Abstract
Rising U.S. interest rates impact emerging economies through capital outflows and currency depreciations. For those with flexible exchange rates, the appropriate monetary policy response weighs the traditional competitiveness effect with a balance sheet effect created by the presence of foreign currency denominated debt (liability dollarization). This paper presents a basic Keynesian macro model that incorporates this balance sheet effect and demonstrates that it significantly complicates the monetary policy response to depreciations. Without full knowledge of the size of these competing effects, the central bank can make large mistakes in setting interest rates.

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1. Introduction

As the Federal Reserve continues its policy normalization, the impact on emerging economies has become an important issue. Even before the federal funds rate’s liftoff from the zero lower bound, the decision in 2013 to taper its large scale asset purchases led to capital outflows and currency depreciations in emerging economies, referred to as the taper tantrum. Similarly, a rising federal funds rate can also trigger an exogenous depreciation. How should monetary policy respond? Countries with fixed exchange rate regimes will likely be forced to raise domestic interest rates, which is contractionary. For flexible exchange rate regimes, however, the response is impacted by the presence of foreign currency denominated debt (liability dollarization) (Banerjee et al., 2016). While an exogenous depreciation can stimulate net exports, the presence of liability dollarization implies that large depreciations can lead to significant reductions in net worth by inflating the domestic currency value of borrowers’ loans (Mishkin, 1996). This can then trigger an investment collapse through the financial accelerator mechanism.¹²

This paper demonstrates that the competing competitiveness and balance sheet effects significantly complicate the monetary policy response to a depreciation shock under flexible exchange rates. Specifically, both the magnitude and the direction of the optimal interest rate

¹ A rise in foreign interest rates could also affect domestic output through other channels as well, such as a contraction in international lending that leads to a fall in domestic investment (Cetorelli and Goldberg, 2012; Miranda-Agrippino and Rey, 2014). The focus of this paper, however, is on the liability dollarization channel.

² There is a growing empirical literature testing the relevance of these balance sheet effects. For example, Aguiar (2006) finds that Mexican firms with heavy exposure to short-term foreign currency debt before the 1994 devaluation experienced relatively low levels of post-devaluation investment. Specifically, observed foreign currency debt exposure reduced net investment rates for 1995 from positive 1% to negative 3.6% following the December, 1994 depreciation. Furthermore, annual GDP growth was 4.5% for 1994 and -6.2% in 1995. Thus the effects of depreciations can impact investment and output soon after the depreciation occurs. Bebczuk et al. (2006) present macro evidence of this effect using a large sample of countries during the period 1976-2003, finding that the presence of liability dollarization weakens the expansionary effect through the standard trade channel. Specifically, in countries with low levels of liability dollarization, a 20% depreciation is associated with a 0.5 percentage point increase in the growth rate of GDP per capita the following year. However, in countries with significant dollar liabilities, including most of their developing country sample, devaluations are in fact contractionary.
response are affected by the extent of liability dollarization. A rising level of foreign currency debt initially implies declining interest rate hikes, then interest rates cuts, and then finally a discontinuity followed by large increases in interest rates. This discontinuity implies that without full knowledge of the parameters of the economy, the central bank can make large mistakes in setting interest rates.3

2. The Model

For simplicity, I assume constant inflation and expected inflation equal to the central bank’s inflation target. Therefore, a central bank operating a flexible exchange rate regime can and will use its influence over aggregate demand to set output equal to potential output in response to a depreciation shock, regardless of the level of liability dollarization.4 However, the level of liability dollarization determines the magnitude and direction of the optimal interest rate response to this shock.

This result can be derived using a modified version of a basic one period Keynesian macro model.5 Specifically, a simple modification of the standard IS curve allows for the possibility of contractionary depreciations and different interest rate responses. The key insight is that a depreciation can lead to a decline in investment and consumption if firms and households have borrowed in dollars but earn revenue in domestic currency. Letting $E$ represent the nominal exchange rate (domestic currency/foreign currency), then the investment function

$$I = \bar{I} - d_1 r - d_2 E$$

3 Bacchetta (2000) also argues that liability dollarization leads to both ambiguous initial effects of depreciation on output and at the same time affects the monetary policy response because of the competing competitiveness and balance sheet effects. The results in this paper, however, imply additional complications, as mentioned above and discussed in the rest of the paper.

4 This abstracts from issues related to the zero lower bound as well as the difficulty exchange rate adjustment can have in insulating an economy from the global financial cycle (Rey, 2013).

