Capital Markets and the Instability of Open Economies*

by

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Abstract

This paper introduces a framework for analyzing the role of financial factors as a source of instability in small open economies. Our basic model is a dynamic open economy model with one tradeable and one non-tradeable good with the non-tradeable being an input to the production of the tradeable. We also assume that firms face credit constraints, with the constraint being tighter at a lower level of financial development. The two basic implications of this model are the following: first, economies at an intermediate level of financial development are more unstable than either very developed or very underdeveloped economies. This is true both in the sense that temporary shocks have large and persistent effects and also in the sense that these economies can exhibit stable limit cycles. Thus, countries that are going through a phase of financial development may become more unstable in the short run. Second, in economies at an intermediate level of financial development, full financial liberalization may actually destabilize the economy. On the other hand, foreign direct investment does not destabilize.

1 Introduction

This paper introduces a framework for analyzing the role of financial factors as a source of instability in small open economies. Our basic model is a dynamic open economy model with one tradeable and one non-tradeable good with the non-tradeable being an input to the production of the tradeable. Into this familiar world, we introduce the assumption that firms face financial constraints: the amount they can borrow is limited to μ times the amount of their current level of investible funds.[1] A high μ then represents an effective and developed financial sector while a low μ represents an underdeveloped one.

Our model can provide some answers to a number of important and rather basic questions. First, we show that it is economies which are at an intermediate level of financial development - rather than very developed or very underdeveloped ones - that are the most unstable. This is true both in the sense that temporary shocks will have large and persistent effects and also in the sense that these economies can exhibit stable limit cycles. Thus, countries that are going through a phase of financial development may become more unstable in the short run.

Second, the model allows us to examine the effects of financial liberalization on the stability of the macroeconomy. Once again it turns out that the interesting economies are the ones at an intermediate level of financial development. In these economies, full financial liberalization, in the sense of opening the domestic market to foreign capital flows, may actually destabilize, making the economy go through chronic phases of growth with capital inflows followed by collapse with capital flight. On the other hand,

[1]The fact that firm level cash-flow is an important determinant of investment is now widely recognized even in the context of economies like the U.S. which have excellent financial markets. (e.g., see Hubbard (1998) or Bernanke, Gertler, and Gilchrist (1998)).

foreign direct investment never destabilizes. This suggests that economies at an intermediate stage of financial development should consider carefully how they liberalize their capital account. Allowing foreign direct investment while initially restricting portfolio investment may be a reasonable approach.

Third, our model allows us to assess the macro effects of specific shocks to the financial sector such as overlending by banks leading to a phase of bank failures or overreaction by investors to a change in fundamentals.[2] Once again our model tells us that these shocks will have their most persistent effects when the financial markets are at an intermediate level of development.

Finally, when a monetary dimension is added to our model, the variations in the relative price of the non-tradeable input are reflected in movements either in the nominal exchange rate or in the level of central bank's reserves. Under fixed exchange rates, a shock that reduces the ability of firms to borrow will lead to a fall in the country's reserves and may potentially lead to a currency crisis and a forced devaluation.

The basic mechanism underlying our model is a combination of two forces: on one side, more investment leads to more output and ceteris paribus, to higher profits. Higher profits improve creditworthiness and fuel more borrowing, which leads to more investment. Capital flows into the country to finance this boom. At the same time, the boom in investment increases the demand for the non-tradeable input and raises its price relative to the tradeable good (unless the supply of the non-tradeable input is extremely elastic). This rise in prices leads to lower profits in the tradeable goods sector and therefore, reduced creditworthiness, less borrowing and less investment and a fall in aggregate output. Of course once investment falls all these forces get reversed and eventually initiate another boom. It is this endogenous instability which causes shocks to have persistent effects and in more extreme cases leads to limit cycles.

[2] Perhaps as a consequence of herd behavior.

The reason why an intermediate level of financial development is important for this result should be easy to see: at very high levels of financial development, most firms' investment is not constrained by their cash flow. Therefore shocks to cash flow are irrelevant. On the other hand, at very low levels of financial development, firms cannot borrow very much in any case and therefore their response to cash-flow shocks will be rather muted - extra cash means more investment but only a little more. Therefore shocks will die out without causing any great turmoil. It is then at intermediate levels of financial development that shocks to cash flow will have a strong enough effect to be a source of instability.

This last argument also helps us understand why opening the economy to foreign capital may destabilize: essentially, an economy with a closed capital market is limited in how much it can respond to a cash flow shock since there is only so much capital available to entrepreneurs. Additional funding sources in an open economy potentially increases the response to a shock and therefore the scope for volatility.

The basic mechanics of instability described here - an increase in the price of non-tradeables leading to a profit squeeze and eventual collapse - has been documented in a number of countries. For example, in the years leading up to the crisis of the early 1980's in the Southern Cone countries, there is evidence that profits in the tradeable sector sharply deteriorated due to a rise in the price of non-tradeables (see Galvez and Tybout, 1985, Petrei and Tybout, 1985, or De Melo, Pascale and Tybout, 1985). Moreover, ample anecdotal evidence supports the impact of 'competitiveness' (e.g. a real appreciation) on the financial conditions of firms.

The dynamic impact of a liberalization coming out of the model is also consistent with the experience of several emerging market countries that have liberalized, in particular in Southeast Asia and Latin America, but also in some European countries. In the years prior to their respective crises, these economies had been going through a process of rapid liberalization of their financial sectors, which facilitated borrowing by domestic firms. Partly as a result of this liberalization, capital was flowing into these economies in large quantities, allowing rapid growth in lending and a boom in investment. However, episodes of large capital inflows have often been associated with growing imbalances, such as a real currency appreciation[3], an increase in real estate prices (e.g., see Guerra de Luna, 1997), or an increase in non-performing loans (see World Bank, 1997, p. 255). When the crisis came, most of these forces got reversed - capital flowed out, the currency collapsed, real estate prices dropped, lending stopped, and investment collapsed.[4]

It is however important to emphasize that the goal of this paper is not to explain exactly what happened in some particular country, but rather to propose a unified macroeconomic framework that gives a central role to financial constraints and financial development. There are certainly a number of strands of the existing literature anticipating a significant part of what we have done here. The idea that financial constraints on firms can play a role in the propagation of the business cycle was modeled in Bernanke and Gertler (1989). Subsequent work by Kiyotaki and Moore (1997), Aghion, Banerjee, and Piketty (1999) and Azariadis and Smith (1998) have shown that these constraints can lead to oscillations, though only in the context of a closed economy.[5] However none of these papers except Aghion, Banerjee, and Piketty (1999) focus on the

[3]See, for example, Calvo et al. (1996). The degree of real appreciation varies across countries; for example, it has been more pronounced in Latin America than in Asia.

[4]See World Bank (1997) and Milesi-Ferretti and Razin (1998) for systematic descriptions of capital flow reversals and currency crises. It is also interesting to notice that the degree of real exchange rate appreciation generally determines the severity of the crisis (e.g., see Tornell, 1998). See also Honkapohja and Koskela (1998) for an illuminating description of the Finnish crisis of the 1990's, which fits well our analysis: first, an economic environment characterized by a large proportion of credit-constrained enterprises, for which investments are highly elastic w.r.t. current profits; second, a financial market deregulation in the 1980's that lead to a huge expansion of bank lending, to major inflows of foreign capital and to a sharp increase in real asset prices (in particular real estate prices) during the boom; and subsequently in the 1990's, a sharp fall in real asset prices, investments, and real GDP, and the occurrence of a banking crisis that eventually led to a tightening of banking regulations and to a devaluation of the Finnish currency after hopeless efforts to maintain a fixed exchange rate.

[5]Gertler and Rogoff (1990) study an open economy model with credit-market imperfections. However, since they use a two-period model with a single good, they consider neither business cycle fluctuations nor relative price movements.

level of financial development as a factor determining the extent of instability and none of them study the effects of opening up the domestic financial sector to foreign capital flows.

A separate literature focuses on the case for free capital mobility. Policy interest in the debate has been aroused by the recent, rather mixed, experience of a number of countries that have liberalized their capital account,[6] but a number of important aspects, including the implications of liberalization for volatility, have not been widely studied.[7] More importantly, none of these papers attempt to relate the effect of liberalization to the functioning of the domestic financial sector.

Finally a number of recent papers stress that specific shocks to the financial sector, such as those brought on by policy mistakes, herd behavior, panics, or corruption in the financial sector, may lead to crises in the real economy. While accepting the validity of these arguments, we feel these models suffer from ignoring some of the interactions between the financial sector and the rest of the economy. As our model makes clear, volatile behavior may arise even in the absence of such shocks; on the other hand, the presence of such shocks does not automatically mean they will have large and persistent real effects.

The paper is organized as follows. Section 2 represents the core of the paper, with a description of the open-economy model and a characterization of the conditions under which macroeconomic volatility arises. Section 3 analyzes the impact of a capital account liberalization and contrasts the stabilizing effect of unrestricted FDI with the potentially destabilizing effects of either foreign *indirect* investments or *restricted* foreign direct investments. Section 4 describes various extensions and draws some tentative policy conclusions.

[6] See, for example, Johnston et al. (1997) or Eichengreen et al. (1998).

[7] Obstfeld (1986), McKinnon (1993), Bacchetta (1992), Bartolini and Drazen (1997) analyze capital account liberalizations. McKinnon and Pill (1997) and Bacchetta and van Wincoop (1998) are among the few examining the issue of volatility.

2 The Basic Mechanism

2.1 A Simple Framework

We consider a small open economy with two goods, respectively tradeable and non-tradeable. Whilst the tradeable good can serve both as a capital input and as a consumption good, the non-tradeable good can only serve as an input in the production of the tradeable good. One should typically think of the non-tradeable good in this economy as input services such as real estate, (skilled) labor,...[8] Until we introduce monetary considerations into the analysis, we take the tradeable good as the numeraire and we denote by p the price of the non-tradeable input when expressed in units of the tradeable good. The relative price p can also be interpreted as the real exchange rate. We assume that the non-tradeable input is not used for consumption.[9]

There are two distinct categories of individuals in the economy. First, the *lenders* who cannot directly invest in production, but yet can lend their initial wealth endowments at the international market-clearing interest rate r. Second, the *entrepreneurs* (or *borrowers*) who have the opportunity to invest in production. The production function for the tradeable good is given by:

$$y_T = f(K, z_N), \tag{1}$$

where K (resp. z_N) denotes the current tradeable (resp. non-tradeable) investments and y_T denotes the current domestic flow of tradeable output. [The production function f obeys the usual concavity assumptions.] With perfect capital markets, investment would simply be determined by the international interest rate r.

Credit-market imperfections: Due to standard agency (moral hazard) considerations, an entrepreneur with initial wealth W_B can borrow at most $L = \mu W_B$. The presence

[8] Most open-economy models focus on the role of non-traded goods through consumption decisions, but typically do not consider non-traded inputs. See Bruce and Purvis (1985) for a survey.

[9] Allowing for consumption of the non–tradeable will not substantially affect the analysis as long as it is not a strong substitute for the tradeable good.

of capital market imperfections is reflected by $\mu > 0$, which increases with the level of financial development. In the extreme case where $\mu = 0$, the credit market collapses and investors can only invest their own wealth. As we shall argue below, volatility is most likely to occur for intermediate values of the parameter μ, corresponding to intermediate levels of financial development.

