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Chapter 3

Foreign Currency Debt as a Barrier to Price Adjustment in a Financially Constrained Economy

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Abstract

This paper develops a model of a small open economy whose corporate sector has foreign currency debts that cannot be refinanced or repudiated. The model shows that the presence of foreign currency debts will make the firms more vulnerable to real exchange rate depreciation, possibly causing them to refrain from lowering the output price (relative to the nominal exchange rate) to boost the sales volume. When such a financially constrained economy is hit by a negative shock to the exports demand, price adjustment (through real exchange rate depreciation) alone may fail to eliminate the excess goods supply. In this case, the excess goods supply has to be eliminated through quantity adjustment, and the economy will be entrapped in a low-employment/output equilibrium with a negative output gap. In a way, foreign currency debts could destabilize the economy by limiting the scope of price adjustment.

Keywords: Balance sheets, borrowing constraints, currency mismatch, foreign currency debt, liability dollarization

1. Introduction

The past fifteen years have seen an unprecedented increase in capital flows from developed countries to emerging market economies. Much of these new capital flows took the form of lending to the private sector (both banks and non-bank firms), which gained direct access to the international capital market as a result of financial liberalization.[1] However, the greater financial integration has its downside: the borrowers are often obliged to repay their debts in foreign creditors' currencies, exposing themselves to exchange rate risk.[2] The peril of foreign currency debts has been revealed by a series of emerging market crises, in which large-scale currency devaluations damaged the balance sheets of domestic banks and firms, inducing severe contraction of output.

A large number of crisis models have been developed to clarify the mechanisms through which foreign currency debts give rise to financial fragility, magnifying the effects of negative external shocks. These models can be classified into two strands of literature. The first strand – represented by Chang and Velasco (2000) – focuses on the banking sector, which faces a potential mismatch between the assets (long-term loans denominated in the domestic currency) and the liabilities (short-term debts denominated in foreign currencies); crises take the form of runs on short-term foreign currency debts. The second (and more recent) strand of literature – initiated by Calvo (1998), Krugman (1999), and Aghion et al. (2000) – focuses on credit constraints of households and firms; crises involve a massive depreciation of borrowers' net worth and a severe credit crunch, which depresses consumption and/or investment.

The burgeoning literature on financial crisis with credit crunch (the second one in the above), while increasingly becoming sophisticated, has some limitations. Firstly, the benchmark model with flexible prices – such as Krugman (1999) – does explain the collapse of investment but does not necessarily explain the *simultaneous* collapse of output. This is because a depreciation of the real exchange rate expands the exports volume and offsets the drop in investment. A decline in output would be observed only *after* the effect of lower investment is

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[1] A concise account of the recent trends in international capital flows can be found in Tirole (2002).

[2] According to the recent estimate of Eichengreen et al. (2005), almost all the external debts (i.e. debts issued abroad) of developing countries are denominated to foreign currencies. The share of foreign currency debts in the total stock of domestically-issued debts varies across countries, ranging from a negligible figure (as in Taiwan and India) to a very high figure (as in Latin American and Mediterranean countries). On the possible causes of such prevalence of foreign currency debts, see (for example) Caballero= Krishnamurthy (2003) and Tirole (2003).

materialized as lower capital stock.[3] Secondly, models which account for simultaneous falls in investment and output – such as Céspedes et al. (2004), Devereux et al. (2006), and Gertler et al. (2006) – often assume nominal rigidity in the goods prices (based on staggered contracts or adjustment costs). The exogenous nature of price determination obscures the mechanism through which foreign currency debts could interfere with equilibrating movements of prices.[4]

The objective of this paper is to re-examine the effect of a negative external shock on output and prices in a financially constrained economy, pointing out a hitherto under-researched mechanism through which foreign currency debts constrain the firms' pricing behavior, thereby increasing the fragility of the economy. For this purpose, the paper develops a simple monetary model of a small open economy without any pre-imposed rigidities in the goods prices. The model is based on the following three major assumptions: 1) the firms in this economy are monopolistically competitive and thus capable of adjusting both the quantity and price of their products; 2) each firm carries a fixed amount of debt obligation denominated in a foreign currency, and neither refinancing nor rescheduling of the debt is possible; 3) bankruptcy is extremely costly, so the firms refrain from reducing the price to the levels such that the nominal value of the gross profits falls short of the required debt services. These assumptions give rise to two equilibrium regimes with differing degrees of price flexibility, which we shall call the "normal regime" and the "debt-constrained regime". In the former (normal) regime, the firms have ample cash flows and can freely choose the price of their product; the standard price adjustment will prevail, equating the actual and potential levels of output. In the latter (debt-constrained) regime, the firms have difficulty in maintaining positive cash flows and cannot freely reduce the price to boost the sales volume; excess goods supply will have to be eliminated through quantity adjustment; in the equilibrium, there will be a negative output gap (i.e. the actual output level will fall short of the potential output level). A negative external shock (e.g. a fall in foreign expenditure) could cause a shift in regime from the former to the latter.