5 The setup of the model follows Honig (2012).
allows a rise in $E$ to reduce investment. Similarly, the consumption function

$$C = \bar{C} + mpc(Y - T) - c_1 r - c_2 E$$

(2)

allows $E$ to affect consumption through household balance sheets.$^6$

The rest of the model is standard. Net exports is given by $NX = \bar{NX} + xE$, where I have assumed constant inflation and foreign inflation so that changes in the nominal exchange rate affect the real exchange rate and therefore net exports. The nominal exchange rate (which can be derived from an interest rate parity condition) is given by $E = \bar{E} - er$, where “$e$” captures the sensitivity of the exchange rate to $r$ and $\bar{E}$ captures exogenous changes in $E$. Abstracting from government spending, taxes, autonomous changes in consumption, investment, and net exports, and setting $mpc = 0$ for simplicity, we can write the IS curve as:

$$Y = [x - (c_2 + d_2)]\bar{E} - \{c_1 + d_1 + [x - (c_2 + d_2)]e\}r$$

(3)

2a. Effect of an Exogenous Depreciation on Output (no interest rate response)

An exogenous depreciation resulting from a rise in foreign interest rates can be captured by an increase in $\bar{E}$. Thus the effect on output (i.e. the shift in the IS curve) is given by

$$\frac{\partial Y}{\partial \bar{E}} = x - (c_2 + d_2)$$

(4)

An exogenous depreciation therefore leads to a fall in $Y$ if the contractionary balance sheet effects on consumption and investment, captured by $c_2 + d_2$, outweigh the expansionary effect on net exports, given by $x$. The former effects are large in countries with a high share of dollar liabilities, producing the observed result that depreciations tend to be contractionary in such economies.$^7,^8$

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$^6$ While I do not model a public sector with foreign currency debt (the debt here is held by domestic firms and households), government spending could also be impacted by currency depreciations as governments may have to run larger budget surpluses when foreign currency debt rises in value following a depreciation. This would strengthen the balance sheet effect.

$^7$ The threshold for the amount of foreign currency debt at which depreciations become contractionary is therefore a relative threshold, not an absolute threshold. For countries with small export sectors, depreciations become
2b. Effect of Monetary Policy

The presence of liability dollarization also has implications for the slope of the IS curve and therefore the impact of monetary policy. The effect of a change in interest rates on output is given by

\[
\partial Y / \partial r = -[c_1 + d_1 + xe - (c_2 + d_2)e]
\]

The traditional effects of a change in \( r \) on consumption, investment, and net exports are captured by \( c_1 + d_1 + xe \). However, in the presence of liability dollarization, lower interest rates that induce a depreciation then lower consumption and investment, captured by \( (c_2 + d_2)e \). Assuming \( c_1 + d_1 + xe - (c_2 + d_2)e > 0 \), these additional effects weaken the expansionary effect of lower interest rates. Graphically, the presence of liability dollarization steepens the IS curve (whose slope is \( \partial r / \partial Y \)) and implies a weaker effect of monetary policy. If \( c_1 + d_1 + xe - (c_2 + d_2)e = 0 \), the IS curve is vertical, and monetary policy has no effect on output.

If, however, \( (c_2 + d_2)e > c_1 + d_1 + xe \), then the traditional effects are dominated by the balance sheets effects stemming from foreign currency debt. In this case, \( c_1 + d_1 + xe - (c_2 + d_2)e < 0 \), and lower interest rates actually reduce output, implying a positively sloped IS curve. This could occur in countries with very high levels of liability dollarization. Finally, as \( (c_2 + d_2) \to \infty \), the slope of the IS curve converges to zero so that any change in \( r \) has a large effect on output.

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8 There are a number of factors that could limit the contractionary effects of depreciation even under significant liability dollarization: sufficient fiscal space to provide support to the economy, IMF loans, and a well-capitalized financial system that can withstand a deterioration in net worth. In addition, not only does a large export sector support the economy through the competitiveness effect, exporters are also more likely to earn revenue in dollars and thus do not suffer from currency mismatches even if they have borrowed in dollars. For both reasons, a strong export sector works to limit the contraction following a depreciation.
3. The Optimal Interest Rate Response to an Exogenous Depreciation

As we have seen, the presence of foreign currency debt determines whether an exogenous depreciation is initially expansionary or contractionary by determining the direction (and size) of the IS curve shift. This then determines whether contractionary or expansionary monetary policy is required to stabilize output. At the same time, the presence of foreign currency debt also determines whether lower interest rates are expansionary or contractionary. Thus, both the magnitude and direction of the optimal interest rate response are affected by the extent of liability dollarization, captured by $c_2 + d_2$. This can be seen solving for

$$\frac{\partial r}{\partial E} = \frac{x - (c_2 + d_2)}{[c_1 + d_1 + xe - (c_2 + d_2)e]}$$

(6)

Graphically, the value of $c_2 + d_2$ implies different possible combinations of IS shifts (determined by the sign of the numerator) and IS slopes (determined by the sign of the denominator) that determine the optimal change in $E$. Note that if $c_1 + d_1 + xe - (c_2 + d_2)e < 0$ so that the IS curve is positively sloped (denominator negative), then $x < c_2 + d_2$ (numerator also negative) and an exogenous depreciation shifts the IS curve to the left. Therefore, there are three (not four) possible combinations of IS shifts and slopes.

