REAL EXCHANGE RATE ADJUSTMENTS TO FOREIGN EXCHANGE INFLOWS IN A FIXED EXCHANGE RATE SYSTEM

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ABSTRACT

Focusing on developing countries with a fixed exchange rate system, this paper analyzes the adjustment mechanism of their real exchange rates in response to a surge in foreign exchange inflows. According to standard theories, these countries should witness a rise in domestic price level and a real exchange rate appreciation as their levels of international reserves and money supply increase. However, we observed that a number of developing economies underwent periods of surging inflows with little inflation or changes in their real exchange rates. In some of these cases, the central bank engaged in sterilization activities in order to control the monetary base and to mitigate the impact of the inflows on the domestic price level under its fixed exchange rate regime. However, there were episodes in which the public increased their holdings of real monetary balances because of a rise in income or change in preferences. By demanding as cash balances what might otherwise be excess liquidity, it helped alleviate some of the inflationary pressure on the economy, and thus making further real exchange rate adjustment unnecessary. In addition, the easing of import restrictions also achieved similar effects by offsetting some of the extra foreign exchange coming into these countries.

INTRODUCTION

We have seen a wide range of exchange rate arrangements being adopted in developing countries in the past few decades. Although many of the countries have let their currencies float, some of them choose to maintain a fixed or pegged exchange rate regime in order to control inflation or to achieve macroeconomic stability. Furthermore, a number of countries that describe themselves as having a flexible regime de jure also exhibit a fear of floating, and have often actively intervened in the foreign exchange markets to keep their exchange rates within a relatively narrow band (Calvo & Reinhart, 2002).

As the developing countries are becoming more open to free trade and international capital flows, they are also more susceptible to shocks such as fluctuations in world demand, sudden reversals in the size and direction of capital flows, and productivity and technological advances. In order to restore equilibrium in the trade and capital accounts in the face of such disturbances, adjustments in the relative price between domestic and foreign goods are often called for. For countries with a fixed exchange rate, however, the full adjustment must take place through the price level of nontradables (an internal variable) relative to that of tradables (an external variable). That is to say, as the real exchange rate moves from one equilibrium to another, the main domestic variable involved in the adjustment is the internal price level.

This paper focuses on the impact of foreign exchange inflows because it is a variable that consolidates a number of types of shock—e.g., capital inflows, price increase of the country's exports, remittances, and productivity advances in the tradable sector—all of which lead to similar reactions from the economy, given that they all entail more foreign exchange flowing

into the economy. To prevent huge fluctuations in the nominal exchange rate, the central bank will purchase the extra foreign currency inflows and add them to its international reserves, leading to an increase in the money supply. Assuming that the demand for real monetary balances remains stable, the monetary approach to the balance of payments predicts that the real exchange rate will appreciate if the excess real money balances are at least partly spent on nontradables (Calvo, Leiderman & Reinhart, 1992; Edwards, 2000). At the same time, the theory suggests that imports will rise as the money supply increases and the real exchange rate falls (i.e., appreciates).

Many developing countries did witness a rising domestic price level and a real exchange rate appreciation as their levels of international reserves and money supply increased, while some experienced a substantial increase in imports following the real appreciation that helped draw down the accumulated reserves. However, we observed that a number of developing economies underwent periods of surging inflows with little inflation or changes in their real exchange rates. In some of these cases, the central banks engaged in sterilization activities, a common practice among developing countries, in order to control the monetary base and to mitigate the impact of the inflows on the domestic price level under its fixed exchange rate regime. However, there were episodes in which the "sterilization" was largely done by the public. By demanding as cash balances what might otherwise be excess liquidity due to an increase in income or a change in preference, the public's action helped alleviate some of the inflationary pressure on the economy, and thus making further real exchange rate adjustment unnecessary. In addition, the easing of import restrictions also achieved similar effects by offsetting some of the extra foreign exchange coming into these countries.

The concept, definition, and measurement of the real exchange rate are explained in the next section ("The Real Exchange Rate"). The section titled "Foreign Exchange Inflows and Real Exchange Appreciation" examines the typical responses of the real exchange rate, imports, and reserves to a surge in foreign exchange inflows using standard theories and presents a few country examples to demonstrate such adjustment mechanism. We then focus on countries that experienced large inflows with moderate to little adjustments in their real exchange rates and seek to explain such phenomenon. The last section summarizes the implications of our study, and concludes.

THE REAL EXCHANGE RATE

To understand how the adjustments come about in countries that have or had fixed exchange rate regimes, we should first define the real exchange rate and explain how it is measured. The real exchange rate can be expressed as

$$RER = E \times \frac{P^*}{P_d} ,$$

where *E* is the nominal exchange rate between the home and a given foreign currencies (in terms of the number of units of domestic currency per each unit of foreign currency), P_d is the domestic price level, and P^* is the foreign price level, expressed in the given currency used for *E*. This measures the price of the home country's goods relative to that of another country or group of countries. A rise in the real exchange rate implies a real depreciation of the domestic currency

and vice versa. When a country adopts a float or managed float regime, adjustments in the real exchange rate can come from both the nominal exchange rate and the domestic price level. However, if it is under a fixed exchange rate system, the adjustments can only be accomplished through changes in the domestic price level.

In practice, there are many factors to be taken into consideration when calculating the real exchange rate (and hence many ways to compute it), such as the appropriate measurements for the domestic and foreign price levels, the choice of foreign countries to be used in the comparison, and the weights that are assigned to each foreign country. In this paper, the consumer price index is selected for the domestic price level, P_d , which contains both tradable and nontradable components in its baskets of goods because of its broad coverage and availability. For the choice of the foreign price level, P^* , we employ the SDR-WPI series developed by Harberger (2004), which is an index of the general price level of tradable goods in the world. We take the wholesale price indices (WPI) of five major industrial countries—France, Germany, Japan, the United Kingdom, and the United States—and multiply them by the bilateral nominal exchange rates with the United States such that all series are expressed in a common currency. The five WPI series are given the weights assigned by the International Monetary Fund in calculating their time series for Special Drawing Rights (SDR). The SDR-WPI is then calculated as a weighted sum of the dollar-denominated WPIs. Lastly, the nominal exchange rate, E, employed in the calculation of the real exchange rate should be the rate between the home currency and the common currency that we selected for the SDR-WPI; in this case, the U.S. dollar. The real exchange rate calculated this way can be re-interpreted as the number of baskets of domestic consumption goods needed to purchase one standard basket of world tradables. The dollar-denominated SDR-WPI series between 1980 and 2012 is presented in Figure 1.

