattern, and international reserve hoarding takes an inverse U shape, which reached its highest ratio in 2009–2010.

Ito and Kawai (2014) argue that “monetary authorities would have to face a trade-off of choosing two out of the three policy choices ... the extent of achievement in the three choices must be linearly related to each other ... as long as we assume that the

⁹ We do not test the structural breaks in FMO and INRE, as the two series use an annual frequency and lack sufficient observations.

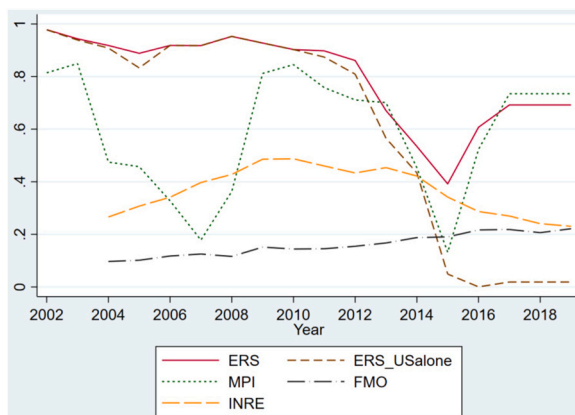


Fig. 2. The Dynamics of International Reserves and Trinity Measures in China.

Table 8
Regression Results.

	Constant = 2
ERS	1.588*** (12.48)
MPI	-0.487** (-2.55)
FMO	6.414*** (10.11)
N	16
r2	0.996
r2_adj	0.995

Note: *t* statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

trilemma triangle is an equilateral triangle with the height of one, the three indexes must add up to two.” Hence, to ensure these indices have theoretical validity, we run a regression of the two constants on the three calculated indices. Table 8 reports the regression results, in which R^2 and the adjusted R^2 are as high as 0.99, which suggests that linear relationship between the three indices has good fitness.

5.3. The trilemma configuration

Fig. 3 illustrates the configuration of the impossible trinity in China in the three periods, for which we report the average values for FMO, MPI, and ERS. The blue triangle represents the period in which the RMB was strictly pegged to the US dollar (2002–2005), the red one reports the period in which the RMB was pegged to a basket of currencies (2006–2016), and the green one is the period in which the RMB was included in the SDR basket (2017–2019). In each diamond chart, the origin is normalized to represent zero monetary independence, pure float, and financial autarky.

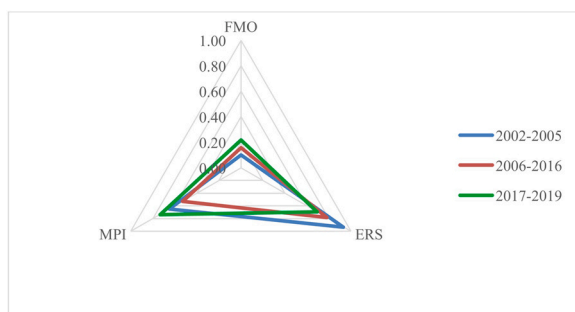


Fig. 3. The Trilemma Diamond Chart for China.

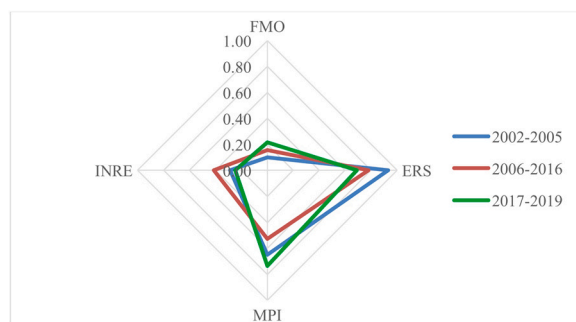


Fig. 4. The “Quadrilemma” Diamond Chart for China.