The parameter μ can be justified in the following way. Once they borrow, entrepreneurs may either produce y_T in 'normal' conditions and repay their loan rL; or they may 'hide' to produce y_T and not repay the loan. There is, however, a cost to 'hiding' proportional to the funds invested: $c \cdot I$. One can think, for example, of entrepreneurs diverting funds to another production site. A higher degree of financial development implies a better monitoring and thus a higher cost c.

The lenders will lend such that the incentive to hide is smaller or equal to the incentive to repay the loan. This gives the following incentive compatibility constraint:

$$y_T - rL \geq y_T - cI$$

When the cost of hiding is large enough $(c > r)$ this constraint is never binding and firms can invest at their first best level. At some c is lower than r, the incentive compatibility constraint may bind. Since $I = W_B + L$, we find:

$$L \leq \frac{c}{r-c} W_B \equiv \mu W_B$$

The constraints hold with equality when entrepreneurs borrow the full amount offered by lenders; then, their total investment is $I = W_B + L = (1+\mu)W_B$. However, entrepreneurs borrow μW_B only if profits are higher than the opportunity cost of their funds, i.e., when $y_T - rL > rW_B$. Otherwise, they are not constrained and the amount borrowed is determined by $I - W_B$, where I depends on r.

Production decision: Entrepreneurs with total initial wealth W_B will choose a non-tradeable investment z_N [with corresponding tradeable investment $K = I - p \cdot z_N$] to maximize current profits, i.e., to solve:

$$\max_{z_N} f\ (\underbrace{I - p \cdot z_N}_{K}, z_N),$$

where $z_N \leq y_N$ (endowment of non-tradeable good). The equilibrium price of the non-tradeable input, p, will then be simply determined as the price for which the demand for non-tradeable input z_N (defined as the solution to the above maximization program) equals the fixed supply y_N of the non-tradeable good. It is generally a positive function of W_B. This equilibrium price is the key variable whose movements over time will produce output volatility.

The Timing of Events: The timing of events within each period t is depicted in Figure 1. Investment, borrowing and lending, and the payment of non-tradeable good services $p \cdot y_N$ by entrepreneurs to the owners of non-tradeable goods, take place at the *beginning* of the period (which we denote by t^-). Everything else occurs at the *end* of the period (which we denote by t^+): first, the returns to investments are realized; second, borrowers repay their debt, rL, to lenders; third, agents make their consumption and savings decisions determining in turn the initial wealth of borrowers at the beginning of the next period (i.e., at $(t+1)^-$).

Savings Behavior: For simplicity, we assume a linear savings behavior: all agents save a fixed fraction $(1 - \alpha)$ of their total end-of-period wealth and thus consume a fixed fraction α.[10]

Now that we have laid out the basic model, we can use it to analyze the dynamics of the economy and in particular try to understand why open economies with imperfect credit markets may experience macroeconomic volatility. Since both I and p depend

[10] Such a saving behavior can be "rationalized" by bequest models with Cobb-Douglas "warm-glow" preferences that have been used by the recent theoretical literature on income distribution and credit constraints (see also Bacchetta and Caminal, 1999, in the context of credit constraints and business cycles). The intertemporal decisions of lenders are of no consequence for output in such an open economy since investors can borrow in international capital markets. It will, however, affect net capital flows and this is further discussed in Section 2.5.

on entrepreneurs' wealth W_B, output itself depends on W_B. Thus, output dynamics are determined by the evolution of entrepreneurs' behavior.[11] Let W_B^{t+1} denote the disposable wealth of entrepreneurs (borrowers) at the beginning of period $(t+1)$. The dynamic evolution of W_B (and therefore of investment and total output) between two successive periods, is simply described by the equation:

$$W_B^{t+1} = (1-\alpha)[e + y_T^t - rL^t] \tag{2}$$

where e is an exogenous income in terms of tradeable goods, $y_T^t = f\left(I - p^t \cdot y_N, y_N\right)$ is the tradeable output in period t (also equal to the gross revenues of entrepreneurs during that period) and p^t is the market-clearing price of the non-tradeable input at time t. The expression in brackets is the *net* end-of-period t revenue of entrepreneurs. The net disposable wealth of entrepreneurs at the beginning of period $(t+1)$ is what remains of this net end-of-period return after consumption, hence the multiplying factor $(1-\alpha)$ on the RHS of equation (2).

When profits are too low, entrepreneurs borrow less than μW_B so their profits are equal to the international return, i.e., such that $y_T - rL = rW_B$. In this case, entrepreneurs are not credit constrained. This occurs when μ or W_B are large, in which case no pure profits are earned from production. The investor simply earns the return r on the wealth he invests. Hence, the evolution of wealth is simply given by:

$$W_B^{t+1} = (1-\alpha)[e + rW_B^t]. \tag{3}$$

Thus, model dynamics are determined by either difference equation (2) or difference equation (3). In this context, we have a stable system when last period wealth has a positive impact on current wealth, i.e., $dW_B^{t+1}/dW_B^t > 0$ in the steady state. When

[11]Since it is a small open economy the interest rate is given and there is separation between the decisions of lenders and entrepreneurs. This does not imply separation between total national savings and investment. Gertler and Rogoff (1990) show that a framework with credit constraints can explain the high correlation between total savings and investment (Feldstein and Horioka, 1980). We obtain a similar result in our framework. However, in general this result also depends on lenders' savings behavior.

$-1 < dW_B^{t+1}/dW_B^t < 0$, the levels of wealth and output oscillate after a shock and converge to a stable steady state. When $dW_B^{t+1}/dW_B^t \leq -1$, we obtain cycles that can be of complex nature, since the system can jump back and forth from to (2) to (3). The next subsection examines the conditions for which volatility or cycles develop.

2.2 Output Volatility and Cycles

As we have just shown, the model with credit-constrained entrepreneurs gives output dynamics that are determined by the dynamics of entrepreneurs' wealth. When the system is described by equation (2), an increase in entrepreneurs' last period wealth W_B^t can have an ambiguous effect on their current wealth W_B^{t+1}. This is due to the fact that wealth itself depends negatively on the input price p, which depends positively on wealth. To see this more clearly we focus on production functions f that exhibit constant returns to scale, i.e., homogeneous of degree one with respect to K and z_N. One can then establish the following.

Lemma 1: The aggregate tradeable output at date t, which for given total investment I^t is defined as:

$$y_T^t = \max_{z_N} f\ (\underbrace{I^t - p^t \cdot z_N}_{K}, z_N),$$

can simply be reexpressed as:

$$y_T^t = \psi(p^t) \cdot I^t,$$

where $\psi' < 0$.

Proof: See Appendix A.

Using this property and the fact that $I^t = (1+\mu)W_B^t$, equation (2) can be written as:

$$W_B^{t+1} = (1-\alpha)[e + \{(1+\mu)\psi(p^t) - r\mu\}W_B^t] \tag{4}$$

The impact of today's wealth on tomorrow's wealth can then be decomposed in two effects:

$$\frac{dW_B^{t+1}}{dW_B^t} = (1-\alpha)[\underbrace{(1+\mu)\psi(p^t) - r\mu}_{\text{wealth effect}} + \underbrace{(1+\mu)W_B^t\psi'(p^t)\frac{dp^t}{dW_B^t}}_{\text{price effect}}] \tag{5}$$

On the one hand, there is a *wealth effect*: for a given price of the non-tradeable good p^t, a higher wealth W_B^t means a higher level of investment $(1+\mu)W_B^t$ in period t which, everything else remaining equal, should produce higher revenues and therefore generate higher wealth at the beginning of period $(t+1)$. On the other hand, more investment in period t also implies a greater demand for the non-tradeable good and raising its price p^t during that period, and thus having a detrimental effect on period t revenues and period $(t+1)$ wealth W_B^{t+1}.

Whether the price effect dominates the wealth effect depends obviously on the production function. To derive more specific results, we now focus on a general CES production function $f(K, z_N) = A(K^\rho + \gamma z_N^\rho)^{\frac{1}{\rho}}$, with parameters $A > 0$ and $\gamma > 0$. The parameter ρ determines the elasticity of substitution between K and z_N (we assume $\rho < 1$ for concavity). Two specific technologies are Cobb-Douglas with $\rho = 0$ and Leontief with $\rho \to \infty$. The CES production function gives:

$$\psi(p^t) = A \cdot \phi^{\frac{1-\rho}{\rho}}$$

where $\phi = 1 + \gamma^{\frac{1}{1-\rho}} \cdot p^{\frac{\rho}{\rho-1}}$. When firms are credit constrained, $I = (1+\mu)W_B$ and equilibrium in the non-traded input market determines p:

$$p^{\frac{1}{1-\rho}}\phi y_N = \gamma^{\frac{1}{1-\rho}}(1+\mu)W_B \tag{6}$$

Except for the Cobb-Douglas case ($\rho = 0$), p is a non-linear function of W_B.[12] Moreover, output depends positively on W_B even when the price effect dominates (see Appendix B), except for the Leontief case.

[12]When firms are not credit constrained, $(1+\mu)W_B$ is replaced by I in equation (6) and p no longer depends on W_B. More precisely, we have $p = \psi^{-1}(r)$, so that I is a negative function of r.

It is now possible to evaluate (5). Appendix B shows that the price effect dominates, i.e., $\frac{dW_B^{t+1}}{dW_B^t} < 0$ when:

$$r\mu(\phi - \rho(\phi - 1)) > (1 + \mu)\psi(p) \tag{7}$$

It can be easily seen that this inequality is more likely to bind when μ increases. Thus, there is no volatility for low levels of μ. Moreover, inequality (7) is also more likely to hold when ρ becomes more negative. This implies that the price effect dominates when the elasticity of substitution between capital and the non-tradeable input is low. In the Cobb-Douglas case ($\rho = 0$), (7) never holds as it becomes $r\mu > (1 + \mu)\psi(p)$ and we always have $\psi(p) > r$. This is not surprising as p is proportional to W_B in this case. Finally inequality (7) is more likely to hold when $\psi(p)$ is small, i.e., when p and W_B are large. In other words, the price effect dominates only for large values of W_B.

The price effect may be so large however that it is no longer profitable to borrow the full amount μW_B. In that case the dynamic system shifts to equation (3). This can obviously happen when W_B is large. Hence the dynamics of the system can be rather complex: as W_B increases, the price effect may start to dominate (when (7) holds). If W_B increases further, the system switches to (3), where there is neither a price nor a wealth effect. This complexity, though, implies a rich set of dynamics (see below for some illustrations).

It should be easy to see that the system is driven by equation (3) when μ is large (i.e., entrepreneurs are not credit constrained). Combined with the argument, made above, ruling out very low values of μ, it tells us that price effects are likely to be important only for intermediate values of μ. This means that the kind of volatility that arises because $\frac{dW_B^{t+1}}{dW_B^t} < 0$, is unlikely to be associated either with a high level of financial development (μ large) nor with the total absence of credit markets ($\mu = 0$): in the former case the increasing price of non-tradeable inputs will not affect borrowing (and therefore investment) capacity; and in the latter case, the absence of credit-opportunities will maintain an upper bound on the demand for (and therefore the price of) non-tradeable inputs.

