

Influence of Renminbi Internationalization on China's Monetary Policy Effects: A Theoretical Analysis

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Abstract

For more than a decade, the People's Republic of China has sought to expand the degree of internationalization of its official currency. In recent decades, China has become the world's second largest economy, as well as the world's largest trading nation, and its securities markets are among the largest in the world. Today, the RMB is among the top five as a world payments currency. One of the significant costs of achieving higher degrees of internationalization of a country's currency is the complicating impact it has on the efficacy and effect of that country's domestic monetary policy. However, what is the nature and extent of that complicating impact? This paper employs an IS-LM model of an open economy as an analytical framework, embeds an RMB internationalization factor into that model. Specifically, with this model we examine the impact of RMB internationalization on the effects of China's monetary policy.

Keywords: Renminbi internationalization, influence, monetary policy effect, international economics

1. Introduction and Background

An international currency is one that is used and held not only for transactions of the residents of the country, but also for a wide range of transactions between non-residents, as well. While the internationalization of a currency is primarily a result of market selection, the phenomenon must be seen as a matter of degree (versus a binary policy choice), and one that involves certain benefits and costs to the issuing country. The choice always involves certain tradeoffs for the host government. Given that reality, it must be recognized that currency internationalization is inevitably based on a series of economic and political conditions. It is a product of a country's economic and social productivity, and does not necessarily align with the subjective desire of the country's leadership. The fundamental determinants of international currency status are essentially tied to two overriding factors—confidence and convenience. Specific factors involve size of the economy, confidence in the currency, and degree of depth and openness of financial markets. Additional but related critical market conditions include the political status and stability of the country, including the government's willingness to establish and maintain an open capital account, and relative stability of the currency's value.

The global importance of the renminbi (RMB) increased significantly with the 1997 Southeast Asian financial crisis, which lasted two years and the effects of which spread globally. In that crisis, the Chinese government promised not to devalue the RMB in order to help limit deterioration of the international economy. Notably, the RMB remained stable while other important currencies in the region, especially the Thai baht, tumbled. In this situation, a few countries and their citizens began to hold the RMB to avoid risks, even when the Chinese government implemented strict controls on its currency. Due in large part, ironically, to China's hesitancy to open its capital account, the Chinese economy was nearly not impacted by the crisis to the degree of surrounding economies. That undoubtedly is one important reason China continues to take a cautious stance against relinquishing control of its capital account, despite the fact that it holds the largest amount of foreign reserves in the world. During the 2007-2008 international financial crisis, while other major international currencies fluctuated dramatically, the RMB became increasingly popular worldwide due to its continuous appreciation.

RMB internationalization developed rapidly following that crisis alongside the rapid development of the Chinese economy. According to SWIFT data, the Chinese yuan overtook both the Canadian and Australian dollars as global payment currencies in November 2014, and the RMB moved into the top five world payments currencies behind the Japanese Yen, British pound, Euro and US dollar. Largest leap for the RMB internationalization was the currency's formal addition to the Special Drawing Rights (SDR) basket of the International Monetary Fund (IMF) in October 2016. However, the RMB continues to lag far behind the US dollar and the Euro in terms of every significant currency internationalization metric. However, the progress to date has not marched forward apace, but rather could more aptly be described in terms of "fits and starts." As Kwan (2018) sums it up, "...the RMB's progress toward internationalization to date can hardly be described as 'smooth sailing' echoing the concerns of Cohen (2012) and Frankel (2012) put forward regarding his anticipation toward full internationalization regardless of how soundly the strategy was conceived. Hu and Liu (2009) illustrated simulation results that show improvements in trade and employment if a high degree of RMB internationalization was achieved. They also submitted to the conclusion that the high level internationalization will take some more time.

Without doubt, two of the more significant costs associated with increasing internationalization of any country's currency are (1) the diminished control over the issuing country's capital account, and (2) the fact that the exercise of monetary policy by the country's central bank becomes more complicated. The Chinese government's reluctance to relinquish control over the country's capital account has been widely recognized and written about (both in popular media and in academic outlets) as one of the major retardants to increased internationalization of the RMB. However, we do find it important to reiterate and emphasize that there are benefits to China as well as the oft-discussed costs associated with its hesitance to relinquish control over its capital account. In addition to the beneficial effects of this policy during the 1997 and 2007-2008 crises (discussed above), more recently China's capital controls have been widely credited with having helped prevent a more serious financial crisis in the country. After China's foreign exchange reserves and the value of its currency peaked in 2014 and its foreign exchange reserves fell by \$1 trillion while the yuan was losing some 14 percent of its value against the U.S. dollar, that deterioration abated and reversed over the next two to three years. One line of argument is that Chinese capital controls prevented the type of capital flight from the country that could have turned balance of payments instability into a broader currency calamity. (Davis, 2017) Suffice it to conclude, the issue of relinquishing control over a country's capital account is a cost-versus-benefit policy tradeoff decision in and of itself.

