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Journal of Monetary Economics 51 (2004) 1077–1106
Journal of MONETARY ECONOMICS
www.elsevier.com/locate/econbase

Financial development and the instability of open economies ☆

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Received 2 January 2002; received in revised form 7 July 2003; accepted 3 December 2003

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 a tradeable good produced with capital and a country-specific factor. We also assume that firms face credit constraints, with the constraint being tighter at a lower level of financial development. A basic implication of this model is that 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 cycles. Thus, countries that are going through a phase of financial development may become more unstable in the short run. Similarly, full capital account liberalization may destabilize the economy in economies at an

☆ We are grateful to an anonymous referee, Beatriz Armendariz, Laura Bottazzi, Raquel Fernandez, Ed Glaeser, Urban Jerman, Hélène Rey, David Weil, and seminar participants at Harvard University, the Universitat Autònoma of Barcelona, and the LSE/FMG conference on market liquidity for comments on a previous draft. Pierre-Alain Bruchez provided excellent research assistance. Financial support from the MacArthur Foundation (Banerjee and Aghion) and the NSF (Banerjee) is gratefully acknowledged. Bacchetta's work on this paper is part of a research network on "The Analysis of International Capital Markets: Understanding Europe's role in the Global Economy," funded by the European Commission under the Research Training Network Program (Contract No. HPRN-CT-1999-00067).

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doi:10.1016/j.jmoneco.2003.12.001

intermediate level of financial development: phases of growth with capital inflows are followed by collapse with capital outflows. On the other hand, foreign direct investment does not destabilize.

JEL classification: E32; F30; F40

Keywords: Financial development; Volatility; Financial liberalization

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 a tradeable good produced with internationally mobile capital and a country-specific factor. Moreover, 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 at an intermediate level of financial development—rather than the very developed or underdeveloped—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 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 (i.e., opening the domestic market to foreign capital flows) may actually destabilize, inducing chronic phases of growth with capital inflows followed by collapse with capital flight. On the other hand, foreign direct investment never destabilizes since foreign direct investors come in with their own credit—their ability to invest is unrelated to the state of the domestic economy. Overall, 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 sometimes be a reasonable approach.

Third, our model allows us to assess the macroeconomic effects of specific shocks to the financial sector such as overlending by banks (leading to a phase of bank

[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 et al., 1999).

failures) or overreaction by investors to a change in fundamentals.[2] Once again, our model predicts these shocks to have their most persistent effects when financial markets are at an intermediate stage of development.

The basic mechanism underlying our model is a combination of two forces: on one side, greater investment leads to greater output and ceteris paribus, higher profits. Higher profits improve creditworthiness and fuel borrowing that leads to greater investment. Capital flows into the country to finance this boom. At the same time, the boom in investment increases the demand for the country-specific factor and raises its price relative to the output good (unless the supply of that factor is extremely elastic). This rise in input prices leads to lower profits 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.

The reason why an intermediate level of financial development is important for this result is easy to comprehend: at very high levels of financial development, most firms' investment is not constrained by cash flow so 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 an effect intense enough to be a source of instability.

This last argument also helps us understand why opening the economy to foreign capital may destabilize: essentially, the response of an economy with a closed capital market to a cash flow shock is limited since only so much capital is 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 input price leading to a profit squeeze and eventual output collapse—have been documented in a number of countries. For example, in the years leading up to the crisis of the early 1980s in the Southern Cone countries, there is evidence that profits in the tradeable sector sharply deteriorated due to a rise in domestic input prices (see Galvez and Tybout, 1985; Petrei and Tybout, 1985; de Melo et al., 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 predicted by 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 financial sector liberalization, which facilitated borrowing by domestic firms. Partly as a result of this liberalization, capital flowed into these economies in large quantities, allowing rapid growth in lending and a

[2]Perhaps as a consequence of herd behavior.

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. Gertler and Rogoff (1990) study an open economy model with credit-market imperfections. However, they do not consider business cycle fluctuations.[5] 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 et al. (1999a) and Azariadis and Smith (1998) have shown that these constraints can lead to oscillations, though only in the context of a closed economy. However, none of these papers study the effects of opening up the domestic financial sector to foreign capital flows and none of them, except Aghion et al. (1999a), focus on the level of financial development as a factor determining the extent of instability. While the model's structure is in a spirit similar to Aghion et al. (1999a), this paper differs in key respects. First, the economic mechanisms at work are of a different nature. Second, the economic questions and the types of policy shocks we focus on are entirely different. Finally, at a methodological level, unlike Aghion et al. (1999a) we show that our results are robust to the introduction of forward-looking entrepreneurs.

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] However, a number of

[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 the link between and capital flow reversals and currency crises. Gourinchas et al. (2001) provide a systematic analysis of lending booms which coincide with movements in output, capital inflows, the current account and the real exchange rate that are fully consistent with our results. See also Honkapohja and Koskela (1999) for an illuminating description of the Finnish crisis of the 1990s, 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 1980s that leads 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 1990s, 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]Caballero and Krishnamurthy (2001) distinguish between credit constraints from foreign investors and constraints from domestic investors to explain the amplification of shocks in an open economy. They also abstract from business fluctuations issues.

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

important aspects, including the implications of liberalization on 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; while on the other hand, the presence of such shocks does not automatically imply 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 a basic version of the open-economy model and a characterization of the conditions under which macroeconomic volatility arises. Section 3 presents the model under more general assumptions and provides numerical simulations to assess the plausibility for volatility. Section 4 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 5 describes various extensions and draws some tentative policy conclusions.

2. The basic mechanism

For pedagogical purposes we consider first a simple model with constant saving rates and a Leontief technology involving a inelastic supply of the country-specific factor. In Section 3, we consider a more general model with three main extensions: first the supply of domestic input is elastic; second, the production technology is more general; and third, saving decisions result from intertemporal utility maximization.

2.1. A simple framework

We consider a small open economy with a single tradeable good produced with capital and a country-specific factor. One should typically think of this factor as input services such as (skilled) labor or real estate. We take the output good as the numeraire and denote by p the price of the country-specific factor when expressed in units of the output good. The relative price p can also be interpreted as the real exchange rate. In this basic framework we assume that the supply of the country-specific factor is inelastic and equal to Z.

[7] Obstfeld (1986), McKinnon (1993), Bacchetta (1992), Bartolini and Drazen (1997) analyze capital account liberalizations. McKinnon and Pill (1997) and Bacchetta and van Wincoop (2000) are among the first examining the issue of volatility.

For the sake of presentation, in this subsection we also assume that all agents *save* a fixed fraction $(1-\alpha)$ of their total end-of-period wealth and thus consume a fixed fraction α. The intertemporal decisions of lenders are of no consequence for output in such an open economy since investors can borrow in international capital markets. They will, however, affect net capital flows.[8]

There are two distinct categories of individuals in the economy. First, the *lenders*, who cannot directly invest in production, but 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. There is a continuum of lenders and borrowers and their number is normalized to one for both categories.