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[3] More recent flexible price models – such as Schneider=Tornell (2004), Chari et al. (2005), and Mendoza (2006) – generate co-movement of investment and output by introducing some additional source of output decline (e.g. a negative productivity shock). In any case, the initial collapse of output in these models ought to be interpreted as *a change in the potential output level itself*, rather than *a temporary deviation* from the potential level. The empirical plausibility of such a wide swing in potential output is still being debated; see for example Gertler et al. (2006).

[4] Nonetheless, these sticky price models can account for the existence of an output gap (difference between the actual and potential levels of output), a concept that plays a central role in policy discussions.

The mechanism of the regime shift can be described as follows.[5] Starting from the initial equilibrium under the normal regime (where there is no output gap), suppose that there is an unanticipated fall in the foreign expenditure, which causes an inward shift in the demand schedule each monopolistic competitor faces. The marginal revenue schedule will also shift in, while the marginal cost schedule will remain in the same position since the firms take all the factor prices as given. The level of output in the interim equilibrium (where the marginal revenue equals the marginal cost) will be lower than before, and there will be a negative output gap in the economy as a whole. The decline in output will lead to falls in the factor prices, which in turn cause a downward shift in each firm's marginal cost schedule. In order to equate the marginal revenue and marginal cost again, each firm will try to lower the price and boost the sales volume. In the absence of foreign currency debt, falls in the price (as well as the recovery of output) will continue until the output gap will be eliminated. However, when there is a foreign currency debt, the falling output price (and the resulting increase in real debt services) could exhaust the firm's cash flows, disabling the firms from adjusting prices further. The recovery of output will halt in the middle (at which each firm's marginal revenue still exceeds the marginal cost), and the economy will be trapped in a debt-constrained regime with a negative output gap.

In sum, foreign currency debts could magnify the external shock not only from the demand side (by depressing investment and/or consumption demand as has been emphasized in the existing literature) but also from the supply side (by limiting the scope of price adjustment by the producers).

The remainder of the paper spells out the details of the model sketched above. The next section (Section 2) describes the basic setup and derives the key equations of the model. Section 3 solves the model diagrammatically and characterizes the two equilibrium regimes arising from the financial constraints. Section 4 analyzes the effect of a negative external shock (a fall in foreign expenditure). Section 5 concludes the paper.

2. The Model

This section develops a simple static model of a small open economy to illustrate the basic causality. We introduce corporate debts (denominated in a foreign currency) in the standard open-macro model of monopolistic competition represented by Obstfeld and Rogoff (1995).

The economy is inhabited by identical workers, whose population size is

[5] The author benefited from comments from Hidehiko Ishihara in developing the following argument.

normalized to one. Each worker is endowed with an amount $\overline{M}$ of money. They also elastically supply an amount ℓ of labor at a nominal wage of W in a perfectly competitive labor market. The representative worker has preferences over consumption, real money balances, and labor given by

$$U = \frac{1}{(1-k)^{1-k}k^k}C^{1-k}\left(\frac{M}{P}\right)^k - \frac{1}{\phi}\ell^{\phi} \quad \text{---(1)}$$

where M is the demand for nominal money balances and P is the consumer price index (CPI) to be defined shortly. The consumption quantity C is an aggregate of home and imported goods:

$$C = \frac{1}{\gamma^{\gamma}(1-\gamma)^{1-\gamma}}(C_H)^{\gamma}(C_F)^{1-\gamma} \quad \text{---(2)}$$

where C_H denotes purchases of a basket of differentiated goods produced domestically (hereafter called H good as a group) and C_F denotes purchases of a single imported good produced abroad (hereafter called F good).