The real exchange rates for the countries covered in this study were calculated, and their movements over periods where the nominal rates were either fixed or kept within a narrow band were tracked. The time paths of the exchange rates and price indices as well as the activities in the money and external accounts for each country are presented in Figures 2 through 10. A summary of the annual percentage changes of key variables is shown in Table 1.

FOREIGN EXCHANGE INFLOWS AND REAL EXCHANGE APPRECIATION

This section provides a theoretical framework that incorporates the monetary approach to the balance of payments to explain the economic adjustments that will take place when a country is faced with a surge in inflows of foreign exchange. Specific attention will be given to the movements of imports and international reserves in the adjustment process of the real exchange rate. Following the theoretical exposition are a few country examples that illustrate the adjustment mechanism.

The Monetary Approach to the Balance of Payments

According to the monetary approach, any disequilibrium between the current money supply and the long-run demand for money will give rise to changes in international reserves. It has been prominent in academic thinking for a number of decades and has served as the foundation for policymakers at the International Monetary Fund (IMF) and around the world when analyzing economic decisions that have both real and monetary consequences.¹

The essential assumption of the monetary approach is that the demand for money is a stable function of a limited number of macroeconomic variables such as output, the interest rate, and the expected inflation rate, and is determined by the economy as a whole. The supply of money, on the other hand, is generated through the central bank and the rest of the banking system and consists mainly of domestic credit and net foreign assets. When the real money supply exceeds the amount that the public is willing to hold, economic agents will get rid of the excess by spending part of it on tradable goods and part on nontradables. While the increased demand for nontradables will lead to a rise in domestic prices, the expenditures on tradables will lead to a loss in international reserves if the country is pursuing a fixed exchange rate policy (Dornbusch, 1973; Blejer, 1979; Frenkel & Mussa, 1985; Harberger, 2005).

When there is an increased inflow of foreign currency into the economy and the nominal exchange rate is not allowed to adjust freely, the central bank will have to purchase the extra foreign exchange at the predetermined exchange rate, leading to an increase in international reserves. In the process of absorbing the foreign exchange, the central bank prints new money and injects additional liquidity into the banking system, resulting in an excess supply of real monetary balances over the demand for them. The monetary approach would claim that, over time, the excess real balances will tend to be spent on tradables and nontradables. Under this framework, imports will play a key role in restoring equilibrium in the goods and capital markets as part of the process of real exchange rate adjustments. There are three channels through which these changes can take place. First, an increase in inflows is often accompanied by a rise in output or income.² People in the economy are therefore induced to spend part of their extra income on tradables, which include imports. Secondly, according to the monetary approach, people tend to spend a portion of their excess real money balances on tradables, generating a rise in real imports. Finally, the new income and the excess cash balances will cause people to increase their spending on nontradables. As the prices of nontradables are bid up and the domestic price level rises accordingly, the real exchange rate will appreciate, increasing peoples' incentive to substitute away from nontradables and towards imports and exportables.³

If the inflow of foreign exchange is a one-time occurrence, the increased demand for foreign exchange due to imports will help draw down the initial rise in international reserves until the economy returns to its original equilibrium.⁴ However, if there is an increase in the rate of inflows, the rise in imports (and the decline in exports) will continue until it fully reflects the increase in inflows. Specifically, during the transition period, any amount of the inflows that are not offset by the increased imports and reduced exports will be added to international reserves. The resulting expansion in money supply will lead to an excess supply of real monetary balances and real exchange rate appreciation, further stimulating imports and reducing exports. The adjustment process will continue until the net increment to reserves becomes zero and the economy attains its new equilibrium. Regardless of whether the inflows are transitory or permanent, the real exchange rate will continue to adjust as long as there is an imbalance in the money market, i.e., an excess supply of real monetary balances.

Country Experiences

Argentina is an example of a country that received a transitory inflow of foreign exchange and witnessed a period of significant real exchange rate appreciation abetted by an accumulation of international reserves between early 1991 and the end of 1993 (see Figure 2). After experiencing hyperinflation episodes in the 1980s, Argentina implemented the

Convertibility Law in 1991 and pegged the Argentine peso to the U.S. dollar under a currency board type of arrangement. With the price level stabilizing, foreign investors began to pour capital into the economy via both direct and portfolio investment (Daseking, Ghosh, Thomas & Lane, 2003). Net portfolio investment contributed most to the surge in capital inflows, which rose by US\$34.4 billion between 1991 and 1993. Total inflows of foreign exchange increased by US\$22.4 billion over the same period to peak in 1993, before declining by US\$9.4 billion in the 1993-95 period.⁵ Consequently, the consumer price index increased by 19.3 percent, while the SDR-WPI remained fairly stable, leading to a real exchange rate that appreciated by 15.6 percent over the period. Amid the foreign exchange inflows and economic expansion, real imports of goods and services increased by US\$4.6 billion over the 1992-95 period. According to our estimations, roughly 66 percent of the increase in real imports was due to a rise in real GDP, 26 percent came from an excess supply of real monetary balances, and the remaining 8 percent from a real exchange rate appreciation.⁶

As the country experienced a transitory increase in foreign exchange inflows, it also went through a period of reserves accumulation, followed by a period of decumulation. The period of reserves accumulation, approximately between 1991 and 1994, was marked by an increase in total inflows of foreign exchange that exceeded the rise in aggregate imports as the real exchange rate appreciated. As the central bank of Argentina purchased the extra foreign exchange according to the currency board arrangement, net foreign assets rose by US\$3.4 billion to reach US\$11.8 billion in 1993 and remained flat in 1994. However, as the total inflows began to decline in 1993, the level of imports became higher than that of inflows, leading to a sharp loss in net foreign assets in early 1995. Consequently, the appreciation in the real exchange rate came to an end in the beginning of 1994 as the country slowly returned to its original equilibrium.

