

MANCHESTER  
1824

The University  
of Manchester

# **Economics Discussion Paper**

EDP-0542

Capital Account Openness and Bankruptcies

By

Luis Angeles

November 2005

[luis.angeles@manchester.ac.uk](mailto:luis.angeles@manchester.ac.uk)

School of Social Sciences,  
The University of Manchester  
Oxford Road  
Manchester M13 9PL  
United Kingdom

Combining the strengths of UMIST and  
The Victoria University of Manchester

# Capital Account Openness and Bankruptcies

Luis Angeles\*  
June 2005

## Abstract

This paper presents a model where opening the capital account of an economy causes more bankruptcies to take place in the non tradables sector. Non tradable firms must forecast the future state of the economy when investing since the demand for their goods depends on this. In our model the interest rate is a powerful signal that non tradable firms use when the capital account is closed, but its informational content decreases once the capital account opens up and international (as well as domestic) shocks affect it.

**Keywords:** Capital Account Openness, Bankruptcies.

## 1 Introduction

The effects of capital account liberalization has been a highly debated subject in economics recently. The suspicion that an open capital account could be at the root of many financial crisis took force after the wave of crisis in Asia in 1997. As has been pointed out by Williamson (1999), what distinguished the Asian countries that suffered a meltdown from those that didn't was not so much crony capitalism, lack of supervision of financial institutions or little transparency; it was rather a recent passage to an open capital account<sup>1</sup>. It

---

\*Department of Economics, School of Social Sciences, The University of Manchester. e-mail: Luis.Angeles@manchester.ac.uk phone: +44 161 275 4855. I thank Philippe Bacchetta, Thierry Verdier, Monika Butler, Daniela Fabbri, Aude Pommeret and seminar participants in Lausanne and the SMYE 2004 for important comments. All remaining errors are mine.

<sup>1</sup>Did Korea, Thailand or Indonesia scored worse in terms of crony capitalism or lack of supervision than, say, China, Pakistan or Bangladesh? On the other hand, the first three countries had opened their capital accounts recently while the others kept it closed.

seems that it was this last point (or the combination of this last point with the others) what determined which countries went into crisis and which not<sup>2</sup>.

The subject is of great interest because until the Asian crisis several institutions like the IMF advised developing countries to open their economies to international financial flows<sup>3</sup>. It was expected that this policy would help countries to grow faster. This view was criticized by several distinguished economists like Joseph Stiglitz or Jagdish Bhagwati (see Stiglitz 2000, Stiglitz 2002 and Bhagwati 1998). These critics have pointed out that the case for free trade in capital cannot be just assumed to be the same as the case for free trade in goods or for free markets in general. Stiglitz (2000) stresses that the problems related to imperfect information are particularly important in financial markets and Bhagwati (1998) reminds us that capital flows can suffer from “Panics, Manias and Crashes”, as Kindleberger (1989) described. The intellectual debate that took place undermined the confidence that probably existed concerning the effects of opening the capital account.

Most of the academic debate on capital account liberalization has been of empirical nature. In short, researchers have used the growth regressions methodology to try to find out whether there is a positive growth effect following the opening of the capital account<sup>4</sup>. A good synthesis is provided by Prasad et al. (2003) who review the evidence of 14 of such studies and conclude that “... there is no strong, robust and uniform support for the theoretical argument that financial globalization per se delivers a higher rate of economic growth.” Most of the papers in this literature show no effect or a mixed effect of the policy in question on growth. An attractive theoretical justification for this empirical fact has been provided by Gourinchas and Jeanne (2003), who use a calibrated neoclassical model to estimate the welfare effects of perfect capital mobility and conclude that they are modest and correspond to a level, not a growth effect.

A liberalized capital account has not only failed to deliver a clear growth

---

<sup>2</sup>Because of some possible confusion we should make clear that this paper is concerned with the liberalization of international *debt* financing (that we call Capital Account Liberalization), which includes both direct and indirect financing (i.e. both firms issuing bonds abroad and banks borrowing from international lenders). Our discussion will not concern Foreign Direct Investment (FDI) or international equity financing (opening the stock markets to international investors). All the above are also to be distinguished from the liberalization of the *domestic* financial system, which refers mainly to eliminating restrictions on interest rates and which is often referred to simply as “financial liberalization”.