Assume that C_H is aggregated through the following CES function:

$$C_H = \left[\int_0^1 c_H(i)^{\frac{\theta-1}{\theta}}di\right]^{\frac{\theta}{\theta-1}}, \quad (\theta > 1) \text{---(3)}$$

Assume also that F good has a fixed price - normalized to one - in terms of the foreign currency (hereafter called the ‘dollar’). Goods are freely traded and the law of one price holds, so that the home price of F good, P_F, is equal to the nominal exchange rate E. The representative worker’s budget constraint can be thus written as

$$PC + M = W\ell + \overline{M} \text{ ---(4)}$$

where P is the CPI given by

$$P = (P_H)^{\gamma}(P_F)^{1-\gamma} = (P_H)^{\gamma}E^{1-\gamma} \quad \text{---(5)}$$

and P_H is the price index for H good given by

$$P_H = \left[\int_0^1 p_H(i)^{1-\theta}di\right]^{\frac{1}{1-\theta}} \quad \text{---(6)}$$

Maximizing utility (given by (1)(2)(3)) subject to the budget constraint (given by (4)(5)(6)) yields the following optimality conditions:

$$C_H = \gamma(1-k)\frac{W\ell + \overline{M}}{P_H} \quad \text{---(7)}$$

$$C = (1-k)\frac{W\ell + \overline{M}}{P} \text{ ---(8)}$$

$$M = k(W\ell + \overline{M}) \text{ ---(9)}$$

$$\ell = \left(\frac{W}{P}\right)^{\frac{1}{\phi-1}} \text{ ---(10)}$$

where (7) and (8) represent the workers' demand for goods, (9) represents that for nominal money balances, and (10) represents the labor supply.

The market for H good is monopolistically competitive. Each firm produces a single differentiated good (indexed by $i \in [0,1]$) from labor, using a linear technology:

$$Q_H(i) = \ell(i) \text{ ---(11)}$$

In addition to the payment of the wage bills $W\ell(i)$, each firms is obliged to make a debt repayment (the principal and interest combined) to foreign creditors, whose amount $D^*(i)$ is predetermined in the dollar terms.[6] The net profits of firm i (in terms of the home currency) are thus given by

$$\Pi(i) = p_H(i)Q_H(i) - W\ell(i) - ED^*(i) \text{ ---(12)}$$

Firm owners (hereafter called entrepreneurs), like the workers, spend a fraction γ of their nominal income on H good and a fraction $1 - \gamma$ on F good. Assuming symmetry across the firms, we can express entrepreneurs' H good consumption as $\gamma\Pi / P_H$, where index i is dropped by aggregation. Notice also that the home good price P_H and the nominal exchange rate E affect the size of the real debt burden, ED^*/P_H (i.e. the total amount of real income transfers from the home entrepreneurs to foreign creditors).

As in the home country, foreign consumers are also assumed to have Cobb-Douglas preferences. Let $X^*(>D^*)$ be the dollar value of foreign expenditure on H good.[7] Then the foreign demand for H good (i.e. exports demand for the home country) can be expressed as

$$X = \frac{X^*}{(P_H/E)} \text{ ---(13)}$$

where (P_H/E) in the denominator is the dollar price of H good. Notice that the foreign expenditure share on H good (γ^*) is assumed to be negligible (i.e. the

[6] Since the dollar price of F good is normalized to one, $D^*(i)$ can be regarded as a fixed amount of F good required for operating the firm.

[7] The inequality $X^* > D^*$ guarantees that the foreign debt will be paid in full amount in the equilibrium.

home country is much smaller than the rest of the world), so changes in the amount of real income transfers ED^*/P_H will not affect the exports demand (13).

The total demand for H good, Y_H, can be obtained by summing up the workers' demand $\gamma(1-k)(W\ell+\overline{M})/P_H$ (given by (7)), the entrepreneurs' demand $\gamma\Pi/P_H$ and the exports demand, EX^*/P_H (given by (13)), namely,

$$Y_H = \gamma(1-k)\frac{W\ell+\overline{M}}{P_H}+\gamma\frac{\Pi}{P_H}+\frac{EX^*}{P_H} \quad \text{---(14)}$$

The CES preference structure (3) implies that the market demand for each differentiated good is given by

$$Q_H(i)=\left[\frac{p_H(i)}{P_H}\right]^{-\theta}Y_H \quad \text{---(15)}$$

Due to the static nature of the model, neither refinancing nor rescheduling of the debt is possible. Furthermore, bankruptcy (i.e. reneging on the debt contract) is assumed to be extremely costly, so the net profits (12) have to be greater than or equal to zero:

$$\Pi(i)= p_H(i)Q_H(i)-W\ell(i)-ED^*(i)\geq 0 \quad \text{---(16)}$$

The above condition (16) can be regarded as a special case of the ordinary cash flow constraint

$$p_H(i)Q_H(i)-W\ell(i)+B(i)\geq ED^*(i) \quad \text{---(17)}$$

where new borrowing $B(i)$ is set equal to zero. We will thus call (16) the cash flow constraint in the below.