In Fig. 3, during the first period, 2002–2005, China remained close to one corner of the triangle. It satisfies the classical impossible trinity theory almost perfectly, in that it has a fixed exchange rate regime ($ERS = 0.93$) and pretty high monetary policy independence ($MPI = 0.65$), but gives up capital mobility ($FMO = 0.10$).

In the second period, when China reformed its exchange rate regime by considering a reference basket of currencies in choosing its target for the RMB, rather than pegging to the US dollar, exchange rate flexibility rises as expected ($ERS = 0.78$). At the same time, China greatly increased the openness of its financial markets ($FMO = 0.16$) but had a decline in its monetary policy independence ($MPI = 0.53$) of 18.69 percent relative to the first period.

In the third period, exchange rate flexibility and financial market openness both rise. The increased exchange rate flexibility is obviously a consequence of the RMB reform in 2005 and the accession of the RMB to the SDR basket in 2016, as the exchange rate policy in China has become more market oriented, and use of the Chinese currency internationally has increased to comply with the IMF agreement on adding the RMB to the SDR basket (Eichengreen and Xia, 2019). However, strategic development of RMB internationalization requires China to relax its capital controls, which increases its financial market openness.

According to the trinity theory, China should become more similar to the economies that have a floating exchange rate regime and perfect capital mobility, such as the US and Japan, and hence gain more monetary independence. In fact, the change in the trinity configuration is consistent with our theoretical prediction. Monetary policy independence increased in the third period relative to the second period, and MPI is 0.73. Our results thus suggest that, as China becomes more financially open and more flexible at pricing its currency, its control over monetary policy rises correspondingly.

5.4. The quadrilemma: adding international reserve hoarding

Following Aizenman et al. (2008, 2011), we add the ratio of international reserves to GDP, denoted by $INRE$, as the fourth index to the traditional trilemma in order to investigate whether trilemma or quadrilemma is the case. Similar to the three indices of the trilemma, this vertex is also normalized from 0 to 1 with the higher value demonstrating more intervention made by the central bank, while the origin represents zero international reserve hoarding.

Following the literature, we add this indicator to determine whether Chinese authorities hoard international reserves to intervene in its trilemma practice. Fig. 4 illustrates the quadrilemma diamond chart for China over the three periods. It shows that the fourth factor was almost fully utilized in the second period, from 2005 to 2016, after the RMB ceased to be pegged to the US dollar but before it was added to the SDR basket. Therefore, it appears that China attempted to manage its trilemma by increasing the extent of sterilization in the second period. The great effort by the PBOC is argued to be reasonable, as it helps to mitigate liquidity problems and exchange rate fluctuations (Han et al., 2011) and output volatility (Aizenman et al., 2011). It is also argued to be a common trend because various combinations of impossible trinity management and international reserves are widely adopted by emerging markets (Aizenman et al., 2011).

However, in the third period, China demonstrates a declining need for hoarding. This is consistent with the rising MPI observed in Fig. 3. In recent years, China has adopted a more flexible exchange rate regime and become more financially open, more monetarily independent, and less reliant on international reserve hoarding, which makes it more like the economies with a floating currency that allow perfect capital mobility and retain full monetary independence, such as the US and Japan.

5.5. The ACI measure

Aizenman et al. (2008) developed a set of “trilemma indexes” (the ACI indexes henceforth), in which the degree of FMO is measured by the capital controls index developed by Chinn and Ito (2006),¹⁰ the index for MPI is described in Eq. (6), and the index

¹⁰ To measure capital control, Chinn and Ito (2006) employ principal component analysis to codify the dummy variables for the four major categories reported in the IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). These four variables characterize (1) the existence of multiple exchange rates, (2) restrictions on current account transactions, (3) restrictions on capital account transactions, and (4) a requirement to surrender export proceeds. As a robustness check, this paper reports the ACI indexes to compare the two methods that quantify the trilemma hypothesis in China.