<sup>3</sup>In 1997, the IMF proposed to make the “liberalization of capital movements one of the purposes of the IMF” (see Wilson 2004).

<sup>4</sup>Examples of this literature are Edison et al. (2002), Edwards (2001) and Arteta et al. (2001).

effect but, in addition, some argue that it has created a more unstable economic environment in emerging countries. Kose et al. (2003) show that countries with larger financial flows had higher volatility of consumption, at least among developing countries.<sup>5</sup> Another piece of evidence comes from Bordo et al. (2001), who note that “banking crises have been less frequent since 1973 when [capital] controls were present.”<sup>6</sup>

This paper will be concerned with the problems that an opening of the capital account might pose to an emerging economy; more particularly to their firms in the non tradables sector. As has been documented by Tornell and Westerman (2002), the consequences of financial crises in middle income countries is asymmetric between the tradables and non tradables sector. In the years preceding the crisis the non tradables sector typically grows faster than the tradables one; but the crisis produces a deeper and longer lasting recession in the non tradables sector. A proximate cause of this difference among sectors can be seen in the evolution of the real exchange rate in times of crises. For the episodes studied by Tornell and Westermann (2002), the real exchange rate falls strongly below its level of tranquil times. This means that the price of non traded goods is particularly low during turbulent times, which help us understand why the non tradables sector was more affected. Arguably, several non tradable firms are forced to abandon the market when their price falls and their replacement is a process that can take a few years. What is less clearly understood is through what mechanism this scenario takes place and what (if any) would be the role of a liberalized capital account.

The model we present in this paper offers a mechanism linking the openness of the capital account with an increased incidence of bankruptcies in the non tradables sector. Our model builds on the important observation that there exist a time lag between the moment when a firm starts investing in the production of a given product and the moment when this product actually reaches the market. A good illustration in the non tradables sector would be real estate, where the time between the beginning of a construction and its sale can be up to several years. This is also true in the tradables sector. An exporter of manufactures who decides to start producing a new good will also need some time to build its production lines and capacitate its labor force before the product can be sold.

This fact implies that any producer must form a forecast of the demand

---

<sup>5</sup>An increase in the measure of financial openness in Kose et al. (2003) increases the volatility of total consumption *relative to* that of total production.

<sup>6</sup>Note, however, that Bordo et al. (2001) also show that *currency* crises were more frequent in countries with capital controls (as opposed to *banking* crises).

for its product in the near future. Underestimating this future demand would mean missing profitable opportunities by investing too little while overestimating it could drive the firm into trouble since it would not be able to realize the gains that are needed to pay for the costs incurred before. When considering this problem, we realize that there is an important difference between tradable and non tradable firms, namely the fact that for the former the demand comes potentially from the whole world while for the latter the demand is exclusively domestic. Thus, non tradable firms are the ones who are interested in the future evolution of domestic demand and could suffer if they fail to see a coming slowdown in it.

Our model argues that firms evaluate the future evolution of the economy by using signals, and that some of these signals become more noisy, and thus less informative, once the capital account is opened. The signal we will be interested in is the interest rate.

More precisely, we will assume that firms must invest at time  $t$  in order to produce at time  $t + 1$  and that the economy is hit by technological shocks every period. If the economy is hit by a positive shock at  $t$  (the good state of nature) then a lot of investment opportunities will arise so firms' investment will increase and the economy's output will be high next period. The opposite is true in case of a negative shock (bad state of nature). Non tradable firms would like to invest more when the state of nature is good and less otherwise; but the state of nature is unobservable. Note that knowing the state of nature is not a concern for tradable firms since their demand is not affected by it.

Non tradable firms will be able to deduce the current state of nature by extracting the information contained in the interest rate. The interest rate will react to movements in the domestic demand for loanable funds, raising when this last one is strong and falling when it is weak. Thus, a high interest rate will signal non tradable producers strong aggregate investment and therefore strong demand for their products next period. Non tradable producers will want to invest a lot in this case. The opposite phenomena would take place when low aggregate investment drives the interest rate down.