But while the issues associated with China's capital controls are widely acknowledged and discussed in the literature, much less has been researched and written regarding the specifics of currency internationalization as a monetary policy-complicating factor. It is ironic that even the role of the Chinese central bank has been largely ignored in the literature. As Chey and Li (2016) has noted, "Despite the central bank's crucial position in the economy, as the issuer of the currency and the body responsible for monetary policy, its preferences regarding currency internationalization and its roles in that process have rarely been analyzed in the literature." Relative to how currency internationalization affects the efficacy of monetary policy, many scholars have analyzed the issue from different viewpoints, employing different methods. Notable such studies include Gibson (1971), Zhang (2005), Bergsten (1975), Otani (2002), Boke and Qinglong (2005), Liu and Wang (2005), Gao (2010) and Lei and Wang (2018). In general, the research shows that currency internationalization produces varying degrees and levels of influence on the efficacy and effects of the country's monetary policy. That suggests that further investigation of the monetary policy impact of currency internationalization may help improve the effectiveness of China's monetary policy under conditions of RMB internationalization. This paper employs an *IS-LM* model of an open economy as an analytical framework, embeds an RMB internationalization factor into the model, and examines the impact of RMB internationalization on the effects of China's monetary policy. The paper offers several suggestions as to how China can more effectively cope with the impact of RMB internationalization.

2. The Framework of the Analysis

Under RMB internationalization, the RMB flows into and out of China frequently, which affects the equilibrium of the financial market of China, meaning that interest rates and exchange rates in the financial sector are determined not only by domestic market factors and monetary policy, but also by cross-border movements of the RMB. Thus, variables in the commodity market such as consumption, investment, export and import, and production are also affected by RMB internationalization. In order to investigate the influence of RMB internationalization on monetary policy effects, this paper adopts the *IS-LM* model of an open economy and analyzes equilibrium of both the commodity market and the money market. We blend the RMB internationalization factor into the model.

In the supply-demand model of the commodity market, imports and exports can be divided into two parts: the renminbi-denominated portion and the foreign-currency-denominated portion. The relative size of imports and exports denominated in the RMB represents the degree of RMB internationalization. We let α express the proportion of renminbi-denominated imports and exports. For convenience to the analysis, the paper assumes that the proportions denominated in the RMB in both exports and imports are α . The higher the α , the higher the level of RMB internationalization. Thus, $1 - \alpha$ represents the proportion of imports and exports denominated in foreign currencies. Therefore, $\alpha P_x^1 Q_x^1$ represents exports denominated in the RMB, and $(1 - \alpha)eP_x^2 Q_x^2$ represents exports denominated in foreign currency, where e is the RMB exchange rate under direct quotation. $\alpha P_m^1 Q_m^1$ denotes the renminbi-denominated portion of import and $(1 - \alpha)eP_m^2 Q_m^2$ the foreign-currency-denominated portion.

In the supply-demand model of the money market, the demand for money also can be divided into two parts: the demand from domestic residents and the demand from foreign residents. The demand for the RMB from foreign residents is a representation of the level of RMB internationalization. The aggregate demand for the RMB includes the demand from domestic residents $n(kY - hi)$ and the demand from foreign residents $(1 - n)[kY^* - h(i - i^*)]$. The demand from foreign residents depends on foreign income Y^* and the spreads between interest rates at home and abroad $(i - i^*)$. The n stands for the proportion of the demand for the yuan from domestic residents in the aggregate demand for the RMB, and $1 - n$ accounts for the proportion of the demand from foreign residents. The smaller the n (the larger the $1 - n$), the higher the level of RMB internationalization. Again, for convenience we assume that the income elasticity of money demand and the interest rate elasticity of money demand are the same for domestic residents and foreign residents, which are both k and h .

