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Monetary Policy and External Shocks in a Dollarized Economy with Credit Market Imperfections

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Abstract

This paper analyses the transmission of monetary and external shocks in a dollarized economy by making use of a small, static analytical model, which dwells on Agénor and Montiel (2006, 2007). The focus is particularly on the implications of endogenous country risk premium on the transmission of shocks. Endogenous risk premium arises from the imperfect information in international capital markets. As is the case for literature on credit market imperfections, net worth of the banks intermediating between the domestic investors and international capital markets, is the main determinant of country´s risk premium. Fluctuations in the exchange rate affect the net worth of the banks and so the cost of foreign resources which is, in turn, reflected into domestic lending rates. We show that the conventional effects of monetary and external shocks might be reversed in such a setting.

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1 Introduction

In recent decades the conventional view of the transmission of monetary policy has been extended in various ways. Credit channel is one of the significant extensions to the conventional framework.[1] According to credit view when there is imperfect information in the credit market and acquiring the information is costly, external resources become more expensive compared with internal resources. In this case the firm's cash flows and net worth plays a critical role in determining the availability and the cost of finance. Besides decreasing the amount of internal funds, contractionary monetary policy deteriorates the balance sheet of firms; which in turn aggravates the external finance premium due to the informational problems. Thus, credit market imperfections magnify the effects of a contractionary monetary policy.

For emerging economies credit market imperfections play a role not only in the domestic credit market but also in international capital markets. Low levels of domestic savings make these economies more dependent on the foreign capital inflows. Owing to the imperfections in the international capital markets, agents in emerging markets face higher interest rates compared with world risk free interest rates. In the case of substantial fluctuations in the risk premium they experience severe problems in servicing their debt and rolling-over their existing debt stock. Fluctuations in risk premium may occur due to the changes in market sentiment, which may not necessarily depend on the fundamentals of the economy. Recent studies focus on the relation between the risk premium and the balance sheets of the indebted agents in the emerging countries.

It is well established that the emerging market countries cannot borrow in their domestic currency.[2] Hence, in these economies, agents who resort to foreign resources to fund their domestic investments will face a currency mismatch problem in their balance sheets. An external shock or an internal shock affecting the exchange rates would directly impinge on the balance sheets. If the risk premium depends on the balance sheets of the borrowers, risk premium will also be affected by the shock. In such a setting an external shock, say, for instance taking the form of a reversal in the capital inflows or an exogenous drop in the exports, would be magnified due to the relation

[1] Two different channels are considered under the credit channel title: *bank lending channel* and *broad credit channel*. We will be focusing on the latter and the term credit channel will be meaning the latter.

[2] This situation is named "Original Sin" by Eichengreen and Hausman (1999).

between the balance sheets and the risk premium.

In various studies the implications of the balance sheet effects on the dynamics of the transmission of shocks and optimal monetary and exchange rate policies have been analyzed by integrating the above-mentioned endogenous risk premium mechanism into general equilibrium models. In a simple static model, Krugman (2000) shows how a deterioration in the sentiment of foreign lenders may justify itself by impairing the balance sheets of the domestic firms, which have foreign currency liabilities in their balance sheets. Aghion et al (2000), focuses on the optimal monetary policy in currency crises where firms have both domestic and foreign debts. By using a two-period model they show that the optimal policy response to a currency crisis may not necessarily be tight monetary policy as was suggested to Asian countries in 1997 crisis by the IMF. They demonstrate that when the share of foreign currency debt is relatively small and when the sensitivity of credit supply to interest rate is high, authorities should not respond to the currency crisis with a tight monetary policy. Cespedes et al (2000) integrates the balance sheet effects into a dynamic infinite-horizon model where firms directly borrow from abroad to fund their capital investments. With their model they compare the performance of the exchange rate regimes in transmitting the external shocks. They found that the relation between the risk premium and the balance sheet magnifies the effect of external shocks. However, contrary to the existing view in the literature, which favours the stability of the exchange rates in financially dollarized economies, they found that, even in the presence of endogenous risk premium and the liability dollarization, the flexible exchange rates are better in absorbing the external shocks. This result arises from the fact that a real devaluation increases the return for capital, which increases the price of the capital and hence the net worth of the firms. By making use of an intertemporal model that is aiming at representing emerging market countries, Devereux et al (2004) analyses the effects of the financial frictions that firms in the emerging economies face in international capital markets on the optimal monetary policy.[3] Although, they note that financial frictions act as a multiplier and magnify the effects of external shocks, they also found that the presence of such friction does not affect the ranking of alternative monetary policies.[4]

[3]In their paper they also checked the implications of exchange rate pass-through on the ranking of alternative monetary policies.

[4]In their analyses they consider three different types of monetary rules; fixed exchange rate rule, and two types of inflation targeting rules under flexible exchange rates. These

Choi and Cook (2004) depart from the other studies in designing a two level financial intermediation; that is banks instead of firms borrow from abroad and allocate the foreign resources to domestic firms.[5] In such a case, it is the bank's balance sheet that would determine the cost of foreign borrowing. As they emphasized in their paper, in that case the implications of the developments in the real economy on the value of the domestic capital stock become irrelevant in the determination of the risk premium.

Recently, another mechanism through which monetary policy can affect the economy has been the focus of extensive research. Contrary to the conventional channels this channel establishes a direct (contemporaneous) link between the interest rate and the supply side. This view is based on the fact that firms need financial resources for their current production activities. Hence, financial resources used for current production are also a part of inputs. These resources are needed to fill the financial gap that is created by the time delay between the factor payments and the proceeds from the sales. By affecting the cost of these resources (known as Working Capital) interest rates become one of the determinants of the production costs. The significance of the magnitude of working capital has been proved by several studies.[6] Accordingly, an increasing number of studies find strong evidence for the existence of this channel.[7][8]

In the presence of the cost channel a contractionary monetary policy both shifts the supply and the demand curves in the same direction (Barth and Ramey, 2006). Such an effect, depending on the direct sensitivity of production to interest rate, might even result in higher prices. Barth and

two inflation targeting rules are i) CPI inflation targeting and ii) the non-traded goods inflation targeting.

[5] Such a two-level financial intermediation is first proposed in Agénor and Aizenman (1998).

[6] Recently, by using sectoral data Barth and Ramey (2001) (for the US) and Gaiotti and Secchi (2006) (for Italy) document that the magnitude of working capital is significantly high.

[7] By introducing the cost channel to a New-Keynesian framework Walsh and Ravenna (2006) find a strong evidence for the existence of the cost channel for the US economy. Chowdhury et al (2006) also present results that are suggestive of the existence of the cost channel in Canada, France, Italy and UK. Kato (2006) presents evidence on the existence of this channel for the Japanese economy.

[8] Although, this channel is attracting increasing interest recently, early papers pointing to the link between credit, working capital and output goes back to Taylor (1983) and van Wijnbergen (1982).

Ramey (2006) state that this implication of the cost channel might resolve three important puzzles that are observed in the actual data. These are: i) large output effects of small and transitory movements in open market rates, ii) price puzzle, iii) the observation that in the short run, the effect of the monetary policy on the economy is more like the effects of a technology shock rather than another demand shocks. Ravenna and Walsh (2006) and Bruckner and Schabert (2006) introduce the cost channel to a standard new Keynesian model and they propose that this channel has significant implications on the optimal monetary policy.

This study will analyze the effects of these mechanisms on the transmission of monetary and external shocks, by making use of a static model originally developed by Agénor and Montiel (2006, 2007). In modelling the country risk premium, this study will assume a two level financial intermediation (as in Choi and Cook (2004)); that is, banks borrow from abroad and lend these resources to firms in the domestic economy. Banks are the only agents who have access to foreign resources and foreigners cannot hold domestic assets. That is, capital account of the balance of payments will only be affected due to the domestic banks' transactions with the rest of the world. Hence, the "country risk premium" term refers to the risk premium that domestic banks faces in international capital markets. The introduction of the cost channel follows the common strategy in the literature, which assumes that firms need working capital solely for paying the wage bill.

The next section describes the model. Section 3 gives the solution of the model by explaining the implications of the channels in detail. Section 4 analyzes the transmission of two shocks into the economy: an increase in refinance rate, an exogenous increase in the country risk premium.

2 The Model

The model economy is a small open economy producing a single (composite) good that is imperfectly substitutable for the foreign good. The world price of the foreign good is exogenous. There are six markets in the economy (for currency, bank deposits, credit, bonds, goods, and foreign exchange), and four categories of agents: households, commercial banks, the government, and the central bank. The nominal exchange rate is flexible.

2.1 Household Portfolio Allocation

Households consume both the domestically produced goods and imported goods. There are four types of financial assets available to households: domestic currency (which bears no interest), domestic currency-denominated deposits, foreign currency-denominated (FX) deposits held in domestic banks, and land, the supply of which is fixed and normalized to one. All assets are imperfectly substitutable with each other and foreigners do not hold domestic assets.

Households' total financial wealth, A^H, is defined as:

$$A^H = BILL + D + P^Q \cdot 1 + E \cdot D^*, \tag{1}$$

where $BILL$ is currency holdings, D (D^*) domestic currency-denominated (foreign currency-denominated) bank deposits, and P^Q the price of land. Households' total wealth is affected by changes in the land prices and the nominal exchange rate. Hence household wealth depends both on beginning of period stocks and the changes in the asset prices. These can be expressed as:

$$A^H = (BILL + D + P_0^Q + E_0 \cdot D^*) + (P^Q - P_0^Q) + (E - E_0)D^*,$$

that is, using (1),

$$A^H = A_0^H + (P^Q - P_0^Q) + (E - E_0)D_0^*, \tag{2}$$

where P_0^Q and E_0 are, respectively, the beginning-of-period values of the price of land and the nominal exchange rate, and D_0^* is the beginning-of-period stock of foreign exchange deposits. The term A_0^H represents the predetermined component of household financial wealth and $(P^Q - P_0^Q) + (E - E_0)D_0^*$ is the endogenous component.

Households' currency demand is a fixed fraction of the domestic currency bank deposits.[9] There is no direct return to holding cash:

$$\frac{BILL}{D} = \nu, \tag{3}$$

[9] In Agénor and Montiel (2006, 2007) this fraction is a function of the interest rate on domestic currency deposits. However, as in this study the results are not altered by this assumption, a simpler specification is preferred.