What changes when the country opens its capital account and lets foreign capital to be offered to domestic firms? In this case the interest rate will be affected not only by the conditions in the local market but also by the different shocks affecting international capital markets. Since the supply of funds will no longer be purely domestic, an external shock will shift it and modify the interest rate. When non tradable firms observe a rising interest rate they can attribute it to two different causes: an increase in the country's demand for loanable funds, as in the preceding case, but also a rise in the international interest rate due to changes in global markets. In one word, the interest rate

will become a more noisy signal and firms will find it more difficult to extract the information they need from it. Under an open capital account non tradable firms will make more mistakes, investing too much when the economy is about to suffer a slowdown. This in turn will lead to an excess supply of non tradable goods and to the bankruptcies of the less efficient firms in the sector.

Our paper is related to other works studying the effects of opening the capital account of an economy. Aghion, Bacchetta and Banerjee (2004), for instance, present a model where economies with an intermediate degree of financial development can become more volatile by opening to international capital flows. This takes place because of the creation of a boom-bust cycle where firms use the new capital inflows to invest more, increase their profits and thus expand their borrowing capacity, which allows them to invest even more and create a boom. This boom comes to an end when the price of a non tradable input is pushed up, causing profits to fall and reducing the firm's borrowing capacity. This reduces investment, which causes a further reduction in profits and creates a bust.

Another relevant paper is the one by Rivera-Batiz (2001), who treats the problem by considering an endogenous growth model where a corrupt government taxes entrepreneurs. This reduces the returns to invest in R&D and therefore slows down growth. He shows that, given this setting, opening the capital account can be growth decreasing. Such a possibility arises if the country is very corrupt and returns to investment are lower at home than in the international market. Capital flight will be the consequence of capital openness for those countries, and slower growth will follow.

## 2 The model

The model has an OLG structure and presents three types of agents: consumers, tradable goods producers and non tradable goods producers. We will note tradable and non tradable goods as T and NT goods respectively. Tradable goods will be the numéraire in the model. Consumers live for two periods, they work in the first period and consume in the second one. The totality of consumer's revenues when young is thus saved and lent to the firms through a perfectly competitive banking sector. When old, consumers receive the amount they have lent plus interests and the totality of the firms' profits, since they are the ultimate owners of the firms created last period. They use all these revenues to finance consumption.

Firms also live for two periods. In the first period, and if it is profitable to do so, they borrow funds from consumers and invest them in order to produce

next period. In the second period they produce, sell their goods, pay back their loans and distribute their profits to their owners, namely old consumers.

In our model bankruptcies will take place in the non tradables sector. All tradable firms will be assumed to be identical and profitable. Non tradable firms, on the contrary, are all different and the least efficient among them will suffer bankruptcies.

As we mentioned before, each period the economy finds itself in a given state of nature, a bad one with probability  $p$  and a good one with probability  $1 - p$ . The good state of nature will be characterized by a high demand for loanable funds; in other words, firms are willing to invest a lot. We can think that the state of nature reflects the variable flow of ideas and innovation in the economy. Each period firms come up with projects for new types of goods and ideas for expanding or improving the existing ones. The realization of these projects requires both time and resources. Any given entrepreneur cannot observe what is the aggregate number of new ideas created this period. All she can observe is whether she has a new idea or not. If the answer is positive then she will proceed to invest in order to realize it. Thus, the periods characterized by a large number of new ideas will also be the periods with a high demand for loanable funds.

To simplify, we will assume that this variable flow of ideas will characterize only tradable firms. It is enough that one sector of the economy suffers from these random shocks for the future domestic demand to be variable.

An important assumption that our model makes is that aggregate investment, and -in the open capital account case- aggregate capital inflows, cannot be observed contemporaneously by any single entrepreneur. If this was the case, entrepreneurs would not need to use any signal in the first place since the level of aggregate investment would give them the level of aggregate domestic demand next period. As already noted, while each entrepreneur knows its own investment decision, she does not know the decision of everyone else. The process of collecting all individual data to form a statistic on aggregate investment takes some time; so at the moment they take their investment decisions entrepreneurs must rely on the signals provided by the economy like the interest rate.