On this basis, we build a simple *IS-LM* model under conditions of RMB internationalization. The equations are as follow:

$$\begin{aligned} \text{IS:} \quad Y &= \frac{\bar{C} + \bar{I} - di + \bar{G} - bT + B}{1 - b} \\ &= \frac{\bar{C} + \bar{I} - di + \bar{G} - bT + [\alpha P_x^1 Q_x^1 + (1 - \alpha)eP_x^2 Q_x^2] - [\alpha P_m^1 Q_m^1 + (1 - \alpha)eP_m^2 Q_m^2]}{1 - b} \end{aligned} \quad (1)$$

where:

α is the proportion of import and export denominated in the RMB;

Y is the national income;

\bar{C} is autonomous consumption;

\bar{I} is autonomous planned investment;

\bar{G} is government purchases of goods and services;

B is the current account balance of payments;

d is the interest elasticity of investment demand;

i is the interest rate in the domestic money market;

b is the marginal propensity to consume;

T is the government taxation;

e is the exchange rate under direct quotation;

$\alpha P_x^1 Q_x^1$ represents exports denominated in the RMB;

$(1 - \alpha)eP_x^2 Q_x^2$ represents exports denominated in foreign currencies;

$\alpha P_m^1 Q_m^1$ represents imports denominated in the RMB;

$(1 - \alpha)eP_m^2 Q_m^2$ represents imports denominated in foreign currencies.

$$\text{LM:} \quad i = \frac{1}{h} \left[nkY - \frac{M_s}{P} + (1 - n)kY^* + (1 - n)hi^* \right] \quad (2)$$

where:

n is the proportion of total RMB demand attributable to domestic residents;

$1 - n$ is the proportion of total RMB demand attributable to foreign residents;

- i is the interest rate in the domestic money market;
- i^* is the interest rate in foreign money markets;
- Y represents national income;
- Y^* represents foreign income;
- M_s is the money supply;
- P is the price level;
- k is the income elasticity of money demand;
- h is the interest rate elasticity of money demand;
- $(1 - n)[kY^* - h(i - i^*)]$ is the demand for the RMB from foreign residents.

Next, based on the above *IS-LM* model into which is embedded the RMB internationalization factor, we analyze the income effect, interest rate effect, consumption effect, balance of payments effect, exchange rate effect, and currency circulation velocity effect of Chinese monetary policy under the condition of RMB internationalization.

3. Impacts of RMB Internationalization on Monetary Policy Effects

In this section, we build simultaneous equations according to the *IS* and *LM* equations, thus arriving at equilibrium equations for income, interest rate, consumption, current account balance of payments and exchange rate under conditions of RMB internationalization. Based on this, we analyze the impacts of RMB internationalization on the various effects of Chinese monetary policy.

3.1 Interest Rate Effect of Monetary Policy

According to the *IS* and *LM* equations, taking the partial derivative of i , the equilibrium interest rate under the conditions of RMB internationalization, with respect to money supply M_s , we obtain:

$$\frac{\partial i}{\partial M_s} = - \frac{1 - b}{P[nkd + (1 - b)h]} \tag{3}$$

In equation (3), since $-\frac{1 - b}{P[nkd + (1 - b)h]} < 0$, $\frac{\partial i}{\partial M_s} < 0$, there are negative correlations between the changes of

money supply and interest rate, with the magnitude of the change in the interest rate induced by the change of money supply being influenced by n , the degree of RMB internationalization. Relative to the situation under RMB non-internationalization ($n = 1$), the impact of money supply changes on interest rate increases relative to what would occur under conditions of RMB internationalization. Since $0 \leq n \leq 1$,

$\left| -\frac{1 - b}{P[nkd + (1 - b)h]} \right| > \left| -\frac{1 - b}{P[kd + (1 - b)h]} \right|$, and the value of $\left| -\frac{1 - b}{P[nkd + (1 - b)h]} \right|$ becomes increasingly large with

the rising level of RMB internationalization (with n becoming smaller), the effect will be stronger and stronger. Therefore, it is concluded that there is a magnified effect of the influence of money supply changes on interest rates under conditions of RMB internationalization. Table 1 depicts the influence of RMB internationalization on the interest rate effect of monetary policy.

The magnified influence of monetary policy on the interest rate might be due to the following aspects: under the condition of RMB internationalization, the financial market is highly developed and open; there are financial assets in various forms, people can not only invest in diversified financial assets in domestic market, but also in a variety of financial assets abroad with the RMB. Money demand is influenced not only by domestic interest rates, but also affected by various domestic yields of financial assets, foreign interest rates and yields of various foreign financial assets. The sensitivity of money demand to domestic interest rates is reduced relatively. Therefore, when an increase in the money supply causes interest rates to fall, the drop will be larger due to lower interest rate sensitivity.