Each monopolistic competitor maximizes the net profits (12) with respect to $p_H(i)$ subject to the linear technology (11) and the market demand (15), provided that the cash flow constraint (16) is satisfied. Solving the maximization problem and imposing symmetry across the firms, we can obtain the price equation:

$$P_H=\frac{\theta}{\theta-1}W \quad \text{---(18)}$$

when the cash flow constraint (16) is not binding and

$$(P_H-W)\ell-ED^*=0 \quad \text{---(19)}$$

when the cash flow constraint (16) is binding.

3. The Equilibrium

As we have derived all the demand and supply functions, we are now ready to characterize the market equilibrium. The equilibrium condition for the market for H good can be written as

$$Y_H = Q_H \quad \text{---(20)}$$

where Y_H and Q_H are given by (14) and (11), respectively (with index *i* dropped by symmetry). The equilibrium condition for the money market can be written as

$$M = \overline{M} \quad \text{---(21)}$$

where the money demand M is given by (9). Finally, recalling the labor supply schedule (10) and the price equations (18)(19) and letting w_H (= W/P_H) denote the real product wage, we can write the equilibrium conditions for the labor market as

$$\begin{aligned} w_H &= \frac{\theta - 1}{\theta} \\ w_H &= \left(\frac{E}{P_H}\right)^{1-\gamma} \ell^{\phi-1} \end{aligned} \quad \text{---(22)}$$

when the cash flow constraint (16) is not binding and

$$\begin{aligned} (1 - w_H)\ell - \frac{ED^*}{P_H} &= 0 \\ w_H &= \left(\frac{E}{P_H}\right)^{1-\gamma} \ell^{\phi-1} \end{aligned} \quad \text{---(23)}$$

when the cash flow constraint (16) is binding. The equilibrium conditions (20)-(23) in the above can determine the equilibrium values of P_H, E, W, and ℓ. By the Walras's law, the market for F good will also clear.

The above equilibrium system (20)-(23) with four unknowns is hard to analyze directly, so we will reduce the dimensionality by eliminating variables. Let us rewrite the equilibrium condition (21) as

$$\overline{M} = \frac{k}{1-k} W\ell \quad \text{---(24)}$$

Substituting (11)(12)(14)(24) into (20) and imposing symmetry across the firms, the equilibrium condition for H good can be rewritten as

$$\gamma \frac{W\ell}{P_H} + \gamma \frac{P_H \ell - W\ell - ED^*}{P_H} + \frac{EX^*}{P_H} = \ell \quad \text{---(25)}$$

Let q denote the relative price of home and foreign good (which coincides with the reciprocal of the real exchange rate E/P_H):

$$q \equiv \frac{P_H}{P_F} = \frac{P_H}{E} \quad \text{---(26)}$$

Then (25) in the above can be greatly simplified as

$$\frac{X^* - \gamma D^*}{q} = (1-\gamma)\ell \quad \text{---(27)}$$

The above equation (27) is very intuitive; the RHS represents the quantity of H good to be supplied in abroad, while the LHS represents the net foreign demand for H good, with the numerator being the net foreign expenditure (in dollars) and the denominator q ($\equiv P_H/E$) being the dollar price of H good by definition[8]; given ℓ, the equilibrium value of q will equate the exports demand and supply.

Recalling the equilibrium conditions for the labor market (22)(23), the model will boil down to the following system in terms of q and ℓ:

$$\frac{X^* - \gamma D^*}{q} = (1-\gamma)\ell \quad \text{---(27)}$$

$$\frac{\theta - 1}{\theta} = \frac{\ell^{\phi-1}}{q^{1-\gamma}} \quad \text{---(28)}$$

$$\left(1 - \frac{\ell^{\phi-1}}{q^{1-\gamma}}\right)\ell - \frac{D^*}{q} = 0 \quad \text{---(29)}$$

Equation (27), the equilibrium condition for H good, will always hold. Either one of the remaining two equations – (28) when the cash flow constraint (16) is not binding or (29) when it is binding – will complete the system.