Below we present each agent in more detail under a closed capital account. Once the equilibrium of the closed capital account case is described we will pass to the open capital account situation.

## 2.1 Consumers

There is a continuum of consumers of measure 1. They work when young and consume when old. A consumer who is young at  $t$  supplies inelastically  $\bar{L}$  units of labor and receives a labor income of  $w_t \bar{L}$ . It then lends all these funds to the firms at the gross interest rate  $R_{t+1}$ . Next period he receives back the funds he has lend plus the profits firms have made since he is the ultimate owner of the firms. This allows him to consume  $C_{t+1}$ :

$$C_{t+1} = w_t \bar{L} R_{t+1} + \sum_j \pi_{t+1}^j \quad (1)$$

where  $C_t$  is a composite consumption good formed by both tradable and non tradable goods<sup>7</sup>:

$$C_t = \left[ v^{\frac{1}{\rho}} (C_t^T)^{\frac{\rho-1}{\rho}} + (1-v)^{\frac{1}{\rho}} (C_t^{NT})^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}} \quad (2)$$

The parameter  $\rho$  defines the degree of substitutability between tradable and non tradable goods. For  $\rho = \infty$  we would have the case of perfect substitutes while for  $\rho = 0$  we would have perfect complements (i.e. the Leontieff function). The parameter  $v$  determines the part of income that consumers allocate to tradable goods.

Note for further use that the price of the composite good is given by:

$$P_t = \left[ v (P_t^T)^{1-\rho} + (1-v) (P_t^{NT})^{1-\rho} \right]^{\frac{1}{1-\rho}} = \left[ v + (1-v) (P_t^{NT})^{1-\rho} \right]^{\frac{1}{1-\rho}}$$

where  $P_t^T$  and  $P_t^{NT}$  are respectively the prices of tradable and non tradable goods and  $P_t^T = 1$  (tradable goods are the numéraire). The utility of consumers at time  $t$  will be given by:

$$U_t = C_t^\alpha$$

The parameter  $\alpha$ , which belongs to the interval  $(0, 1)$ , defines both the elasticity of the utility function (which equals  $\alpha$ ) and the relative risk aversion of the consumers (which equals  $1 - \alpha$ ).

---

<sup>7</sup>Note that equation (1) tells us that both the wage  $w_t$  and the firms' profits  $\pi_t$  are measured in units of the composite consumption good.



## 2.2 Tradable goods producers

Tradable goods producers suffer the technological shocks described earlier. If at time  $t$  the state of nature is good then there are a lot of new profitable opportunities and the number of tradable firms investing is high. In a bad state of nature few profitable opportunities are available so there will be less tradable firms willing to invest. The number of tradable firms investing at time  $t$  will be noted  $n_t^T$  and will equal  $n^{T,h}$  in a good state of nature and  $n^{T,l}$  in a bad one ( $n^{T,h} > n^{T,l}$ ).

Each tradable firm that is investing borrows one unit of the composite good at time  $t$  that it must pay back at  $t + 1$ . This constitutes the fixed costs of setting up the firm. Having done this at  $t$ , a firm can produce at  $t + 1$  using the production function  $y^T = f_T(L_j)$ . The firm hires labour in order to maximize its profits, measured in units of the composite good:

$$\text{Max } \pi_{t+1}^T = f_T(L_j) \frac{1}{P_{t+1}} - w_{t+1}L_j - R_{t+1}$$

which gives the demand for labor of a T firm:

$$L_j = f_T'^{-1}(w_{t+1}P_{t+1})$$

Finally, note that since the number of T firms investing is  $n_t^T$  and each one of them needs to invest one unit of the composite good in order to produce next period, the demand of loanable funds from the T sector will equal just  $n_t^T$ .

## 2.3 Non Tradable goods producers

Non tradable goods producers are not subject to shocks like in the tradables sector. The problem that NT producers face when deciding whether to invest or not is the uncertainty concerning the demand for their goods next period. If at time  $t$  the number of tradable firms investing is large then the country's GDP next period will also be large, so they should invest a lot in order to respond to this prospective large demand. The opposite is true when the number of tradable firms investing falls.