Table 1. Interest rate effect with RMB internationalization

	Expansionary monetary policy (Money supply increases)	Contractionary monetary policy (Money supply decreases)
	$\partial i / \partial M < 0$	
Degree of RMB Internationalization rises (n goes down)	The drop in interest rate increases	The rise in interest rate increases
Degree of RMB internationalization declines (n goes up)	The drop in interest rate decreases	The rise in interest rate decreases

The above analysis reflects the short-term effect of an increase in the money supply on interest rates under conditions of RMB internationalization. In the long run, as interest rates on the yuan decline, foreign residents will increase the demand for the yuan, a low-cost international currency, which may prevent the RMB interest rate from falling further. At the same time, while the RMB interest rate falls, if the interest rate of the yuan in the offshore RMB market is higher than in the domestic market, this can trigger an outflow of yuan into the offshore RMB market, which will also serve to ameliorate the RMB interest rate decline.

3.2 Exchange Rate Effect of Monetary Policy

Given the *IS* and *LM* equations, taking the partial derivative of e , the equilibrium exchange rate under the condition of RMB internationalization, with respect to money supply M_s , we obtain:

$$\frac{\partial e}{\partial M_s} = -\frac{d}{Ph(1-\alpha)[P_x^2Q_x^2 - P_m^2Q_m^2]} \quad (4)$$

In equation (4), the relationship between changes in the money supply and the exchange rate depends on the value of $P_x^2Q_x^2 - P_m^2Q_m^2$, which is defined as the difference between exports and imports invoiced in foreign currency. If $P_x^2Q_x^2 - P_m^2Q_m^2 > 0$, i.e., there is a surplus in import and export trade denominated in foreign currency, then $\partial e / \partial M_s < 0$, indicating there are negative correlations between changes in the money supply and the exchange rate. Conversely, if $P_x^2Q_x^2 - P_m^2Q_m^2 < 0$, i.e., there is a deficit in import and export trade denominated in foreign currency, then $\partial e / \partial M_s > 0$, meaning there are positive correlations between the changes. Furthermore, the degree of the change of the exchange rate resulting from the change of money supply will be affected by α , the degree of RMB internationalization. From the point of absolute value of

$\left| -\frac{d}{Ph(1-\alpha)[P_x^2Q_x^2 - P_m^2Q_m^2]} \right|$, relative to the situation of non-RMB internationalization ($\alpha = 0$), under the condition

of RMB internationalization, the impact of money supply changes on the exchange rate increases. Since $0 \leq \alpha \leq 1$, then $\left| -\frac{d}{Ph(1-\alpha)[P_x^2Q_x^2 - P_m^2Q_m^2]} \right| > \left| -\frac{d}{Ph[P_x^2Q_x^2 - P_m^2Q_m^2]} \right|$. Furthermore, the value of $\left| -\frac{d}{Ph(1-\alpha)[P_x^2Q_x^2 - P_m^2Q_m^2]} \right|$

becomes increasingly large with the increasing degree of RMB internationalization (α becomes larger and larger), and the effect becomes stronger and stronger. Therefore, there is a magnified effect of the impact of money supply changes on exchange rates under conditions of RMB internationalization. The exchange rate effect of monetary policy under conditions of RMB internationalization is shown in Table 2.

Table 2 shows that the impact of monetary policy on exchange rates depends on the size of $P_x^2Q_x^2$ and $P_m^2Q_m^2$ under different degrees of internationalization of the RMB. When the degree of RMB internationalization (α) rises, if $P_x^2Q_x^2 > P_m^2Q_m^2$, that is, there is a surplus in import and export trade denominated in foreign currency, then $\partial e / \partial M < 0$, and expansionary monetary policy (money supply increases) will lead to an appreciation of the RMB. Relative to same it must be noted that expansionary monetary policy may lead to a deficit in import-export trade in the short term, but with a high degree of RMB internationalization, and if most of the trade deficit is denominated in the RMB, this portion of the deficit will not cause devaluation pressure for the RMB exchange rate. However, the existence of a surplus in foreign-currency-denominated import and export trade does lead to an appreciation of the RMB. In financial markets, expansionary monetary policy leads to a decline in interest rates, rising prices of RMB assets, appreciation of the RMB and a resulting expectation of RMB appreciation—all of which further strengthen the demand for the yuan and its assets. Under conditions of RMB internationalization, huge investment demand on the yuan and RMB assets may be expected to emerge in offshore renminbi and RMB asset markets. This should then trigger positive currency substitution in domestic and foreign financial markets, i.e., RMB and its assets will replace foreign currency and its assets, which should further promote the appreciation of the RMB. In short, the higher the degree of RMB internationalization, the greater the demand of domestic and foreign residents for the RMB and its assets, the greater the degree of currency substitution, and the greater the magnitude of the appreciation of the RMB. If $P_x^2Q_x^2 < P_m^2Q_m^2$, i.e., there is a deficit in imports versus exports denominated in foreign currency, then $\partial e / \partial M > 0$, expansionary monetary policy will lead to magnified depreciation of the RMB. This occurs because the expansionary policy may lead to a deficit in total import and export trade, not only in yuan-denominated import and export trade, but also in foreign-currency-denominated import-export trade. The deficit in monetary policy import and export trade denominated in foreign currency leads to depreciation of the RMB. The lower interest rates induced by expansionary monetary policy and RMB depreciation result in the outflow of capital in financial markets, which will further increase the pressure of RMB depreciation. Furthermore, under conditions of RMB internationalization, in the offshore renminbi market there will emerge a large number of investors selling the RMB and its assets. At this time, there will appear in the markets both at home and abroad reverse currency