Once the equilibrium values of q and ℓ are determined by the above system (27)-(29), we can use (24) to recover the home good price P_H :

$$P_H = \frac{(1-k)\overline{M}}{k w_H \ell} = \frac{(1-k)q^{1-\gamma}\overline{M}}{k\ell^{\phi}} \quad \text{---(30)}$$

Likewise, the nominal exchange rate (E) and the CPI (P) can be easily recovered by (26) and (5):

$$E = \frac{P_H}{q} \quad \text{---(31)}$$

$$P = (P_H)^{\gamma} E^{1-\gamma} \quad \text{---(32)}$$

The determination of equilibrium can be described in diagrams. Figure 1 illustrates the labor market equilibrium for a given level of the relative home price,

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[8] In general, the numerator of (27) will be $X^* - (\gamma - \gamma^*)D^*$, so income transfers from the home to foreign country (D^*) may or may not reduce the home exports demand (depending on the sign of $\gamma - \gamma^*$). Here, the foreign expenditure share on H good (γ^*) is assumed to be negligible, so the effect of D^* on the home exports demand will unambiguously be negative.

$q = q_0$. Panel (a) corresponds to the case in which the cash flow constraint (16) (the dashed schedule labeled CFC in the figure) is not binding. The equilibrium levels of employment (ℓ) and real product wage (w_H) are given by point E_0, the intersection of the price setting schedule $w_H = (\theta - 1)/\theta$ (labeled PS in the figure) and the labor supply schedule $w_H = \ell^{\phi-1}/q^{1-\gamma}$ (labeled LS in the figure). Notice that the equilibrium employment level ℓ_0 is equal to the full employment level ℓ_n (i.e. one consistent with potential GDP). Notice also that equilibrium point E_0 lies below CFC, meaning that the net profits of the firms are strictly positive.[9]

Panel (b) of Figure 1 describes the case in which the cash flow constraint (16) is binding. The equilibrium pair of (ℓ, w_H) is given by point E_0 in the diagram, where the labor supply schedule LS and the cash flow constraint schedule CFC intersect. At this point, the gross profits of the firms are exhausted by debt services, and the net profits will be equal to zero. Notice that the intersection of the price setting schedule PS (dashed line) and the labor supply schedule LS – designated by point E' in the diagram – is lying above the CFC schedule and would not be feasible. As a result, the equilibrium employment level ℓ_0 will be lower than the full-employment level ℓ_n.

Figure 2 depicts the determination of the goods market equilibrium. The downward-sloping curve (labeled GG) represents (27), which describes the set of (ℓ, q) that equilibrate the market for H good; a higher ℓ increases the supply of home exports, so a lower q will be necessary to boost the exports demand. The upward-sloping curve (labeled LL) represents (28), which in turn represents the intersections of the PS and LS schedules in Figure 1 for various values of q. In the absence of the cash flow constraint, this curve would describe the set of (ℓ, q) that equilibrate the labor market. Finally, the V-shaped curve (labeled FF) represents (29), which in turn represents the intersections of the CFC and LS schedules in Figure 1 for various values of q. For each ℓ, this curve will give the lower bounds for q the firms can accommodate without violating the cash flow constraint.[10] The region below this curve corresponds to negative cash flows (i.e. bankruptcy) and will not be feasible.

[9] The area above CFC (characterized with higher wages and lower output) represents negative net profits.

[10] The V-shape of the FF curve stems from the relationship between employment (ℓ) and the real gross profits of the firms (the first term of (29)). A decrease in ℓ will engender two conflicting effects on the gross profits; on the one hand, it will have a positive effect on the gross profits by depressing the real wages and increasing the profit margin; on the other hand, it will have a negative effect on the gross profits by reducing the output quantity. When ℓ is relatively high, the first effect will prevail, so a lower ℓ will lead to higher gross profits; the firms will be able to break even with a smaller q. In contrast, when ℓ is relatively low, the second effect will prevail, so a lower ℓ will lead to lower gross profits; the firms will need a larger q to break even.