There is a continuum of  $\bar{n}$  potential NT producers and we will note  $n_t^{NT}$  the number of potential NT producers who actually decide to invest at time  $t$ . In order to produce at  $t + 1$  NT firms must proceed in the same way T firms do: first they must invest some quantity of the composite good at period  $t$  as an initial fixed cost and at period  $t + 1$  they can take advantage of the production function  $y^{NT} = f_{NT}(L_i)$ . Just as for T firms, their demand for labor of NT

firms can be calculated and will be given by:

$$L_j = f_{NT}^{\prime-1}\left(w_{t+1} \frac{P_{t+1}}{P_{t+1}^{NT}}\right)$$

The main difference with respect to the T sector is that we will assume that each NT firm has a different level of efficiency and that this is reflected in the amount each one needs to invest at  $t$ . Each firm's efficiency is private information. The most efficient firms will need to invest a smaller amount while the less efficient ones would need to invest more. We will note this amount  $h_i$  and assume that  $h_i$  is distributed among firms following a *cdf* that we will note  $G(h_i)$ . Due to this heterogeneity among NT firms the supply of NT goods will vary according to the future prospects of the economy.

The only source of incertitude in the model comes from the state of nature. Assume for the moment that NT firms are able to deduce correctly the current state of nature (this will be proved to be the case under a closed capital account). Once the state of nature is known the rest of the variables of the model can be calculated. In particular, NT firms' profit in terms of the composite good will be given by:

$$\begin{aligned} \pi_{t+1}^{NT,i} &= y^{NT} \frac{P_{t+1}^{NT}}{P_{t+1}} - w_{t+1}L_i - h_i R_{t+1} & \text{if } y^{NT} \frac{P_{t+1}^{NT}}{P_{t+1}} - w_{t+1}L_i - h_i R_{t+1} > 0 \\ &= -\gamma & \text{otherwise.} \end{aligned}$$

As can be seen, the above equation considers the possibility of bankruptcy. If the firm's revenues are not enough to pay wages and debts then the firm will be bankrupt and will suffer a private cost of bankruptcy equal to  $\gamma$ . This cost of bankruptcy can have several interpretations: it can represent the loss of intangible assets that bankrupt firms suffer, the efforts that have been used up in managing the firms that finally provides no benefits or it can stand for a reputational cost that bankrupt entrepreneurs must bear. For simplicity we will assign an exogenous and constant value to this cost, but one could endogenize it by assuming that bankrupt entrepreneurs are excluded from capital markets for one period. In this case the cost of going bankrupt would equal the amount of profits that will not be realized because of the firm's failure.

The profit function is depicted in figure 1. All firms whose profit will be positive will decide to invest. This will be the case of the most efficient segment of firms, namely those for which  $h_i$  is lower or equal than a limit value  $h_t^*$  given by:

$$h_t^* = \frac{y^{NT} \frac{P_{t+1}^{NT}}{P_{t+1}} - w_{t+1}L_i}{R_{t+1}}$$

It follows that the number of NT firms investing at  $t$  is  $n_t^{NT} = \bar{n}G(h_t^*)$ , the supply of NT goods at  $t+1$  will be  $y_t^{NT}n_t^{NT}$  and the demand for funds coming from the NT sector equals  $\bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i$ , where  $g(h_i)$  is the *pdf* associated to  $G(h_i)$ .

What should be underlined is that, given our assumption that NT firms can perfectly deduce the current state of nature of the economy, no bankruptcies will take place in the NT sector. As argued in the Introduction, this will be possible by exploiting the information given by the interest rate when the capital account is closed. This can be explained by looking at the market for loanable funds, represented in Figure 2.

The supply of loanable funds equals  $w_t L_t$ , i.e. the total revenues of young consumers. The demand for loanable funds is  $n_t^T + \bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i$ . This demand is decreasing in  $R_{t+1}$  (because of the presence of  $h_t^*$ ) and shifts for different values of  $n_t^T$ . NT firms know all aspects of the economy except the current state of nature. Thus, they can calculate the interest rate that should prevail in a good state of nature and in a bad state of nature. If they believe the state of nature is good then they will expect to observe  $R_1$ . If the interest rate turns out to be lower this will signal them that the actual state of nature is the bad one, so they will change their behavior until the observed interest rate coincides with the one they expect.