substitution, that is, foreign currency and its assets will replace RMB and its assets, which will further increase the pressure on depreciation of the RMB. Therefore, the higher the degree of RMB internationalization, the greater the expected magnitude of RMB depreciation.

Table 2. Exchange rate effect with RMB internationalization

		Expansionary monetary policy		Contractionary monetary policy	
		$\partial e / \partial M < 0$	$\partial e / \partial M > 0$	$\partial e / \partial M > 0$	$\partial e / \partial M < 0$
		$(P_x^2 Q_x^2 > P_m^2 Q_m^2)$	$(P_x^2 Q_x^2 < P_m^2 Q_m^2)$	$(P_x^2 Q_x^2 > P_m^2 Q_m^2)$	$(P_x^2 Q_x^2 < P_m^2 Q_m^2)$
Degree of RMB Internationalization rises (α increases)	RMB appreciation increases	RMB depreciation increases	RMB depreciation increases	RMB appreciation increases	
Degree of RMB internationalization falls (α decreases)	RMB appreciation decreases	RMB depreciation decreases	RMB depreciation decreases	RMB appreciation decreases	

3.3 Consumption Effect of Monetary Policy

Given the *IS* and *LM* equations, taking the partial derivative of *C*, the equilibrium consumption under the condition of RMB internationalization, with respect to money supply M_s , we obtain:

$$\frac{\partial C}{\partial M_s} = \frac{1}{nkP} \quad (5)$$

In equation (5), since $1/nkP > 0$, $\partial C/\partial M_s > 0$, meaning that there are positive correlations between changes in the money supply and consumption, and the magnitude of the change of the consumption induced by the change of money supply is affected by *n*, the degree of RMB internationalization. Relative to the situation of RMB non-internationalization ($n = 1$), the effect of the change in the money supply on the change of consumption increases under the condition of RMB internationalization. Since $0 \leq n \leq 1$, $1/nkP > 1/kP$, it occurs that with the increasing RMB internationalization degree (*n* becomes smaller and smaller), the value of $1/nkP$ increases. The relationships between RMB internationalization and the consumption effect of monetary policy are shown in Table 3.

Table 3. Consumption effect with RMB internationalization

	Expansionary monetary policy	Contractionary monetary policy
	(Money supply increases)	(Money supply decreases)
$\partial C / \partial M > 0$		
Degree of RMB Internationalization rises (<i>n</i> goes down)	The growth of consumption increases	The decline of consumption increases
Degree of RMB internationalization declines (<i>n</i> goes up)	The growth of consumption decreases	The decline of consumption decreases

RMB internationalization has such an impact on the consumption effect of monetary policy due to the fact that from the perspective of exports, if a country's export trade is denominated in foreign currency, the change in the exchange rate will not have as much influence on the export prices of goods invoiced in foreign currency, meaning that the impact of shifting world demand from foreign goods to domestic goods is weakened. If expansionary monetary policy results in depreciation of the RMB, export prices denominated in foreign currency remain unchanged, and thus overseas demand for Chinese export commodities is difficult to increase. The lower the degree of RMB internationalization, the higher is the proportion of exports denominated in foreign currencies, and the lower the growth of foreign consumption. All these effects tend to reduce exports, real income and the growth in consumption. And if exports are invoiced in the yuan, depreciation of the RMB will reduce the prices of exports measured by foreign currencies, thus increasing China's exports, real income and consumption.