The real demand for domestic-currency deposits, depends positively on output, Y, and the interest rate on this type of deposits, as well as negatively on the rate of return on alternative assets, that is, the domestic-currency rate of return on foreign currency denominated deposits and the expected rate of increase in the price of land, $\hat{q}$:

$$\frac{D}{P} = d(i_D, i^{FX} + \varepsilon, \hat{q}, Y), \tag{4}$$

where P is the cost-of-living index, i^{FX} the interest rate on FX denominated deposits, and ε the expected rate of depreciation of the nominal exchange rate. The derivatives in this equation are such that d_1, $d_4 > 0$ and d_2, $d_3 < 0$.[10]

Land and FX deposits are taken to be imperfect substitutes. Accordingly, the household's desired allocation of its non-monetary financial wealth between the two assets depends on their expected rates of return:

$$\frac{E \cdot D^*}{P^Q + E \cdot D^*} = f(i^{FX} + \varepsilon, \hat{q}),$$

or,

$$E \cdot D^* = \frac{f(i^{FX} + \varepsilon, \hat{q})}{1 - f(i^{FX} + \varepsilon, \hat{q})} P^Q = h(i^{FX} + \varepsilon, \hat{q}) P^Q, \tag{5}$$

where $f_1 > 0$, $f_2 < 0$, and $h = f/(1-f)$, so $h_1 > 0$, $h_2 < 0$.

In turn, the effective demand for land can be derived residually from equation (1) as

$$P^Q = A^H - BILL - D - E \cdot D^*,$$

that is, using (3), (4), and (5),

$$P^Q = A_0^H + (P^Q - P_0^Q) + (E - E_0) D_0^* - (1+\nu) d(\cdot) P - h(\cdot) P^Q.$$

Rearranging terms yields

$$P^Q = \frac{A_0^H - P_0^Q - [1+\nu] d(i_D, i^{FX} + \varepsilon, \hat{q}, Y) P + (E - E_0) D_0^*}{h(i^{FX} + \varepsilon, \hat{q})},$$

or equivalently

$$P^Q = P^Q(i_D, i^{FX} + \varepsilon, \hat{q}, Y, E; A_0^H). \tag{6}$$

[10] Here and below, $g_i(\cdot)$ represents the partial derivative of function $g(\cdot)$ with respect to its ith argument.

As the supply of land is exogenous, this equation also represents the equilibrium condition in the market for land. It, therefore, determines the equilibrium value of the land price, P^Q. It has the following properties:

$$P_1^Q = -Pd_1(1+\nu) < 0,$$

$$P_2^Q = -\frac{P^Q h_1 + (1+\nu)Pd_2}{h} < 0,$$

$$P_3^Q = -\frac{P^Q h_2 + (1+\nu)Pd_3}{h} > 0,$$

$$P_4^Q = -\frac{(1+\nu)Pd_4}{h} < 0,$$

$$P_5^Q = D_0^*/h > 0,$$

$$P_6^Q = 1/h > 0.$$

An increase in the deposit rate shifts households into money (bills and domestic bank deposits), without altering relative weights of land and FX deposits in non-monetary assets. Hence, other things being equal, both the demand for land and FX deposits decline, which results in a decrease in land prices. An increase in the rate of return on FX deposits shifts household from money into non-monetary assets on one hand and it increases the weight of FX deposits in the non-monetary assets. While the first effect increases the demand for land, the second effect works in the opposite direction and decreases the demand for land. The net effect on the demand for land is thus ambiguous in principle. However, if land is a closer substitute for FX deposits than for money, the second effect must dominate. By following Agénor and Montiel (2007), who find this assumption plausible, it also assigns a negative sign to P_2^Q. An increase in the expected rate of increase in land prices unambiguously raises the demand for land. Thus, an expected future increase in the price of land raises its current price. A rise in domestic output increases households' disposable income and raises their money demand (for transactions purposes), reducing the demand for land as an asset and lowering its price. A nominal depreciation creates a capital gain on FX deposits, which increases household wealth and, therefore, also the demand for, and equilibrium price of land. As initially $E_0 D_0^*/P_0^Q = h$, then $P_5^Q E_0/P_0^Q = 1$, that is, the equilibrium land price and the nominal exchange rate change in the same proportion. Finally, an increase in initial level of household wealth raises the demand for land and increases the equilibrium price of land.

2.2 Commercial Banks

Banks assets consist of loans to firms, $L^F$and holdings of government bonds, B^B.[11] They can borrow reserves from the central bank or borrow from abroad in order to match their assets and liabilities. Their liabilities consist of FX deposits, D^*, and domestic currency-denominated deposits, D held by households, and borrowing from the central bank, L^B, and finally borrowing from abroad, FB.[12] Accordingly, net worth of the banks is defined as:

$$NW = L^F + B^B - D - D^* \cdot E - L^B - FB \cdot E. \tag{7}$$

Banks' balance sheet can therefore be written as:

$$L^F + B^B = D + D^* \cdot E + L^B + FB \cdot E + NW. \tag{8}$$

Deposit and lending rates are set by the banks. As this study assumes that the domestic-currency deposits and the central bank liquidity are perfect substitutes at the margin, the deposit rate on domestic-currency deposits, i_D, is set equal to the cost of funds provided by the central bank, i_R:

$$1 + i_D = 1 + i_R. \tag{9}$$

In principle households can invest abroad, however it is assumed that domestic banks try to avoid losing a dependable source of funds by giving the same return to FX deposits at home that households would have by holding deposits abroad. The net return to deposits abroad is equal to world risk free interest rate less the transaction costs. Thus, banks determine the interest rates on FX deposits by setting a constant (negative) mark-up over the world risk-free interest rates, which reflects the transaction costs involved in depositing abroad. Thus, although households have the possibility to deposit abroad they do not do so as they can have the same return at home.[13] In

[11] This ignores the required reserves to simplify the notation.

[12] All these variables are measured in nominal terms.

[13] Here, by isolating the interest rates on FX deposits from the country risk premium it is implicitly assumed that domestic households do not perceive any bankruptcy risk for the domestic banking system.

If banks have a preference as to the composition of two types of deposits then they would set the interest rates according to their preferences by taking the household preferences into account. Such a setting would complicate the analysis without adding much to the substance.

light of the above explanation the interest rates on FX deposits are specified as follows:

$$1 + i^{FX} = (1 - \mu)(1 + i^{WF}) \tag{10}$$

where $0 < \mu < 1$. As the transaction costs goes to zero, in the limit, the two interest rates will be equal ($i^{FX} = i^{WF}$). Accordingly, in the text i^{FX} is taken to be equal to i^{WF}.

As it is assumed that the domestic currency denominated deposits and the foreign currency denominated deposits are imperfect substitutes, the expected returns on these deposits need not to be equal.

Owing to the imperfections in the world capital markets banks face higher interest rates than world risk-free interest rate. Banks' default risk is the main source of the higher borrowing costs. Therefore, banks' foreign borrowing costs are determined by adding a risk premium over the world risk-free interest rate. Thus, risk premium is negatively related with the banks' net worth.[14] Banks' domestic currency denominated assets and liabilities are fixed in nominal terms. Hence, the only variable that can alter the banks' net worth in the period of interest is the change in the nominal exchange rate. The magnitude of this effect would depend on the initial level of the banks' foreign-currency (denominated) liabilities. Therefore the risk premium is specified as a function of the net worth, which in turn is a function of the nominal exchange rate. We also specify an exogenous shift term, x_E, which stands for the foreign investors' sentiment towards the domestic economy:

$$\theta_E = \theta_E(x_E, NW), \tag{11}$$

or using the fact that net worth is a function of nominal exchange rate one could write risk premium as $\theta_E = \theta_E(x_E, E)$.

Hence the cost of foreign borrowing takes the following form:

$$1 + i^* = (1 + i^{WF})(1 + \theta_E) \tag{12}$$

or equivalently:

$$i^* = i^*(i^{WF}, x_E, E). \tag{13}$$

[14] Instead of specifying the risk premium as function of level of net worth, it is possible to specify it as being function of the ratio of net worth to total foreign borrowings. However, it is easy to see that this would not change the results of the analyses.

Borrowings from the Central Bank and from abroad are imperfect substitutes. Imperfect substitutability between two types of resources arises from the different maturity structures of the funds. Foreign borrowings are assumed to have longer maturity than the Central Bank resources.[15] The composition of these two sources of funding are determined according to the relative costs:

$$\frac{FB \cdot E}{L^B} = h(i_R, i^*), \tag{14}$$

with $h_1 > 0$, $h_2 < 0$.

The instantaneous adjustment of the portfolio is not possible; instead banks can adjust their portfolios only gradually then the level of foreign borrowing would be expressed as:

$$FB = \lambda(\frac{L^B \cdot h(i_R, i^*)}{E} - FB_0) + FB_0 \tag{15}$$

Marginal cost of the funds is determined by the composition of the foreign borrowing and borrowing from Central Bank:

$$i_{RB} = i_{RB}(\overset{+}{i_R}, \overset{+}{i^*}). \tag{16}$$

The domestic lending rate is set by adding a premium over the marginal cost of funds to the commercial banks:

$$1 + i_L = (1 + \theta_L)(1 + i_{RB}). \tag{17}$$

The risk premium, θ_L on lending to firms is inversely related to the ratio of firms' assets over their liabilities. Firms' assets are beginning-of-period physical capital stock, times P_D, the price of the domestic good while liabilities are beginning-of-period loans, L_0^F:

$$\theta_L = \theta_L(\frac{P_D K_0}{L_0^F}), \tag{18}$$

where $\theta_{L_1} < 0$.[16]

[15] This assumption is quite realistic. In practice Central Bank sources are very short-term (mostly overnight) whereas the foreign borrowings (which sometime take the form of syndicated credit) have longer maturity.

[16] It could be assumed that only a proportion of the value of the total assets can effectively be used or pledged as collateral as in Agénor et al (2006).