In contrast to Argentina, South Korea experienced a continuous increase in foreign exchange inflows from 1986 until the onset of the Asian currency crisis in 1997 (Figure 3). The surge in inflows occurred as the country accelerated its efforts to open the domestic market and liberalize its current and capital accounts beginning in 1983 (Sakong, 1993). A transitional period, roughly from 1986 to 1989, was identified as the level of foreign reserves increased from US\$1.2 billion at the end of 1985 to US\$15.5 billion in 1989. Total accumulated foreign exchange inflows over the 1986-89 period, amounting to US\$213 billion, exceeded the US\$198 billion recorded for aggregate imports. The positive net increment to reserves lead to growth in base money at an average rate of 17.8 percent per year. Reflecting the rapid money growth, the real exchange rate appreciated at an annualized rate of 5.0 percent, when the Korean won was pegged to a basket of currencies of its major trading partners throughout the period (Nam & Kim, 1999). Beginning in 1990, the reserves accumulation came to an end as the rise in inflows of foreign exchange was fully reflected in the increased demand of imports. As a result, the appreciation in the real exchange rate slowed sharply, so that the real exchange rate remained fairly stable throughout the first half of the 1990s.

ANOMALOUS RESPONSES OF THE REAL EXCHANGE RATE

Contrary to the experiences of the emerging economies discussed above, there were countries that underwent periods of surging inflows and vast reserves accumulation with little inflation or changes in their real exchange rates. One may argue that the lack of inflationary pressure is due to policy actions taken by the central banks that were aimed at cutting short the series of natural consequences described above. For example, a central bank may choose to engage in sterilized intervention by selling government bonds in the open market and use the proceeds to buy the extra foreign exchange. By doing so, it avoids expanding the monetary base through issuance of new domestic currency and keeps the real exchange rate from appreciating (Obstfeld & Rogoff, 1995). Alternatively, the authority can achieve similar effect by tightening domestic credit in the consolidated banking system (Saxena & Wong, 1999). Regardless of which actions the authorities choose, the goal is to offset the inflows by absorbing the excess liquidity and controlling the growth in money supply, hence reducing the inflationary pressures on the economy. However, we observed cases in which a country's money supply increased tremendously despite its central bank's efforts to sterilize the inflows. If the lack of domestic price adjustment or real exchange rate appreciation in these countries was not merely a product of the sterilization operations engaged by the central bank, how else could we explain such "anomaly" of low inflation combined with high money growth? To investigate a phenomenon like this, we first look at the unique case of China in the late 1990s to the early 2000s.

China (1998-2006)

China has gone through one of the most dramatic shift in its money demand function over the last decade, specifically during its fixed exchange rate period between 1998 and 2006. While enjoying tremendous capital inflows and exports growth mainly due to rapid economy growth and liberalization of its trade and capital accounts, the economy showed little sign of overheating despite the rapid expansion in its broad money supply. Accompanying the inflows was an accelerated accumulation of international reserves and expansion in monetary base, which normally would create tremendous inflationary pressure on the economy. However, instead of observing a surge in the domestic price level, inflation in China averaged less than one percent a year. We even witnessed a moderate real exchange rate depreciation over the 2002-2006 period as the rise in world price level dominated the relative price movements.

As shown in Figure 4, the total inflows of foreign exchange in China escalated from US\$170 billion in 1998 to over US\$1 trillion in 2006, an increase of over sixfold. The surge in inflows was mainly due to the trade and capital accounts that had become increasingly open as the country prepared its accession to the World Trade Organization (WTO) in December 2001. Consequently, exports in goods and services jumped from US\$200 billion in 1998 to over US\$1 trillion in 2006, amounting to an average growth rate of about 20 percent a year. On the other hand, China also began to liberalize its capital account in 2002 by allowing qualified foreign investors to invest in Chinese stocks and bonds, which resulted in a steady increase in portfolio investment (Prasad, Rumbaugh & Wang, 2005). While the inflows of foreign exchange contributed to an accelerated accumulation of international reserves, the increased demand for foreign exchange due to imports helped draw down the rise in reserves. Over the 1998-2006 period, total imports rose from US\$164 billion to US\$853 billion, partly due to the inflows of capital and rapid growth in the country's GDP. However, the growth in imports was also a result of the trade liberalization that began in the 1990s.⁷ The average tariff rate, which stood at 36 percent in 1995, was reduced to a relatively low level of 9.7 percent in 2005.⁸ Also, virtually all import licensing requirements and import quotas were eliminated by the same year. The result of the loosening of import restrictions was evidenced by an import to GDP ratio that rose from 0.13 in 1998 to almost 0.30 in 2004. The reduction in trade barriers helped accelerate the process of transitioning to the new equilibrium in China, as a large amount of the increment of international

reserves is offset by the imports expansion, hence reducing the inflationary pressure on the economy.

Despite the surge in import demand, the payment surplus continued to contribute to an accelerated accumulation of international reserves, which rose from US\$143 billion in 1998 to almost US\$1.1 trillion in 2006. This seems to be in line with the mechanism ensured by the standard theories. However, the domestic price level in China only rose by 6 percent over the 1998-06 period, equivalent to an average inflation rate of less than one percent per annum. We even witnessed a real exchange rate depreciation between 2002 and 2006 as the increase in world price level dominated the relative price movements. As mentioned, one possible explanation of the lack of real exchange rate adjustment is that the People's Bank of China (PBC) might have engaged in sterilization activities in order to control the monetary base and to mitigate the impact of the inflows on the domestic price level under its fixed exchange rate regime. One such way was to withdraw excess liquidity in the banking system through an increase in reserve requirements. The PBC raised the required reserve ratio from 6 percent in 2003 to 9 percent in 2006. However, according to Ma, Yan, and Xi (2013), it was not until 2007 that reserve requirements became a regular and significant policy tool for the PBC. As shown in the central bank's balance sheet, domestic credit in China expanded steadily over the 1998-2006 period, rising from \$1.8 trillion RMB in 1998 to \$3.1 trillion RMB in 2006.