Output y is given by the following production function:

$$y = \min\left(\frac{K}{a}, z\right), \tag{1}$$

where $1/a > r$, i.e., we assume that productivity is larger than the world interest rate. K denotes the current level of capital and z denotes the level of the country-specific input. 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 μW^B. The presence of capital market imperfections implies that entrepreneurs cannot borrow up to the net present value of their project; they can only borrow an amount proportional to their current cash-flow (as in Bernanke and Gertler, 1989). The proportionality coefficient, or *credit multiplier* $\mu > 0$, reflects the level of financial development in the domestic economy. In the extreme case where $\mu = 0$, the credit market collapses and investors can only invest their own wealth. Higher values of μ correspond to higher levels of financial development.

A simple justification for relating the capital market to the level of financial development and basing it on moral hazard by the borrower, can be found in Holmstrom and Tirole (1997) and in Aghion et al. (1999a). In general μ will depend on the rate of interest being charged, which in turn implies a constant credit multiplier in a model where the interest rate is given by the world capital markets. However, in Section 4 and the Appendix we compare our basic model with a model with a closed capital market where the interest rate is endogenously determined by domestic investment demand and domestic savings supply. Yet, for convenience, we shall maintain the assumption of a μ that does not depend on the interest rate in that section as well. As shown in Aghion et al. (1999a), this corresponds to a particular parametrization of the more general model of the credit market presented in that

[8] Notice that the separation between the decisions of lenders and entrepreneurs 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.

paper. Our results would only be stronger if we allowed the usual negative relation between the interest rate and μ.[9]

Production decision: Denote by L the amount borrowed. The funds available to an entrepreneur with total initial wealth W^B are $I = W^B + L$. When the credit constraint is binding, $I = (1+\mu)W^B$. Entrepreneurs will choose the level of the country-specific factor z, with corresponding investment $K = I - p \cdot z$, to maximize current profits. Given the above Leontief technology, the optimum involves $z = K/a$, so that:

$$I - p \cdot z = a \cdot z. \tag{2}$$

Depending on the level of entrepreneurs' wealth, there are three cases:

(i) *Binding credit constraint and p = 0.* W^B is low so that the credit constraint is binding ($L = \mu W^B$) and $K/a < Z$. In this case, there is an excess supply of the country-specific input. This immediately gives us $p = 0$. Output at date t is then given by

$$y_t = \frac{K_t}{a} = \frac{1}{a}(1+\mu)W_t^B.$$

(ii) *Binding credit constraint and* $p > 0$. W^B is low so that $L = \mu W^B$, but $K/a \geqslant Z$. Thus, there is excess demand for the immobile factor. Therefore $p > 0$ and output is determined in equilibrium by the supply of the country-specific input: $y_t = Z$. From (2) and the definition of I, the equilibrium price of the country-specific input is given by

$$p_t = \frac{(1+\mu)W_t^B - aZ}{Z}. \tag{3}$$

Notice that in this case the entrepreneur's entire wealth is invested in the domestic technology since it has returns higher than the world interest rate, i.e., $y - rL > rW^B$.[10]

(iii) *Unconstrained entrepreneurs.* W^B is large enough so that $L < \mu W^B$. As in (ii), $p > 0$ and $y_t = Z$, but p is not affected by the level of investment. When W^B is large, entrepreneurs borrow until profits equal the international interest rate: $y - rL = rW^B$, i.e., until $y = rI$. This determines the maximum price level. Hence, $I = Z/r$ so that the price is given by:

$$p_t = \frac{1}{r} - a.$$

The equilibrium price p_t, i.e., the real exchange rate, which is a positive function of W^B, is the key variable whose movements over time will produce volatility.

[9]From Aghion–Banerjee–Picketty, we find $\mu = 1/(1 - \tau/ac)$, where τ is the cost of cheating for the borrower and c is proportional to the debt collection cost in case of default for the lender. With a higher level of financial development, τ is larger and c smaller. This implies that μ is larger.

[10]Using $y = Z$ and $L = \mu W^B$, this inequality can be written as $Z > (1+\mu)rW^B$. Using (3), this implies $1/(a+p) > r$. This holds for p not too large since $1/a > r$. When p is large enough that this inequality does not hold, we are in case (iii).

The timing of events: The timing of events within each period t is the following. Investment, borrowing and lending, and the payment of the country-specific factor services $p \cdot Z$ by entrepreneurs to the owners of that factor, 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^+): the returns to investments are realized; borrowers repay their debt, rL, to lenders; and finally, 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 $(t+1)^-$).

Dynamic equations: Now that we have laid out the basic model, we can analyze the aggregate dynamics of the economy and in particular investigate why open economies with imperfect credit markets may experience macroeconomic volatility. Since both I and p depend on entrepreneurs' wealth W^B, output does too. Thus, output dynamics are determined by the evolution of entrepreneurs' behavior. Let W_{t+1}^B 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:

$$W_{t+1}^B = (1-\alpha)[e + y_t - r\mu W_t^B], \tag{4}$$

where e is an exogenous income in terms of output goods, $y_t = \min(\frac{I}{a}, Z)$ is output in period t (also equal to the gross revenues of entrepreneurs during that period). 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 right-hand-side of Eq. (4).

Entrepreneurs invest and borrow only if their profits are larger than or equal to the international return. When μ or W^B are large, entrepreneurs invest only up the point where $y - rL = rW^B$. Any remaining wealth is invested at the international market rate. In this case, no pure profits are earned from production and the evolution of wealth is simply given by

$$W_{t+1}^B = (1-\alpha)[e + rW_t^B]. \tag{5}$$

Thus, the dynamics are fully described either by difference equation (4) or by difference Eq. (5).

2.2. Volatility

When the dynamic evolution of domestic entrepreneurs' wealth is described by Eq. (4), an increase in entrepreneurs' wealth W_t^B at the beginning of period t has an ambiguous effect on next period's wealth W_{t+1}^B. This is due to the fact that the amount of invested wealth itself depends *negatively* on the input price p, whilst p depends *positively* on current wealth. Using the fact that:

$$(a + p_t)y_t = (1+\mu)W_t^B,$$

we have:

$$\frac{\mathrm{d}y_t}{\mathrm{d}W_t^B} = \frac{(1+\mu)}{a+p_t} - \frac{y_t}{a+p_t}\frac{\partial p_t}{\partial W_t^B}.$$

Then, from (4), the impact of last period wealth on current end of period wealth can be decomposed into two effects:

$$\frac{\mathrm{d}W_{t+1}^B}{\mathrm{d}W_t^B} = (1-\alpha)\left[\underbrace{\frac{1+\mu}{a+p_t} - r\mu}_{\text{wealth effect}} - \underbrace{\frac{y_t}{a+p_t}\frac{\partial p_t}{\partial W_t^B}}_{\text{price effect}}\right],$$

On the one hand, there is a positive *wealth effect* of current wealth on future wealth: for a given price of the country-specific factor p_t, a higher inherited wealth W_t^B from period $(t-1)$ means a higher level of investment $(1+\mu)W_t^B$ in period t which, all else equal, should produce higher revenues and thus higher wealth W_{t+1}^B at the beginning of period $t+1$. On the other hand, there is a negative *price effect* of current wealth on future wealth: more investment in period t also implies a greater demand for the country-specific factor to thus raise its price p_t during that period. This, in turn, has a detrimental effect on period t revenues and therefore on the wealth W_{t+1}^B at the beginning of period $t+1$.