In this way, the interest rate will transmit all the information needed in order to deduce the actual state of nature.

## 2.4 Equilibria with a closed capital account

In its closed economy version, the equilibrium of the model can be found by solving a system of 3 equations in the 3 endogenous variables  $R_{t+1}$ ,  $P_{t+1}^{NT}$ ,  $w_{t+1}$ . The equations are given by the equilibrium conditions of the market for loanable funds, the market for NT goods and the labor market. They can be found in the Appendix A of this paper.

## 2.5 The Economy with an open capital account

Let us address now the situation under an open capital account. In this case, the supply of loanable funds will come not only from domestic sources but also from foreign ones. As a result, this supply schedule will become more elastic<sup>8</sup>. Still, NT firms could use the same mechanism as before to infer the current state of nature of the economy. The fact that the supply of loanable funds has

---

<sup>8</sup>See Appendix B for a formal derivation of the supply of loanable funds under an open capital account.

become more elastic doesn't change anything: firms could still calculate the interest rate that would prevail in a good and in a bad state of nature just as in the closed capital account case.

The critical difference that will render the interest rate a less powerful signal is the fact that the foreign supply of funds can be affected by changes in world financial markets. This will be represented by an international risk-free interest rate which equals  $R^* + \varepsilon_t$ , where  $\varepsilon_t$  is an exogenous shock affecting world capital markets and following a distribution  $N(0, \sigma)$ . A change in  $R^* + \varepsilon_t$  shifts the foreign supply of loanable funds and as a consequence produces changes in the domestic interest rate. Thus, there will be two sources of fluctuation in the interest rate, one of domestic origin and one of international origin, and NT firms will not be able to distinguish among them. A high interest rate can be caused by a strong demand for loanable funds but also by a rise in the international interest rate.

In figure 3 we represent the market for loanable funds under an open capital account. The supply of loanable funds is more elastic than in the closed capital account case but we do not assume the extreme case of perfect elasticity<sup>9</sup>. As in the closed capital account case, NT producers observe the interest rate and use it as a signal informing about the current state of nature. But contrary to the closed capital account situation, any observed interest rate is now compatible with both a good and a bad state of nature.

Suppose, for instance, that the interest rate  $R_1$  is observed. Does this signal a good or a bad state of nature? As figure 3 shows, this interest rate would be obtained if the demand for loanable funds was high (i.e. in a good state of nature) and the supply of loanable funds was at the relatively high level given by  $Sf_{high}$ . However, this interest rate is also compatible with a low demand for funds (a bad state of nature) and a relatively low level of the supply of funds, given by  $Sf_{low}$ . It follows that the interest rate does not perfectly uncover the actual state of nature as it did when the international shock did not affect the country. But it is still the case that the interest rate provides some information about the state of nature. Since the demand for funds can take only two values (high or low), when observing  $R_1$  investors know that the economy must be either in equilibrium  $A$  or in equilibrium  $B$  on figure 3. They don't know on which one but they do know the unconditional probability of

---

<sup>9</sup>With a perfectly elastic supply curve our conclusion would be even more drastic since the interest rate would not react to changes in the demand for funds and therefore would become completely uninformative about the state of nature. Since this results holds only for an infinite elasticity of supply we prefer to concentrate on the more general case of a finite elasticity of supply. The interest rate is still informative but less than in the closed capital account case.

having a good and a bad state of nature and the distribution of international financial shocks (i.e. how likely it is that the supply of funds is as high as  $Sf_{high}$  or as low as  $Sf_{low}$ ). It follows that they can use Bayesian updating to calculate the probability of being in equilibrium  $A$  or  $B$ , which is just the probability that the state of nature is good or bad *conditional* on the observed  $R_1$ .