Another way for the central bank to offset the inflows is through a corresponding sale of domestic securities in the open market, the so-called "sterilized intervention." Looking at the liability side of the central bank's balance sheet, we see limited bond selling activities prior to 2002. However, the monetary authority began to intensify its sterilization effort by increasing its issuance of central bank bills from \$150 billion RMB in 2002 to almost \$3.0 trillion RMB in 2006. Additional measures and financial market reforms were carried out during this period with the aim of withdrawing some of the high-powered money and bringing the excessive growth in broad money under control (Wang, 2010). In summary, we see some evidence of the Chinese authority's attempt to sterilize the inflows of foreign exchange through open market operations. However, the expansion in domestic credit offset roughly 40 percent of the sterilization efforts produced by increase in bond sales over the 2002-06 period (domestic credit increased 1.4 trillion RMB versus an increase in bond sales of 3.4 trillion RMB).

Despite the sterilization operations that began in 2002, money supply grew tremendously over the 1998-2006 period. The stock of broad money expanded at an average growth rate of 15.9 percent a year, reaching \$40 trillion RMB in 2006 from about \$9.2 trillion RMB in 1998. In fact, the growth rates were as high as 18.3 percent in 2002 and 19.6 percent in 2003 despite the bond selling activities. A plausible explanation for this puzzling phenomenon, as proposed by Harberger (2008), is that the Chinese people were "sterilizing" the inflows by increasing their willingness to hold much larger monetary balances. As the central bank is obliged to purchase the foreign exchange inflows under a fixed exchange rate system, it prints domestic currency and injects money into the economy. Domestic prices will go up only if the public views the extra money as unwanted balances and spends it at least partly on nontradables. However, if the people choose to increase their money holdings instead of spending them down, no inflationary pressure will emerge. China appears to have undergone such changes in people's demand for monetary balances, particularly prior to 2002. The effect was similar to sterilization by the central bank, but in this case, what might seem to be excess liquidity was offset by actions taken by private agents in the economy.

There are many reasons as to why people are willing to hold greater monetary balances as the foreign exchange pours in. The change in money holdings can be endogenized by viewing money demand as a function of aggregate income in the economy. As real income rises, people will want to hold proportionally more cash balances in order to carry out their everyday transactions. However, the increase in demand can also be generated through changes in the tastes of the public. In the case of China, we saw the income effect at work as people demanded more money for the purchase of goods and services as a consequence of the rapid growth in real GDP, which averaged 9.2 percent a year over the period. On the other hand, the income elasticity of demand for real monetary balances needed to fully explain the change in money demand implied by the data is 1.55, compared with an elasticity of 1.44 estimated by the author,⁹ suggesting that a change in preference might also be at work to induce the public to hold larger monetary balances per unit of real GDP. Such a change in tastes might partly be a result of the economic restructuring and deterioration of the social safety net in China. The Chinese people have increased their precautionary savings due to the reduction in healthcare coverage, unemployment insurance, and workers' compensation provided through the government and their employers. The lack of coverage of the pension system, as well as the need to finance education expenditures, also motivated people to save more (Lardy, 2006; Ma & Wang, 2010). On the corporate side, the limited access to credit due to an imperfect financial system helped explain the needs of Chinese firms to accumulate larger amount of liquid assets to insure themselves against uncertainties or to fund future projects (Jha, Prasad & Terada-Hagiwra, 2009; IMF, 2009).

Similar Experiences in Developing Economies

Motivated by the experience of China in the past decade, we now look into other developing countries that have undergone large inflows of foreign exchange without significant appreciation in their real exchange rates. We identify similar experiences in emerging economies such as Russia and India, which, as in China, involved some degree of sterilization by the people. Some countries also went through a simultaneous reduction in barriers to imports, which helped further mitigate the impact of the inflows on the real exchange rate.

India (2002-2006)

The first such case we will investigate is India in the early 2000s. Between 2002 and 2006, the country saw its total inflows of foreign exchange increased by roughly US\$160 billion to reach US\$254 billion in 2006 (Figure 5). On the capital account side, the inflows mainly came from an increase in external private borrowings and portfolio investment as the country slowly liberalized its financial markets. Net external commercial borrowings went up by US\$21.0 billion over the period, while net portfolio investment rose by US\$8.5 billion to stand at US\$9.5 billion in 2006. Net foreign direct investment (FDI) also increased moderately as the government eased its restrictions on FDI in several sectors. The impressive growth of the current account recorded in the service sector also contributed to the inflows of foreign exchange. The balance of trade in services increased from a net import of US\$1.6 billion in 2002 to a net export of US\$11.8 billion in 2006, with the surge in exports of software and information technology-related services being the main driving force. A rise in workers' remittances also brought the country extra foreign exchange over the period (Joshi & Sanyal, 2004; Mohan, 2008).

The increase in capital inflows was accompanied by an appreciation of the rupee at 0.8percent a year in nominal terms, but a mild depreciation in real terms as the world price level increased relatively faster than the domestic price level. Although the Reserve Bank of India (RBI) allowed the nominal exchange to absorb some of the pressures created by the inflows, it had intervened heavily in the foreign exchange market (Joshi & Sanyal, 2004; Behera, Narasimhan & Murty, 2008; Goyal & Arora, 2010), as evidenced by the vast accumulation of international reserves which expanded by nearly \$5.5 trillion rupees over the 2002-06 period, up from an initial value of \$2.3 trillion rupees in the end of 2001. In order to absorb part of the excess liquidity, the RBI engaged in sterilization operations by tightening its credit to the government in 2002 and 2003. Claims on government were reduced by almost \$1 trillion rupees in those two years before climbing back up again by \$443 billion between 2004 and 2006. Beginning in early 2004, the RBI further tightened the monetary conditions by gradually raising the repo rate from 6 to 7.25 percent and the reverse repo rate from 4.5 to and 6 percent over the course of two years.¹⁰ The cash reserve ratio was also increased from 4.5 percent in mid-2003 to 5.5 percent in the end of 2006. Lastly, the RBI introduced the Market Stabilization bond in March 2004 with the sole purpose of using it as a sterilization instrument.¹¹