With the above Leontief specification, the price effect is eliminated whenever the current wealth W_t^B is so small that current investment cannot absorb the total supply of the country-specific factor. In this case $p_t \equiv 0$ and:

$$W_{t+1}^B = (1-\alpha)\left[e + \left\{\frac{1+\mu}{a} - r\mu\right\}W_t^B\right], \tag{6}$$

so that $\mathrm{d}W_{t+1}^B/\mathrm{d}W_t^B > 0$.

On the other hand, the price effect dominates when the current wealth W_t^B is sufficiently large that current investment exhausts the total supply of the country-specific factor. In this case, we simply have:

$$W_{t+1}^B = (1-\alpha)[e + Z - r\mu W_t^B], \tag{7}$$

so that $dW_{t+1}^B/dW_t^B < 0$.

Fig. 1 shows the relationship between W_{t+1}^B and W_t^B in this basic Leontief setup. This relationship is represented by three segments corresponding to the three cases described in Section 2.1. The first one is the upward sloping curve described by (6) for $W < \underline{W} = aZ/(1+\mu)$; this is the case where the wealth effect dominates as $p = 0$. The second segment, for $\underline{W} < W < \overline{W} = Z/(1+\mu)r$, is described by (7); in this case, the price effect always dominates. Finally, the third segment $(W > \overline{W})$ represents Eq. (5) where entrepreneurs are not credit-constrained. As drawn in the figure, the 45° line intersects the $W_{t+1}^B(W_t^B)$ curve at the point $\widehat{W}$ which lies in the second segment. This intersection can also be in either of the other two segments. It will be in the first segment when $(1-\alpha)e/1-(1-\alpha)\{((1+\mu)/a)-r\mu\}$, the fixed point of Eq. (6), is less than $\underline{W}$. Since $(1-\alpha)e/1-(1-\alpha)\{((1+\mu)/a)-r\mu\}$is increasing in μ while $\underline{W}$ is decreasing, it is clear that this can only happen when μ is very small. On

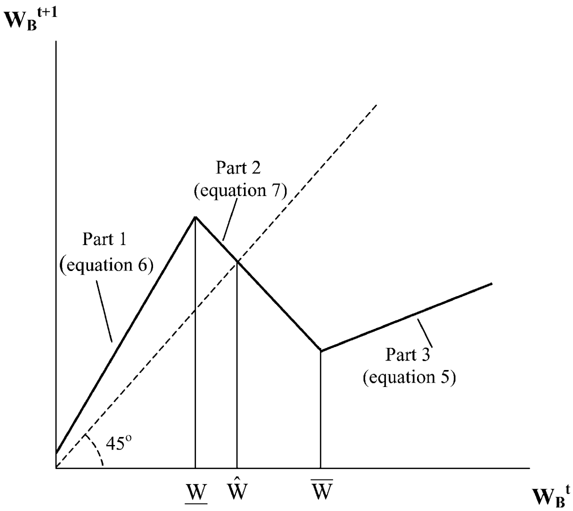

Fig. 1. Phase diagram with Leontief technology.

the other hand, the intersection will be in the third segment when the fixed point of Eq. (5), $(1-\alpha)e/(1-(1-\alpha)r) > \overline{W} = Z/(1+\mu)r$. This will only happen when μ is sufficiently large. For intermediate values of μ, corresponding to an intermediate level of financial development, the case is depicted in Fig. 1, the one case where the economy does not converge monotonically to its steady state.

In this case there are two possibilities—*short run fluctuations*, represented by oscillations that eventually converge to the steady state, $\widehat{W}$, and *long run volatility*, represented by a system which does not converge to a steady state but instead continues to oscillate forever. A necessary condition for the existence of such a limit cycle is that the steady state at $\widehat{W}$ be unstable, true only when the slope of the $W_{t+1}^B(W_t^B)$ schedule at $\widehat{W}$ is less than -1, corresponding to when $\widehat{W}$ lies in the second segment of that schedule. Thus, for *long run volatility* to occur, we must have $\underline{W} < \widehat{W} < \overline{W}$ and $-(1-\alpha)\mu r < -1$.

If these conditions hold, one can easily derive additional sufficient conditions under which long-run volatility actually occurs. For example, a two-cycle (W_1, W_2) will satisfy:[11]

$$W_1 = \frac{(1-\alpha)(e+Z)}{1 + r\mu(1-\alpha)^2(e + \frac{1+\mu}{a} - r\mu)}, \quad W_2 = \frac{(1-\alpha)^2(e + \frac{1+\mu}{a} - r\mu)(e+Z)}{1 + r\mu(1-\alpha)^2(e + \frac{1+\mu}{a} - r\mu)}$$

[11]This follows immediately from the equations:

$$W_1 = (1-\alpha)(e + Z - r\mu W_2),$$
$$W_2 = (1-\alpha)\left(e + \frac{1+\mu}{a} - r\mu\right)W_1.$$

with $W_1 < \underline{W} < W_2 < \overline{W}$. This two-cycle will be stable whenever $(1-\alpha)^2 r\mu(((1+\mu)/a) - r\mu) < 1$. Conditions for the existence of longer (and more plausible) cycles can be derived using standard techniques. The dynamic simulations will show that the fluctuations can be complex since wealth can fluctuate between the constrained (the first two segments in Fig. 1) and the unconstrained (the third segment) regions.

Intuitively, the basic mechanism underlying this cyclicality can be described as follows: during a boom the demand for the domestic country-specific factor goes up as (high yield) investments increase, thus raising its price. This higher price will eventually squeeze investors' borrowing capacity and therefore the demand for country-specific factors. At this point, the economy experiences a slump and two things occur: the relative price of the domestic factor collapses, while a fraction of the factor available remains unused since there is not enough investment. The collapse in the factor price thus corresponds to a contraction of real output. Of course, the low factor price will eventually lead to higher profits and therefore to more investment. A new boom then begins.

The reason why the level of financial development matters is also quite intuitive: economies at a low level of financial development have low levels of investment and do not generate enough demand to push up the price of the country specific factor while economies at a very high level of development have sufficient demand for that factor to keep its price positive.

2.3. Discussion

Although the above framework is extremely simple, it generates a number of predictions for empirical analysis on emerging markets. In particular, our model predicts: (i) that the investment to GDP and private credit to GDP ratios should increase during a "lending boom";[12](ii) that lending booms are times of net capital inflows; (iii) that the real exchange rate (p_t in our model) should increase during a lending boom; (iv) that the fraction of defaulting loans should increase towards the end of a lending boom (in a straightforward extension of our model with uncertainty and defaults, which we develop in Section 5.1 below). Recent work by Gourinchas et al. (2001) provides an interesting cross-country study of lending booms and examine the pattern of a set a macroeconomic indicators around these booms.[13] The behavior of these indicators is shown to be fully consistent with the above predictions. In particular, by comparing with "tranquil periods", Gourinchas et al. show that during lending booms the output gap is higher, the investment/GDP ratio increases, the proportion of short term debt increases, the current account worsens, the real exchange rate appreciates, especially at the end of the boom period. When lending

[12]In the context of the above model, we have:

$$\frac{I_t}{y_t} = a + p_t,$$

which indeed increases during a lending boom as a result of the price effect.