Using equations (16), (17), and (18), and normalizing the initial capital stock K_0 to 1, the banks' loan rate can be written as:

$$i_L = [1 + \theta_L(\frac{P_D}{L_0^F})](1 + i_{RB}) - 1,$$

or equivalently

$$i_L = i_L(P_D, E; B^B, i_R, i^{WF}, x_E), \tag{19}$$

with $i_{L1} < 0, i_{L2} > 0, i_{L3} > 0$, $i_{L4} > 0, i_{L5} > 0$, and $i_{L6} > 0$. The domestic price level increases the value of the firms' collateralizable net worth, therefore decreases the lending rate. A nominal depreciation worsens the banks' balance sheets and increases the country risk premium and so the marginal cost of the funds for them. As the domestic lending rate includes also the risk premium for government bonds, stock of banks' bond holdings, which is positively related with this premium, increases the lending rate as well. It is also increasing in the marginal cost of funds to banks (which is determined by refinance rate, i_R world risk free interest rate, i^{WF}) and in the shift parameter x_E.

Government bond stock is only held by the Central Bank and the commercial banks. Hence, any change in the Central Bank's holdings is mirrored in the commercial banks' holdings of governments bonds. Specifically, banks' holdings of government bonds are equal the total stock of bonds outstanding, $\bar{B}$, less the Central Bank's holding of government bonds, B^C:

$$B^B = \bar{B} - B^C. \tag{20}$$

On the asset side B^B, is determined by Central Bank and the Government, L^F is determined by the firms' demand. On the liability side given the commercial banks' interest rate-setting behavior D and D^* is determined by the household. Balance sheet constraint (8) requires that borrowing from the central bank and from abroad be determined as:

$$L^B + FB \cdot E = L^F + B^B - D - E \cdot D^*.$$

Using (4) and (14) this equation becomes:

$$L^B = \frac{L^F + B^B - d(i_D, i^{FX} + \varepsilon, \hat{q}, \bar{Y})P - E \cdot D^*}{1 + h(i_R, i^*)}. \tag{21}$$

2.3 Central Bank

Central Bank has two policy instruments; open market operations, which alter the holding of government stock commercial banks and the refinance rate. Supply of Central Bank reserves to commercial banks at the fixed refinance rate, i_R is perfectly elastic. As the change in refinance rate is completely passed through to the deposit rate, the refinance rate directly affects household's consumption decisions. Besides, as the domestic lending rate is determined by adding a premium over the marginal cost of funds, which in turn is determined by the refinance rate and the cost of foreign borrowing; Central Bank's rate does also affect the cost of capital for firms.[17]

The Central Bank's balance sheet consists, on the asset side, of loans to commercial banks, L^B, foreign exchange reserves, R^* (measured in foreign-currency terms), and government bonds, B^C. On the liability side, it consists of monetary base, MB, plus capital, which is comprised solely of capital gains or losses on foreign exchange reserves arising from fluctuations in the market exchange rate relative to the reference rate, E_0:

$$E \cdot R^* + (B^C + L^B) = MB + (E - E_0)R^*. \tag{22}$$

Because banks hold no reserves, the monetary base is equal to the currency in circulation:

$$MB = BILL. \tag{23}$$

which determines the supply of cash.

2.4 Price Level and the Real Sector

Domestic output is produced by labour and capital:

$$Y = F(L, K_0) \tag{24}$$

Capital is fixed and normalized to one. Hence, we will drop the term K_0 in the production in the following equations.

Firms need financial resources (working capital) for their current production due to the delay between the factor payments and the proceeds form the

[17] As in this setting the supply of liquidity is perfectly elastic at rate i_R, base money is endogenous. Money supply has not any feedback effect on the macroeconomic equilibrium as it is the beginning-of-period stock of financial assets that creates the wealth effect.

sales. Thus, the cost of working capital would directly affect the marginal cost of production. In the specification it was assumed that the firms need working capital solely for paying the wage bill. Hence, the cost of working capital affects the marginal cost of labour, which in turn determines firms' labour demand.

Profit maximizing firms would equate the marginal cost of the labour to the marginal product revenue of the labour. Marginal cost of the labour, as explained above, consists of the real wage and the financing cost of the wage bill:[18]

$$F_L = \frac{W}{P_D}(1 + i_R) \tag{25}$$

It is assumed that the nominal wage is contracted in the beginning of the period and remains constant for one period:

$$W = \bar{W}. \tag{26}$$

Thus a change in the price level would directly translate into a change in the real wage. At the given real wage, equilibrium employment is determined by the labour demand, which implies that there is unemployment in the economy. Although several labour market specifications can yield the above-mentioned conditions, it is not necessary to specify under which specific conditions there is disequilibrium in the labour markets as this is irrelevant for our analyses.

Solving (25) for L and replacing it in the (24) and using (26), it is possible to write supply as a function of i_R and P_D as follows:

$$Y = Y(\frac{\bar{W}}{P_D}(1 + i_R)). \tag{27}$$

where $Y_{P_D} < 0$ and $Y_{i_R} < 0$.

The cost of living, P, derived from the Cobb-Douglas utility function, is a geometric weighted average of the price of the domestic good, P_D, and the

[18]It is assumed that the cost of working capital is different from the interest rate on domestic loans extended for investment. As the funds for the working capital by their nature very short-term, it is assumed that banks use Central Bank resources for these loans. This simplifies the derivations considerably while not taxing the substance of the analysis.

price of the imported good, EP_M^* (where P_M^* is the foreign-currency price of the imported good, assumed exogenous)[19]:

$$P = P_D^{1-\delta}(E \cdot P_M^*)^{\delta}. \tag{28}$$

Parameter $\delta \in (0,1)$ is the share of spending by domestic households on imported goods. Setting $P_M^* = 1$, this equation becomes

$$P = P_D z^{\delta}, \tag{29}$$

where $z = E/P_D$ is the real exchange rate.

Consumption function is not explicitly derived from an intertemporal optimizing framework. However, it allows real consumption expenditure by households, C, measured in units of the domestic good, to depend on real financial wealth, and intertemporal relative prices, as well as current income. The intertemporal relative prices are captured by allowing consumption to depend negatively on real rates of return on the assets held by households (domestic- and foreign-currency denominated deposits, and land). As in Agénor and Montiel (2006, 2007), the partial effects of each of these rates of return on consumption are assumed to be identical. Thus, consumption spending takes the following form:

$$C = C_0 + \alpha_1 Y - \alpha_2[(i_D - \pi^a) + (i^{FX} + \varepsilon - \pi^a) + (\hat{q} - \pi^a)] + \alpha_3(A^H/P_D), \tag{30}$$

where π^a is the expected inflation rate, $\alpha_1 \in (0,1)$ is the marginal propensity to consume out of disposable income, $\alpha_2 > 0$ denotes the sensitivity of consumption to the rate of returns on the assets and $\alpha_3 > 0$ is the coefficient denoting the sensitivity of consumption to wealth.[20]

Domestic investment is financed only by the loans extended by domestic banks. Hence, the cost of physical capital is equal to the real interest rate on loans set by the banks. Therefore, the desired level of capital stock, K^d, is inversely related to the real lending rate, $i_L - \pi^a$. Real investment spending by domestic firms, I is a linear function of the difference between the desired stock and the actual stock, K_0:

$$I = K^d(i_L - \pi^a) - K_0 = I(i_L - \pi^a), \tag{31}$$

[19] Due to the Cobb-Douglas specification, expenditure shares are constant.

[20] In principle, it is only wage payments that should appear in (32), because they are paid in advance; profits are distributed only at the end of the period. However, the results are not altered by this simplification.

where $I_1 < 0$. Thus, with the beginning-of-period stock of loans given by L_0^F, new loan demand from commercial banks is expressed as follows:

$$L^F = L_0^F + P_D I + WL, \tag{32}$$

where, the last term is the demand for credit arising from working capital needs.

As noted earlier, the supply of credit is perfectly elastic at the given rate and firms do not face credit constraints, which imply that the actual stock of credit is demand-determined.

Demand for exports, $X(z)$ is only a function of real exchange rate with $X' > 0$.

The supply of domestic goods to the domestic market is $Y - X(z)$. The equilibrium condition of the market for domestic goods is given by:

$$Y - X(z) = (1 - \delta)C + I. \tag{33}$$

2.5 Balance of Payments

In principle, in flexible exchange rate regimes Central Banks do not intervene in the foreign exchange rate, accordingly it is possible to disregard the possibility of intervention to foreign exchange markets in this model. Hence, official foreign reserves will be taken to be constant at $R_0^* = 0$. The only domestic agent that can borrow from abroad is the banking sector. Hence, capital flows depend only on banks' borrowings. The model is completed by specifying the economy's balance-of-payments equilibrium condition, which takes the following form:

$$E^{-1}P_D[X(z) - \delta C] - i^* FB_0 + (FB - FB_0) = 0,$$

where FB_0 is the beginning-of-period stock of banks' foreign liabilities. Given that $E/P_D = z$, this condition becomes:

$$z^{-1}[X(z) - \delta C] - i^* FB_0 + \Delta FB = 0. \tag{34}$$

3 Model Solution

We derived the equilibrium in the asset market and accordingly wrote the equilibrium value of the key variable, namely, the land prices in terms of the

other variables. There are two more equilibrium conditions corresponding to the equilibrium in domestic goods market and balance of payments which have to be solved simultaneously. In this two by two system there are three key equations: the banks' lending rate, i_L, the price of domestic goods, P_D, and the nominal exchange rate, E.[21] By using equation (19), it is possible to eliminate the lending rate, i_L, and replace nominal exchange rate, E with zP_D. Hence, two equations, (33) and (34), and two unknowns, P_D and z, are left.

Following the ordering in the text we first consider the internal balance condition expressed by equation (33). This equation represent the equilibrium condition simultaneously in both the domestically produced goods market and the financial sector as (19) indicates the equilibrium condition in the financial sector. Substituting the consumption function (30) and the investment function (31) in equation (33), and setting $C_0 = 0$, the goods market equilibrium condition can be written as the requirement that the excess demand for domestic goods be equal to zero:

$$(1-\delta)\left\{\alpha_1 Y - \alpha_2[(i_D - \pi^a) + (i^{FX} + \varepsilon - \pi^a) + (\hat{q} - \pi^a)] + \alpha_3(A^H/P_D)\right\} + I(i_L - \pi^a; K_0) + X(z) - Y = 0.$$

Using equations (2), (6), (9) and (17), this condition can be written in the following form:

$$(1-\delta)\left\{\alpha_1 Y(\frac{\bar{W}}{P_D}(1+i_R)) - \alpha_2[i_D - \pi^a + (i^{FX} + \varepsilon - \pi^a) + \hat{q} - \pi^a] + \right.$$

$$\left.\frac{\alpha_3}{P_D}[A_0^H + P^Q(i_R, i^{FX} + \varepsilon, \hat{q}, Y(\frac{\bar{W}}{P_D}(1+i_R)), zP_D) - P_0^Q + (zP_D - E_0)D_0^*]\right\}$$

$$+I\left\{[1+\theta_L(\frac{P_D}{L_0^F})][1+i_{RB}(i_R, i^*(i^{WF}, x_E, zP_D))]\right.$$

$$\left.-1-\pi^a\right\} + X(z) - Y(\frac{\bar{W}}{P_D}(1+i_R)) = 0$$

[21] As noted earlier, the expected rate of change in land prices, the expected rate of inflation, and the expected rate of depreciation are all taken to be exogenous.