These three outcomes are depicted in Figures 1 and 2. In Region 1, $c_2 + d_2$ is small (or zero) so that the IS curve shifts right and has a negative slope. In this case, a rise in $E$ is needed to stabilize output, i.e. $\frac{\partial r}{\partial E} > 0$ (both the numerator and denominator in Equation (6) are positive). In Region 2, $c_2 + d_2$ is in an intermediate range in which it is large enough that the IS curve shifts left (numerator negative) but not so large that it has a positive slope (denominator still positive, slope still negative). Therefore, a fall in $r$ is optimal so that $\frac{\partial r}{\partial E} < 0$. In Region
$c_2 + d_2$ is so large that the IS curve shifts left and has a positive slope (both the numerator and denominator are negative), requiring a rise in $r$ to stabilize output so that $\frac{\partial r}{\partial E} > 0$.\(^9\)

Figure 1: The IS Curve and $\frac{\partial r}{\partial E}$ for different $c_2 + d_2$

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\(^9\) The interest rate changes in Regions 1 and 3 are consisted with empirical evidence that emerging economies respond to a rise in U.S. interest rates with interest rate hikes of their own, even those with flexible exchange rates (Bhattarai et al. 2017)
Considering some specific values of \( c_2 + d_2 \) illustrates a few key implications of the model. First, without any foreign currency debt \( (c_2 + d_2 = 0) \), the central bank raises interest rates to stabilize output but by less than \( 1/e \), which is the change required to fix the exchange rate. Thus a fixed exchange rate requires a higher interest rate and therefore a fall in output when there is an exogenous depreciation shock. Second, when \( c_2 + d_2 = x \), the IS curve does not shift so the central bank keeps interest rates unchanged. Third, there is a discontinuity between Regions 2 and 3. This corresponds to the case where \( c_1 + d_1 + xe - (c_2 + d_2)e = 0 \) so that the IS curve is vertical. Immediately before and after this point, \( |\partial r/\partial E| \) is large because the IS curve is steep, implying that large changes in \( r \) are necessary when the IS curve shifts left. In this range, a very small increase in \( c_2 + d_2 \) can mean a drastically different response to an exogenous depreciation: first a large decrease in \( r \) and then a large increase. This implies that a central bank could make large mistakes in setting interest rates without full information about the parameters of the economy, in particular the relative size of the competitiveness and balance sheet effects.
In Region 3, the increase in \( r \) is greater than when \( c_2 + d_2 = 0 \), implying that as the amount of liability dollarization increases, eventually the optimal response to an exogenous depreciation requires higher interest rates than without liability dollarization. The intuition is that with sufficient liability dollarization, not only are depreciation shocks contractionary but increasing interest rates is necessary to combat them. In addition, as \((c_2 + d_2) \to \infty\), \( \partial r / \partial E \to 1/e \), which is the change in \( r \) needed to keep the exchange rate fixed. The reason is that the effects of foreign currency debt are so large following an exchange rate shock that stabilizing output almost requires fixing the exchange rate. Comparing the three regions reveals that the effect of liability dollarization on the interest rate response to a depreciation shock is ambiguous and depends on the initial level of liability dollarization, both in terms of the magnitude of the interest rate change and its direction.

Finally, the fall in output following an exogenous depreciation shock under a fixed exchange rate regime is independent of foreign currency debt. Specifically, the change in output (setting \( \partial r / \partial E = 1/e \), which is required to fix \( E \) regardless of \( c_2 + d_2 \)) is given by:
\[
\partial Y / \partial E = -(c_1 + d_1)(1/e) < 0
\] (7)
which does not depend on \( c_2 + d_2 \). Intuitively, the presence of foreign currency debt is irrelevant when the exchange rate does not change.

4. Conclusion

This paper presents a modification to a basic Keynesian macro model to incorporate the effects of liability dollarization on the optimal interest rate response to rising foreign interest rates. The model demonstrates that balance sheet effects significantly complicate the monetary policy response to depreciations. Seemingly small changes in the extent of liability dollarization
can lead to dramatic changes in the ideal response, raising the possibility that central banks can make large mistakes in setting interest rates.

References