Figures 2 and 3 below depicts the evolution of W_B^{t+1} as a function of W_B^t with two different sets of parameters. In both Figures we assume that $\alpha = 0.2$, $e = 1$, $y_N = 100$, $r = 1.05$, $A = 1.5$, $\gamma = 1$. In Figure 2, we assume a low $\mu = 1$ and ρ close to zero ($\rho = -1$), while in Figure 3 μ and ρ are large in absolute values ($\mu = 3$, $\rho = -50$).[13]

In Figure 2, the overall curve $W_B^{t+1}(W_B^t)$ intersects the 45° line with an upward slope which implies a system without oscillations. This is the case where the wealth effect always dominates the price effect.[14] In Figure 3, the curve is comprised of three segments. The first, upward sloping, segment above the 45° line represents the initial wealth levels which bring no price effect. The third segment is also upward sloping, but below the 45° line; it represents the range of initial wealth for which credit constraints do not bind so again, there is no price effect (eq. (3)). However, in the intermediate, *downward* sloping, segment the price effect dominates the wealth effect, which in turn generates macroeconomic volatility. In this case, we know that the steady state value of W_B^t (where the downward curve intersects the 45° line) is unstable (the slope is equal to -2.34). Figure 4 shows the impact on output of a very small perturbation to W_B^t at time 1.[15] It is striking that for 7 periods no change in output can be observed (the changes are too small to be visible), but then, the economy starts to fluctuate with an irregular pattern. We discuss further below other potential dynamics of the model.

Intuitively, the story underlying this volatility goes as follows: during a boom the domestic demand for non-tradeable input goes up as (high yield) investments build up,

[13] Although the parameter values are somewhat arbitrary for the sake of the illustration, we have attempted to choose plausible numbers. For example, $\mu = 3$ implies a cash flow-capital ratio of 0.25 for low p; this lies within the range reported by Fazzari, Hubbard, and Petersen (1998) for US firms.

[14] The line cutting the 45° line is slightly concave and then becomes a straight line. This happens when the wealth level is large enough so that firms are no longer credit constrained and equation (3) applies.

[15] We set the value of W_B^t to 33.43, while its steady-state value is W_B^t is 33.429898.

and this raises the price of non-tradeables relative to tradeables. This, together with the accumulation of debt continuing during booms, eventually squeezes investors' borrowing capacity and therefore the demand for non-tradeable goods. At this point, the economy experiences a slump and two things occur: the price of non-tradeable collapses (i.e., it falls relative to that of tradeables), while a fraction of the non-tradeable inputs on offer is not purchased as there are not enough investment funds. The collapse in the price of non-tradeables thus corresponds to a contraction of the tradeable goods sector and of the level of real output. Of course, the low price of non-tradeables will eventually lead to higher profits in the tradeable sector and therefore to more investment. A new boom then begins.

2.3 Illustration: The Leontief Case

The Leontief production function is of particular interest for two reasons. First, it represents the extreme case of complementarity between capital and the non-traded input in production. Second, it provides an extremely simple analytical solution.[16] Assume that $f(K, z_N) = \min(\frac{K}{a}, z_N)$ where $a < 1$. At the optimum it is easy to see that $z_N = K/a$. Thus:

$$I - p \cdot z_N = a \cdot z_N \tag{8}$$

One can distinguish between two cases. Either the demand for the non-traded input is lower than its supply y_N, in which case the non-traded input price p is equal to zero; or the quantity of the non-traded input used is equal to its supply and $p > 0$. We look at each case in turn.

i) $y_N > \frac{K}{a}$ and $p = 0$.

In this case it is easy to see that output is given by:

$$y_T^t = \frac{K^t}{a} = \frac{1}{a}(1+\mu)W_B^t$$

[16] In Aghion, Bacchetta, and Banerjee (1998) the Leontief case is analyzed in more detail.

The evolution of wealth (equation (2)) becomes:

$$W_B^{t+1} = (1-\alpha)[e + \{\frac{1}{a}(1+\mu) - r\mu\}W_B^t] \tag{9}$$

It can be easily checked that in this case $dW_B^{t+1}/dW_B^t > 0$.

ii) $p > 0$.

In this case output is determined by the supply of the non-traded input: $y_T^t = y_N$. From (8) and the definition of I, the price of the non-traded input is given by:

$$p^t = \frac{(1+\mu)W_B^t - ay_N}{y_N}$$

The evolution of wealth is now given by:

$$W_B^{t+1} = (1-\alpha)[e + y_N - r\mu W_B^t] \tag{10}$$

Clearly $dW_B^{t+1}/dW_B^t < 0$.

Figure 5 shows the Leontief case. The relationship between W_B^{t+1} and W_B^t is represented by three segments. The first one is the upward sloping curve described by (9) for $W < \underline{W}$; this is the case where the wealth effect dominates as $p = 0$. The second segment, for $\underline{W} < W < \overline{W}$ is described by (10); in this case, the price effect always dominates. It cuts the 45° line at $\widehat{W}$. Finally, the third segment ($W > \overline{W}$) represents equation (3) where entrepreneurs are not credit constrained (it can be shown that this is the case when $(1+\mu)rW_B^t > y_N$).

The slope of the second segment basically depends on μ. It can be seen that we have a cycle for $\mu > \frac{1}{(1-\alpha)r}$. Moreover, the configuration shown in Figure 5 occurs only for intermediate values of μ, which is the case where $\underline{W} < \widehat{W} < \overline{W}$. When μ is too low, the first segment cuts the 45^o degree line, i.e., $\widehat{W} < \underline{W}$. When μ is too high it is the third segment that cuts the line, with $\widehat{W} > \overline{W}$.

2.4 The Effect of Shocks

We have so far concentrated our attention on permanent volatility and the existence of (permanent) cycles. However, equally interesting is the effect of shocks on an economy of the kind analyzed above where firms are credit constrained and which is fully open to foreign borrowing and lending.[17] To investigate the effects of a negative shock in our model we write the production function in the form:

$$y_T = \sigma \cdot f(K, z_N), \tag{11}$$

where σ is a parameter that reflects productivity or current demand conditions, and y_T is the flow of current tradeable sales by domestic firms.

Consider first a permanent unanticipated shock on σ in the case where the price effect can dominate. It is clear from (2) that the schedule $W_B^{t+1}(W_B^t)$ is shifted down in the constrained region; on the other hand the schedule is unaffected when firms are unconstrained (eq. (3)). Figure 6 illustrates the shift in the wealth schedule after a downward productivity shock.

Now, consider the case in which the wealth schedule intersects the 45^o degree line on its downward sloping part (this corresponds to intermediate values of μ), with a slope less than one, so that the steady-state equilibrium X is an attractor in the absence of a shock on σ. It can be shown that the steady-state equilibrium X' *after* the permanent shock $\sigma \rightarrow \sigma'$ remains an attractor, so that the economy ends up stabilizing in the long-run. However, starting at the steady-state point X, the initial effect of a negative shock on σ is to induce a sharp fall in wealth W_B^t *below* its new steady-state level X'. Recovery will then occur and the economy will converge to the new steady-state X'. In other words, *the shock $\sigma \rightarrow \sigma'$ is initially amplified by an economy with an intermediate*

[17] For example, Honkapohja and Koskela (1998) argue that the severe depression experienced by Finland during the 1990's was the combined result of "bad luck" - namely the collapse of trade with former Soviet Union in 1991 - and "bad banking" - namely the deregulation of banking activities and the ensuring explosion of domestic credit. Asian economies were also affected by negative shocks on their exports demand before their crises.

level of financial development and which has been fully open to foreign borrowing and lending.

Similarly, a *temporary* productivity shock from σ to σ' (represented by a one-time downward shift in the wealth schedule), will generate a larger fall in output than is warranted by the shock itself. As in the previous case, the reason for this amplified effect is that immediately after the shock the price of the non-traded good remains too high relative to its steady-state level. Figure 7 shows the dynamic response of output in this case.

Two short remarks conclude our discussion in this subsection: first, we have concentrated on the special case in which the steady-state is an attractor. The same analysis - although clearly more complicated - could be carried out for the case in which the economy converges to a cycle. It can be shown that a negative shock on σ also brings initially a lower than steady-state level of output. Finally, the amplified and non-monotonic response pattern indicated above can be contrasted with the slow (and monotonic) response of output and wealth to a negative productivity shock in an economy with very low or very high degree of financial development, for which the wealth map $W_B^{t+1}(W_B^t)$ that intersects the 45^o degree line is upward-sloping.

2.5 Capital Flows and the Current Account

Actual volatility in small open economies is typically reflected in capital flows and current account volatility. In the model, the dynamics of investment and output can be determined exclusively by the dynamics of entrepreneurs' wealth, but capital flows and the current account also depend on lenders' wealth. We show below that for large values of μ capital inflows are procyclical, i.e., a boom is accompanied by capital inflows.

For simplicity, we assume that lenders also consume a proportion α of their current income. This assumption does not affect output dynamics, but it does affect capital flows. Alternatively, we could assume that lenders can freely optimize their consumption in an infinite-horizon framework. The latter assumption, however, would have difficulties explaining the empirical behavior of consumption and savings. Some evidence suggests that a proportion of consumers are liquidity-constrained and consume a proportion to their current income.[18] Thus, our assumption may be a reasonable approximation. The evolution of lenders' wealth, W_L, in this case is simply:

$$W_L^{t+1} = (1-\alpha)[e + p \cdot y_N + rW_L^t]. \tag{12}$$

We assume that lenders receive the same endowment in tradeable good e as entrepreneurs. Moreover, they sell the non-tradeable input and receive interest income on last period's wealth. In our context it does not matter whether lenders lend to domestic entrepreneurs or to the international capital markets since we only examine net capital flows. Interestingly, consumption fluctuates in parallel with output and investment. For example, in periods of booms the non-tradeable price p increases and this increases lenders' income and therefore consumption.

Since total national savings is equal to $W_B + W_L$ and total investment is $(1+\mu)W_B$ when firms are credit constrained, net capital flows or equivalently the current account CA (savings minus investment) is equal to $W_L - \mu W_B$. It is interesting to examine how the current account evolves with the cycle, i.e., how it changes with W_B (assuming we stay in the credit-constrained case):

$$\frac{dCA^t}{dW_B^t} = \frac{dW_L^t}{dW_B^t} - \mu$$

Clearly the current account is countercyclical ($dCA^t/dW_B^t < 0$) for μ large, precisely the case where oscillations or cycles are likely.[19] For example, with a Leontief production function, the current account is countercyclical when $\mu > (1-\alpha)/\alpha$.

[18] See Campbell and Mankiw (1989, 1991). Copelman (1996) and de Brouwer (1996) provide evidence for some emerging markets.

[19] dW_L/dW_B may also depend positively on μ, but it can be shown that this effect is less than proportional.

It is useful at this stage to summarize the evolution of the main macroeconomic variables. The economy has oscillations or cycles for intermediate values of μ. Booms periods are characterized by higher growth in output, investment, consumption, and total savings. Moreover, there are net capital inflows or a current account deficit as well as a real appreciation. In periods of slumps the reverse is observed.

3 Financial Liberalization and Instability

The previous analysis shows that a fully open economy with imperfect credit markets exhibits volatility or a cycle. We show in this section that the same economy is stable if it is closed to capital flows or if only foreign investment (FDI) is allowed. Thus a full liberalization to capital movements may destabilize an economy: while it stabilizes the real interest rate, it also amplifies the fluctuations in the price of the non-tradeable input; which, in turn, increases the volatility in firms' cash-flows and therefore aggregate output.