In the above equation internal balance of the economy is expressed in terms of two endogenous variables: z and P_D. The effect of a change in z on the excess demand is given by:

$$(1-\delta)\frac{\alpha_3}{P_D}(P_5^Q + D_0^*) + X' + I'(1+\theta_L)i'_{RB}i^*_{\theta_E}\theta'_E(D_0^* + FB_0)P_D$$

A real depreciation (increase in z) affects the excess demand through three channels. The first channel, which is represented by the first term of the above expression is the wealth implications of the real depreciation; an increase in z causes the domestic value of foreign currency denominated deposits to increase and this in turn also increases the demand for and the price of land. The sensitivity of the consumption to wealth (α_3) together with the share parameter (δ) would determine the portion of the increasing consumption demand that falls over the domestically produced goods. The second term, representing the effects of the second channel, is the change in the exports as a result of increased competitiveness brought about by real depreciation.[22] The last term, which corresponds to the third channel, indicates the decrease in the investment expenditures due to an increase in the domestic lending rates related to the increase in the country risk premium. The change in the country risk premium stems from the deterioration of the net worth of the banking system, which in turn is a result of an increase in the value of foreign currency denominated liabilities. While the first two channels increases the excess demand, the third channel works in the opposite direction. These effects are summarized in Table 1.[23]

Holding the real exchange rate constant, the effect of an increase in the domestic price level (P_D) on the excess demand reads:

$$(1-\delta)\left\{-\alpha_1\frac{W}{P_D^2}(1+i_R)Y_1 + \frac{\alpha_3}{P_D}\left[P_4^Q\frac{W}{P_D^2}(1+i_R)Y_1 + P_5^Q z + zD_0^* -\right.\right.$$

[22] The aforementioned effects of the real depreciation on consumption and exports also appear in Agénor and Montiel (2007).

[23] The abbreviation Con. in the tables stands for conventional. "Conventional sign" means the sign of the derivative of excess demand and excess currency inflow with respect to z or P_D that would occur in the absence of country risk premium channel and FX deposits.

	Affects	**Through**	**Sign**
$\frac{\partial(Excess\ Demand)}{\partial z}$	Consumption	Wealth Effect	+
	Investment	CRP*	-
Con. sign (+)	Exports	Comp*	+

(*) CRP: Country Risk Premium, Comp: Competitiveness

Table 1: Effects Of Real Depreciation On Excess Demand

$$\left.\frac{\left(A_0^H + P^Q - P_0^Q + (E - E_0)D_0^*\right)}{P_D}\right]\Bigg\} + I'\left[(1+\theta_L)i'_{RB}i^*_{\theta_E}\theta'_E(D_0^* + FB_0)z + \theta'_L(1+i_{RB})\right] + \frac{W}{P_D^2}(1+i_R)Y_1 \tag{35}$$

The expression in the curly bracket shows the effect of a change in the domestic price level on consumption and the coefficient multiplying the whole term indicates the portion of the consumption demand falling over the domestically produced good. Consumption is affected by the price level through two channels; income and wealth. The first term in the curly bracket stands for the effects of the higher income on the consumption demand. Increase in income stems from the decreasing real wages, which increases the labour demand. Household wealth is affected by prices in various ways and in various directions. The first term in the squared brackets shows the effect on land prices of an increase in income due to the change in price level. Households try to increase their money holdings as their income increases and this decreases the demand for and the price of land. The second and third terms in the squared brackets show the effect of the nominal depreciation (as an increase in P_D holding z constant means a proportional depreciation in nominal exchange rate) on the household wealth. Its effects are an increase in the value of FX denominated deposits measured in domestic currency and an increase in the land prices as the higher wealth due to the higher value of FX deposits increase the demand for land. The last term in the squared bracket shows the decrease in the real value of the household wealth as a result of higher prices. The net effect of a price increase on the household wealth is negative.[24]

[24] Nominal depreciation increases the value of the wealth through FX deposits but as the

Domestic price level affects the investment by changing both the domestic risk premium and the country risk premium. Holding z constant, an increase in the domestic price level would mean a nominal depreciation which means deterioration in the net worth of the banks and so an increase in the external risk premium for banks. Banks reflect higher costs to the firms as higher lending rates. At the same time, however, an increase in the domestic price level means improvement in the net worth of the firms as the nominal value of the capital stock rises while the firms' liabilities remains unchanged. This effect would decrease the risk premium on domestic lending.

Finally, the last term of the derivative shows the increase in the domestic supply. As the nominal wage is rigid an increase in prices translates into lower real wages. Lower real wages stimulate the labour demand and so the equilibrium level of output. By raising the output, this effect decreases the excess demand in the domestic goods market.

The upshot is that, the income effect created by an increase in domestic price level decreases the excess demand as income increases more than the consumption in terms of levels. Apart from the income effect, wealth effects, by decreasing the consumption, further widens the gap between supply of, and demand for, domestic goods. On the other hand, conflicting effects are created on the domestic lending rate through firms' and banks' balance sheets, which makes the effect of the prices on the investment demand ambiguous. In the light of the above descriptions it is reasonable to assume that an increase in P_D in net, decreases the excess demand as in the conventional case. The information given above is summarized in Table 2.

According to the implicit function theorem, the slope of the Internal Balance locus, which is drawn in (P_D, z) axis, is:

$$\left.\frac{dP_D}{dz}\right|_{IB} = -\frac{\frac{\partial(Excess\ Demand)}{\partial z}}{\frac{\partial(Excess\ Demand)}{\partial P_D}}.$$

By using our derivations the slope can be written in the following form:

$$\left.\frac{dP_D}{dz}\right|_{IB} = -\frac{C_W\frac{dW}{dz} + I_{\theta_E}\frac{d\theta_E}{dz} + X'}{C_W\frac{dW}{dP_D} + C_Y\frac{dY}{dP_D} + I_{\theta_E}\frac{d\theta_E}{dP_D} + I_{\theta_L}\frac{d\theta_L}{dP_D} - Y_{P_D}}.$$

percentage increase in prices and nominal exchange rate is equal, in net, increase in the real value of domestic FX deposits is zero. However, as the value of the other components of the household wealth, which are nominally fixed, decreases in real terms, the net effect of an increase in P_D on real wealth is negative.

	Affects	Through	Sign
$\frac{\partial(Excess\ Demand)}{\partial P_D}$	Consumption	Income effect	+
	Consumption	Wealth Effect	-
	Investment	CRP$^{(*)}$	-
Con. Sign (-)	Investment	DRP$^{(*)}$	+
	Output	Real Wages	-

(*) C(D)RP : Country (Domestic) Risk Premium.

Table 2: Effect of A Rise In Domestic Price Level On Excess Demand

If one ignores all the credit market imperfections (and the FX deposits) the slope of the Internal Balance Locus would be:

$$\left.\frac{dP_D}{dz}\right|_{IB} = -\frac{X'}{C_W \frac{dW}{dP_D} + C_Y \frac{dY}{dP_D} - Y_{P_D}}.$$

The implication of the presence of FX deposits on household wealth is to increase the numerator while decreasing the denominator in absolute terms hence it certainly increases the slope of IB locus. However, the effect of the FX deposits, through the country risk premium channel, works in the opposite direction. By weakening the conventional effect of real exchange rate and strengthening the conventional effect of prices, country risk premium makes IB curve flatter. Domestic risk premium weakens the effect of a price rise on the excess demand so it makes the locus steeper. In general if the country risk premium effect is equal or stronger than the domestic risk premium the internal balance locus would be flatter than what it would be without these effects. Depending on the strength of the country risk premium channel, there can even be a negatively sloped IB locus. In light of the above information:

- the higher the share of FX deposits and foreign borrowings in banks' total liabilities,
- the higher the sensitivity of country risk premium to the net worth of banks,
- the lower the effect of prices on domestic risk premium, the flatter would be the slope of IB locus.

It is possible to follow the same steps for the external balance condition. Substituting the consumption function (30) and equation for foreign borrowing (15) into the balance-of-payments equilibrium condition (34), the external balance condition can be written as:

$$z^{-1}[X(z) - \delta\{\alpha_1 Y - \alpha_2[(i_D - \pi^a) + (i^* + \varepsilon - \pi^a) + (\hat{q} - \pi^a)]$$

$$+\alpha_3(A^H/P_D)\}] - i^* FB_0 + \lambda[h(i^* + \varepsilon, \hat{q})L^B/E - FB_0] = 0.$$

Substituting the supply function (27), land prices (6), household wealth (2) and the cost of foreign borrowing (13), this condition, in the most explicit form, can be written as:

$$z^{-1}\Bigg\{X(z) - \delta[\alpha_1 Y(\frac{\bar{W}}{P_D}(1+i_R)) - \alpha_2(i_R - \pi^a + i^{FX} + \varepsilon - \pi^a + \hat{q} - \pi^a)$$

$$+\frac{\alpha_3}{P_D}[A_0^H + P^Q(i_R, i^{FX} + \varepsilon, \hat{q}, Y(\frac{\bar{W}}{P_D}(1+i_R)), zP_D) - P_0^Q + (zP_D - E_0)D_0^*]\Bigg\}$$

$$-i^*(i^{WF}, x_E, zP_D)FB_0^* +$$

$$\lambda[\frac{h(i^*(i^{WF}, x_E, zP_D) + \varepsilon, i_R)}{zP_D}L^B(i^*, i_R) - FB_0] = 0 \qquad (36)$$