From the perspective of imports, if they are invoiced in foreign currencies, the devaluation of the RMB induced by expansionary monetary policy will cause import prices to rise, worsen the trade terms, and reduce real income and consumption. And if imports are invoiced in the RMB, regardless of RMB depreciation, import prices will no longer rise, any deterioration of trade terms will be ameliorated, and expansionary monetary policy will directly increase domestic real income, resulting in an increase in domestic consumption.

In summary, under conditions of RMB internationalization, expansionary monetary policy tends to increase consumption, and the higher the degree of RMB internationalization, the greater the expansionary impact on consumption.

3.4 Income Effect of Monetary Policy

Given the *IS* and *LM* equations, taking the partial derivative of *Y*, the equilibrium income under the condition of RMB internationalization, with respect to money supply M_s , we obtain:

$$\frac{\partial Y}{\partial M_s} = \frac{d}{P[nkd + (1-b)h]} \tag{6}$$

In equation (6), since $\frac{d}{P[nkd + (1-b)h]} > 0$, $\frac{\partial Y}{\partial M_s} > 0$, there are positive correlations between the changes of money supply and income, and the degree of the change of income induced by the change of money supply will be affected by *n*, the degree of RMB internationalization. Relative to the situation of RMB non-internationalization ($n = 1$), the effect of the influence of the change of money supply on income increases under conditions of RMB internationalization. Since $0 \leq n \leq 1$, $\frac{d}{P[nkd + (1-b)h]} > \frac{d}{P[kd + (1-b)h]}$, then with

the increasing degree of RMB internationalization (*n* becomes smaller and smaller), the value of $\frac{d}{P[nkd + (1-b)h]}$ becomes larger and larger, and the effect becomes stronger and stronger. Therefore, we conclude that there is a magnified effect of the influence of money supply changes on national income under conditions of RMB internationalization. The relations between RMB internationalization and income effect of monetary policy are shown in Table 4.

Table 4. Income effect with RMB internationalization

	Expansionary monetary policy (Money supply increases)	Contractionary monetary policy (Money supply decreases)
	$\partial Y / \partial M > 0$	
Degree of RMB Internationalization rises (<i>n</i> goes down)	The growth of income increases	The decline of income increases
Degree of RMB internationalization declines (<i>n</i> goes up)	The growth of income decreases	The decline of income decreases

The relationships between RMB internationalization and the income effect of monetary policy can be explained in terms of the relationships between RMB internationalization and the interest rate effect, exchange rate effect and consumption effect of monetary policy. As discussed above, RMB internationalization has an amplification effect on the above three variables. Under expansionary monetary policy, the amplification effect of the interest rate helps increase domestic investment demand and national income. From the perspective of the exchange rate effect, if expansionary monetary policy results in depreciation of the RMB, the amplification effect of the exchange rate is conducive to increased exports, stabilized import prices and increased consumption demand, which further increases the amplification effect of consumption and real national income.

3.5 Balance of Payments Effect of Monetary Policy

Given the *IS* and *LM* equations, taking the partial derivative of *B*, the equilibrium current account balance of payments under conditions of RMB internationalization, with respect to money supply M_s , we obtain:

$$\frac{\partial B}{\partial M_s} = \frac{1-b}{nk d} \tag{7}$$

In equation (7), since $(1-b)nkP > 0$, $\partial B / \partial M_s > 0$, so there are positive correlations between changes in the money supply and the current account balance of payments., and the degree of the change of the current account balance of payments induced by the change of money supply is affected by *n*, the RMB internationalization degree. The impact of the influence of the change in the money supply on the change in the current account balance increases under conditions of RMB internationalization vis-à-vis under conditions of RMB non-internationalization. Since $0 \leq n \leq 1$, $(1-b)nkP > (1-b)/kP$, and with the increasing of RMB internationalization degree (*n* becomes smaller and smaller), the value of $(1-b)/nkP$ becomes larger and larger, and the effect becomes stronger and stronger. Therefore, there is a magnified effect of the impact of a change in the money supply on the current account balance of payments under conditions of RMB internationalization. The relationships between RMB

internationalization and balance of payments effect of monetary policy are shown in Table 5.