On the back of rising investment and strong domestic demand, the Indian economy expanded by 40 percent over the 2002-06 period, or at an average rate of 7.8 percent per annum. Total imports of goods and services also increased threefold to reach US\$230 billion in 2006 from US\$75 billion in 2002, causing the current account balance to turn negative in both 2005 and 2006.¹² The increase in total imports was partly a natural response to the growing domestic economy and the presence of excess liquidity created by the inflows. However, initiated in the early 1990s, the trade liberalization process that continued through the 2002-06 period also played a role in it. The greater openness of India's trade account was evidenced by the increase in total merchandise imports and exports, which rose from 21 percent of GDP in 2002 to roughly 32 percent in 2006. According to the review of the WTO, India had continued to reduce its barriers to imports between 2002 and 2007. The average applied Most-Favored Nation (MFN) tariff went down from over 32 percent in 2002 to 16 percent in 2007, while the use of import restrictions was also on the decline. In addition to participating in the WTO, India also engaged in regional trade agreements by offering preferential tariff rates to most countries in the South Asian Free Trade Area (SAFTA). The reduction in import tariffs helped lower the relative prices of tradable goods and increased people's incentive to purchase imports over nontradable products. The higher level of imports accelerated the absorption of the increment of reserves and reduced the rate of monetary expansion. Combining with a strong surge in aggregate income and an excess supply of money, the increase in imports helped offset roughly 85 percent of the extra foreign exchange flowing into the economy over the period, hence dampening the impacts of the inflows on the domestic price level and the real exchange rate.

Despite the central bank's intervention to limit monetary expansion and the government's efforts to relax trade controls, the level of real broad money grew by 74 percent, or at an average annual rate of 11.8 percent over the 2002-06 period, reflecting some degree of sterilization by the people. In the case of India, the expansion of real money demand was predominantly a reflection of the rapid increase in aggregate income, which grew by 45 percent or at an average annual rate of 7.8 percent.¹³

Russia (2002-2007)

At first glance, Russia appeared to be another standard case of a country undergoing real exchange appreciation in response to huge inflows of foreign exchange over the 2002-2007 period, where the country experienced a period of impressive economic growth following the financial crisis in summer of 1998. However, with an annualized rate of growth of over 30 percent for its foreign exchange inflows and 38 percent for its broad money, Russia's real exchange rate appreciation, at little over 7 percent, appeared to be relatively subdued. As shown in Figure 6, Russia received a windfall of foreign exchange during the period, with total inflows increasing by 4.5 times to reach over US\$430 billion in 2007. The increase was mainly driven by the soaring prices in oil and natural gas, the country's major export commodities. Crude oil exports rose from US\$29 billion in 2002 to US\$121 billion in 2007, thanks to an average crude oil price that jumped from US\$21 to US\$64 per barrel over the period. Similarly, exports in natural gas nearly tripled to stand at US\$45 billion in 2007, with the increase in total value almost fully accounted for by the rising per unit price.¹⁴ Beginning in 2006, the country's net capital inflows started to turn positive and hit a record US\$84 billion in 2007.

There was tremendous pressure on the ruble to appreciate over the period as the foreign exchange had become increasingly abundant. To keep the nominal exchange rate within a narrow band, the Bank of Russia intervened by buying dollars on the foreign exchange market.¹⁵ Consequently, the appreciation in the real exchange rate was accomplished through a combination of adjustment in the nominal exchange rate and a rise in the domestic price level. The nominal exchange rate of the ruble appreciated steadily against the U.S. dollar, declining by 18 percent over the 2002-2007 period, while domestic prices almost doubled.

The central bank's intervention in the foreign exchange market led its international reserves to increase by more than tenfold to end at US\$457 billion in 2007. Despite the vast accumulation in reserves, the central bank largely restricted its sterilization efforts to oil-related inflows. Following the examples of many oil-exporting countries, the government set up the Stabilization Fund of the Russian Federation in January 2004 with the aim of accumulating revenues when the world price for oil exceeded certain value, and drawing them down when the external conditions worsened.¹⁶ According to the Ministry of Finance, the Stabilization Fund, which was held in several government accounts at the Bank of Russia, totaled US\$157 billion at the end of 2007, up from US\$19 billion at the end of 2004.¹⁷ The sterilization function of the Iiability side of the central bank's balance sheet as government deposits. The sterilization efforts by the central bank were further augmented when the Russian government used the capital of the Fund to repay its external debt in advance.¹⁸ The repayments amounted to US\$22.6 billion in 2005 and US\$23.0 billion in 2006.

As the foreign exchange interventions were only partially sterilized, the money supply ended up increasing by sevenfold to reach \$14.6 trillion rubles in 2007. Accompanying the monetary expansion was a domestic price level that rose at an average rate of 11.8 percent per annum. Although inflation remained high in Russia, it was surprising that the price increase was not larger, given that M2 grew at an average annual rate of 38 percent over the period. It appears that, as the money stock expanded, the country also underwent a rapid growth in its demand for real monetary balances that allowed the domestic economy to absorb some of the excess liquidity generated by the foreign exchange inflows. Without such change in money demand, a larger real exchange rate adjustment might have been called for. It appeared again to be a case of sterilization by the people where the increase in demand for monetary balances helped reduce the excess supply of money that would otherwise be spent on tradable and nontradable goods. Consequently, the Russian economy was able to grow at a rapid rate without causing runaway inflation in the face of a windfall in foreign exchange inflows.