The equilibrium levels of (ℓ, q) are given by the intersection of the GG curve and either one of the LL and FF curves. Panel (a) of Figure 2 corresponds to the case in which the cash flow constraint (16) is not binding. The equilibrium is depicted by point E_0, the intersection of the GG and LL curves. Notice that point E_0 lies above FF, meaning that the firms are making positive net profits. Notice also that the equilibrium employment level ℓ_0 will be equal to the full employment level ℓ_n, and there will be no output gap in the equilibrium. In contrast, Panel (b) of Figure 2 corresponds to the case in which the cash flow constraint (16) is binding. The equilibrium is depicted by point E_0, the intersection of the GG and FF curves. Notice that the intersection of the GG and LL curves - point E' in the diagram - lies below the FF curve and will not be feasible. The equilibrium employment level ℓ_0 will be lower than the full employment level ℓ_n, and there will be a negative output gap in the equilibrium.

In sum, the presence of the dollar-denominated debt obligations gives rise to a constraint on the firms' cash flows (represented by (16)). Depending on whether or not the constraint is binding, there will be two equilibrium regimes: one is depicted by Figure 2(a) (which we shall hereafter call the "normal regime"), and the other is depicted by Figure 2(b) (which we shall hereafter call the "debt-constrained regime"). As seen in the above, the normal regime is characterized by a zero output gap, while the debt-constrained regime is characterized by a negative output gap.

4. Effects of External Shock

The model developed above can be used to analyze the effects of a negative external shock (represented by a fall in the foreign expenditure, X^*) on the prices, employment, and output. A case of particular interest is when the negative external shock causes a shift in regime (from the normal to the debt-constrained), which we will examine in the below.

The dynamics of the regime shift can be depicted by Figure 3. Panel (a) describes the H sector as a whole, while Panel (b) describes the behavior of the i th firm.[11] The initial equilibrium (in the normal regime) is represented by point E_0; in Panel (a), this is the intersection of the LL curve and the initial GG curve (G_0G_0); in Panel (b), it is a point on the initial demand schedule ($D_0(i)$) where the marginal revenue (depicted by dashed line MR_0) is equal to the marginal cost (depicted by solid line MC_0). The initial employment/output level is given by ℓ_0, with the size of output gap being equal to zero.

[11] In order to simplify the exposition, all the nominal variables (the price of i th good, marginal revenue, marginal cost, etc.) are deflated by P_H and graphed in real terms in Figure 3(b).

Suppose now that there is an unanticipated fall in the foreign expenditure X^*. By (27), we can see that the demand for H good at a given relative price q will fall, causing an inward shift of the GG curve (from G_0G_0 to G_1G_1) as in Figure 3(a). As for each monopolistic competitor, the decrease in X^* will cause inward shifts in the demand schedule (from $D_0(i)$ to $D_1(i)$) as well as in the marginal revenue schedule (from MR_0 to MR_1). Since each firm initially takes all the factor prices as given, the marginal cost schedule will remain in the same position. As a result, the initial equilibrium E_0 will move to an interim equilibrium E_0', where the new marginal revenue (MR_1 in Figure 3(b)) is equal to the initial marginal cost (MC_0). Notice that there will be little change in the price level, while there will be a substantial fall in the employment/output level (from $\ell_0(i)$ to $\ell_0'(i)$). Likewise, the equilibrium in the H sector as a whole will move from point E_0 to E_0' in Figure 3(a).

Since the interim equilibrium E_0' will be characterized by an excess supply labor, real wages will fall, shifting down the marginal cost schedule (from MC_0 to MC_1 in Figure 3(b)). Each firm – in attempt to equating the marginal revenue and marginal cost again – will reduce the price and expand output. The recovery of the supply of H good will lead to a depreciation of the nominal exchange rate, which in turn increases the real debt burdens of the firms. The depreciation of the nominal exchange rate will continue until the firms exhaust the cash flows and the economy is trapped in the debt-constrained regime (depicted by point E_1 in Figure 3(a) and (b)).

Notice that, if the cash flow constraint were not binding, each firm would expand the employment/output level up to $\ell_1'(i)$, at which the marginal revenue MR_1 is equal to the new marginal cost MC_1, and the economy as a whole will reach point E_1' in Figure 3(a). In reality, point E_1' will be characterized by negative cash flows and will not be feasible. The recovery of the employment level will halt at $\ell_1(i)$ in Figure 3(b) (at which the marginal revenue still exceeds the marginal cost), and the economy as a whole will have a negative output gap of ($\ell_1 - \ell_1'$) as in Figure 3(a).