Table 5. Balance of payments effect with RMB internationalization

	Expansionary monetary policy (Money supply increases)	Contractionary monetary policy (Money supply decreases)
	$\partial B / \partial M > 0$	
Degree of RMB Internationalization rises (n goes down)	The growth of current-account surplus increases	The decline of current-account surplus increases
Degree of RMB internationalization declines (n goes up)	The growth of current-account surplus decreases	The decline of current-account surplus decreases

The explanation for such relationships between RMB internationalization and the current account balance of payments effect of monetary policy is along these lines: under conditions of RMB internationalization, the Chinese financial market will be more fully open, and capital can flow freely between the domestic and foreign markets. The conditions of capital flows and the capital account determine the change of exchange rates in the short term. When deficits in the current account appear (both the imports and exports denominated in the RMB and foreign currencies are in deficit), the central bank implements expansionary monetary policy to eliminate the current account deficit. In the short term, expansionary monetary policy will not only further lead to the current account deficit, but cause a decline in interest rates, and capital outflows. These factors impel the depreciation of the RMB. In the long run, depreciation of the RMB helps increase exports under conditions of RMB internationalization. The above analyses have shown that, compared to the case of being denominated in foreign currencies, if exports are denominated in the RMB, prices of export products are lower in the case of RMB depreciation, which is more conducive to increased exports. From the point of imports, if imports are denominated in the RMB, the prices of import products are relatively stable in the case of RMB depreciation, and thus the import demand also remains relatively stable. The surplus of current account will increase in the case that import keeps stable and export increases significantly. At the same time, under the condition of RMB internationalization, expansionary monetary policy has an amplification effect on the change of exchange rate. All these are the reasons why expansionary monetary policy produces an amplification effect on the changes of current account balance of payments under the condition of RMB internationalization.

3.6 Influence of RMB Internationalization on Currency Circulation Velocity

According to the Fisher transaction equation $MV = PY$ and the equilibrium equation in the money market, we can develop the formula for currency circulation velocity under conditions of RMB internationalization:

$$V = \frac{Y}{\frac{M_s}{P}} = \frac{Y}{n(kY - hi) + (1-n)[kY^* - h(i - i^*)]} = \frac{Y}{n(kY - kY^* - hi^*) - hi} \quad (8)$$

Equation (8) indicates that the magnitude of currency circulation velocity is influenced by n , the RMB internationalization degree. Compared to the situation of RMB non-internationalization ($n = 1$), currency circulation velocity increases under conditions of RMB internationalization. Under the condition of RMB non-internationalization, currency circulation velocity is $V_{n=1} = \frac{Y}{kY - hi}$. Since $(kY - hi) > n(kY - kY^* - hi^*) - hi$,

so $\frac{Y}{kY - hi} < \frac{Y}{n(kY - kY^* - hi^*) - hi}$, that is, currency circulation velocity increases under conditions of RMB

internationalization. Moreover, the higher the degree of RMB internationalization (n is smaller), the smaller the value of $n(kY - kY^* - hi^*) - hi$, the greater the value of currency circulation velocity V . In conclusion, the internationalization of the renminbi increases currency circulation velocity, and the higher the degree of RMB internationalization, the larger the currency circulation velocity. The relationships between RMB internationalization and currency circulation velocity are shown in Table 6.

Table 6. Influence of RMB internationalization on money velocity

	Currency circulation velocity (V)
Degree of RMB Internationalization rises (n goes down)	Currency circulation velocity increases
Degree of RMB internationalization reduces (n goes up)	Currency circulation velocity decreases

Equation (8) also indicates that changes in foreign national income Y^* and foreign interest rates i^* will also influence currency circulation velocity. With the increase of foreign national income Y^* and foreign interest rates i^* , currency circulation velocity rises. Conversely, the velocity will reduce. Therefore, following the internationalization of the RMB, currency circulation velocity of China is increased, and changes in foreign national income and interest rates can also cause a change of money velocity in China.

4. Conclusions and Policy Implications

The internationalization of the RMB is the result of market selection. After more than three decades of rapid development since the reform and opening up in 1978, the Chinese economy has grown into the second largest in the world. Chinese economic development has laid a solid foundation for RMB internationalization. However, there is still a considerable distance to go for the RMB to become a world currency on the order of the Dollar and Euro. Among the obstacles (costs) that China must confront are two related issues: (1) the Chinese government must more fully relinquish their capital account controls, and (2) the exercise of monetary policy by the central bank, the People's Bank of China, becomes more complicated. The focus of this study is the latter concern. Absent what has been described as China's "one-sided capital account controls," (Yeung, 2019) once more complete RMB internationalization is achieved, the Chinese financial system must be able to cope with the shocks from speculative funds and hot money in the international financial markets. That in turn will increase the difficulty of the central bank in implementing monetary policy.