[13]See also Tornell and Westermann (2002).

declines, all these movements are reversed. In particular, the fact that investment follows a credit expansion and is sharply procyclical is fully consistent with our approach.

The above model is very simple, but simplicity and tractability always come at a cost. In particular, the analysis has been drastically simplified by assuming a Leontief technology, a constant savings rate, and an inelastic supply of the non-tradeable input. In the next section we relax these three assumptions. Moreover, in the concluding section we discuss mechanisms that lead to a procyclical μ and therefore amplify the underlying volatility.

An important question is whether the basic mechanism leading to volatility depends on the assumption of discrete time. It is well known that volatility occurs more easily under discrete time. However, it is not difficult to show that a similar mechanism can occur under continuous time. First, this can happen with a system of two differential equations. For example, if domestic lenders are also workers paid by the entrepreneurs and use the local input for their consumption, then a second dynamic equation describing the evolution of domestic lenders' wealth must be added to the dynamic equation describing the evolution of domestic entrepreneurs' wealth. If domestic lenders' demand for the local input is not too price elastic, we still get the same type of volatility as in the basic model with a single difference equation. Second, Bruchez (2001) shows that if the lags between the wealth realization in period t and the wealth investment in period $t+1$ differ across firms, Eq. (4) becomes an ordinary differential equation that can also exhibit periodic solutions.[14]

3. Assessing plausibility: some simulation results

The main purpose of this section is to ask whether the analytical conclusions derived in the previous section are empirically plausible. The simulation results are again focused on the possibility of—and the conditions for—long run volatility in economies at intermediate levels of financial development.[15]

We shall first extend our basic model in three respects: first, we allow for elastic supply of the non-tradable factor; second, we replace the Leontief technology by a more general CES technology, thereby allowing for substitutability between the tradable and non-tradable factors; third, we replace the constant savings rate assumption of the basic model with intertemporal utility maximization by entrepreneurs. The implications of each of these, are analyzed in detail in Aghion et al. (2001b). Our main conclusion there is that for endogenous fluctuations to obtain in equilibrium, we need: (i) enough inelasticity in the supply of the non-tradable input; (ii) enough complementarity between the two inputs; (iii) a

[14]This result obtains when the discrete lags are randomly gamma distributed, as shown in Invernizzi and Medio (1991).

[15]When looking at the real world, the distinction between persistent oscillations that eventually die out, and those that never die out, may not be so important as our analysis suggests. This is because in reality, even if oscillations eventually die out, there are always shocks that start them off again.

sufficiently low intertemporal elasticity of substitution between current and future consumption. In the simulations presented in this section, the three extensions are being simultaneously considered.

3.1. Generalizing our framework

We modify our previous model by assuming:

1. *Elastic supply of the country-specific factor*: we relax the assumption of a fixed supply of the country-specific factor and assume that Z is instead produced by (domestic) lenders using the tradeable good at a cost $c(Z) = \varphi Z^{\nu}$, where $\nu > 1$. Maximization of a domestic lender's profit $pZ - \varphi Z^{\nu}$, yields the optimal supply of the country-specific factor:

$$Z = \left(\frac{p}{\varphi \nu}\right)^{\frac{1}{\nu-1}}. \tag{8}$$

2. *CES technology*: we replace the Leontief technology by a CES production function, with $f(K, z) = A(K^{\theta} + \gamma z^{\theta})^{1/\theta}$, with $A > r$ and $\gamma > 0$.[16] The parameter θ determines the elasticity of substitution between K and z (we assume $\theta < 1$ for concavity). This CES specification includes as special cases, both the Cobb–-Douglas technology when $\theta = 0$, and a Leontief technology when $\theta \to -\infty$.
3. *Optimal savings by entrepreneurs*: we replace the constant savings rate assumption in our basic model by the assumption that entrepreneurs are infinitely-lived and maximize their net present utility of consumption, with instantaneous utility being given by: $u(C^B) = C^{B(1-\rho)}/(1-\rho)$, where $1/\rho$ is the elasticity of intertemporal substitution and $\rho > 0$. Then domestic entrepreneurs solve:

$$\max \sum_{t=0}^{\infty} \beta^t u(C_t^B) \quad s.t. \quad C_t^B = \Pi_t - W_{t+1}^B.$$

The first order conditions for this problem give us:

$$\frac{C_{t+1}^B}{C_t^B} = (\beta M_{t+1})^{1/\rho}, \tag{9}$$

where $M_t = \Pi_t / W_t^B$. It is clear from Eq. (9) that the ratio $\frac{C_{t+1}^B}{C_t^B}$ approaches 1 as ρ increases. This implies that an increase in ρ (a reduction in the elasticity of intertemporal substitution) reduces consumption changes and gives correspondingly larger intertemporal savings changes, i.e., savings become more pro-cyclical over time. This, in turn, will tend to amplify the cycle as the price of the country-specific input increases more sharply during a boom. True, to the extent that the returns to savings are higher when the economy is in a slump (slumps are typically followed by

[16]This is to make sure that it pays to produce at least some times and that the country-specific factor is used.

periods with high investment profitability), there should be a greater tendency to save more in a slump, thereby attenuating the cyclical variations. However, this latter effect is weaker, the higher the cost of intertemporal substitution (i.e., with a larger ρ).[17]

3.2. Simulations

We present our simulation results by successively varying three parameters: (i) the elasticity of substitution between capital and the other factor in the production function, measured by θ; (ii) the intertemporal elasticity of substitution $1/\rho$; (iii) the elasticity of country-specific factor supply as measured by v. The other parameters are taken to be constant in these simulations, and we fix them at empirically plausible values. We set the gross interest rate $r = 1.02$ and the productivity factor $A = 1.5$. Whenever it is fully inelastic we set the total supply of the immobile factor $Z = 100$ and its weight in the production function $\gamma = 1$ (these two parameters have little influence on the simulation results). The discount rate of entrepreneurs is $\beta = 0.9$, a value implying that domestic entrepreneurs are impatient relative to the interest rate. Finally, we set the credit multiplier $\mu = 4$, a value implying a cash flow-capital ratio of 0.2 when firms are credit-constrained, a plausible number even for US firms (see Fazzari et al., 1988). The values considered for θ lie between -0.5 and -4; those for v lie between 4.33 and 7.66 corresponding to elasticities $(1/(v-1))$ of 15% and 30%; and those for ρ are between 0.5 and 10. In all simulations, we assume $e = 0$.