Firstly, consider the effect of an increase in real exchange rate on the country's external accounts. Derivative of the excess currency flow with respect to real exchange rate (z) reads:

$$\frac{-1}{z^2}(X(z) - \delta C) + z^{-1}\{X' - \delta\{\alpha_3[P_5^Q + D_0^*]\}\} - i^*_{\theta_E}\theta'_E(D_0^* + FB_0)P_D FB_0$$

$$+\lambda[\frac{h_1 i^*_{\theta_E}\theta'_E(D_0^* + FB_0)P_D z - h}{(zP_D)}L^B + \frac{h}{z}L^B_{i^*}i^*_{\theta_E}\theta'_E(D_0^* + FB_0)]$$

The first term is the change in the value of the initial trade surplus (expressed in foreign currency units) as a result of a change in the real exchange rate (RER). The sign and the importance of the magnitude of this effect

would depend on the initial level of the trade surplus. With a large initial trade surplus (deficit) this term would be negative (positive) and significant. The second term shows the difference between the increase in exports and the imports due to a change in the real exchange rate. Increase in imports stem solely from the wealth effects, which is created through FX deposits.[25] The third term shows the increase in net factor services, which is the result of higher cost of foreign borrowing. Increase in the cost of foreign borrowing stems from the increase in the risk premium, which is brought about by the deterioration of the net worth of the banks. The last term reflects the portfolio adjustment of the banks as a response to higher foreign borrowing costs. The last two effects, which are arising from the country risk premium channel and the increasing imports (due to the wealth effect created by FX deposits), mean currency outflow while the first two effects correspond to inflow of currency.[26] The perverse effects arising from the presence of FX deposits and the country risk premium channel raises the possibility of having a negative sign for the effect of real depreciation on the excess currency inflow. The likelihood of having such an outcome would depend on the parameters and the initial values of the relevant variables. For low levels of initial foreign debt and/or mild changes in real exchange rate one would expect the increase in z to improve the external account.[27] The channels through which real exchange rate affects the external balances are summarized in Table 3.

The effect of a change in the price of domestic good (P_D) on the external balances can be expressed as follows:

$$-z^{-1}\delta\left\{-\alpha_1\frac{W}{P_D^2}(1+i_R)Y_1+\frac{\alpha_3}{P_D}[P_4^Q\frac{W}{P_D^2}(1+i_R)Y_1+P_5^Q z+zD_0^*]-\frac{\alpha_3}{P_D^2}A_0^H\right\}$$

$$-i^*_{\theta_E}\theta'_E(D_0^*+FB_0)zFB_0+\lambda[\frac{h_1 i^*_{\theta_E}\theta'_E(D_0^*+FB_0)zP_D-h}{P_D^2}L^B+\frac{h}{P_D}L^B_{i^*}i^*_{\theta_E}\theta'_E(D_0^*+FB_0)]$$

[25] The effects of z on external balances up to that point also appear in Agénor and Montiel (2007).

[26] Although, emerging market economies display very different patterns in terms of their trade balances; here, it is assumed that the initial trade balance is either insignificant and/or negative.

[27] One interesting case would be to specify the country risk premium as an increasing function of z. In this case the sign of the derivative would depend on the level of real exchange rates.

	Affects	Through	Sign
$\frac{\partial(Excess\ Cur.\ Inflow)}{\partial z}$	Trade Balance	$TB_0^{(*)}$	?
	Exports	$Comp^{(*)}$	+
	Import	Wealth Effect	-
Con. sign (+)	Net Factor Ser.	$CRP^{(*)}$	-
	Foreign Bor.	CRP	-

(*) TB_0:Initial Trade Balance, Comp: Competitiveness, CRP: Country Risk Premium

Table 3: Effects Of Real Depreciation On Excess Currency Inflow

Higher domestic price levels correspond to higher levels of income and so higher import demand (first term in the curly brackets), higher income increases the demand for money and accordingly decreases the demand for and price of non-monetary assets (first term in the squared brackets). As explained before, an increase in the price level, leaving z unchanged means a nominal depreciation. The second and third terms in the squared bracket stand for the wealth effects, which are due to the increase in the nominal exchange rate. On the other side, higher prices would mean a lower level of real wealth, which puts downward pressure on the consumption (last term in the curly brackets). Nominal depreciation also implies deterioration in the net worth of the banks. Lowering net worth raises the risk premium charged by foreign lenders to the domestic banks. The increasing cost of foreign borrowing raises the net factor services paid abroad and at the same time makes the Central Bank resources more attractive, which stimulates banks to resort more to Central Bank reserves. Both of those imply currency outflow. For the trade balance, we would assume that the income effect is stronger than the wealth effect which means that an increase in domestic price level deteriorates the trade balance.[28] Hence, the presence of the country risk premium strengthens the conventional effect of prices. Table 4 summarizes the effect of prices on the external accounts of the economy.

The slope of the external balance locus is the negative of the ratio of the partial derivatives of external balance with respect to real exchange rate (z) and the price of the domestic good (P_D):

[28] One would accept that this assumption is quite realistic.

	Affects	**Through**	**Sign**
$\frac{\partial(Excess\ Cur.\ Inflow)}{\partial P_D}$	Import	Income Effect	-
	Import	Wealth Effect	+
	Net Factor Ser.	CRP	-
Con Sign (-)	Foreign Bor.	CRP	-

Table 4: Effects Of An Increase in Domestic Good Price On External Accounts

$$\left.\frac{dP_D}{dz}\right|_{EB} = -\frac{\frac{\partial(Excess\ Demand)}{\partial z}}{\frac{\partial(Excess\ Demand)}{\partial P_D}}.$$

Accordingly, the actual expression reads:

$$\left.\frac{dP_D}{dz}\right|_{EB} = -\frac{\frac{d(TB_0)}{dz} + X' - M_{A_H}\frac{dA_H}{dz} - FB_0 i^*_{\theta_E}\frac{d\theta_E}{dz} + \frac{LB}{zP_D}h_{i^*}i^*_{\theta_E}\frac{d\theta_E}{dz}}{-M_Y\frac{dY}{dP_D} - M_{A_H}\frac{dA_H}{dP_D} - FB_0 i^*_{\theta_E}\frac{d\theta_E}{dP_D} + \frac{LB}{zP_D}h_{i^*}i^*_{\theta_E}\frac{d\theta_E}{dP_D}},$$

where TB_0 is the initial trade balance and M is imports.

If one considers only the traditional channels the slope of EB locus would be:

$$\left.\frac{dP_D}{dz}\right|_{EB} = -\frac{\frac{d(TB_0)}{dz} + X'}{-M_Y\frac{dY}{dP_D} - M_{A_H}\frac{dA_H}{dP_D}} \tag{37}$$

Here, by weakening the effect of real exchange rate on the external accounts and strengthening the effect of prices on the external accounts, the country risk premium flattens EB locus. Contrary to its effect on IB locus, here the wealth effect created via FX deposits weakens the conventional effect of real exchange rates by stimulating consumption and so the import demand. The presence of FX deposits also makes banks' net worth more sensitive to exchange rates. Hence, this further weakens the conventional effects of RER on the external accounts. On the other hand, wealth effects created by the presence of FX deposits support the conventional effect of prices on

the external accounts. Hence, the existence of FX deposits decreases the slope of EB locus. The effects of the relevant parameters and initial values on the slope of EB locus are summarized as follows:

- the higher the share of FX deposits in household's assets,
- the higher the share of FX deposits and foreign borrowings in banks' total liabilities,
- the higher the sensitivity of country risk premium to the net worth of the banks,
- the higher the sensitivity of foreign borrowing to the relative cost of domestic and foreign sources,
- the higher the sensitivity of consumption to the wealth the lower would be the slope of EB.

In a conventional model, which does not account for credit market imperfections and FX deposits, the slope of both of the curves would have the same sign. This would leave the question of which one of the two curves is steeper. The slopes of the two loci, so to speak, give the relative power of z and P_D in affecting the internal balance and the external balance. One would expect the relative power of z to be greater than the P_D on external balance compared with the internal balance, which implies that EB locus should be steeper than IB locus. However, the channels introduced have the potential to alter the ordering of the slopes and even the sign of the slopes. Depending on the strength of the balance sheet effects, in principle, there can be six different outcomes related to the relative slopes and the signs of the two loci.

1) Both EB and IB are flatter with positive slopes, and EB is steeper than IB.

2) Both EB and IB are flatter with positive slopes, but EB is flatter than IB.

3) EB is flatter, but it has a positive slope. IB has a negative slope.

4) IB is flatter but has a positive slope. EB has a negative slope.

5) Both EB and IB have negative slopes, and EB is steeper than IB.

6) Both EB and IB have negative slopes, and EB is flatter than IB.

Only the first three cases, which are most likely to occur, will be considered

CASE 1: In the first case credit market and international capital market imperfections and the presence of FX deposits weaken the quantitative effects of the exchange rate on both external and the internal accounts, while strengthening the effect of the price level on again both accounts. However, neither the ordering nor the sign of the slopes change by this effect.

CASE 2: Both curves are flatter, but the signs of the slopes are preserved. However, the ordering of the slopes is now different.

CASE 3: The third case describes the situation in which the effects of real depreciation on the internal accounts that are working through the country risk premium channel dominate the conventional effects of the real depreciation. As a result real depreciation creates excess supply rather than excess demand.

In the first two cases the slopes of the two curves have the same sign, which requires checking the stability of the system. In the third case stability analysis is not needed as the slopes of the two curves have opposite signs.

4 Policy and Exogenous Shocks

This section considers two types of shocks to the model economy. The first of these shocks is an increase in the Central Bank refinance rate, the second one is an exogenous increase in the country risk premium. We will try to explain how the transmission of these shocks is altered with the presence of the cost channel, FX deposits and risk premium channels.

The effects of the shocks are illustrated graphically in (z, P_D) space. Figure 1 shows the equilibrium in the baseline case (or in case 1, where the sign and the ordering of the slopes are preserved).

4.1 An Increase in the Central Bank Refinance Rate

Before elaborating the effects of the channels of interest, in order to show how the model works, it is necessary to explain the monetary transmission mechanism in the most simple framework, that is, without the cost channel and the risk premium channels.