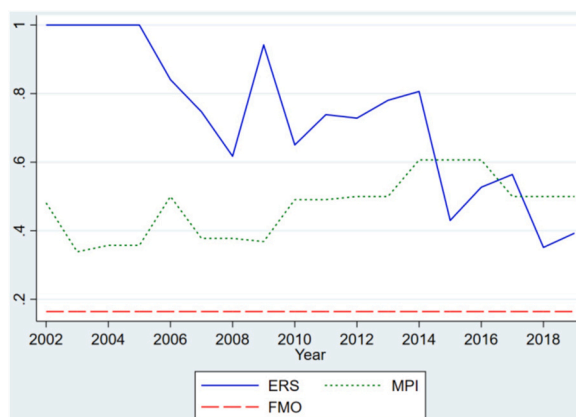


Fig. 5. China's ACI Indexes from 2002 to 2019.

Source: Hiro Ito's website, http://web.pdx.edu/~ito/trilemma_indexes.htm.

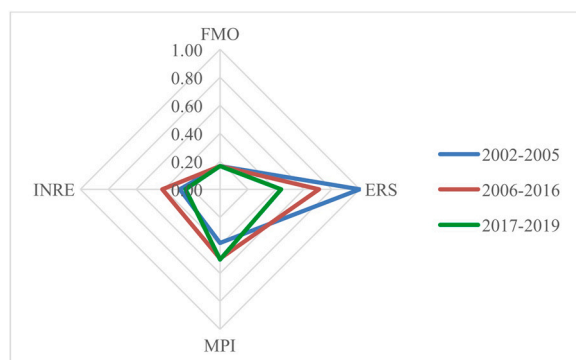


Fig. 6. The Quadrilemma Diamond Chart for China Based on the ACI Method.

for ERS is an reverse inversion of exchange rate volatility, given by

$$ERS = \frac{1}{1 + \frac{\text{stdev}(E_t)}{|\text{dlog}E_t / dt| + 0.01}} \quad (8)$$

where E_t is the monthly exchange rate between the home country and the base country. $\text{dlog}E_t/dt$ is the absolute value of the year-on-year depreciation rate using the exchange rate as of December in the same year. The higher the value of ERS, the more stable is movement in the exchange rate against the currency of the base country.

We obtained these measures from Hiro Ito's website.¹¹ Fig. 5 reports the time series of the ACI indexes. The blue line represents ERS, the dotted green one reports MPI, and the dashed red line shows FMO. Again, it shows that China has greatly increased its exchange rate flexibility. But, based on the de jure measure of FMO, we barely see any changes in China's financial integration with the rest of the world.¹² Obviously, this de jure measure does not reflect the fact that China has opened its capital market substantially due to both Chinese authorities' promotion and pressures from large foreign capital inflows.

Fig. 6 demonstrates the quadrilemma diamond chart based on the ACI indexes. Again, we conclude that in recent years, China has adopted a more flexible exchange rate regime, become more monetarily independent, and less reliant on international reserve hoarding, but with little change in its financial openness.

¹¹ http://web.pdx.edu/~ito/trilemma_indexes.htm.

¹² The stable ACI FMO index between 2002 and 2018 is to some extent due to the weakness of the principal component analysis that Aizenman et al. (2016) employ to measure the FMO (KAOPEN-Chinn-Ito index). In particular, when a dataset is updated, this index is recalculated based on the full sample for the initial variable. As a result, the indicator is not compatible across different versions, which is one of the most important reasons that our paper applies the most updated method by Ito and Kawai (2014) to quantify FMO, instead of the ACI method.

6. Conclusion

In the process of its RMB exchange rate reforms and the RMB's inclusion in the SDR basket, China has gradually increased its exchange rate flexibility, and a substantial amount of capital flows into and out of the country. Theoretically, this implies a changed trinity configuration in China, and it should move closer to the economies that adopt floating exchange rate regimes and perfect capital mobility to maintain monetary independence, such as the US, Japan, or Canada. Aizenman et al. (2008) also suggest that reserve accumulation may be closely related to changing patterns in the trilemma.