Similar to the case of China, we found the rapid growth in income to be the main factor that caused a higher demand for cash balances in Russia. With the real GDP growing at an average annual rate of 7.3 percent over the 2002-2007 period, the increase in money stock was a natural consequence of the increased money demand for transaction purposes. However, we also see evidence that the public was adapting their preference for money holdings to the changing macroeconomic conditions. The ratio of total broad money to GDP rose from 0.26 to 0.44. Such increase in money demand might partly be due to the decline in inflation expectations that had taken place in recent years. Russia's domestic price level had been highly unstable in the previous decade, with its 12-month inflation rates peaked at 1,066 percent in late 1993 after the removal of price controls by Yeltsin's government, and again at 126 percent in mid-1999 following the financial crisis. Since then, the country has undergone a series of substantial reforms with the aim of stabilizing the economy and re-establishing credibility in its policies. With the implementation of inflation targeting and a managed floating regime, the domestic inflation rate slowly came down and remained stable at around 10 percent per annum between 2003 and 2007, while volatility in the exchange rate was greatly contained.¹⁹

On the other hand, as the public regained confidence in the ruble and the banking system, they also began a process of de-dollarization and remonetization by gradually decreasing their holdings of U.S. dollars in favor of the domestic currency (Korhonen & Mehrotra, 2007). According to the IMF, the share of foreign-currency deposits as a percentage of total deposits decreased from 35 percent in 2002 to 12 percent in 2007. Alternatively, the broad money supply in ruble rose from \$1.6 trillion rubles in December of 2001 to \$13.3 trillion rubles in December of 2007, an increase of over sevenfold. As a result, the increase in demand for ruble helped offset some of the appreciation pressure on Russia's real exchange rate as its foreign reserves expanded.

Jordan (2001-2007)

Jordan experienced the combination of an acceleration in foreign exchange inflows and a mild depreciation in its real exchange rate between 2001 and 2007. Total inflows increased by US\$10.6 billion to reach US\$16.4 billion in 2007 (Figure 7), mainly as a result of the strong growth in manufacturing exports and a significant boom in FDI. Total exports rose by US\$5.3 billion, of which roughly 70 percent was due to increase in export prices. Net FDI surged from a mere 2 percent of GDP in 2001 to almost 24 percent in 2006, before retreating to approximately 11 percent of GDP in 2007.

Although the Jordanian dinar is officially linked to the SDR, Jordan has de facto pegged its currency at 0.71 dinars per U.S. dollar since October of 1995. With a fixed exchange rate, any adjustments in the relative price have to be channeled through changes in domestic prices. Inflation in Jordan averaged 4.1 percent per annum over the period, slightly lower than the 5.8 percent annual increase in the world price level. As a result, the real exchange rate depreciated moderately by 21 percent over the 2001-07 period.

The inflows were largely offset by an outpouring of foreign exchange stemming from a rapid increase in imports as the strong economic expansion boosted domestic demand.

Approximately 81 percent of the cumulated foreign exchange earnings were used to finance the imports of goods and services over the period. Nevertheless, the strong surge in export receipts and private capital inflows enabled the Central Bank of Jordan (CBJ) to raise its level of net foreign assets by \$3.3 billion dinars to a record \$6.1 billion dinars in 2007. To keep the growth of domestic liquidity under control, the CBJ conducted open market operations, particularly through the issuance of Certificates of Deposit (CDs),²⁰ and increased the overnight window deposits held at the central bank. As a consequence, only 55 percent of the increase in net foreign assets was reflected in an expansion in base money.

The partial sterilization by the central bank was justified by the fact that the public was at the same time sterilizing the inflows by increasing their demand for real balances, as evidenced by the steady increase in real broad money supply over the 2001-07 period. Nominal M2 grew at an annual rate of 13 percent, while domestic inflation only amounted to 4 percent per annum on average. The rising level of money demand was partly a reflection of the increase in economic activities as people's income went up.²¹ However, with a M2/GDP ratio that increased from 1.15 in 2001 to 1.4 in 2007, it also suggests that there was a change in the tastes of the public. Different factors may have contributed to such change, including the increasing demand for money balances arising from larger cash-based trade with Iraq.²²

Pakistan (2004-2007)

Pakistan has implemented significant structural reforms and prudent macroeconomic policies since the turn of the new century. Along with the relatively stable macroeconomic condition came a greater influx of foreign exchange which nearly doubled in four years to reach US\$39.7 billion in 2007 (Figure 8). Net FDI and portfolio flows, both increased by roughly fivefold over the period, contributed most to the increase in inflows.²³ On the other hand, total exports of goods and services increased moderately by 36 percent over the 20004-07 period, while private transfers rose by 32 percent.

Although the State Bank of Pakistan (SBP) classifies its exchange rate policy as a managed float, its currency has been pegged to the U.S. dollar de facto since late 2004. On the back of the record-high foreign exchange inflows, its real exchange rate remained virtually unchanged during the period as the domestic price level in Pakistan went up at about the same rate as the world price level.

As explained earlier, if the increase in inflows was continuous, Pakistan should experience a period of reserves accumulation, rising domestic price level, and imports expansion combined with exports decline as the economy transitioned to its new equilibrium. However, Pakistan did not experienced a rapid pileup of reserves between 2004 and 2005 as a pickup in import growth helped offset nearly all of the foreign currencies coming into the economy during the period. Total imports continued to increase in subsequent years, although not as fast as the inflows of foreign exchange. The strong import demand was partly due to a rapid expansion in the domestic economy, which grew at an impressive average rate of 7 percent a year over the 2004-07 period, and a rise in import prices.

On the other hand, the fact that the imports as a share of GDP increased from 19 percent in 2004 to 23 percent in 2007—compared with a steady 15 percent in the four preceding years—suggests that the growth in import demand have other contributing factors. According to the WTO, Pakistan liberalized its trade policies and reduced its import restrictions considerably over the 2002-07 period. For instance, the average tariff on agricultural products was reduced from

22.1 percent in 2001 to 14.8 percent in 2007, while the average tariff on non-agricultural goods declined from 20.4 percent to 14.5 percent over the same period. Most of the import prohibitions have also been either lifted or relaxed. In Pakistan's case, the increase in imports induced by factors such as trade liberalization and high economic growth helped offset roughly 81 percent of the influx of foreign exchange over the 2004-07 period, hence reducing some of the inflationary pressure created by the inflows on the economy, and thus making further real exchange rate adjustment unnecessary.