To sum up, dollarized debts combined with cash flow constraints will reduce the indebted firms' tolerance to real exchange rate depreciation. For each employment/output level ℓ, there will be a lower-bound for the relative price q (or an upper-bound for the real exchange rate $1/q$) the firms can bear. A negative export shock and the resulting real exchange rate depreciation could cause the economy to hit the lower bound, entrapping it in the low-employment equilibrium with a negative output gap. Since the model does not have any nominal rigidity, expansionary monetary policies will have no effect on real variables such as the relative price q and employment/output level ℓ. Unless a sufficient amount of debt services (D^*) is forgiven (thereby shifting down the FF curve below point E_1' in

Figure 3(a)), the negative output gap will persist.

5. Concluding Remarks

Emerging market crises in the past decade has generated great interest in the destabilizing role of foreign currency debts. A large number of models have clarified the mechanism through which the impact of a negative external shock is magnified by currency devaluations, increases in real debt burdens, and the deterioration of the corporate balance sheets. However, most of these models focus on the demand-side effects – such as a credit crunch and the resulting fall in investment - leaving out the supply-side effects of foreign currency debts. The model developed in this paper complements the existing models of emerging market crises by pointing out a hitherto under-researched link between foreign currency debts and the indebted firms' pricing behavior.

The model shows that the presence of foreign currency debts could weaken the indebted firms' ability to absorb negative demand shocks through price adjustment. Changes in the relative prices may halt before completely eliminating the output gap if the cash flows of the firms are exhausted by the real exchange rate depreciation. Unless a sufficient amount of foreign currency debts is reduced (e.g. by partial debt forgiveness), the economy will be entrapped in a low-employment/output equilibrium with a negative output gap.

References

Aghion, Philippe; Philippe Bacchetta: and Abhijit Banerjee. 2000. "A Simple Model of Monetary Policy and Currency Crises." *European Economic Review* 44, no.4-6: 728-38.

Caballero, Ricardo, and Arvind Krishnamurthy. 2003. "Excessive Dollar Debt: Financial Development and Underinsurance." *Journal of Finance* 58, no.2: 867-93.

Calvo, Guilleromo. 1998. "Capital Flows and Capital-Market Crises: The Simple Economics of Sudden Stops." *Journal of Applied Economics* 1, no.1:35-54.

Céspedes, Luis Felipe; Roberto Chang; and Andrés Velasco. 2004. "Balance Sheets and Exchange Rate Policy." *American Economic Review* 94, no.4: 1183-92.

Chang, Roberto and Andrés Velasco. 2000. "Banks, Debt Maturity and Financial Crises." *Journal of International Economics* 51, no.1: 169-94.

Chari, V. V.; Patrick Kehoe; and Ellen McGrattan. 2005. "Sudden Stops and Output Drops." *American Economic Review* 95, no.2: 381-87.

Devereux, Michael B.; Philip Lane; and Juanyi Xu. 2006. "Exchange Rates and Monetary Policy in Emerging Market Economies." *Economic Journal* 116, no.511: 478-506.

Eichengreen, Barry; Ricardo Hausmann; and Ugo Panizza. 2005. "The Pain of Original

Sin." In Barry Eichengreen and Ricardo Hausmann, eds. *Other People's Money: Debt Denomination and Financial Instability in Emerging Market Economies*. Chicago: University of Chicago Press: 13-47.

Gertler, Mark; Simon Glichrist; and Fabio Natalucci. 2006. "External Constraints on Monetary Policy and the Financial Accelerator." *Journal of Money, Credit, and Banking* (forthcoming).

Krugman, Paul. 1999. "Balance Sheets, the Transfer Problem, and Financial Crises." In Peter Isard; Assaf Razin; and Andrew Rose, eds. *International Finance and Financial Crises*. Boston: Kluwer Academic: 31-44.

Mendoza, Enrique. 2006. "Lessons from the Debt Deflation Theory of Sudden Stops." *American Economic Review* 96, no.2: 411-16.

Obstfeld, Maurice and Kenneth Rogoff. 1995. "Exchange Rate Dynamic Redux." *Journal of Political Economy* 103, no.3: 624-60.

Schneider, Martin, and Aaron Tornell. 2004. "Balance Sheet Effects, Bailout Guarantees and Financial Crises." *Review of Economic Studies* 71, no.3: 883-913.

Tirole, Jean. 2002. *Financial Crises, Liquidity, and the International Monetary System*. Princeton: Princeton University Press.

Tirole, Jean. 2003. "Inefficient Foreign Borrowing: A Dual-and Common- Agency Perspective." *American Economic Review* 93, no.5: 1678-1702.