In each case, we consider the dynamic impact on output of a negative shock that makes wealth fall by 1% below the steady-state wealth. We normalize output so that it is initially equal to 100 and we look at the dynamic evolution of output over 30 periods after the shock. Figs. 2, and 3c and 3d display the simulations in the log utility case where $\rho = 1$. It can easily be shown (see the working paper version) that this case is equivalent to the constant savings rate economy analyzed in the previous section.[18]

Fig. 2 presents the log utility case with a fixed supply of the country specific factor. The diagrams show four cases corresponding to different values of input substitutability θ, each leading to a different dynamic path. In Fig. 2a,

[17] To assess the overall effect of a change in the elasticity of intertemporal substitution on volatility, it is instructive to replace C_t^B by $\Pi_t - W_t^B$ in (9), giving a dynamic relationship:

$$W_{t+1}^B = \frac{(\beta M_{t+1})^{1/\rho}}{M_{t+1} + (\beta M_{t+1})^{1/\rho}} \Pi_t + \frac{1}{M_{t+1} + (\beta M_{t+1})^{1/\rho}} W_{t+2}^B$$

Entrepreneurs' wealth available for next period is now a weighted average of past profits and expected future wealth. While this second order (highly non-linear) difference equation does not lend itself to analytical solutions, it can be resolved numerically as we show in the next subsection.

[18] Note that the simulation technique differs between the constant savings rate case and the log-utility case with infinitely lived and forward-looking entrepreneurs. In the former case, we simply need to run a first order difference equation with given initial wealth level. In the latter case, as shown in footnote 17, the dynamic system is described by a forward-looking second order difference equation which requires that we compute the initial consumption level for given initial wealth (e.g., using a shooting algorithm). When $\rho = 1$, however, the two methods generate exactly the same dynamics.

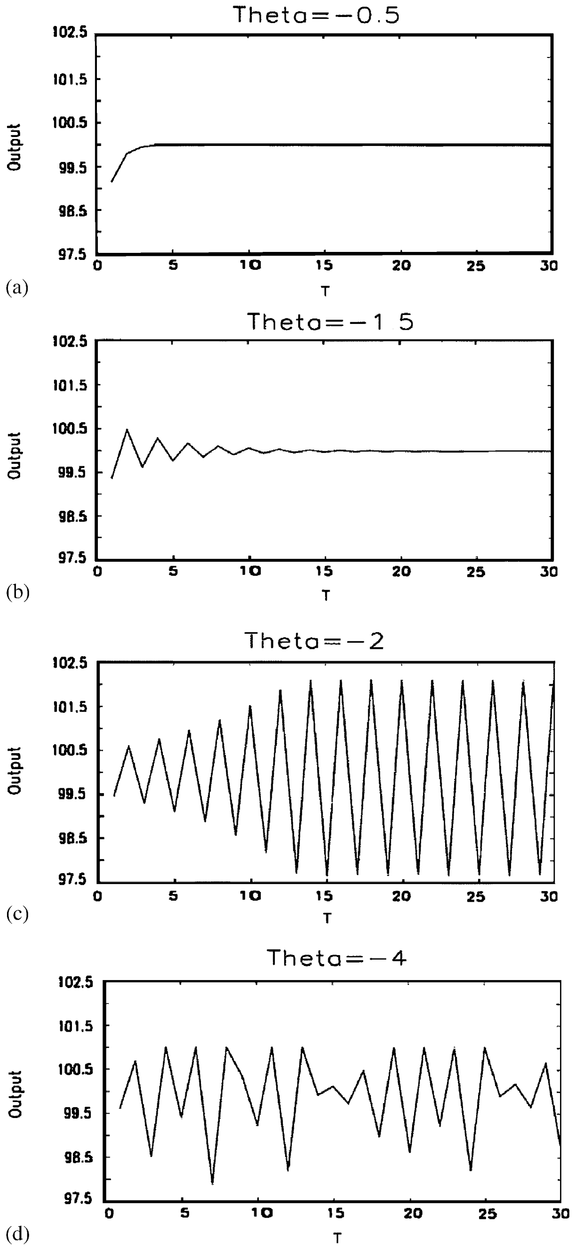

Fig. 2. Simulations for log utility. Note: See text for description.

where $\theta = -0.5$, there is no instability and output converges smoothly to its initial level. When θ decreases to -1.5 (Fig. 2b), output still converges but includes oscillations.

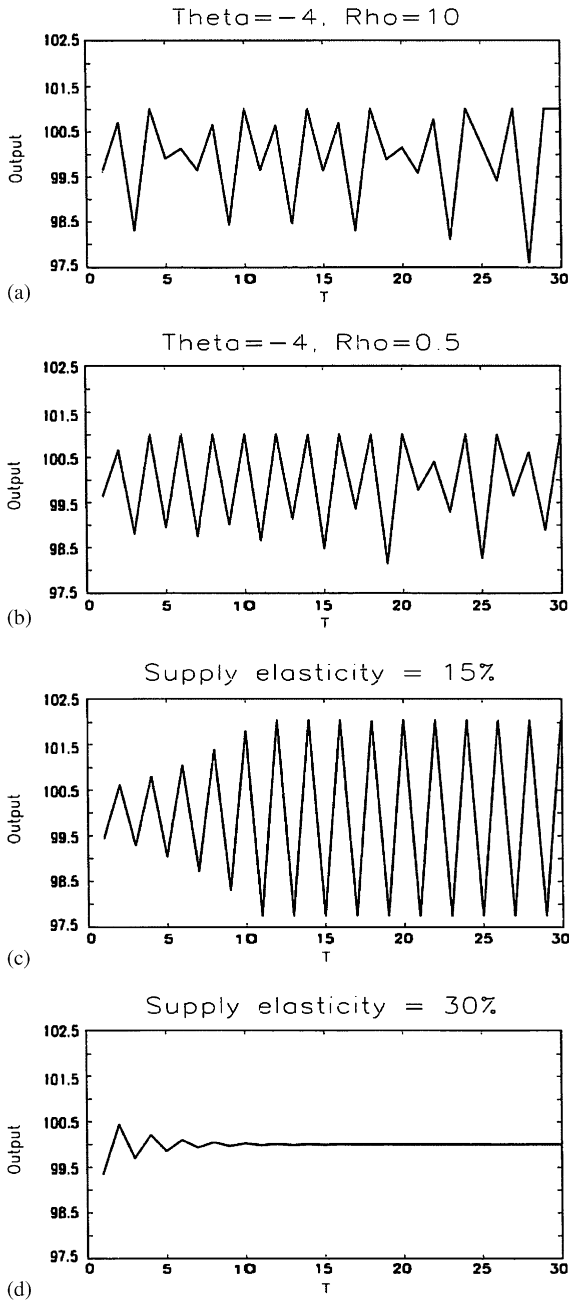

Fig. 3. Simulations. Note: See text for description.

Fig. 2c shows a two-cycle, which arises when $\theta = -2$. Finally, when $\theta = -4$ (Fig. 2d), more complex dynamics arise due to 'regime switching': large increases in wealth lead the system to the unconstrained region (the third segment in Fig. 1), but the system returns to the constrained region since $\beta r < 1$. Notice that the fluctuations in 2c and 2d are larger than the initial shock, so that small shocks are amplified (actually infinitesimal shocks would lead to similar fluctuations).

In Figs. 3a and b, we assume that $\theta = -4$ with an inelastic supply of the country-specific factor, while we depart from log utility by varying the intertemporal elasticity parameter ρ. With a lower elasticity of intertemporal substitution, $\rho = 10$, the system tends to be even more unstable and switches more easily across regimes. When entrepreneurs are more ready to substitute intertemporally, which in this figure corresponds to the case where $\rho = 0.5$, regime switches are less frequent. The most important conclusion from Fig. 3, however, is that the long-run instability results established under constant savings rates (or with optimal intertemporal savings in the log utility case), carry over to a wide range of elasticities of intertemporal substitution.