That full financial liberalization may de-stabilize an emerging market economy, also comes out quite clearly from the following experiment, described in more detail in Appendix C: consider opening to foreign borrowing and lending a closed economy which previously had its total investment constrained by domestic savings ($W_B + W_L$). The opening up of the economy then results in net capital inflows as investors can satisfy their excess demand for funds in international capital markets. The corresponding increase in borrowings will increase the scope for bidding up the price of the non-tradeable input, thereby inducing permanent fluctuations in p, W_B and aggregate output. Figure 8 presents an illustration of a liberalization in the Leontief case. The wealth schedule shifts up after a financial liberalization. $\widetilde{W}_B$ refers to the stable steady-state level of borrowers' wealth before the economy opens up to foreign borrowing and lending.[20]

[20] This initial value is assumed to be sufficiently small that the non-tradeable input is not fully employed in domestic production in the absence of borrowing and lending, so that $p = 0$ initially.

After the liberalization W_B progressively increases as capital inflows allow investors to increase their borrowing, investments and profits. During the first two periods following the liberalization, the demand for the non-tradeable input remains sufficiently low that $p = 0$. In period 3 (at W_B^3) p increases but we still have growth. However, in period 4 (at W_B^4) the price effect of the liberalization becomes sufficiently strong as to squeeze investors' net worth, thereby bringing on a recession. At that point, aggregate lending drops, capital flows out and the real exchange depreciates (p drops). The resulting gain in competitiveness allows firms to rebuild their net worth so that growth can eventually resume. Thereafter, the economy ends up experiencing permanent fluctuations of the kind described in the previous section.

We should stress that the dynamics in Figure 8 occurs only for *intermediate* levels of financial development. As we argued in Section 2, with a large μ there is no volatility, as it is the third segment of the curve that cuts the $45°$ line.[21] When μ is too low investment capacity is likely to be smaller than savings in the closed economy (i.e., $W_B(1+\mu) < W_B + W_L$). In this case, a financial opening will not help investment and no capital inflow will occur, so that there will be no upward pressure on relative prices.[22] It is obviously desirable for a country to increase its μ, i.e., to develop the domestic financial sector *before* fully opening up to foreign lending.

Whilst a full financial liberalization can have destabilizing effects on economies with intermediate levels of financial development, those economies are unlikely to become volatile as a result of opening up to foreign *direct* investments alone. We distinguish FDI from other flows by assuming that it is part of firms' equity and that FDI investors have full information about firms.[23] Furthermore, we first concentrate on the benchmark

[21]When several developed countries did liberalize their capital movements in the 1970s and 1980s periods of high instability could not be observed.

[22]This may be the case in some of the poorer African and Asian countries.

[23]Typically, measured FDI implies participations of more than 10% in a firm's capital so this appears to be a reasonable assumption. Razin et al (1998) make a similar distinction about FDI.

case where the supply of FDI is infinitely elastic at some fixed price greater than the world interest rate, say equal to $r + \delta$.[24]

Then, starting from a situation in which domestic cash flows are small and therefore domestic investment cannot fully absorb the supply of non-tradeable inputs, foreign direct investors are likely to come in to profit from the low price of the non-tradeable inputs. This price will eventually increase and it may even fluctuate as a result of FDI. But these price fluctuations will only affect the distribution of profits between domestic and foreign investors, not aggregate output. For example, in the Leontief case with FDI, aggregate output will stabilize at a level equal to the supply of non-tradeable resources y_N, whereas the same economy may end up being destabilized if fully open to foreign *indirect* investment (i.e., to foreign lending).

Similarly, consider the economy described above, but now with the economy open to foreign *direct* investment only. Then FDI will flow into the economy as long as the rate of return on that investment remains greater than or equal to $r + \delta$. Thus, if F denotes the net inflow of direct investment, we have, in equilibrium:

$$F > 0 \Rightarrow R = r + \delta,$$

where $R = \frac{y_t - rL}{W_B + F}$ is the net rate of return on foreign direct investment.

Now using the fact that $L = \mu(W_B + F)$ and that $y_T = \psi(p^t)(W_B + F + L)$, we can rewrite the above free-entry condition as:

$$r + \delta = \psi(p^t) + (\psi(p^t) - r)\mu.$$

In other words, if there are no limitations on FDI inflows and outflows, the price of the non-tradeable input and therefore aggregate domestic GDP or GNP will remain constant in equilibrium.

[24] This, in turn, implies that in our model FDI is a substitute to domestic investment. The effects of FDI on macroeconomic volatility when domestic and foreign investments are complementary, are discussed at the end of this section.

The reason why FDI acts as a stabilizing force is again that, unlike foreign lending, it does not depend on the creditworthiness of the domestic firms, and furthermore it is precisely during slumps that foreign direct investors may prefer to come in to profit from the low price of the non-tradeable good.

Now what happens if foreign *direct* investment becomes *complementary* to domestic direct investment, i.e., to W_B? Such complementarity may be due to legal restrictions whereby the total amount of FDI cannot be greater than a fixed fraction x of domestic investors' wealth W_B, or it may stem from the need for local investors to enforce dividend payments or to help exert control. Appendix C shows that foreign direct investments that are subject to complementarity requirements of the form $F \leq xW_B$, may sometimes *de*-stabilize an emerging market economy. Indeed, in contrast to the unrestricted FDI case analyzed above, direct investments that are subject to the above constraint will end up being *lower* during slumps, i.e., when investors' wealth W_B^{t+1} is experiencing a downturn; moreover, downturns will typically be deeper than in absence of FDI since, by amplifying the increase in p^t during booms, FDI also accentuates the credit-crunch induced on firms by the corresponding increase in their production costs. Thus whilst unrestricted FDI has a stabilizing effect on an open emerging market economy, opening such an economy to restricted FDI may actually have opposite effects.

4 Extensions and Policy Conclusions

The previous sections have analyzed a stylized model that illustrates how the interaction between credit market imperfections and real exchange rate fluctuations can cause instability in some open economies. We have purposely abstracted from numerous factors making the analysis more realistic which could further affect the dynamics. In this section we examine several directions in which our simple framework can be extended.

4.1 Analyzing Monetary and Exchange Rate Policy

Our analysis so far has focused on the real sector of the economy. However, nominal and monetary factors are often an integral part of financial crises and volatile environments. For example, policies of pegged nominal exchange rates and subsequent speculative attacks are often blamed as being responsible for the crises. The impact of devaluations on firms' finances and the optimal policy response after a crisis are also crucial issues.

Our basic framework can be easily extended to incorporate a nominal sector. Here we sketch a simple model with money neutrality. We show that a flexible exchange rate would mirror fluctuations in the relative price of the non-tradeable input, p. With a fixed exchange rate, it is the level of central bank's foreign exchange reserves that mirrors fluctuations in p. We first introduce nominal prices: p_T for the output good and p_N for the non-tradeable input good. The relative price of the non-tradeable input is $p = p_N/p_T$.

We assume that money must be held in advance to buy either the tradeable good or the non-tradeable input and that the seller's currency is used by convention. If the aggregate quantity of money is M, in equilibrium we simply have

$$M = p_T y_T + p_N y_N \tag{13}$$

(the cash-in-advance constraint is binding since interest rates are positive). Let s be the nominal exchange rate, defined as the quantity of domestic currency per unit of the foreign currency. Assuming Purchasing Power Parity (PPP) on traded goods and foreign prices for that good equal to unity, i.e., $p_T = s$, a flexible exchange rate is given by (using (13), the PPP assumption and the definition of p):

$$s = \frac{M}{y_T + p y_N} \tag{14}$$

In the Leontief case, y_T and y_N are constant so that s only depends on M and p.

Movements in the relative price of the non-tradeable input are then fully reflected in the nominal exchange rate (a decrease in s reflecting an appreciation of the domestic currency).

Consider now a fixed exchange rate policy. In this case, s is fixed at $\overline{s}$ and M is endogenously determined by money demand. What is most interesting is the evolution of foreign exchange reserves at the central bank. The central bank's balance sheet is described by the equation: $M = DC + IR$, where DC represents domestic credit and IR international reserves. Assume that DC consists exclusively of existing government debt, fixed at $\overline{DC}$. From (13), and the fact that $p_T = \overline{s}$, the evolution of IR is given by

$$IR = \overline{s}(y_T + py_N) - \overline{DC} \tag{15}$$

International reserves move in parallel with the non tradeable's price p, so that periods of capital inflows (outflows) are reflected by increases (decreases) in both p and IR. In particular, the fall in p during slumps will correspond to a decline in international currency reserves. This decline in international reserves may in turn become critical: in line with the speculative attack literature, there may typically be a lower limit of reserves at which the central bank is forced to abandon the fixed exchange rate.[25] Consequently, downturns in lending at the end of booms will be associated with a depletion of reserves and the abandonment of the fixed exchange rate policy. Interestingly, the kind of currency crisis we are describing is not caused by inconsistent policies as argued in most of the speculative attack literature, but rather by the endogenous changes in firms' financial health.[26]

[25]See Krugman (1979).

[26]The optimal monetary policy response to financial crises cannot be directly analyzed using the above model where money is neutral. However, if prices were rigid and money demand depended negatively on the interest rate, it would be possible to analyze the impact of unexpected monetary shocks. See Aghion, Bacchetta, and Banerjee (1999) for such an analysis.

4.2 Uncertainty and Defaults

The model presented above can easily be extended to incorporate random project returns and defaults. With a risk of default from borrowers, lenders will charge a risk premium on their loans. If we denote the interest rate on a risky loan by R, we have $R > r$ where r is the international interest rate (the interest rate in the absence of default risk); the risk premium is thus $R - r$.

Suppose that the tradeable output technology is random, equal to $\widetilde{\sigma} \cdot f(K, z_N)$ where the firm-specific productivity shock $\widetilde{\sigma}$ is uniformly distributed on the interval $[\underline{\sigma}, \overline{\sigma}]$ and is realized at the end of the period. The same will be true for the *equilibrium* gross return generated by investors, namely:

$$\begin{aligned} \widetilde{y}_T &= \max_{z_N} \widetilde{\sigma} \cdot f(I - p \cdot z_N, z_N) \\ &= \widetilde{\sigma} \cdot \psi(p^t) I, \end{aligned}$$

where $I = W_B + L$ is the current flow of investment.

Now, if an entrepreneur defaults on his debt, it may be genuine because the revenue $\sigma\psi(p)I$ does not cover the repayment obligation on L (a "*liquidity* default"), or it may be deliberate when the entrepreneur chooses not to repay his debt despite the higher chance of facing a penalty (a "*strategic* default"). Consistent with our earlier modelling approach, we assume *strategic* defaults are *ex ante* decisions whereby defaulting borrowers sink a cost of $c \cdot I$ to hide their investment funds I.

But now additional uncertainty about the productivity parameter $\widetilde{\sigma}$ introduces the possibility of *ex post liquidity* defaults, namely whenever $\widetilde{\sigma} < \sigma^*$ where σ^* is defined by the zero profit-condition:

$$\sigma^* \psi(p)(W_B + L) - RL = 0, \tag{16}$$

where R is the repayment obligation specified in the loan contracts between lenders and borrowers (borrowers are protected by limited liability, and therefore cannot be asked to repay more than $\min(\sigma^*\psi(p)(W_B + L), RL))$.