An increase in the Central Bank refinance rate is directly passed through to the domestic currency denominated deposit rate. An increase in the deposit rate decreases consumption by raising the intertemporal price of consumption and by decreasing the household wealth. Decrease in the household

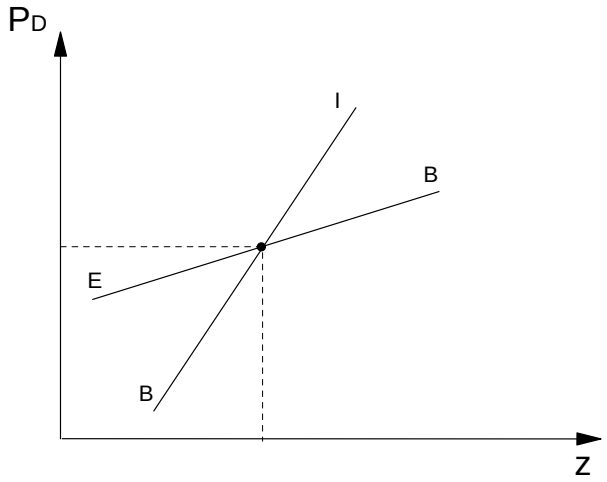

Figure 1: Equilibrium In Internal And External Accounts

wealth stems from the declining demand for land as a result of higher returns on financial assets. All these decrease the demand for domestic goods and create excess demand. In order to restore the internal balance, demand for (supply of) domestic goods should go up (down). This would require the price level to go down for a given level of RER, which implies a downward shift in IB locus. Or it can be thought of in terms of the RER; if there is a positively sloped IB locus, in order to balance the decreasing excess demand, RER should depreciate.[29]

Higher interest rates affect the external balance by influencing consumption and altering the optimal composition of the funding resources for banks. Lower consumption translates into lower import demand, which means an improvement in the trade balance. Capital inflows increase as banks would try to increase their foreign currency liabilities, which become relatively cheaper after the increase in the domestic refinance rate. Both the improvement in trade surplus and the rise in capital inflows would mean an excess inflow of currency into the domestic economy. Restoring balance in the external accounts would require an appreciation for a given level of domestic prices,

[29]In case of a negatively slopped IB, which implies that the conventional effects of real depreciation on the external balances are dominated by the non-standard channels, there needs to be a real appreciation to restore the equilibrium under the same conditions.

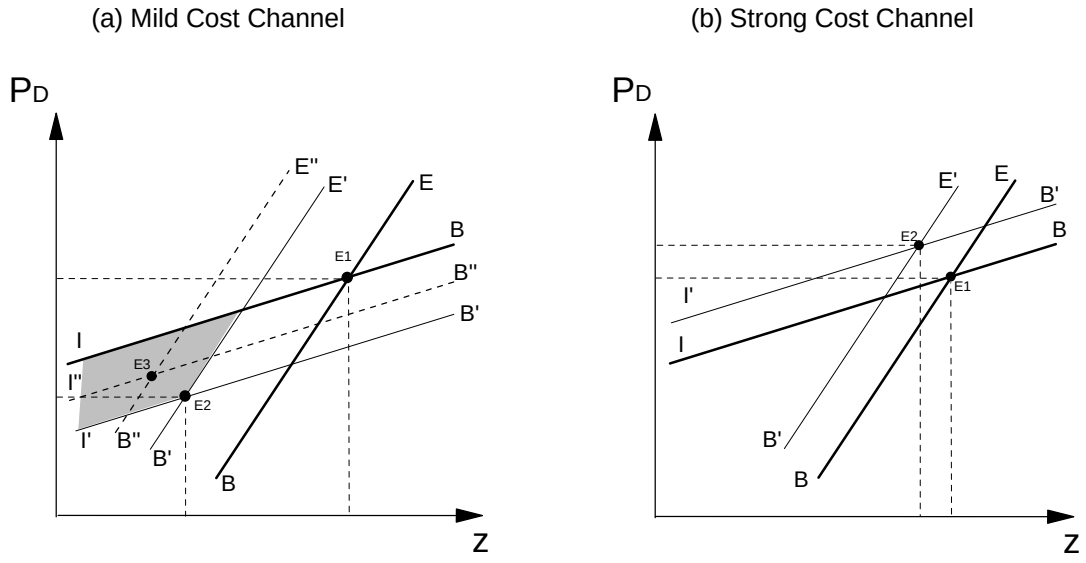

Figure 2: The Effects Of Cost Channel

which means a leftward shift in EB locus.

Below, by making use of the figures, we try to explain in detail the implications of cost channel, FX deposits and domestic and country risk premiums on the monetary transmission mechanism.

Figure 2 is designed to show how the effects of an increase in the refinance rate would be changed when one integrates the cost channel into the most basic framework, where there are only the traditional channels.[30] Besides the demand side, interest rate also affects the supply side through the cost channel. This is because the interest rate impinges on the wage bill; hence any increase in the interest rate would mean an increase in the effective marginal cost of labour. By decreasing the equilibrium output, the effect of cost channel on the equilibrium prices (or on the excess demand) works in the opposite direction compared with the conventional interest rate channel, which only operates through the demand side. Panel (a) of Figure 2 assumes that the cost channel is not as strong as to reverse the conventional effects of interest rate on the excess demand.[31] E1 shows the initial equilibrium before

[30]However, all the results would remain valid for Case 1 as well, where the IB and the EB loci have still positive slope and the EB is steeper than the IB locus.

[31]In the sense that the demand for the domestic good decreases more than the supply

the increase in refinance rate. E2 shows the equilibrium that would occur without the cost channel. The shaded area shows all the possible outcomes when the cost channel is introduced and E3 shows just one of the possible equilibrium points with the cost channel. As a hike in interest rate also suppresses the supply through the cost channel, the imbalance created in the domestic goods market would be less severe, implying that the required decrease in the price of domestic goods, to restore the equilibrium, would be less. As a result, the downward shift in IB would be less. On the other side, as the tight monetary policy is now more contractionary; consumption and so the import demand would contract more, which require higher appreciation in order to maintain external equilibrium. Hence, EB should shift further to the left. Depending on the slopes and the relative shifts, equilibrium compared with the no-cost channel case may result in i) less appreciation with higher prices, ii) more appreciation with higher prices, and iii) more appreciation with lower prices. The last case is at odds with the literature as the cost channel is shown to restrict the size of the decrease in the equilibrium prices in the case of a contractionary monetary policy.[32]

Above, the analyses were based on the assumption that the cost channel does not change the direction of the conventional effect of the interest rate on excess demand but only weakens it. If, instead one considers the opposite case, where supply is highly sensitive to the interest rate, so much so that an increase in interest rate would raise excess demand, then the presence of the cost channel alters qualitative results as well. This would imply an upward shift in IB locus (Panel (b) of Figure 2). As lower income would imply an improvement in the trade balance, EB locus should again shift further to the left. In this case results can change in qualitative terms. This can result in higher prices instead of lower prices. Figure 2 (panel (b))shows just one of the possible equilibrium points (E2) which reflects this situation.

Movements in the exchange rate will have wealth effects on the side of the

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of it.

[32]The intuition behind the third case is as follows; due to the cost channel, output contracts more, this creates a trade surplus (excess currency inflow) and requires additional appreciation in z to mop up the trade surplus. This in turn creates excess supply in domestic goods market and a decrease in prices in equilibrium. Apparently, the increase in price level due to the leftward shift in EB cannot fully offset the effect of upward shift in IB on price level. However, if one accounts for external risk premium channel, appreciation would mean higher capital inflow (as it decreases the risk premium), so the decrease in the trade surplus should be higher, which creates a higher excess supply in the domestic goods market and a sharper decrease in prices.

households if they hold FX deposits. Ignoring the implications on banks' balance sheets, the presence of FX deposits makes IB curve steeper by strengthening the effects of a change in real exchange rate and decreasing the effect of price changes on the excess demand. In other words, with FX deposits in place an appreciation would imply a greater decrease in the domestic price level to restore the internal imbalance. EB locus on the other side will be less steeper as the wealth implications of the exchange rate movements strengthens the effect of P_D (for a given level of z) while weakening the effect of z on the external balances. It is easy to show that in such a case the equilibrium levels of the domestic price and real exchange rate that would occur as a result of an increase in the refinance rate would be lower (more appreciated RER). That is, the presence of FX deposits strengthens the recessionary effect of the contractionary monetary policy.[33]

In Agénor and Montiel (2006, 2007) the implication of having a domestic risk premium channel is shown to strengthen the contractionary effects of an increase in interest rates. Not surprisingly, the presence of credit market imperfections in domestic credit market gives the same results in our framework as well. As the presence of domestic risk premium implies a negative relation between the lending rates and the prices, the decrease in prices, arising from a hike in the refinance rate, further increases the lending rates and result in lower prices, lower output and more appreciated domestic currency than otherwise would be.[34]

Figure 3 shows how the existence of the country risk channel alters the effects of an increase in Central Bank refinance rate on the economy. Firstly, consider the case where conventional effects are still dominant (Case 1). E1 shows the initial equilibrium whereas E2 shows the equilibrium after the monetary shock without the country risk premium. In the new equilibrium domestic prices are lower and the domestic currency is appreciated in real terms. The grey area shows the set of all possible outcomes with the country

[33] However, if the country risk premium is included in the basic framework, the effects of FX deposits on the equilibrium price and RER are not clear. Appreciation brought about by higher interest rates improves the banks' net worth and lowers the cost of funds and so the lending rate, which weakens the recessionary effect of contractionary monetary policy.

[34] This mechanism is known as "financial accelerator". Agénor and Montiel (2008), shows that when there is a strong cost channel, (supply side effects of interest rates dominates the demand side effects) increase in interest rates result in a rise in prices, which decreases the risk premium. In such a case what we have is "financial decelerator" effect as the authors name it.