Finally, in Figs. 3c and d we show simulations with an elastic supply of the country-specific factor, assuming $\theta = -4$ and log utility. Obviously, with an elastic supply there is less scope for fluctuations. For example, Fig. 3d shows that with a supply elasticity of 30% fluctuations die out rapidly. However, with an elasticity of 15%, which appears reasonable in the short run, we still have fluctuations with a two-cycle.

Thus, even though our model is highly stylized, long-run output volatility and/or large amplification of shocks occur for empirically reasonable parameter values and are not confined to one particular functional form.

4. Financial liberalization and instability

The previous analysis shows that a fully open economy with imperfect credit markets can exhibit volatility or a cycle. We show in this section that the same economy can be 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 country-specific factor. This in turn, increases the volatility in firms' cash-flows and therefore aggregate output. We first consider the case of an economy that opens up to foreign lending. Then, we examine the case of FDI, where foreign investors are equity holders and are fully informed about domestic firms. Even though the results are valid with general production functions, we present the Leontief case for pedagogical reasons.

4.1. *Liberalizing foreign lending*

We consider an economy with low domestic savings, with the Leontief technology specified in Section 2.1, and we first assume that this economy is *not* open to foreign borrowing and lending (this closed economy is described in details in Appendix A). In that case, at each date, the current wealth of domestic lenders W^L matters since domestic investment is constrained by domestic savings $W^B + W^L$. Now suppose that the initial levels of wealth held by entrepreneurs and domestic lenders, W^B and W^L respectively, are sufficiently small so that initially $p_0 = 0$ This corresponds to a situation where domestic entrepreneurs cannot exhaust the supply of country-specific inputs. Let us also assume that at date 0 domestic savings $W_0^B + W_0^L$ are less than the investment capacity $(1+\mu)W_0^B$.[19]If $\mu > 1$ there will then be excess investment capacity in following periods as long as p_t remains equal to zero. To see this, note that the domestic interest rate r_t, determined in a closed economy by the comparison between W_t^L and μW_t^B, is such that entrepreneurs are indifferent between borrowing and lending, that is: $r_t = 1/a$ in the Leontief case. Therefore, if $p_t = 0$ and $W_t^L < \mu W_t^B$, we have:

$$W_{t+1}^B = (1-\alpha)\left[e + \frac{1}{a} W_t^B\right] \quad \text{and} \quad W_{t+1}^L = (1-\alpha)\left[e + \frac{1}{a} W_t^L\right],$$

so that $W_t^L < \mu W_t^B$ implies that: $W_{t+1}^L < \mu W_{t+1}^B$ and therefore $r_{t+1} = 1/a$. In Appendix A we provide sufficient conditions under which $p_t = 0$ and $r_t = 1/a$ for all t. Under these conditions, entrepreneurs' wealth will grow as the (low) rate $(1-\alpha)/a$, since it is constrained by the (low) level of domestic savings, and the $W_{t+1}^B(W_t^B)$ schedule will intersect the 45° line on its first branch along which $p_t = 0$. This, in turn, implies that there will be no persistent fluctuations in this closed economy.

What happens if this economy is fully opened up to foreign borrowing and lending? The interest rate will be fixed at the international level r. By itself, this could only help stabilize any closed economy that otherwise might (temporarily) fluctuate in reaction to interest rate movements. However, the opening up of the economy to foreign lending also brings net capital inflows as investors satisfy their excess funds demand in international capital markets. The corresponding rise in borrowing in turn increases the scope for bidding up the price of the country-specific factor, thereby inducing permanent fluctuations in p, W^B and aggregate output.

Fig. 4 presents an illustration of a liberalization in the Leontief case. The wealth schedule shifts up after a capital account liberalization. $\widehat{W}^B$ refers to the stable steady-state level of borrowers' wealth before the economy opens up to foreign borrowing and lending. 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 country-specific factor remains sufficiently low that $p = 0$. In period 3 (at W_3^B) p increases, but we still have growth. However, in period 4 (at W_4^B) 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

[19]If $\mu W^B < W^L$, opening up the economy to foreign lending would make no difference: since the investment capacity of domestic entrepreneurs cannot even absorb domestic savings, there is no need for foreign lending in this case.

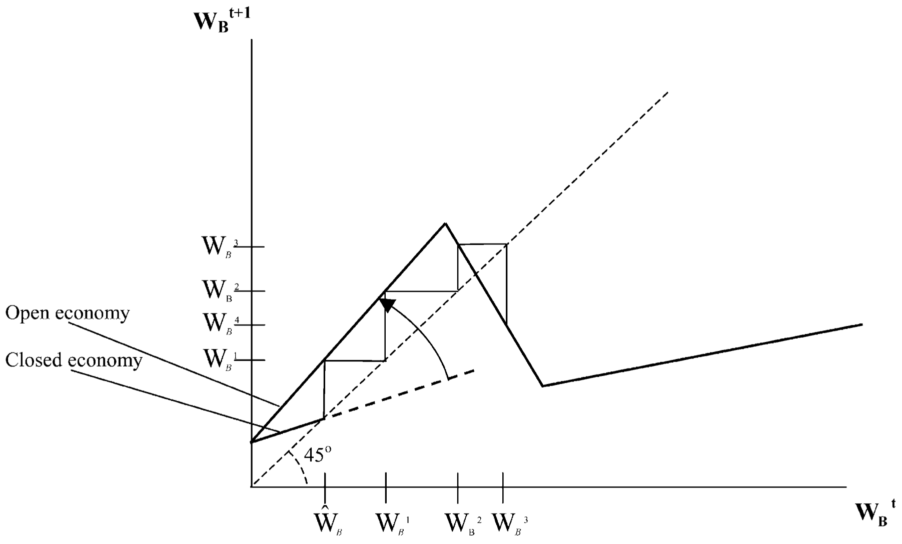

Fig. 4. Liberalizing foreign lending.

exchange depreciates (p drops). The resulting gain in competitiveness allows firms to rebuild their net worth so that growth can eventually resume. The economy ends up experiencing permanent fluctuations of the kind described in the previous section.

We should stress that the dynamics in Fig. 4 occurs only for *intermediate* levels of financial development. As we argued in Section 2, with a large μ there is no volatility in an open economy, as it is the third segment of the curve that cuts the 45° line.[20] When $\mu = 0$, financial opening will not help investment and no capital inflow will occur, so there will be no upward pressure on the price of the country-specific input.[21] The above example therefore suggests that it might be desirable for a country to increase its μ, i.e., to develop its domestic financial sector *before* fully opening up to foreign lending.

4.2. Foreign direct investment

Whilst a full liberalization to foreign lending 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* investment alone. We distinguish FDI from other financial flows by assuming that it is part of firms' equity and that FDI investors have full information about firms.[22]

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

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

[22]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.