To investigate the dynamics and features of the trilemma policies in China, we first apply the metrics developed by Ito and Kawai (2014) and Aizenman et al. (2008) to construct the trinity indexes and international reserve hoarding. We then perform structural break tests of exchange rate stability to examine whether the exchange rate reforms and the RMB's inclusion in the SDR have introduced breaks in the measure of ERS.

Two points should be noted. First, we find structural breaks in 2005 and 2016, indicating that since the market-oriented RMB exchange rate reform in 2005 and the RMB's inclusion in the SDR in 2016, exchange rate flexibility has significantly increased. Additionally, we find the MPI, FMO, and the international reserve hoarding in China vary significantly over these sample periods. Second, we find that over the course of the RMB exchange rate reforms and the RMB's inclusion in the SDR, China has adopted a more flexible exchange rate regime and become more financially open. Consistent with the theoretical prediction, we find that rising exchange rate flexibility and increased FMO have brought China more control over its monetary autonomy and decreased its reliance on hoarding international reserves.

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References

- Aizenman, J., Lee, J., 2007. International reserves: precautionary versus mercantilist views, theory and evidence. *Open Econ. Rev.* 18 (2), 191–214.
- Aizenman, J., Sengupta, R., 2013. The financial trilemma in China and a comparative analysis with India. *Pacific Econ. Rev.* 18 (2), 123–146.
- Aizenman, J., Chinn, M., Ito, H., 2008. Assessing the emerging global financial architecture: measuring the trilemma's configurations over time. NBER Working Paper Series. pp. 14533.
- Aizenman, J., Chinn, M., Ito, H., 2011. Surfing the waves of globalization: Asia and financial globalization in the context of the trilemma. *J. Jpn. Int. Econ.* 25 (3), 290–320.
- Aizenman, J., Chinn, M., Ito, H., 2016. Monetary policy spillovers and the trilemma in the new normal: periphery country sensitivity to core country conditions. *J. Int. Money Finance* 68, 298–330.
- Anderson, R.W., 2016. The Internationalization of the Renminbi. London School of Economics and Political Science, pp. 11.
- Beckman, J., Ademmer, E., Belke, Ansgar, Schweickert, R., 2017. The political economy of the impossible trinity. *Eur. J. Polit. Econ.* 47, 103–123.
- Carton, B., 2011. The impossible trinity revised: an application to China. CEPII Working Paper, no. 2011-27.
- Chinn, M.D., Ito, H., 2006. What matters for financial development? Capital controls, institutions, and interactions. *J. Dev. Econ.* 81 (1), 163–192.
- Das, M.S., 2019. China's Evolving Exchange Rate Regime. International Monetary Fund.
- Eichengreen, B., Xia, G., 2019. China and the SDR: financial liberalization through the back door. *Q. J. Finance* 9 (3), 1950007.1–1950007.36.
- Feenstra, Robert C., Taylor, Alan M., 2017. International Macroeconomics, 4th ed. Worth, New York, pp. 145.
- Han, J., Cheng, S.Y., Shen, Y.Z., 2011. Capital inflows and the impossible trinity in China. *J. Int. Global Econ. Stud.* 4 (2), 30–46.
- International Monetary Fund, 2015. Press Release No. 15/466: The People's Republic of China Subscribes to the IMF's Special Data Dissemination Standard. <https://www.imf.org/en/News/Articles/2015/09/14/01/49/pr15466/>.
- International Monetary Fund, 2016. Press Release No. 16/90: Chinese Renminbi to Be Identified in the IMF's Currency Composition of Foreign Exchange Reserves. <https://www.imf.org/en/News/Articles/2015/09/14/01/49/pr1690/>.