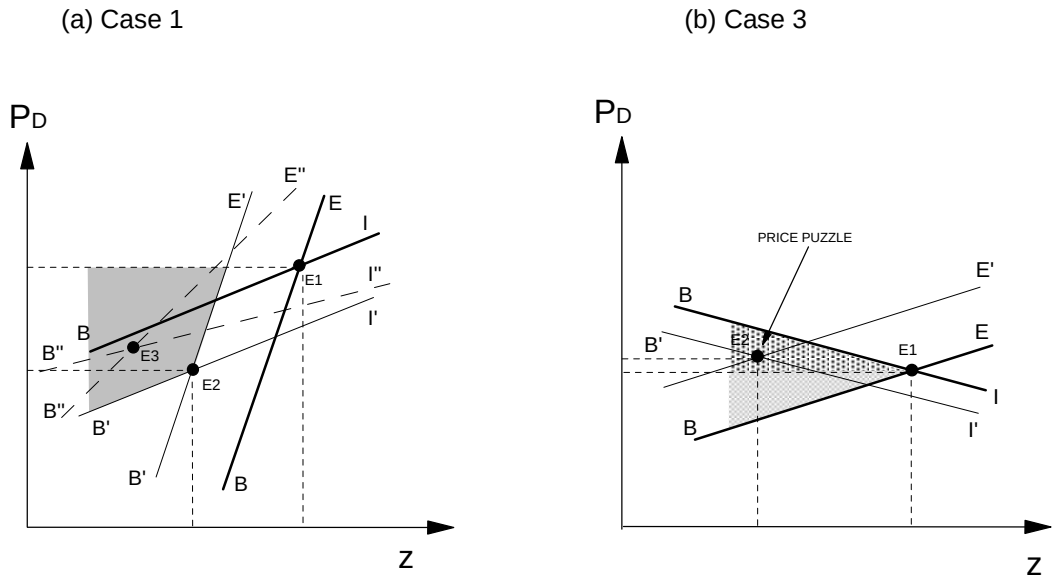

Figure 3: The Effects of Country Risk Premium

risk premium. E3 shows just one of the possible outcomes. As mentioned above the country risk premium makes both curves flatter. Besides, as the country risk premium weakens the conventional effect of the real exchange rate on both the external balance and internal balance, the magnitude of horizontal shift required in EB locus as a response to a shock in the refinance rate would be higher. Beginning from the same initial state with the country risk premium, an increase in interest rate may result in i) less appreciation with higher prices, ii) more appreciation with higher prices, and iii) more appreciation with lower prices than what it would be without this channel. The last possibility is of more interest because it is conflicting with the view, which is arguing that the presence of the country risk premium decreases the deflationary (contractionary) effects of tight monetary policy as at the same time, it improves the balance sheets of domestic agents. However, if foreign borrowing is highly sensitive to the relative cost of the (domestic and foreign) funds and investment is relatively less sensitive to interest rates, deterioration in the trade balance (due to larger inflows of capital) may dominate the increase in the investment and can result in even lower prices (output).

Panel (b) in Figure 3 shows the equilibrium under case 3. An increase in

the refinance rate elevates the deposit rates and the marginal cost of funds. This implies decreasing consumption and investment demand. Hence, IB locus shifts down. On the other hand, an increase in interest rate increases the capital inflow, which requires appreciation to restore equilibrium; that is EB shifts left. The country risk premium effect creates a loop as appreciation itself decreases the risk premium and the cost of foreign borrowing and brings about even higher foreign borrowing. Decreasing cost of foreign borrowing may partially, or even more than fully, offset the higher refinance rate on the marginal cost of funds for the banks. If, in net, marginal cost of funds for banks decreases and if the improvement in the domestic lending rate is strong enough to offset the decreasing trade surplus that is brought about by appreciation, then it can result in higher aggregate demand and so higher prices.[35] If the economy is in such a state, procyclical monetary policy, such as IMF advised for Mexico in 1994 and to Asian Countries in 1997-1998 period, could be justified.[36], [37]

These analyses are valid only in a neighborhood of the initial equilibrium. If, the external risk premium is a convex function of net worth, then the slope of IB would be a negative function of depreciation.[38] In such a case the slope can change sign depending on the value of real exchange rates. Assume that at the initial equilibrium IB is negatively sloped (as in case 3) but it changes sign in some neighborhood of the equilibrium (Figure 4). Then the sign of the effect of the interest rate hike on prices (and on output) would depend on the magnitude of the shock. An increase in the refinance rate stimulating foreign borrowing can be expansionary up to some point, but if it implies larger real

[35] If one is interested in the consumer prices instead of price of domestic goods; to see the area corresponding to a lower level of CPI, it is necessary to split the grey area with a line starting from E1 (to the left) with a slope $-\delta\frac{P_{D0}}{z_0}$. The area below the line would correspond to a lower level of CPI (Obviously, if this slope is steeper than the slope of IB locus in absolute terms, CPI would always decrease). Hence, although domestic prices may increase as a response to higher interest rates, appreciation could still decrease CPI by decreasing the imported goods' prices.

[36] If the cost channel is added into this picture in the way above (where interest rate on working capital is equal to refinance rate) then the likelihood of ending up with higher output (not prices) would decrease.

[37] One should keep in mind that here we do not account for the stock effects of high interest rates on public debt, banks´ balance sheets and etc. Hence, justification of such an arguement, in practice, needs much more than this.

[38] Of course in such a situation EB locus would be non-linear as well, which we ignored in the figure.

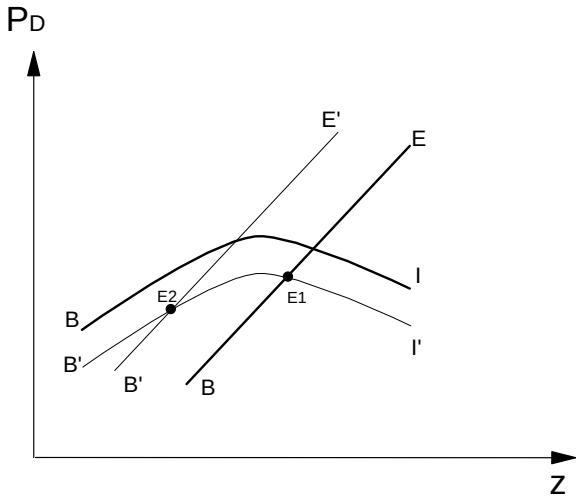

Figure 4: Risk Premium Convex In "z"

depreciation it may turn out to be contractionary after that point.

4.2 An Exogenous Increase in the Country Risk Premium

The second shock to consider is an exogenous increase in the country risk premium. This, for example, could stem from an increasing risk aversion towards the emerging economies. When the risk aversion of the international investors increases they will be more reluctant to lend to emerging market countries and they would want to charge a higher risk premium for the funds they supplied.

Again, it will be in order to briefly explain the transmission of the shock by using the basic framework, namely, without the risk premium channels and FX deposits, then, to look at the implications of these channels in the transmission process.[39]

Higher costs for foreign funds encourage domestic banks to increase the

[39] As cost of working capital is determined solely by the refinance rate, which is exogenous, cost channel does not play any role here. If the cost of working capital was equal to lending rate, then external shocks would impinge upon directly on the supply side as well. See Agénor (2006) for the analyses of such a case.

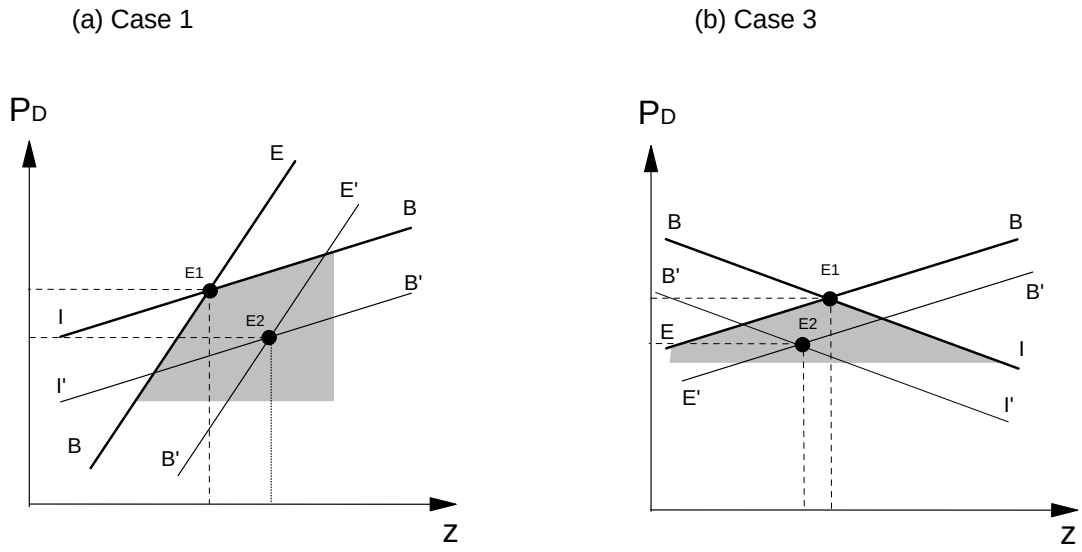

Figure 5: An Exogenous Shock To Country Risk Premium

share of the Central Bank resources in their liabilities. As banks will be holding a less desirable portfolio in their liability side they would increase their lending rates. Firms would respond to higher lending rates by decreasing their investment expenditures.[40] As a result, there would be an excess supply in domestic goods market. In order to restore internal balance for a given level of real exchange rate, domestic prices should decrease, which means a downward shift in IB locus.

Decreasing weight of the foreign borrowings in banks' total borrowings would mean capital outflow. Higher foreign borrowing cost also increases net factor services, which contribute to the outflow. Currency outflow would require a real depreciation in order to restore the equilibrium in external accounts, and that implies a rightward shift in EB locus.

There is no clear cut result as to the direction of the changes in P_D and z at the new equilibrium. Possible outcomes are i) depreciation and lower

[40] As mentioned before banks do not increase the interest rate on foreign currency denominated deposits. This would implicitly mean that the assumption is made that the domestic agents do not have any risk perceptions regarding to the domestic banking system.

prices, ii) depreciation and higher prices, iii) appreciation and lower prices.[41] By causing a real depreciation, capital outflows, on one hand, increase the net exports; but, on the other hand, due to the deterioration in the net worth of banks, decrease the investment. Depending on the relative strengths of these effects it can result in either lower prices or higher prices.

The presence of FX deposits, ignoring their effects on banks' balance sheets, softens the contractionary effect of the external shock because of the positive wealth effect created by real depreciation.

The effect of the financial accelerator mechanism, or in other words domestic risk premium channel, would depend on the net effect of the shock on the output (or price of domestic good). This mechanism would only magnify the magnitude of the shock on the output without having any influence on the direction of the effect.