Furthermore, we first concentrate on the benchmark case where the supply of FDI is infinitely elastic at some fixed price greater than the world interest rate, say equal to $r+\delta$.[23]

Starting from a situation in which domestic cash flows are small so that domestic investment cannot fully absorb the supply of country-specific factors, foreign direct investors are likely to enter in order to profit from the low price of the country-specific factors. This price will eventually increase and 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 factor resources Z, whereas the same economy may end up being destabilized if fully open to foreign *portfolio* investment (i.e., to foreign lending).

Consider a closed Leontief economy open to foreign *direct* investment only. Assume also that W^L is large enough so that firms can still borrow their desired amount domestically (otherwise investment is still constrained by savings and the scope for fluctuations is much smaller). 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, in equilibrium we obtain the free-entry condition:

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

where $R=(y-\widetilde{r}L)/(W^B+F)$ is the net rate of return on foreign direct investment and $\widetilde{r}$ is the domestic interest rate. If domestic savings are less than the investment capacity of domestic entrepreneurs (i.e., $W^L<\mu W^B$), we would have $\widetilde{r}=1/a$. However, as domestic savings exceed the investment capacity of domestic entrepreneurs, $\widetilde{r}=\underline{\sigma}$, where $\underline{\sigma}$ is the return of an alternative, inefficient, storing technology (as in Aghion et al., 1999a). In a closed economy, lenders will invest their excess savings in this technology.

Assume that $R>r+\delta$ as long as $p=0$ (this implies $r+\delta<(1/a)(1+\mu)-\mu\underline{\sigma}$), so that there will be a positive flow of FDI as long as $p=0$. Using the fact that $L=\mu(W^B+F)$ and that $y=Z$ when $p>0$, we can rewrite the above free-entry condition as

$$(r+\delta)(W^B+F)=Z-\mu\underline{\sigma}(W^B+F).$$

This, together with the price equation (3), implies that:

$$p=\frac{1+\mu}{r+\delta+\underline{\sigma}\mu}-a,$$

which in turn gives a stable value for p. Thus, even though FDI leads to a price increase it does not generate price and output volatility.

Consider now an economy which has already been opened up to foreign borrowing and lending at rate r, that is to foreign portfolio flows only, and which, as

[23]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.

a result has become volatile as in the example depicted in Fig. 4. What will happen if this economy is now also opening up to FDI? By the same reasoning as before, opening up to FDI will stabilize the price of the country-specific factor at level p^* such that:

$$(r+\delta)(W^B+F)=Z-r\mu(W^B+F).$$

This again will eliminate investment and output volatility in this economy (assuming that initially the country is attracting FDI). In other words, if there are no limitations on FDI inflows and outflows (and FDI involves complete information on domestic firms), the price of the country-specific factor and therefore aggregate domestic GDP or GNP will remain constant in equilibrium.

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 so as to benefit from the low price of the country-specific factor.

What happens if foreign *direct* investment is *complementary* to domestic direct investment, that is, 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 A shows that foreign direct investments subject to complementarity requirements of the form $F \leqslant xW^B$ may sometimes *de*-stabilize an emerging market economy. Indeed, in contrast to the unrestricted FDI case analyzed above, such direct investments ultimately will fall during slumps, that is, when investors' wealth W^B_{t+1} is experiencing a downturn. Downturns will also typically be deeper than in absence of FDI since, by amplifying the increase in p_t during booms, FDI increases production costs and thus accentuates the credit-crunch induced on firms. Thus, whilst unrestricted FDI has a stabilizing effect on an open emerging market economy, opening such an economy to restricted FDI may actually have the opposite effect.

5. 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 and discuss policy implications.

5.1. Uncertainty and defaults

The model presented above can easily be extended to incorporate random project returns and defaults. We consider the case of a CES production function. 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:

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

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:

$$\sigma^*\psi(p)(W^B+L)-RL=0, \tag{10}$$

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:

$$rL=\int_{\underline{\sigma}}^{\overline{\sigma}} \min(RL, \widetilde{\sigma}\psi(p)(W^B+L))\frac{\mathrm{d}\sigma}{\overline{\sigma}-\underline{\sigma}}. \tag{11}$$

Appendix B shows that the number of defaulting firms, equal to $(\sigma^*-\underline{\sigma})/(\overline{\sigma}-\underline{\sigma})$, can be easily derived from (10) and (11). 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.[24]

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

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

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.

5.2. Amplifying factors

Additional destabilizing factors of the kinds discussed in the recent literature on financial crises, 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.

5.2.1. 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*[25] (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.[26] (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 $W_{t+1}^B(W_t^B)$ on its downward sloping part, thenpro-cyclical 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.

[25]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.

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

5.2.2. 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).[27] 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;[28] 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 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.

5.3. Some policy conclusions

Our model provides a simple and tractable framework for analyzing financially-based crises in economies which are at an intermediate level of financial development. The story we tell is based on some very basic features of these economies, in contrast with other more institutionally-based theories which invoke moral hazard among lenders, herd behavior among investors, etc. This is not to say that our model is inconsistent with this class of theories—as shown in the previous subsections. However, our model does suggest a somewhat different policy response: slumps should be seen as part of a 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. We should therefore not over-react to the occurrence of financial crises, especially in the case of emerging market economies.

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

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

In particular, hasty and radical overhauling of their economic system may do more harm than good.[29]

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 can be extended to allow for both monetary non-neutrality and a less infinitely elastic supply of foreign loans (see Aghion et al., 2000, 2001a, 2004). Once we take our framework in this 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 help restore the firms' financial health (and therefore their investment capacity), the net obligations of those who have borrowed in foreign currency will also rise if it leads to a devaluation of the domestic currency. 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 a slump, also suggests that a policy of allowing insolvent banks to fail may in fact prolong the slump if it restricts firms' ability to borrow (because of the comparative advantage of banks in monitoring firms' activities[30]). 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 during a slump since doing so would further limit the borrowing capacity of domestic entrepreneurs and therefore delay the subsequent recovery.

Third, our model also delivers *ex ante* policy implications for emerging market economies not currently under a financial crisis. In particular: (i) an unrestricted financial liberalization may actually *destabilize* the economy and engender a slump that would otherwise not have happened. If a major slump is likely to be costly even in the long-run (because, for example, it sets in process destabilizing political forces), 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 (that is, until the credit-multiplier μ becomes sufficiently

[29] 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, in the context of our model, banks may typically engage in preemptive lending to speculators in domestic inputs and/or to 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.

[30] See Diamond (1984).

large); (ii) 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 country-specific factor 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;[31] (iii) what brings about financial crises is precisely the rise in the price of country specific factors. If one of these factors (say, real estate) is identified to play a key role in sparking a financial crisis, it would be sensible to control its price, either directly or though controlling its speculative demand using suitable fiscal deterrents. This, and other important aspects in the design of stabilization policies for emerging market economies, await future elaborations of the framework developed in this paper.

Appendix A. The analytics of financial liberalization

A.1. Liberalization to foreign lending

Here, we construct an example of an economy which, in the absence of foreign borrowing and lending, would be asymptotically stable and actually converge to a permanent boom, but which becomes permanently volatile once fully open to foreign borrowing and lending. The analysis of the closed economy is similar to Aghion et al. (1999a).