Competition among lenders will set the equilibrium repayment schedule R so as to make any lender indifferent between making a (risky) loan on the domestic market and making a safe loan at rate r on the international credit market ($R = r$ in the absence of uncertainty). More formally:

$$rL = \int_{\underline{\sigma}}^{\overline{\sigma}} \min(RL, \tilde{\sigma}\psi(p)(W_B + L)) \frac{d\sigma}{\overline{\sigma} - \underline{\sigma}} \tag{17}$$

Appendix D shows that the number of defaulting firms, equal to $(\sigma^* - \underline{\sigma})/(\overline{\sigma} - \underline{\sigma})$, can be easily derived from (16) and (17). It is shown that this number is increasing in p (and thus in W_B) when entrepreneurs are credit constrained. Thus, the number of defaults increases during periods of real appreciations, which in turn happen towards the end of booms. This prediction appears to be consistent with available anecdotal evidence on the dynamics of default rates in emerging market economies.[27]

Once a firm defaults, it is often declared bankrupt. If we assume that bankruptcy is declared one period after the default, then our model predicts a counter-cyclical number of bankruptcies in equilibrium, with the highest number of bankrupted firms being observed in slumps. If we further assume that bankruptcies involve a substantial liquidation or restructuring cost, borne by the entrepreneurial class in the following periods either directly (disruption of supply chains, etc.) or indirectly (because the government needs resources for the clean-up and taxes the entrepreneurs for them), then the slumps may ultimately be significantly deeper and longer-lasting than what our benchmark model predicts. Notice, however, that bankruptcy costs will significantly deepen the slumps only in those economies facing credit constraints.

[27]See Mishkin (1996) for the case of Mexico, and World Bank (1997) for capital inflows episodes.

4.3 Amplifying Factors

Additional destabilizing factors of the kinds discussed in the recent literature on the East-Asian crisis, which in economies with highly developed financial systems would have little or no impact on the dynamics of real economic activity, are likely to exacerbate output volatility in economies with intermediate levels of financial development. In the model, this implies that μ can be pro-cyclical. The following discussion is largely informal and suggestive, as a more elaborated analysis would certainly require another paper.

4.3.1 Moral hazard on the lenders' side

Suppose that the bulk of lending activities is performed by banks, which in turn are regulated by the central bank or by the government. Now, in most countries (including such developed countries as Japan or France) banking regulation is imperfect and what we often observe over the cycle is that banks tend to *overlend* during booms. This in turn may be due, either to an *overload* problem (there are too many lending opportunities during booms and banks have limited time and attention to perform adequate screening and monitoring on each project), or to an increase in *bank competition*[28] (which in turn may induce some banks to engage in preemptive lending). This tendency for banks to overlend during booms can be easily captured in our model by assuming that the credit-multiplier μ varies pro-cyclically. A small pro-cyclical variation of μ around a given average $\overline{\mu}$ would have no effect on the dynamics of wealth and output if $\overline{\mu}$ is sufficiently large, in other words if the financial system is sufficiently developed.[29] (For example, the S & L crisis did not produce major macroeconomic effects on the U.S. economy.) However, if $\overline{\mu}$ lies in the intermediate range for which the 45° line intersects the wealth schedule $W_B^{t+1}(W_B^t)$ on its downward sloping part, then pro-cyclical

[28] Competition may increase because of an increase in the volume of lending - loan officers who fail to make lots of loans at time when everybody else is increasing lending, may fear that they will look inept.

[29] When $\overline{\mu}$ is sufficiently high the 45° line intersects the wealth schedule $W_B^{t+1}(W_B^t)$ on its rightward upward sloping part, so that the dynamics of wealth is actually independent of μ.

fluctuations of μ will obviously exacerbate volatility in the corresponding economy (as overlending will magnify the price effect during booms). In other words, moral hazard in the financial sector can be an important source of instability, but only in an economy with an intermediate level of financial development.

4.3.2 Investors' overreactions to changes in fundamentals

Consider further a straightforward extension of our model with defaults in which foreign investors have imperfect information about the efficiency of creditors' monitoring (and therefore about the actual value of the credit-multiplier μ).[30] Then, suppose that the economy experiences a negative but temporary productivity shock (i.e., a negative but temporary shock to σ) which will naturally have the effect of increasing the equilibrium amount of defaults in the short-run. Now, given that the lenders are uncertain about μ, if they do not observe the shock to σ, they will not know whether to ascribe these extra defaults to a change in σ or to lower value of μ - in other words, they will be unsure of whether most of these are strategic defaults (suggesting incompetence of the financial sector) or rather liquidity defaults (associated with a shock to profits). As a result they will respond in part by adjusting their assessment of μ downwards. From then on, the comparison between an economy with a level of financial development (i.e., a high μ) and an economy with an intermediate level of financial development (i.e., an intermediate level of μ) exactly parallels the previous case: if μ is high, the updating of μ will have no effect on the dynamics of wealth and output, since the $45°$ line intersects the wealth schedule $W_B^{t+1}(W_B^t)$ on its third-upward-sloping part;[31] on the other hand, if we start from an economy at an intermediate level of financial development, the downward updating in μ will prolong and amplify the initial effect of the temporary productivity shock on σ. This implies, for example, that the number of defaults can increase over

[30] For example, financial liberalization has just occurred and foreign investors cannot yet asses the new monitoring cost c that should result from it.

[31] We implicitly assume that the updating on c, and therefore on μ, is relatively small.

several periods.

Once again, the model tells us that overreactions by investors, as captured for example in models which stress herd behavior, can only be source of substantial instability in economies at a certain stage of financial development.

4.4 General Policy Conclusions

What is our model telling us about what should be done *ex post*, for example, in the Asian economies that are currently in crisis? A first implication of our model is that slumps should be seen as part of the normal process in economies like these which are both at an intermediate level of financial development and in the process of liberalizing their financial sectors. This is a clear warning that we should not view these emerging market economies as being beyond repair. Calls to undertake hasty and radical overhauling of their economic system should thus be restrained.[32]

Second, policies allowing firms to rebuild their credit worthiness quickly will at the same time contribute to a prompt recovery of the overall economy. In this context it is worth considering the role for monetary policy and, more generally, for policies affecting the credit market. Whilst our model in its present form cannot be *directly* used for this purpose since money is neutral (and in any case the interest rate is fixed by the world interest rate), it would be a simple extension to allow for both monetary non-neutrality and a less infinitely elastic supply of foreign loans. Once we take the model in this

[32]Indeed, if our model is right, the slump sets in motion forces which, even with little interference, should eventually bring growth back to these economies. The risk is that by trying to overhaul the system in a panic, one may actually undermine those forces of recovery instead of stimulating them. This is not to deny that there is a lot that needs changing in these economies, especially on the institutional side with the establishment and enforcement of disciplinary rules in credit and banking activities. For example, as argued by Aghion-Armendariz-Rey (1998), unregulated banks often try to preempt potential competitors in booming sectors by investing excessively and too early, that is before they have acquired the necessary information and expertise, into those sectors. In the context of our model, banks may typically engage in preemptive lending to speculators in non-tradeable inputs and/or to tradeable good producers during booms. This in turn will further increase output volatility whenever inadequate monitoring and expertise acquisition by banks increases aggregate risk and therefore the interest rate imposed upon domestic producers.

direction it quickly becomes clear that a low interest rate policy is *not* necessarily the right answer *even in a slump induced by a credit crunch.* The problem is that while such an interest rate reduction may be beneficial by helping restore the firms' financial health (and therefore their investment capacity), if at the same time it leads to a devaluation of the domestic currency, the net obligations of those who have borrowed in foreign currency will also rise. Therefore, the optimal interest rate policy ex post during a financial crisis cannot be determined without knowing more about the details of the currency composition of the existing debt obligations of domestic enterprises.

This emphasis on creditworthiness as the key element in the recovery from the slump also suggests that a policy of allowing insolvent banks to fail, runs the danger of reducing firms' ability to borrow (because of the comparative advantage of banks in monitoring firms' activities[33]) thereby prolonging the slump. If banks must be shut down, there should be an effort to preserve their monitoring expertise on the relevant industries. Moreover to the extent that the government has to spend resources on restructuring and cleaning-up after a spate of bankruptcies, it should avoid raising taxes in a slump since it will further limit the borrowing capacity of the entrepreneurial class to therefore lead to a slower recovery.

Our model also delivers policy implications *ex ante* for emerging market economies *not yet* in the middle of a financial crisis. First, our analysis suggests that an unrestricted financial liberalization may actually *destabilize* the economy and bring about a slump that would not have happened otherwise. If a major slump is likely to be costly even in the long-run (because, for example, it sets in process political forces which are destabilizing), fully liberalizing foreign capital flows and fully opening the economy to foreign lending may not be a good idea at least until the domestic financial sector is sufficiently well-developed (i.e., μ becomes sufficiently large).

[33]See Diamond (1984).

Second, in our model, foreign *direct* investment does *not* destabilize. Indeed, as we have argued above, FDI is most likely to come in during slumps when the relative price of the non-tradeable input is low; furthermore, even if this price ends up fluctuating when the economy is open to FDI, these fluctuations will only affect the distribution of profits between domestic and foreign investors but not aggregate output. Therefore there is no cost a priori to allowing FDI even at low levels of financial development.[34]

Third, what brings about financial crises in our model, is precisely the rise in the price of non-tradeables. If one specific non-tradeable good (say, real estate) could be identified as playing a key role in the emergence of a financial crisis, there could be an argument for controlling its price, either directly or though controlling the speculative demand for that good using suitable fiscal deterrents.

Finally, there may be a role for monetary policies *ex ante* to prevent the occurrence of a financial crisis, i.e., to avoid slumps. One option is to sterilize capital inflows whilst maintaining a fixed exchange rate so as to keep the prices of non-tradeables down. The problem is that such a sterilization may also increase the interest rate to an extent which may again result in domestic firms' net cash revenues being squeezed down, thereby also leading to an investment slump. This, and other important aspects in the design of stabilization policies for emerging market economies, should await future elaborations of the framework developed in this paper.

[34] This strategy of allowing only FDI at early stages of financial development is in fact what most developed countries have done, in particular in Europe where restrictions on cross-country capital movements have only been fully removed in the late 1980's whereas FDI to - and between - European countries had been allowed since the late 1950's.

Appendix A: Proof of Lemma 1

Consider the maximization problem:

$$\max_{z_N} f(I - p \cdot z_N, z_N)$$
$$s.t.\ z_N \le y_N,$$

where f is homogenous of degree one and can thus be reexpressed as:

$$f(K, z_N) = K \cdot g\left(\frac{z_N}{K}\right). \tag{18}$$

The first-order condition for the above maximization problem can be

$$-pf_1 + f_2 = 0, \tag{19}$$

where $f_1 = g\left(\frac{z_N}{K}\right) - \frac{z_N}{K} g'\left(\frac{z_N}{K}\right)$ and $f_2 = g'\left(\frac{z_N}{K}\right)$.

We can reexpress equation (2) as:

$$p = \frac{f_2}{f_1} = h\left(\frac{z_N}{I - pz_N}\right).$$

Note that for a fixed p, if (z_N, I) solves the above equation, so does $(\lambda z_N, \lambda I)$ for any λ. If z_N^* is the solution to the above maximization problem, we have:

$$z_N^* = \alpha(p) I.$$

where $\alpha(p) = h^{-1}(p)/(1 - ph^{-1}(p))$. Substituting for z_N^* in equation (18), we finally obtain the following expression for the aggregate tradeable output in equilibrium:

$$\begin{aligned} y_T &= f(I - p \cdot z_N^*, z_N^*) \\ &= (I - p\alpha(p)I) \cdot g\left(\frac{\alpha(p)}{I - p\alpha(p)}\right) \\ &= I \cdot \psi(p), \end{aligned}$$

where:

$$\begin{aligned}
\psi(p) &= (1 - p\alpha(p))g\left(\frac{\alpha(p)}{I - p\alpha(p)}\right) \\
&= f(1 - p\alpha(p), \alpha(p)).
\end{aligned}$$

Since the non-tradeable good is used as an input only, a straightforward revealed preference argument implies that $\psi(p)$ must necessarily decrease in p.