Despite the increase in imports, the level of net foreign assets at SBP rose 61 percent between the end of 2003 and 2007 to reach a record \$830 billion rupees. The SBP began to tighten its monetary policy in January of 2004, as reflected in a rise of the Monetary Conditions Index (MCI), a composite indicator that measures the policy stance of the monetary authority (Hyder & Khan, 2007).²⁴ However, the sterilization efforts of the central bank were complicated by the expansionary impact of an increase in its lending to the government, which rose by \$491 billion rupees over the 2004-07 period. The resulting effect was a broad money supply that expanded at an average rate of 17.8 percent per annum, compared with an average annual inflation rate of 8.4 percent over the four-year period. Again, we observe a partial sterilization by the people as they increased their demand for real cash balances in conjunction with an accelerated inflow of foreign exchange. The rising level of real M2 in Pakistan's case was, in all likelihood, due mainly to the growth in real GDP, which averaged 7.1 percent over the period.

Hungary (2002-2007)

Inflows of foreign exchange to Hungary increased rapidly between 2002 and 2007. Total inflows more than doubled to reach US\$107 billion in 2007 (Figure 9). The extra foreign exchange was largely coming from an increase in exports, machinery and equipment in particular, which rose from US\$42 billion in 2002 to over US\$111 billion in 2007. Net capital inflows also increased more than fivefold to peak in 2005, mainly due to heavy external borrowings, before retreating to around US\$9.2 billion in 2007.

Despite the heavy inflows, Hungary's real exchange rate only appreciated moderately at 3.7 percent a year over the period, while its nominal exchange rate was pegged to the euro within a narrow band. Over the period, net foreign assets at the National Bank of Hungary (NBH) rose nearly threefold to stand at \$4.3 trillion forints in 2007. However, only 44 percent of the reserves accumulation was reflected in a rise of base money, as the central bank reduced its credit to the central government by over \$1.5 trillion forints over the five-year period on the back of continued efforts by the government to reduce fiscal deficits. Despite the contraction of claims on central government, base money expanded by 79 percent over the period, while the broad money supply almost doubled to end at \$13.8 trillion forints in 2007, an increase of 12.1 percent per annum on average. On the other hand, inflation averaged at a moderate 5.5 percent over the 2002-07 period.

Hungary experienced some degree of sterilization by the people, with a broad money supply that grew faster than the domestic price level. The monetary expansion in real terms was partly a direct result of the real output growth in Hungary, which increased at an annual rate of 3.8 percent over the period. However, the Hungarians also increased their money holdings per unit of GDP starting 2000 as the country's price level began to come under control after a period of hyperinflation for the most part of the 1990s.²⁵ The inflation rate had averaged 22.1 percent a year over the 1990-99 period and fell to 6.3 percent during the period between 2000 and 2007.

Indonesia (1987-1996)

Before the currency crisis hit the economy, Indonesia had enjoyed a period of high economic growth and relatively stable inflation rates between 1987 and 1996. As the economy went through a period of financial reforms and structural changes, total inflows of foreign exchange surged from US\$17.6 billion in 1987 to US\$63.9 billion in 1996 (Figure 10). The extra inflows were mainly foreign exchange earned from goods exports, which increased threefold to reach US\$50.2 billion in 1996. Net FDI also increased by US\$5.2 billion over the period, while net portfolio investment picked up in 1993 and rose by US\$5.1 billion.

Despite the inflows, Indonesia's real exchange rate remained fairly stable over the decade, while its nominal exchange rate depreciated steadily over the managed float period. As the central bank purchased the extra inflows, its net foreign assets rose by more than fourfold to reach US\$2.6 billion in 1996. In an enforced sterilization move, major state-owned enterprises were required to increase their deposits at the central bank beginning in January of 1991. Liabilities of the Indonesian central bank to other depository corporations (a base money component) jumped from \$1.5 trillion rupiahs in 1990 to over \$10.9 trillion rupiahs in 1991, and continued to climb until the onset of the financial crisis. The resulting expansion in base money amounted to \$28.6 trillion rupiahs, reflecting 55 percent of the rise in foreign reserves. Nevertheless, the sterilization operation by the central bank did not prevent a tremendous increase in broad money supply, which rose tenfold at an annual average rate of 26.2 percent over the period, as banks continued to expand their credits to the private sector. Yet, in spite of this rapid growth in liquidity, the domestic price level rose at a much slower rate of 8.1 percent per annum, reflecting a major increase in people's demand for real monetary balances.

Again, the rise in real demand of broad money was partly due to an increase in economy activity as the real GDP of Indonesia grew at an average annual rate of 6.9 percent over the period. However, the monetary expansion was also accompanied by a fall in the income velocity of broad money, which declined from 3.7 in 1987 to 1.9 in 1996. Dekle and Pradhan (1999) attributed it to the process of financial liberalization and rapid monetization as the country eased its control on deposit and lending interest rates and increased competition in the banking system through deregulation. Regardless of the causes of the increase in money demand, the sterilization by the people in Indonesia helped hold inflation down and keep the real exchange rate stable.

CONCLUSION

This paper examines the response of real exchange rate in fixed exchange rate countries that experienced increasing inflows of foreign exchange. According to standard theories, such country should witness a rise in domestic price level and a real exchange rate appreciation as the stocks of foreign reserves and broad money supply increase. However, we observed that a number of developing economies underwent periods of surging inflows and vast reserves accumulation without significant inflation or changes in their real exchange rates. Although in some of these episodes there were sterilization activities performed by the central banks aimed at limiting the expansion of their money supply, there were circumstances where additional economic forces operate in conjunction with the increase in inflows and the economic adjustments that follow. This paper argues that sometimes such sterilization can be initiated by the people, meaning that the public increased their holdings of real monetary balances because of a rise in income or a change in preferences. By demanding as cash balances what might otherwise be excess liquidity, it helped alleviate some of the inflationary pressure on the economy, and thus making further real exchange rate adjustment unnecessary. In addition, the liberalization of imports also achieved similar effects by offsetting some of the extra foreign exchange coming into those countries.