More specifically, consider an economy in which:

(a) The production technology is Leontief with an inelastic supply of the country-specific factor, that is: $f(K,z) = \min(K/a, z)$, $a<1$, where $K = I - p \cdot z$.
(b) 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 $(1+\mu)W_t^B$ and of total domestic savings $W_t^B + W_t^L$. That is:

$$I_t = \min\{(1+\mu)W_t^B, W_t^B + W_t^L\}.$$

(c) Initially, at time $t=0$, the investment capacity of domestic entrepreneurs exceeds the total amount of domestic savings, so that $\mu W_0^B > W_0^L$ (in the opposite case, opening up to foreign borrowing and lending would have no effect on investment and output in the domestic economy).
(d) We impose the following restrictions on the parameters of the economy:
   (i) $\mu > 1$
   (ii) $1-\alpha < a$

[31]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 1980s whereas FDI to—and between—European countries had been allowed since the late 1950s.

(iii) W_0^L and W_0^B are less than $\widehat{W} = (1-\alpha)e/(1-(1-\alpha))(1/a)$
(iv) $\widehat{W} < \frac{a}{2} Z$.

We now show that a closed economy which satisfies assumptions (a), (b), (c), (d), is *stable*, with constant price $p_t \equiv 0$ and constant interest rate $r_t \equiv 1/a$, and wealth levels W_t^B and W_t^L which both converge monotonically to $\widehat{W}$ as $t \to \infty$.

First, assumption (c) implies that $r_0 = 1/a$, and it also implies that $I_0 = W_0^L + W_0^B$; assumptions (d)-(iii) and (d)-(iv) then imply that $I_0 < aZ$, so that $p_0 = 0$. Next, one can show that at any date s, $r_s = 1/a$ and $p_s = 0$. To see this, suppose that for all $s \leqslant t$, $r_s = 1/a$ and $p_s = 0$, and let us show that $r_{t+1} = 1/a$ and $p_{t+1} = 0$. If $r_s = 1/a$ and $p_s = 0$ for all $s \leqslant t$, then for all $s \leqslant t$ the wealth levels W_{s+1}^L and W_{s+1}^B satisfy the equations:

$$W_{s+1}^L = (1-\alpha)\left[e + \frac{1}{a} W_s^L\right] \tag{$(1)_s$}$$

and

$$W_{s+1}^B = (1-\alpha)\left[e + \frac{1}{a} W_s^B\right]. \tag{$(2)_s$}$$

It then follows from assumption (d)-(i), i.e., from $\mu > 1$, and from assuming that $r_t = 1/a$ (which implies that $\mu W_t^B > W_t^L$), that $\mu W_{t+1}^B > W_{t+1}^L$ and therefore $r_{t+1} = 1/a$. Furthermore, it follows from assumption (d)-(iii) and equations $(1)_s$ and $(2)_s$ for $s \leqslant t$, that $W_s^L < \widehat{W}$ and $W_s^B < \widehat{W}$ for all $s \leqslant t+1$; this in turn implies that:

$$I_{t+1} = W_{t+1}^L + W_{t+1}^B < 2\widehat{W},$$

so that $I_{t+1} < aZ$ by assumption (d)-(iv) and therefore $p_{t+1} = 0$. We have thus shown that if $r_s = 1/a$ and $p_s = 0$ for all $s \leqslant t$, then $r_{t+1} = 1/a$ and $p_{t+1} = 0$. Together with the fact that $r_0 = 1/a$ and $p_0 = 0$, this proves by induction that $r_s = 1/a$ and $p_s = 0$ for all s, so that the entire wealth trajectory (W_s^L, W_s^B) is determined by (W_0^L, W_0^B) together with the dynamic equations $(1)_s$ and $(2)_s$. But this, together with assumption (d)-(ii), implies that the equilibrium trajectory (W_s^L, W_s^B) is *stable*, with both W_s^L and W_s^B converging monotonically towards $\widehat{W}$ when $t \to \infty$. Thus, a closed economy characterized by (a)–(d) will display *no* volatility in price, interest rate, wealth and (tradeable) output.

Now, a closed economy that satisfies (a)–(d) and therefore is stable, may end up becoming volatile if fully open to foreign borrowing and lending. For example, this will be the case if that same economy satisfies the sufficient conditions provided in Section 2.2 for the existence of two-cycles. And one can easily verify that the two sets of conditions are consistent, in the sense that there exists a non-empty set of parameters which satisfy both sets of conditions simultaneously.

A.2. Restricted FDI

Let F denote the current amount of FDI, and let us impose the constraint: $F \leqslant xW^B$, with the fraction x being initially small. We assume that foreign investors receive their proportional share of output and that this is always larger than their reservation return $r+\delta$ (given the constraint x, the supply is no longer fully elastic as in the preceding case). The equilibrium price for the country-specific factor is now equal to:

$$p_t = \max\left(0, \frac{(1+\mu)(W_t^B + F_t) - aZ}{Z}\right).$$

Let $L_t = \mu(W_t^B + F_t)$. Then the dynamics of investors' wealth is described by the equations:

$$\text{(I)} \quad W_{t+1}^B = (1-\alpha)\left[e + \frac{1}{a}(W_t^B + F_t + L_t) - \tilde{r}L_t\right]$$

when W_t^B is small and therefore $p_t \equiv 0$ (part 1 of the $W_{t+1}^B(W_t^B)$ curve), and:

$$\text{(II)} \quad W_{t+1}^B = (1-\alpha)\left[e + \frac{Z}{1+x} - \tilde{r}L_t\right]$$

when there is excess demand for the country-specific factor and therefore p_t becomes positive (part 2 of the $W_{t+1}^B(W_t^B)$ curve).

(In (I) and (II) the variable $\tilde{r}$ denotes the domestic interest rate, which is equal to $\underline{\sigma}$ if $\mu(W^B + F) < W^L$ and to the profit rate otherwise.

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

$$W_{t+1}^B + xW_{t+1}^B = (1-\alpha)\left[e(1+x) + Z - \tilde{r}\mu W_t^B(1+x)^2\right],$$

which for e small is *decreasing* in x. In particular, starting from an economy without any FDI, introducing highly constrained FDI may end up *deepening* the slump which it was meant to eliminate.

Appendix B. Uncertainty and defaults

Here we derive the number of defaulting firms when there is firm-specific uncertainty. Deriving RL from (10) and substituting into (11) gives:

$$rL = \frac{\psi(p)(W^B + L)}{\overline{\sigma} - \underline{\sigma}} \int_{\underline{\sigma}}^{\overline{\sigma}} \min(\sigma^*, \sigma)\, \mathrm{d}\sigma. \tag{12}$$

The number of defaulting firms, $(\sigma^* - \underline{\sigma})/(\overline{\sigma} - \underline{\sigma})$, can be derived from (12). When firms are credit constrained, we can use the fact that $L/(W^B + L) = \tau/r$ and get:

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

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:

$$\sigma^* = \overline{\sigma} - \sqrt{(\overline{\sigma} - \underline{\sigma})\left[\overline{\sigma} + \underline{\sigma} - \frac{2(I - W^B)}{I}\right]},$$

where I is determined by the world interest rate r.

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