Appendix B:
Solving the Model with a CES Production Function

In this Appendix we derive the results for the CES case presented in Section 2. Assume that $f(K, z_N) = A(K^\rho + \gamma z_N^\rho)^{\frac{1}{\rho}}$ and f_K, f_Z represent the derivatives with respect to K and z_N. The first order condition with respect to z_N gives $f_Z = pf_K$, which implies:

$$z_N = \left(\frac{\gamma}{p}\right)^{\frac{1}{1-\rho}} \cdot K \tag{20}$$

Since $K = I - pz_N$, (20) implies:

$$I = \phi(p)K \tag{21}$$

where:

$$\phi(p) \equiv 1 + \gamma^{\frac{1}{1-\rho}} \cdot p^{\frac{\rho}{\rho-1}}$$

Moreover Euler's theorem implies that $y_T = f_K K + f_Z Z$, which using the first order condition and the definition of K gives:

$$y_T = f_K \cdot I \tag{22}$$

Using (21) and the expressions for y_T and f_K, after some manipulations we find:

$$y_T = A \cdot \phi(p)^{\frac{1-\rho}{\rho}} \cdot I$$

which gives the definition for $\psi(p)$. It is easy to see that:

$$\psi'(p) = -\frac{\phi(p) - 1}{p\phi(p)} \cdot \psi(p) \tag{23}$$

We can now derive dp/dW_B. By setting $z_N = y_N$, the first order condition (20) can be written as equation (6) (using $K = I - pz_N$). Differentiating (6) with respect to p and W_B gives:

$$\frac{dp}{dW_B} = \frac{(1-\rho)p\phi(p)}{\phi(p) - \rho(\phi(p) - 1)} \frac{1}{W_B} \tag{24}$$

Using (23), (24) and the definition of $\psi(p)$, (5) becomes:

$$\frac{dW_B^{t+1}}{dW_B^t} = (1-\alpha)[\frac{(1+\mu)\psi(p)}{\phi(p)-\rho(\phi(p)-1)} - r\mu]$$

For this expression to be negative, we simply need condition (7).

Finally, we show that fluctuations in W_B^t are reflected positively in y_T^t, i.e., that $dW_B^t/dy_T^t > 0$. From Lemma 1 and the fact that $I^t = (1+\mu)W_B^t$, this inequality implies that:

$$\psi(p) + W_B\psi'(p)\frac{dp}{dW_B} > 0$$

Using (23) and (24), the latter condition implies that

$$1 - \frac{(1-\rho)(\phi-1)}{\phi-\rho(\phi-1)}$$

which always hold since $\phi > 1$.

Appendix C:
The Analytics of Financial Liberalization

In this Appendix we construct an example of an economy with an intermediate degree of capital market imperfection which, in the absence of foreign borrowing and lending, would be stable and actually converge to a permanent boom, but which becomes permanently volatile once fully open to foreign borrowing and lending. We then show that a liberalization to restricted FDI can also destabilize. We focus on the Leontief production function.

More formally, consider an economy whose financial markets are initially closed to foreign capital inflows so that the aggregate supply of funds available to domestic investors, I^t, is now equal to the min of the investment capacity $(1+\mu)W_B^t$ and of total domestic savings $W_B^t + W_L^t$, where W_L^t denotes the disposable wealth of *domestic* lenders at the beginning of date t.[35] That is:

$$I^t = \min\{(1+\mu)W_B^t, W_B^t + W_L^t\}.$$

With a Leontief production function, there are two cases (as in 2.3):

(a) $I^t < ay_N$: then $p^t = 0$ and the dynamics of entrepreneurs' wealth is given by:

$$W_B^{t+1} = (1-\alpha)[e + \frac{1}{a}I^t - \widetilde{r}(I^t - W_B^t)], \tag{I}$$

where $\widetilde{r}$ is the domestic interest rate, equal to $\frac{1}{a}$ if $\mu W_B > W_L$ (i.e., if investment capacity is greater than savings) and equal to the opportunity cost of lending (say $\widetilde{r} = \underline{\sigma}$) if $\mu W_B < W_L$.

(b) $I^t > ay_N$: then $p^t = \frac{I_t - ay_N}{y_N}$ and the dynamics of entrepreneurs' wealth is expressed by the equation:

$$W_B^{t+1} = (1-\alpha)[e + y_N - \widetilde{r}(I^t - W_B^t)]. \tag{II}$$

[35]Aghion, Banerjee, and Picketty (1999) analyze a closed economy version of this economy when relative prices are constant.

Since total funds to investors I^t now depend on domestic lenders' wealth W_L^t, we need to specify the dynamic equation for W_L^t. Taking $e \simeq 0$ for simplicity, we have:

$$W_L^{t+1} = (1-\alpha)[p^t y_N + \tilde{r} W_L^t].$$

Now, one can show the existence of parameter values for which this economy with closed financial markets converges to a permanent 'boom'[36] (with $\tilde{r} = \frac{1}{a}$ and $p^t = 0$) even though the economy experiences persistent cycles once financial markets are fully liberalized, i.e., open to foreign borrowing and lending.

More formally, during a 'boom' (i.e., when $\mu W_B > W_L$) with $p^t = 0$, the dynamics of domestic entrepreneurs' and domestic lenders' wealth endowments, respectively W_B^t and W_L^t, is governed by the equations:

$$\begin{aligned} W_B^{t+1} &= (1-\alpha)[\frac{1}{a}(W_B^t + W_L^t) - \frac{1}{a}W_L^t] \\ W_L^{t+1} &= (1-\alpha)\frac{1}{a}W_L^t \end{aligned} \tag{25}$$

Notice that we need $(1-\alpha)\frac{1}{a} \leq 1$ to have a stationary value for W_L. If $q_t = \frac{W_B^t}{W_L^t}$ denotes the ratio between domestic entrepreneurs' and lenders' wealth endowments at date t, then during 'booms':

$$q^{t+1} = q^t = q^0, \quad \text{where } \mu q^0 > 1.$$

During a 'slump' ($\mu W_B > W_L$), the dynamic equations for W_B^t and W_L^t become:

$$\begin{aligned} W_B^{t+1} &= (1-\alpha)[\frac{1+\mu}{a} - \mu\underline{\sigma}]W_B^t \\ W_L^{t+1} &= (1-\alpha)\underline{\sigma}W_L^t. \end{aligned} \tag{26}$$

Hence during slumps:

$$q^{t+1} = [\frac{1+\mu}{a\underline{\sigma}} - \mu]q^t$$

[36]The terms 'boom' and 'slump' are borrowed from Aghion, Banerjee and Picketty (1999) who analyze the closed economy version of the model. It should be noticed, however, that in a closed economy 'boom' growth is usually smaller that in open economy boom.

A sufficient condition for the economy to converge to a permanent boom is $\frac{1}{a\underline{\sigma}} > 1$; and for this permanent 'boom' to be consistent with $p^t \equiv 0$ we need that

$$W_B^{t+1} + W_L^{t+1} = I^{t+1} < ay_N \quad \text{for all } t.$$

Consider an example where $1 - \alpha = a = (\mu r + \varepsilon)^{-1}$, with $\varepsilon > 0$ and small, $\underline{\sigma} = 1$ and $r = 1 + \mu$. The reader can check that in this example for e sufficiently small the *closed* economy converges to a permanent 'boom' with $p^t \equiv 0$, whilst the same economy, once *fully* open to foreign lending and borrowing, exhibits *permanent fluctuations*. More precisely, it can be verified that $dW_B^{t+1}/dW_B^t \leq -1$ and that the downward segment of the curve crosses the 45° line.

Now we want to show that FDI can also be destabilizing when it is restricted. Consider the Leontief case where $y_T = \min\left(\frac{K}{a}, z_N\right)$, and let us impose the constraint: $F \leq xW_B$, with the fraction x being initially small. The equilibrium price for the non-tradeable good is now equal to:

$$p^t = \max(0, \frac{(1+\mu)(W_B^t + F^t) - ay_N}{y_N}).$$

Let $L^t = \mu(W_B^t + F^t)$. Then the dynamics of investors' wealth is described by the equations:

$$\text{(I)} \qquad W_B^{t+1} = (1-\alpha)\left[e + \frac{1}{a}(W_B^t + F^t + L^t) - rL^t\right]$$

when W_B^t is small and therefore $p^t \equiv 0$ (part 1 of the $W_B^{t+1}(W_B^t)$ curve)

$$\text{(II)} \qquad W_B^{t+1} = (1-\alpha)\left[e + \frac{y_N}{1+x} - rL^t\right]$$

when there is excess demand for the non-tradeable good and therefore p^t becomes positive (part 2 of the $W_B^{t+1}(W_B^t)$ curve).

For x sufficiently small, we have $F^s = xW_B^s$ so that the above equation (II) implies a total level of *direct* investment (domestic and foreign) equal to:

$$W_B^{t+1} + xW_B^{t+1} = (1+x)(1-\alpha)\left[e + \frac{y_N}{1+x} - r(1+x)\mu W_B^t\right],$$

which for e small is unambiguously decreasing in x. In particular, starting from an economy without any FDI, introducing highly constrained FDI may end up *deepening* the slump whilst it should obviously amplify the boom and the resulting increase in the price of the non-tradeable input.[37]

[37]This in turn will lead to a higher level of investors' wealth during a boom, i.e. to a higher level of W_B^t, which in turn will further contribute to aggravating the credit crunch and therefore the slump experienced next period by domestic firms.

Appendix D: Uncertainty and Defaults

Here we derive the number of defaulting firms when there is firm-specific uncertainty. Deriving RL from (16) and substituting into (17) gives:

$$rL = \frac{\psi(p)(W_B + L)}{\overline{\sigma} - \underline{\sigma}} \int_{\underline{\sigma}}^{\overline{\sigma}} \min(\sigma^*, \sigma) d\sigma \tag{27}$$

The number of defaulting firms, $(\sigma^* - \underline{\sigma})/(\overline{\sigma} - \underline{\sigma})$, can be derived from (27). When firms are credit constrained, we can use the fact that $L/(W_B + L) = c/r$ and get:

$$\sigma^* = \overline{\sigma} - \sqrt{(\overline{\sigma} - \underline{\sigma})[\overline{\sigma} + \underline{\sigma} - \frac{2c}{\psi(p)}]}$$

Thus, σ^* depends positively on p and so does the number of defaulting firms. Since p is a positive function of W_B, σ^* depends also positively on W_B. On the other hand, when entrepreneurs are unconstrained the numbers of defaults depends negatively on W_B (the larger the wealth, the smaller the probability of defaults). In that case we have:

$$\sigma^* = \overline{\sigma} - \sqrt{(\overline{\sigma} - \underline{\sigma})[\overline{\sigma} + \underline{\sigma} - \frac{2(I - W_B)}{I}]}$$

where I is determined by the world interest rate r.