- Ito, H., Kawai, M., 2014. New measures of the trilemma hypothesis: implications for Asia. Reform of the International Monetary System. Springer, Tokyo, pp. 73–104.
- Jermann, U.J., Wei, B., Yue, Z., 2019. The Two-pillar Policy for the RMB. Available at SSRN 3360617. .
- Kaltenbrunner, A., Paineira, P., 2017. The impossible trinity: inflation targeting, exchange rate management and open capital accounts in emerging economies. *Dev. Change* 48 (3), 452–480.
- Kaur, R., 2019. Sensitivity of macroeconomic policy goals to trilemma and quadrilemma choices. *Asian Dev. Policy Rev.* 7 (4), 219–238.
- Kawai, M., Liu, G.L., 2015. Trilemma challenges for the People's Republic of China. *Asian Dev. Rev.* 32 (1), 49–89.
- Klein, W.M., Shambaugh, C.J., 2015. Rounding the corners of the policy trilemma: sources of monetary policy autonomy. *Am. Econ. J. Macroecon.* 7 (4), 33–66.
- Kwan, C.H., 2018. Issues facing renminbi internationalization: Observations from Chinese, regional and global perspectives. *Policy Res. Inst. Ministry Finance Jpn. Public Policy Rev.* 14 (5), 871–900.
- Lane, P.R., Milesi-Ferretti, M.G., 2001. The external wealth of nations: measures of foreign assets and liabilities for industrial and developing countries. *J. Int. Econ.* 55 (2), 263–294.
- Lane, P.R., Milesi-Ferretti, M.G., 2007. The external wealth of nations mark II: revised and extended estimates of foreign assets and liabilities. *J. Int. Econ.* 73 (2), 223–250.
- Lane, P.R., Milesi-Ferretti, M.G., 2017. International financial integration in the aftermath of the global financial crisis. IMF Working Paper, WP/17/115.
- Magas, A.I., 2018. Financial adjustment in small, open economies in light of the “impossible trinity” trilemma. *Financ. Econ. Rev.* 17 (1), 5–33.
- Mundell, R.A., 1963. Capital mobility and stabilization policy under fixed and flexible exchange rates. *Can. J. Econ. Political Sci.* 29 (4), 475–485.
- Obstfeld, M., Shambaugh, C., Taylor, A., 2004. Monetary sovereignty, exchange rates, and capital controls: The trilemma in the interwar period. IMF Staff. Pap. 51 (1), 75–108.
- Obstfeld, M., Shambaugh, C.J., Taylor, M.A., 2005. The trilemma in history: tradeoffs among exchange rates, monetary policies, and capital mobility. *Rev. Econ. Stat.* 87 (3), 423–438.
- Patnaik, I., Shah, A., 2010. Asia confronts the impossible trinity. ADBI Working Paper. pp. 204.
- Qiao, Y., Ge, J., 2015. Adding the RMB into the SDR basket: an evaluation. *Fed. Debate* 1, 34–37.
- Rose, A.K., 1996. Explaining exchange rate volatility: an empirical analysis of ‘the holy trinity’ of monetary independence, fixed exchange rates, and capital mobility. *J. Int. Money Finance* 15 (6), 925–945.

- Spiegel, M., 2005. A Look at China's New Exchange Rate Regime. Center for Pacific Basin Studies, pp. 15.
- Sun, G., Li, W., 2017. Monetary policy, exchange rate, and capital flow: from "equilateral triangle" to "scalene triangle". People's Bank of China Working Paper Series. 2017(3).
- Sun, G., Payette, A., 2016. China and the impossible trinity: Economic transition and the internationalization of the renminbi. *Contemp. Chin. Polit. Econ. Strategic Relations: Int. J.* 2 (3), 1049.
- Upper, C., Valli, M., 2016. Emerging derivatives markets? *BIS Q. Rev.* (December), 67–80.
- Wang, T., 2018. The impact of RMB international on pricing power of China's bulk stock. *J. Financ. Risk Manag.* 7 (1), 139–147.