Capital outflow, which arises as a response to increase in exogenous risk premium, would be magnified when there is an endogenous country risk premium channel; as deteriorated banks' balance sheets would raise the risk premium and boost the cost of borrowing further. Higher costs for domestic financial system would result in higher lending rates for domestic firms and lower investment expenditures. If IB curve is positively slopped, as in case 1, it is not possible to state in which direction the prices and the real exchange rate would go (shaded area in panel (a) of the Figure 5). Although, depreciation brought about by capital outflows increases the output in case 1, the initial impact of increasing lending rates on investment makes the equilibrium outcome ambiguous. The result again depends on the parameters and the relevant initial values of the model's variables.

In case 3, where the effect of real depreciation on the internal accounts is reversed due to the country risk premium, the effect of the shock on the economy is certainly a decrease in prices and output (panel (b) of Figure 5).[42] Hence, deterioration in market sentiment results in contraction in output.

[41] The least unexpected result among these is the last one, which leads to appreciated currency. The main reason for having this possibility is the relation between the cost of foreign borrowing and the domestic lending rate. This situation could only occur if the sensitivity of investment to interest rate is too high and hence the decrease in the equilibrium output creates an improvement in the trade balance, which more than offsets the decrease in the capital outflows. Then in the equilibrium real exchange rate should appreciate to clear the surplus in the external balance.

[42] However, it is not possible to determine the direction of the change in real exchange rate (Figure 3b).

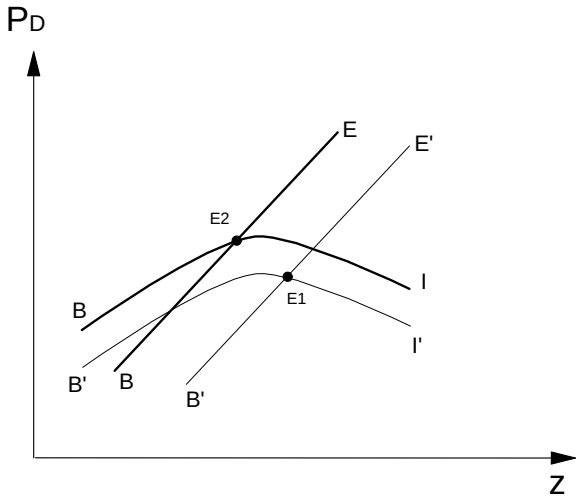

Figure 6: Risk Premium Convex In "z"

Stronger country risk premium means a larger depreciation is required to restore external equilibrium (as the impaired net worth of the banks further increases the cost of foreign borrowing and strengthens capital outflows), which further increases the marginal cost of funds for the banks and depresses investment more. In summary, the stronger the country risk premium (the higher would be the depreciation), the higher the sensitivity of domestic interest rates to the foreign cost of borrowing and the higher the interest elasticity of investment, the more severe would be the contraction in output and decrease in the price level.

Above, there were mentioned two cases separately regarding the slope of IB. Both could be combined and put into one picture. Consider the case where both IB and EB are positively sloped at the initial equilibrium (as in case 1). If one assumes that the slope of IB is negatively related to z, (that is, if country risk premium is a convex function of the net worth of banks) then the slope of IB would change sign when one moves to the right on the horizontal axis. In this case an arbitrarily small external shock could not be so contractionary (or even expansionary), however, if the depreciation is greater than a certain level (remember the country risk premium increases the degree of the depreciation required to balance the external accounts)

namely the point where the slope of IB changes sign, external shock turn out to be strongly contractionary, suppressing prices and output. This situation is shown in Figure 6.

5 Concluding Remarks

This paper has attempted to analyze the implications of credit market imperfections (both in the domestic credit market and in the international capital markets) on the transmission of monetary and external shocks in a small dollarized open economy by using a simple framework developed by Agénor and Montiel (2006, 2007).

Nominally fixed wages, (during the period of analyses) unemployment and flexible prices determines the main characteristics of the supply side. In order to integrate the cost channel it was assumed that the firms needed to finance the wage bill due to the delay between production and sales. Hence, interest rates affect the wage bill and so the supply decision of the firms.

Country risk premium arises from the currency mismatch in the balance sheets of the domestic banking system. Risk premium is specified as a function of the net worth of the banks. The net worth of the banking system can change within the period of analysis due to the movements in the exchange rate. The higher the FX deposits and initial foreign debt stock relative to domestic currency liabilities the higher would be the sensitivity of banks´ net worth to exchange rates.

It has been shown that, depending on the sensitivity of supply of and demand for domestic good to interest rates, the cost channel may not only change the quantitative effects of interest rate on the economy and in particular price level, but also the qualitative effects. In other words, an increase in the refinance rate, aimed at decreasing the price level, can result in even higher prices. We also showed that in an open economy the presence of cost channel might not necessarily decrease the effect of monetary policy on the price of domestic good, (albeit it may be the case that under realistic parameter configurations this situation could never emerge).[43]

The presence of FX deposits magnifies the recessionary effect of an interest rate increase on the economy. This situation stems from the fact that owing to the presence of FX deposits, changes in real exchange rate

[43]If one considers the consumer prices instead of price of domestic good this situation is more likely to emerge.

create a wealth effect for households, which in turn affect the consumption demand.[44] As is shown in Agénor and Montiel (2006, 2007) domestic risk premium channel also strengthens the effect of interest rates on the domestic economy. Decreasing prices, owing to the contractionary monetary policy, dampens the value of firms' capital (which is used as collateral), so increases the risk premium charged from the firms and this further depresses the investment and output.

Country risk premium mechanism increases the momentum of the change in exchange rates that is initiated by an exogenous shock (as financial accelerator mechanism does for changes in output). If an exogenous shock implies a depreciation (appreciation); due to the balance sheet effects, country risk premium increases (decreases) and this results in capital outflow (inflow). Hence, the initial movement in exchange rates is strengthened by this mechanism.

Capital inflows affect the domestic output through exports and investments. Higher capital inflow appreciates the currency and harms the exports but on the other hand appreciation improves the banks' balance sheets and decrease the risk premium on foreign borrowings and hence on the domestic lending rates and boost the investment.

In the paper we distinguished two cases in terms of the strength of the country risk premium channel. In the first case, where this channel is relatively weak, effect of real exchange rates on exports dominates its effect on the investment, which implies that depreciation (appreciation) increases (decreases) the output. In the second case, effect of real exchange rate on investment dominates its effect on exports hence depreciation results in a decrease in output.

In the case of a mild country risk premium channel, the negative effect of contractionary monetary shocks on investment is weakened; however, the negative effect of this shock on the exports is deepened. Although, output decreases for sure (as is the case without this mechanism), it is not possible to assert how the existence of country risk premium channel affects the magnitude of change in output due to the conflicting effects on investment and exports. On the other hand, conventional effects of a monetary shock

[44] As is noted earlier higher FX deposits, everything else being held constant, means higher open position for domestic banks, which increase the sensitivity of banks´ net worth (and so the domestic lending rates) to the fluctuations in exchange rates. This aspect of FX deposits works in the opposite direction compared with wealth effect for households.

on prices and the output could even be reversed in case of a strong country risk premium channel; that is, an increase (decrease) in refinance rate could be expansionary (contractionary).

The effects of an external shock that takes the form of an exogenous increase in country risk premium are ambiguous. Presence of a mild country risk premium does not impose a particular result in terms of the equilibrium output as well. But, if this channel is strong deterioration in market sentiment will always bring about a sharp decrease in investment, which dominates the positive changes in exports, and result in lower output.

It is proposed that these results are of importance for the design and the conduct of the monetary policy. A better assessment of the effects of these channels can be made by using empirically plausible parameter values. A further step would be to integrate these mechanisms into a dynamic framework with rational expectations. Thus the implications of the short-term dynamics on the stocks could also be accounted for.

Appendix
Stability Analysis

To make the stability analyses of the system one can make use of the Samuelson's correspondence principle.

The possibility of specifying the adjustment process of the endogenous variables in different, but yet plausible ways, is one of the weaknesses of this approach.

It will firstly be assumed that any imbalance in the domestic goods market would trigger the domestic price level, and exchange rate would be the variable to adjust in case of an imbalance in the external accounts.

Excess demand in the domestic goods market requires an increase in the price of the domestic good, P_D. Accordingly, adjustment equation for P_D is given by:

$$\frac{\partial P_D}{\partial t} = \lambda_1 \left\{(1-\delta)C + I + G + X - Y\right\}$$

where λ_1 is the speed of adjustment.

Excess inflow of currency would require an appreciation in real exchange rate in order to restore equilibrium in external accounts. That is z should be decreasing. Hence, adjustment equation for z takes the following form:

$$\frac{\partial z}{\partial t} = -\lambda_2 \left\{z^{-1}(X - \delta C) - i^* FB_0 + h(FB - FB_0)\right\}$$

where $\lambda_2 > 0$ is the speed of adjustment.

It is shown before in the text that an increase in P_D decreases the excess demand and an increase in z increases the excess demand. On the other hand, for the external accounts side it is shown that increase in the domestic price level increases the currency outflow while the depreciation would mean capital inflow. Using this information, it is possible to linearize the two by two dynamic system:

$$\frac{\partial P_D}{\partial t} = \lambda_1.a_{11}.P_D + \lambda_1.a_{12}.z,$$

$$\frac{\partial z}{\partial t} = -\lambda_2.a_{21}.P_D - \lambda_2.a_{22}.z,$$

where $a_{11} < 0$, $a_{12} > 0$, $a_{21} < 0$, $a_{22} > 0$.

In order to have a stable dynamic system it is necessary to find two negative eigenvalues. Necessary and sufficient conditions for having two negative eigenvalues are i) matrix of coefficients should have a positive determinant; ii) the trace of the matrix should be negative. As the λ_i's are negative the second condition is automatically satisfied. Hence the focus is on the first condition. The matrix of coefficient is named matrix A. The first order condition can be stated as:

$\det A = -\lambda_1\lambda_2(a_{11}a_{22} - a_{12}a_{21}) > 0$ which leads to:

$$-\frac{a_{22}}{a_{21}} > -\frac{a_{12}}{a_{11}}$$

On the left hand side of the inequality we have the slope of EB locus and on the right hand side we have the slope of IB locus. In order to have a stable equilibrium IB should be steeper than EB locus.

Under these conditions stability requires that the slope of IB locus is greater than EB locus. Hence, the second case is discarded as the equilibrium under this case is not stable.

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