Among the countries under study, China has gone through the most dramatic shift in its money demand function over the last decade. While enjoying tremendous capital inflows and exports growth, the economy showed little sign of overheating despite the rapid expansion in its broad money supply. The current study help shed some light on the controversy over a potential real exchange rate misalignment in China since the beginning of the century. Many policymakers have claimed that the Chinese authorities have kept their currency undervalued, as indicated by its real exchange rate depreciation, current and capital account surpluses, and surging international reserves, suggesting potential imbalances in the country's external and internal macroeconomic environment. Our findings cast doubt on such assertions, as such rapid reserves accumulation, in tandem with lack of real exchange rate adjustment, could be an equilibrium phenomenon rather than an active manipulation by the government.



Figure 1: Dollar-Denominated SDR-WPI (1995=100)



Figure 2: Argentina (1991-2001)



Figure 3: Korea (1983-1997)



Figure 4: China (1994-2006)



Figure 5: India (1999-2006)



Figure 6: Russia (1996-2007)

Figure 7: Jordan (1998-2007)

Figure 8: Pakistan (2000-2007)

Figure 9: Hungary (1999-2007)

Sources: International Financial Statistics; author's own calculation.

Figure 10: Indonesia (1984-1997)

Sources: International Financial Statistics; author's own calculation.

Table 1 Summary							
		FX Inflows	RER	NER	CPI	NER/CPI	SDR-WPI
Country	Period	(average annual percentage change)					
Argentina	1991:1993	75.53	-12.37	2.35	17.54	-12.92	0.99
China	1998:2006	26.83	2.90	-0.47	0.72	-1.18	4.13
Hungary [*]	2002:2007	20.73	-3.69	0.71	5.29	-4.35	8.10
India	2002:2006	28.01	1.84	-1.74	4.40	-5.89	8.20
Indonesia	1987:1996	15.40	-1.32	4.01	8.31	-3.97	2.75
Jordan	2001:2007	19.00	2.95	0.00	3.64	-3.51	6.71
Korea	1986:1989	27.12	-6.61	-8.67	5.44	-13.39	6.54
Pakistan	2004:2007	24.24	0.91	1.40	8.19	-6.28	7.26
Russia	2002:2007	35.06	-6.27	-3.98	11.17	-13.63	8.10

*The nominal exchange rate is measured against the euro.

ENDNOTES

- ¹ The seminal paper on the monetary approach by Polak (1957) and articles written by other staff members of the IMF can be found in Rhomberg and Heller (1977).
- ² Studies show that various sources of foreign exchange inflows—such as capital inflows, exports, and remittances—lead to economic growth: for positive relationships between capital inflows and economic growth, see Borensztein, De Gregorio, and Lee (1998), Bekaert, Harvey, and Lundblad (2005), and Aizenman, Jinjarak, and Park (2013); for exports, see Xu (1996) and Kristjamnpoller and Olson (2014); for remittances, see Nsiah and Fayissa (2013) and Imai, Gaiha, Ali, and Kaicker (2014).
- ³ Magud and Sosa (2013) provide a good survey of the theoretical and empirical studies on the relationships among foreign exchange inflows, real exchange rate appreciation, and factor reallocation in the tradable and nontradable sectors.
- ⁴ There will also be a decrease in the supply of foreign exchange as the increased demand for exportables reduces total exports.
- ⁵ For details on the capital inflows into Argentina in the early 1990s, see Calvo, Leiderman, and Reinhart (2011).
- ⁶ See Chan (2015).
- ⁷ Santos-Paulino (2002) found a strong positive relationship between trade liberalization and import growth in 22 countries over the 1976-98 period.
- ⁸ According to the World Bank's World Development Indicators.
- ⁹ See Chan (2015).
- ¹⁰ The repo rate is the rate at which the RBI repurchases government securities from the commercial banks, while the reverse repo rate is the return earned by commercial banks on excess funds deposited with the central bank against government securities. Introduced in June 2000, the repo and reverse repo auctions are part of the Liquidity Adjustment Facility (LAF) used by the RBI to adjust short-term liquidity in the banking system.
- ¹¹ The data and information are obtained from the RBI website, IMF (2007), and Mohan (2011).
- ¹² The nominal exchange rate experienced a mild depreciation between August 2005 and August 2006 as the current account record a deficit in 2005-06.
- ¹³ The results are in line with an income elasticity for money demand of 1.3 estimated by the author.
- ¹⁴ Data from the Central Bank of the Russian Federation (CBR) website.
- ¹⁵ Although Russia adopted a managed float regime *de jure*, the IMF classified its exchange rate policy as a *de facto* pegged arrangement (IMF, 2008).
- ¹⁶ The Stabilization Fund was replaced by the Russian Reserve Fund in January 2008.
- ¹⁷ As reported by the Russian Ministry of Finance, the currency composition of the Stabilization Fund was 45 percent in U.S. dollar, 45 percent in euro, and 10 percent in British pound in 2007.
- ¹⁸ Early external debt repayments were made to the International Monetary Fund, the members of the Paris Club, as well as the Vnesheconombank.
- ¹⁹ According to the author's estimation, a one percent point reduction in inflation expectation raised the real demand for broad money by 0.7 percent over the 2001-06 period.
- ²⁰ The amount of CDs issued by the CBJ increased from \$1.2 billion dinars in Dec-2001 to peak at \$2.5 billion dinars in Dec-2004 before coming down to \$2.0 billion dinars in Dec-2007.
- Assuming the income elasticity of money demand to be 1.1 in Jordan, consistent with the author's estimation, the growth in real GDP would explain roughly 56 percent of the increase in real M2 demand over the 2001-07 period.
- ²² According to the 2008 IMF Staff report.
- ²³ An important source of FDI in Pakistan was privatization proceeds, which reached US\$1.5 billion or 40 percent of net FDI in 2006. On the other hand, the increase in portfolio inflows was mainly due to the successful sales of eurobond and GDRs beginning in 2003.
- ²⁴ The MCI is calculated as a weighted average of short-term interest and exchange rates.
- ²⁵ According to the author's estimation, a one percent point reduction in inflation expectation would lead to a 0.64 percent increase in real money demand.

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