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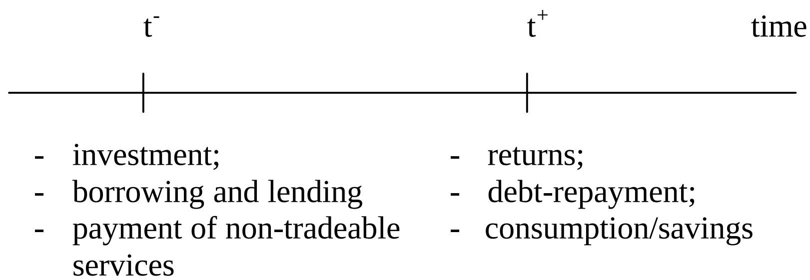


Figure 1: The Timing

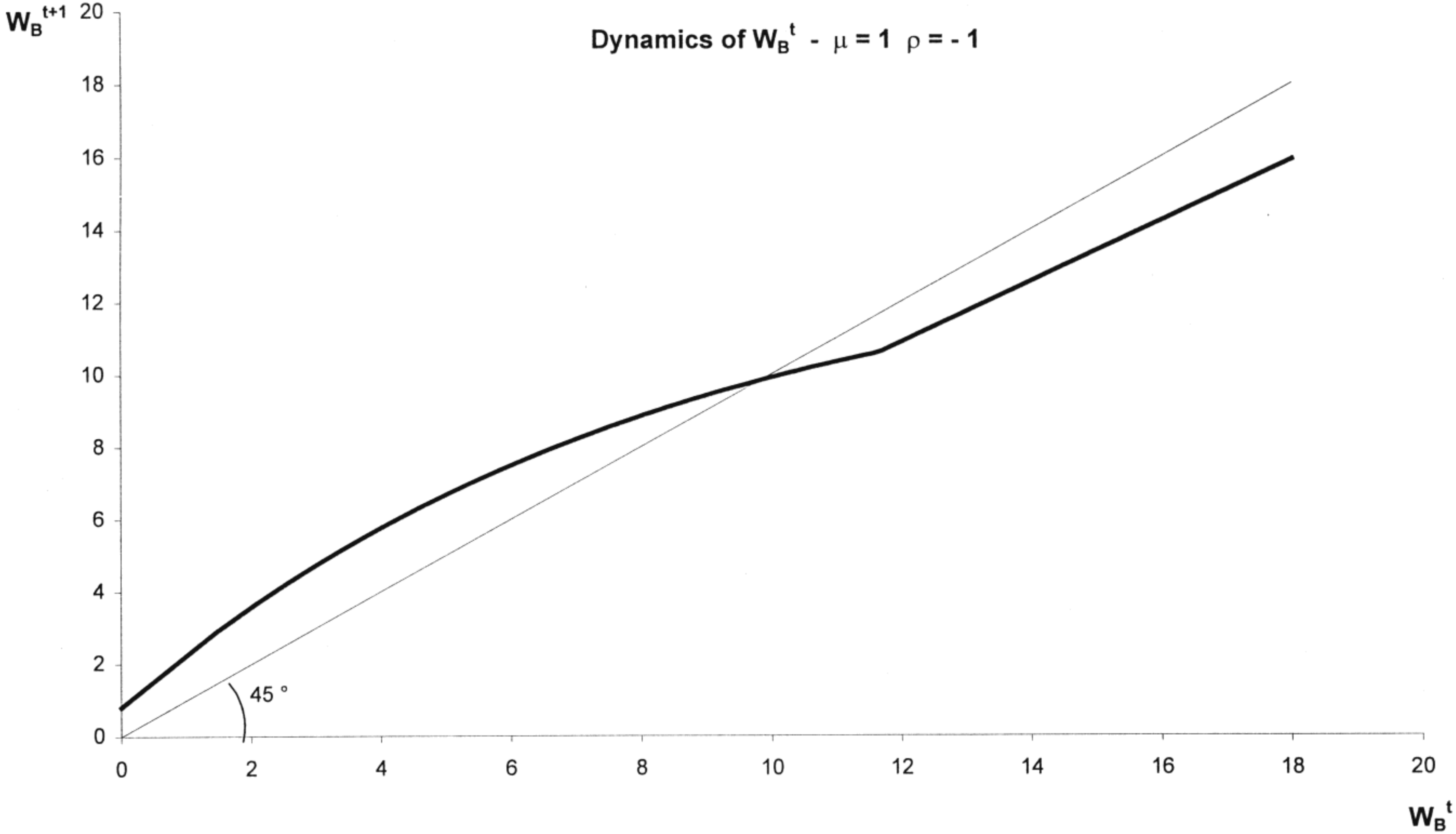
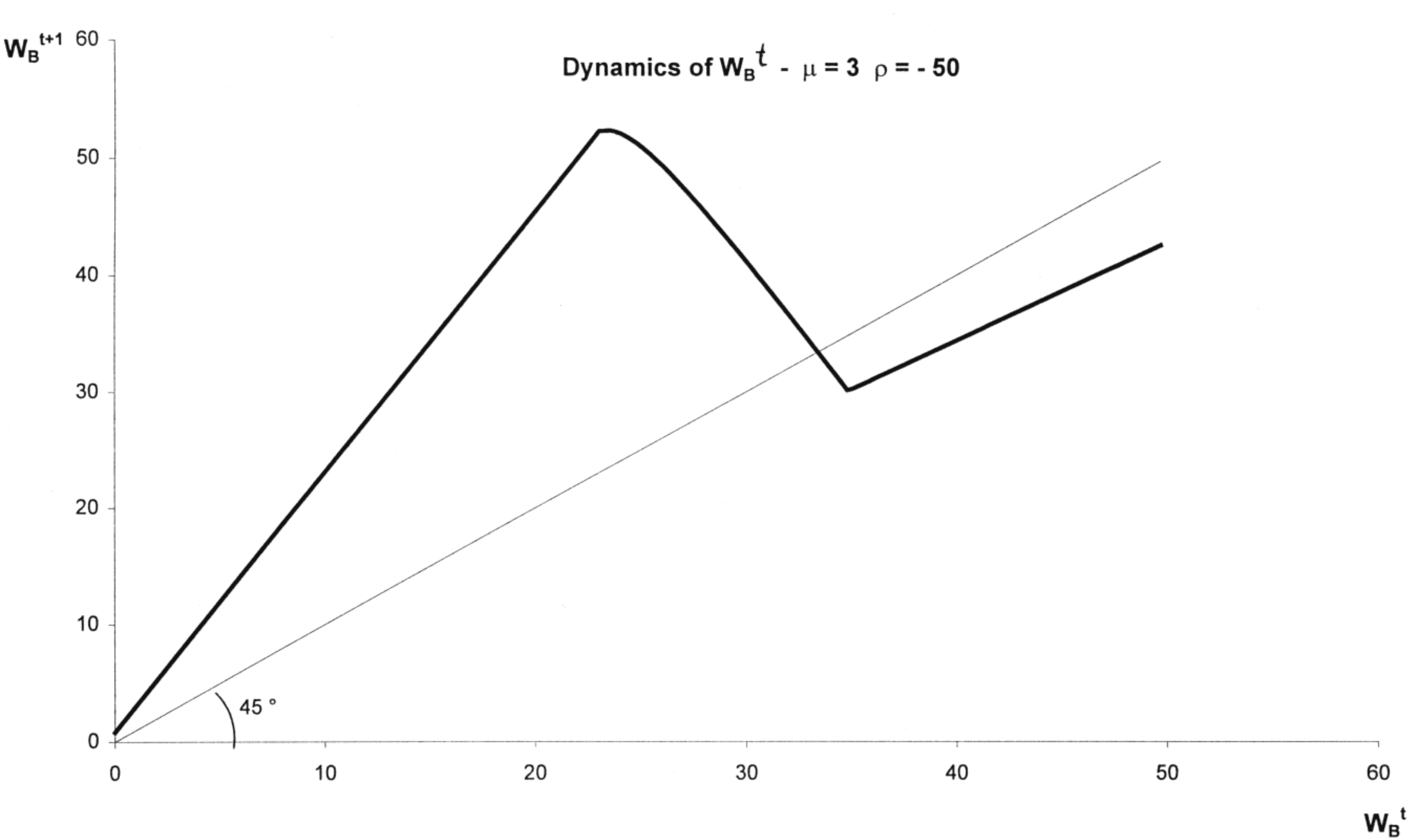


Figure 2



Dynamics of $W_B{}^t$ - $\mu = 3$ $\rho = -50$
$W_B{}^{t+1}$
60
50
40
30
20
10
0
45 °
0
10
20
30
40
50
60
$W_B{}^t$

Figure 3

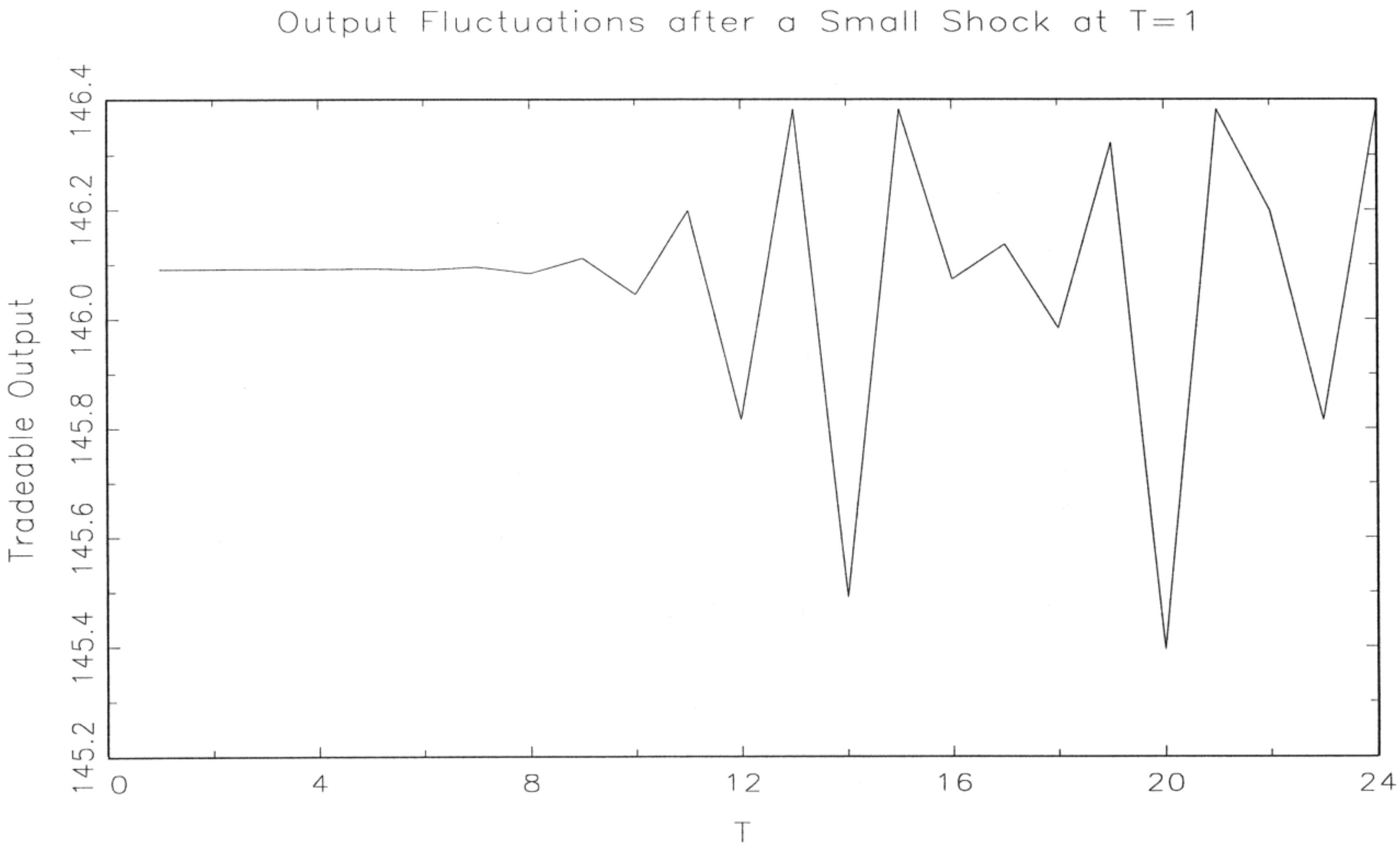

Output Fluctuations after a Small Shock at T=1
Tradeable Output
145.2
145.4
145.6
145.8
146.0
146.2
146.4
0
4
8
12
16
20
24
T