Figure 1: Equilibrium in the Labor Market

(a) Case of Non-binding CFC (b) Case of Binding CFC

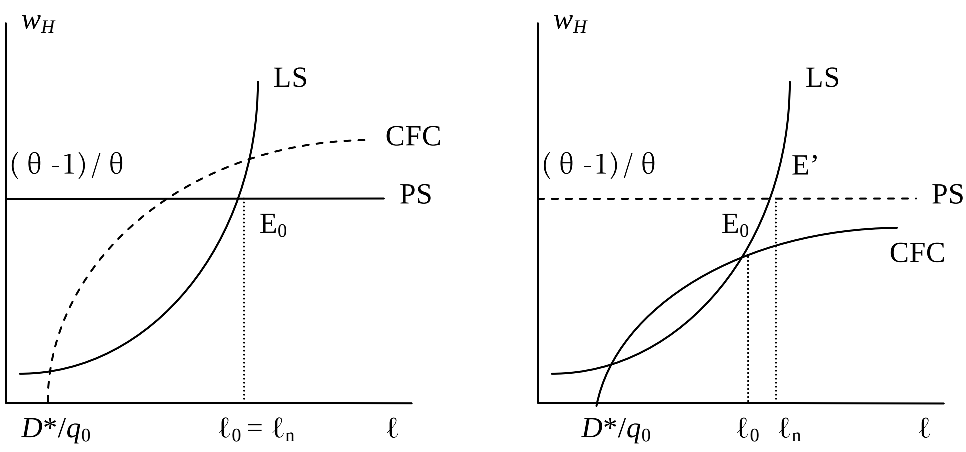


Figure 2: Equilibrium in the Goods Market

(a) Normal Regime (b) Debt-constrained Regime

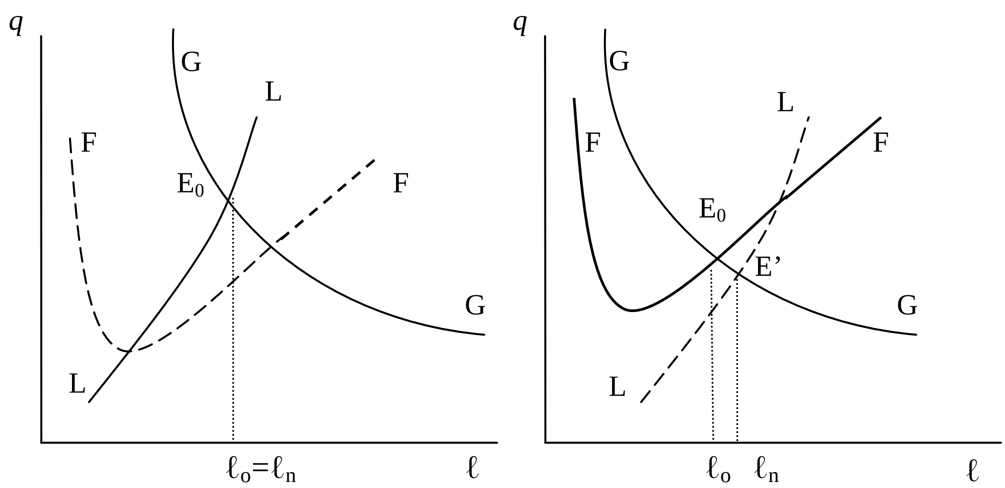
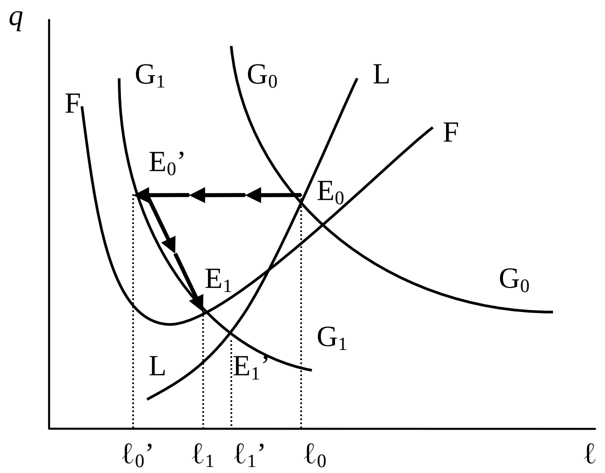


Figure 3: Effects of Negative Exports Shock

(a) The H Sector as a Whole



(b) Variety *i* in the H Sector