The above analysis shows that under certain assumptions, the internationalization of the RMB has a plethora of influences on the effect and effectiveness of Chinese monetary policy, and there is an amplification effect. Obviously, monetary policy under conditions of RMB internationalization becomes more complicated. The most important reason lies in cross-border flows of the RMB. Monetary policy may be transmitted between markets at home and abroad, which makes it more difficult for the central bank to adjust interest rates and exchange rates, the intermediary targets of monetary policy, as well as its current account balance and national income, the ultimate goals of monetary policy. Based on our analysis, and considering the Chinese government's continuing push to increase the degree of internationalization of the RMB, the following policy implications become apparent.

4.1 China Should Accelerate the Liberalization of Interest and Exchange Rates

Under conditions of RMB internationalization, the sensitivity of market participants to interest rate changes may be reduced, which would potentially cause monetary policy to have a magnified or overshoot effect on interest rate changes. Therefore, if China would accelerate its interest rate liberalization, establish a sound formation mechanism for interest rate determination by market forces of supply and demand, and strengthen the sensitivity of microcosmic subjects to interest rate changes, this should serve to reduce the amplification effect of monetary policy on interest rates.

While accelerating interest rate liberalization, China should steadily promote reform relative to the marketization of the exchange rate, and enhance the mechanism of linkage between interest rates and the exchange rate. Such reform would make interest rates and the exchange rate better able to accurately reflect the relative prices of local and foreign currencies, as well as stabilizing the flows of cross-border capital through timely and effective conduction of exchange rate changes by interest rate changes, thereby improving the effectiveness of the central bank's monetary policy.

4.2 China Should Promote the Development of a More Fully Internationalized RMB Assets Market

Cross-border flows of the RMB can better be stabilized through the development of such a market based regime. For instance, assume that the central bank implements expansionary monetary policy and the interest rate falls dramatically, leading to cross-border yuan outflow, thereby weakening the effect of expansionary monetary policy by the central bank. At this point, if there is a highly developed, internationalized RMB assets market, lower interest rates potentially lead to rising prices of RMB assets, in response to which domestic and foreign residents may increase their holdings of RMB assets, thus suppressing any cross-border outflow of the RMB or even attracting a cross-border RMB inflow. In this way, a developed and internationalized of RMB assets market can stabilize the cross-border flows of the RMB, thereby helping improve the effect of monetary policy of the central bank. What's more, the internationalized RMB assets market can stabilize exchange rate of the RMB through stabilizing the RMB cross-border flows.

4.3 China Should Promote the Development of the Treasury Bond Market

The establishment of a highly developed Treasury bond market is of particular importance to improve the effectiveness of monetary policy under conditions of RMB internationalization. Treasury bond market can

provide a useful trading asset for both foreign and domestic investors, it also provides the central bank a high-flexibility regulatory tool, open market operations. When the financial market sees a sudden, large-scale inflow of the yuan, the central bank can withdraw money from circulation by selling Treasury bonds so as to cover the inflow of the yuan. Conversely, when the emergence of large yuan outflows weakens the central bank's expansionary monetary policy, it can respond by putting more money into circulation by buying Treasury bonds. Thus the central bank can flexibly adjust money supply as well as the level and structure of interest rates by actively buying and selling bonds (especially short-term Treasury securities). Additionally, if errors are found, it can then conduct reverse operations immediately so as to correct the mistakes. By having a convenient tool for the timely and effectively offset to sudden changes in the money supply caused by cross-border capital flows, it enhances the monetary authority's means of mitigating against the possibility of the serious situation that monetary policy becomes invalid due to external shocks.

4.4 China Should Carefully Monitor and Forecast Cross-Border RMB Flows

The above analysis demonstrates that the central bank can offset cross-border currency flows through open market operations. However, to achieve an effective offset, it is necessary to carefully monitor the volume of cross-border RMB flows, and on that basis adopt targeted open market operations in order to achieve the offset effect. Moreover, it is important to forecast potential and probable cross-border flows of the RMB. Will a RMB cross-border flow happen after expansionary or contractionary monetary policy has been implemented? The accuracy of these forecasts could have an important impact on the effect of monetary policy.

4.5 China Should Endeavor to Strengthen International Monetary Cooperation

It has been demonstrated that under conditions of RMB internationalization, China's monetary policy not only is influenced by changes in foreign monetary policy and economic variables, but also will produce important influences on other countries. Therefore, under conditions of RMB internationalization, China must take into account its impact on other countries and their reactions in implementing its monetary policy.

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