Figure 4

The Leontief Case

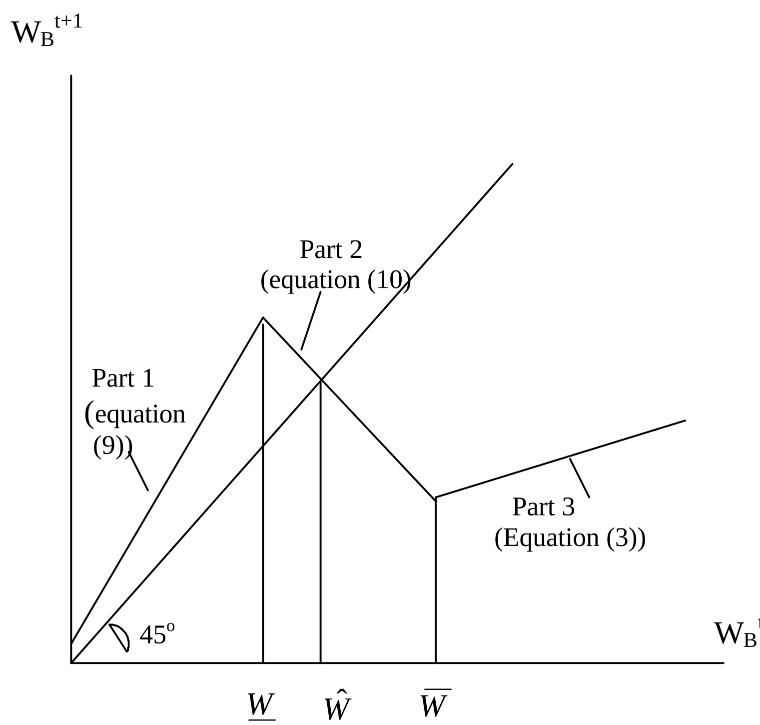


Figure 5

Permanent productivity shock

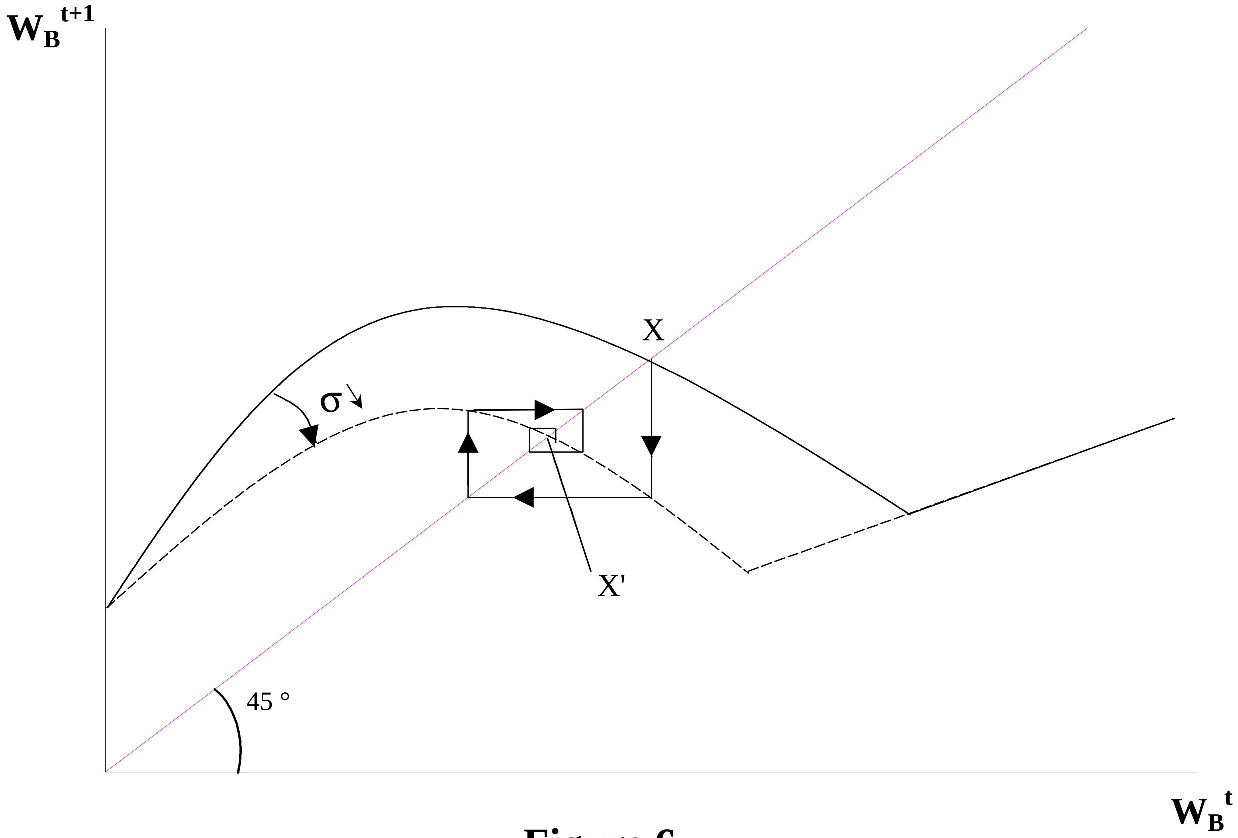


Figure 6

Temporary productivity shock

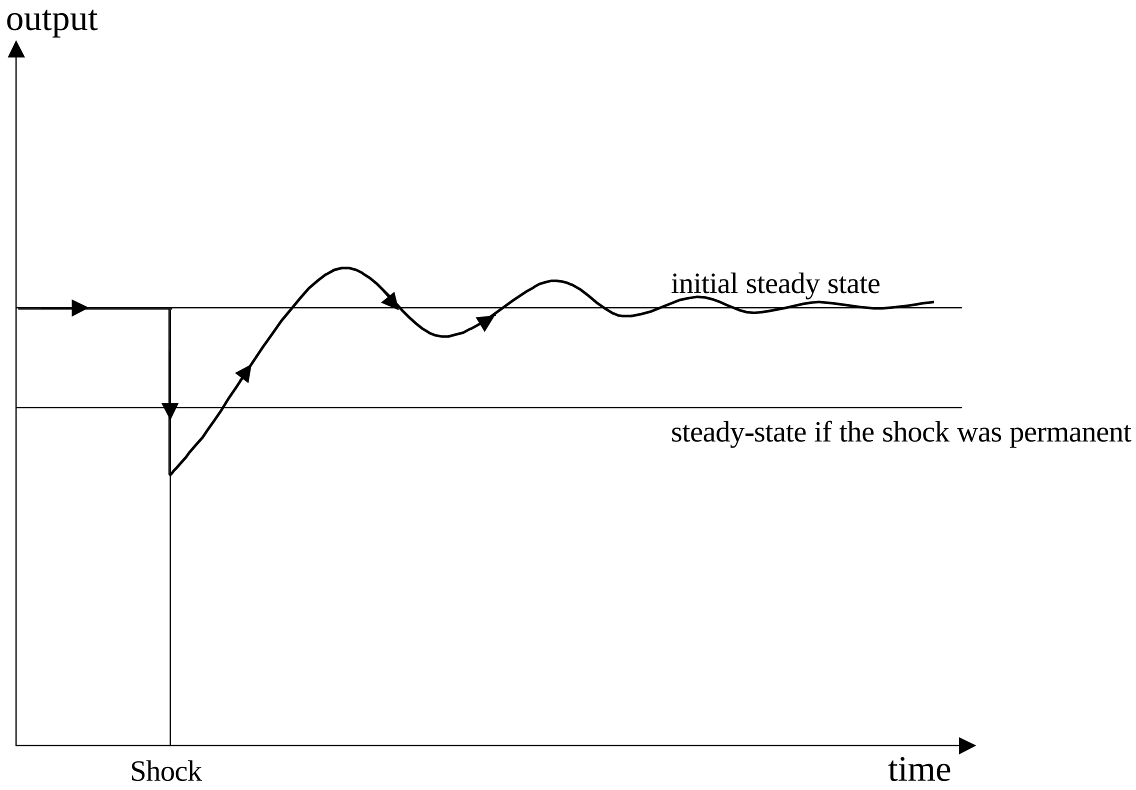


Figure 7

Financial Liberalization

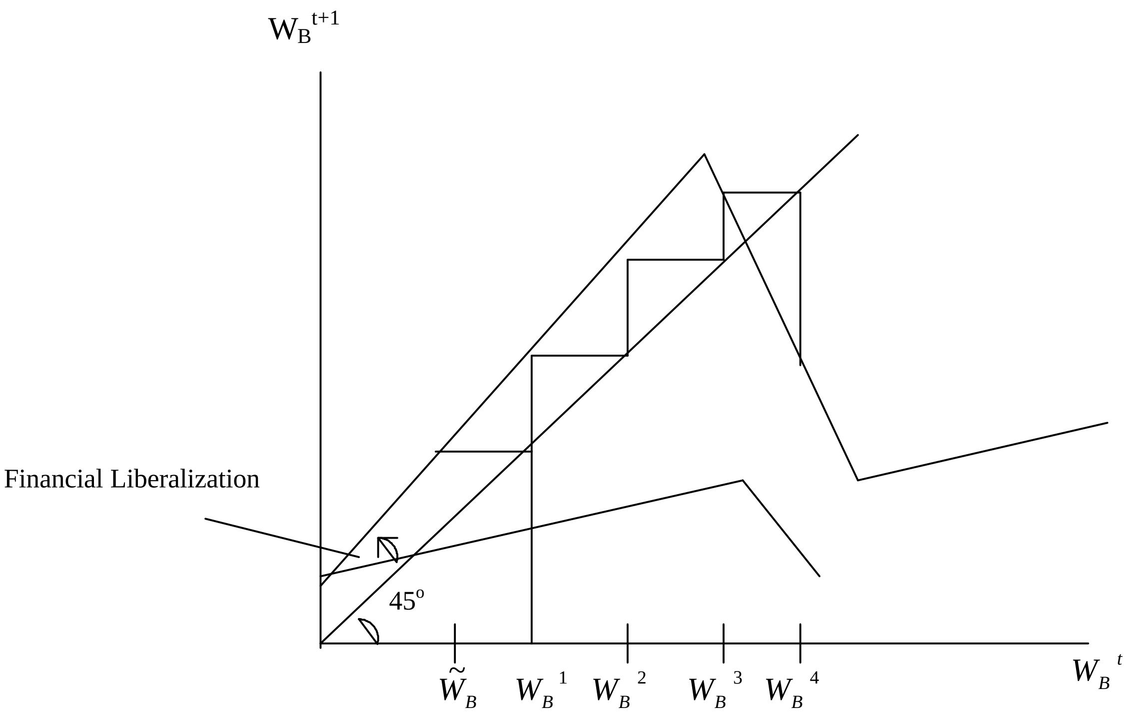


Figure 8