Let us note as  $\varepsilon_t^l(R_1)$  the value of the shock that shifts the supply of funds to  $Sf_{low}$  and  $\varepsilon_t^h(R_1)$  the one that shifts it to  $Sf_{high}$  (note that we have pointed out that these values depend on the observed  $R_1$ ). Then, the probability of a bad state of nature conditional on the observed  $R_1$  will be given by:

$$p_t^l = \frac{pf(\varepsilon_t^l)}{pf(\varepsilon_t^l) + (1-p)f(\varepsilon_t^h)}$$

where  $f$  is the density function of  $\varepsilon_t$  and  $p$  the unconditional probability of a bad state of nature.

Being uncertain about the state of nature, NT firms will base their decision to invest no longer on known future profits but rather on expected profits, given by:

$$E\pi_{NT,t+1}^i = (1-p_t^l)\pi_{NT,t+1}^{i,h} + p_t^l\pi_{NT,t+1}^{i,l}$$

where

$$\begin{aligned} \pi_{t+1}^{NT,i,h} &= y^{NT,h} \frac{P_{t+1}^{NT,h}}{P_{t+1}^h} - w_{t+1}^h L_i^h - h_i R_{t+1} & \text{if } y^{NT} \frac{P_{t+1}^{NT,h}}{P_{t+1}^h} - w_{t+1} L_i - h_i R_{t+1} > 0 \\ &= -\gamma & \text{otherwise} \end{aligned}$$

$$\begin{aligned} \pi_{t+1}^{NT,i,l} &= y^{NT,l} \frac{P_{t+1}^{NT,l}}{P_{t+1}^l} - w_{t+1}^l L_i^l - h_i R_{t+1} & \text{if } y^{NT} \frac{P_{t+1}^{NT,l}}{P_{t+1}^l} - w_{t+1} L_i - h_i R_{t+1} > 0 \\ &= -\gamma & \text{otherwise} \end{aligned}$$

As can be seen, profits can be high or low according to the state of nature and each eventuality is assigned the updated probability discussed before. The decision of NT firms on whether to invest or not can be explained with the help of figure 4. This figure is similar to figure 1 but now we represent the profit function under a good state of nature and under a bad state of nature. As can be seen the most efficient firms (i.e. those with lower  $h_i$ ) make positive profits both with a good and with a bad state of nature. These firms will

certainly invest. The less efficient firms, on the other hand, will go bankrupt under any state of nature. They will certainly not invest. Finally, for middle values of  $h_i$  we have firms that would do a positive profit under a good state of nature but that would go bankrupt if the state of nature is bad. Some of these firms will invest.

We can define  $h_t^{**}$  such that:

$$E\pi_{NT,t+1}^i = (1 - p_t^l)(y^{NT,h} \frac{P_{t+1}^{NT,h}}{P_{t+1}^h} - w_{t+1}^h L_i^h - h_t^{**} R_{t+1}) - \gamma p_t^l = 0$$

$$h_t^{**} = \left( y^{NT,h} \frac{P_{t+1}^{NT,h}}{P_{t+1}^h} - w_{t+1}^h L_i^h - \frac{\gamma p_t^l}{1 - p_t^l} \right) \frac{1}{R_{t+1}}$$

The NT firm with  $h_i = h_t^{**}$  has an expected profit of zero. It follows that all NT firms with  $h_i \leq h_t^{**}$  will decide to invest. But this means that at every period there will be a positive amount of firms that will go bankrupt if the state of nature is bad. These are the firms with  $h_t^b \leq h_i \leq h_t^{**}$ , where  $h_t^b$  is defined as:

$$y^{NT,l} \frac{P_{t+1}^{NT,l}}{P_{t+1}^l} - w_{t+1}^l L_i^l - h_t^b R_{t+1} = 0$$

$$h_t^b = \frac{1}{R_{t+1}} (y^{NT,l} \frac{P_{t+1}^{NT,l}}{P_{t+1}^l} - w_{t+1}^l L_i^l)$$

The main conclusion of this section is then that under an open capital account bankruptcies will take place each time the state of nature is bad. This happens because the interest rate is affected by both domestic and international shocks and has become a noisy signal. NT firms guide themselves by expected profits in order to invest, so too few firms invest when the state of nature is good and too many when it is bad. This second fact has the consequence that the less efficient firms that did invest will find themselves in bankruptcy in bad states of nature. When a firm goes bankrupt its creditors lose all the funds they had lent to it. Since old consumer's revenue depends in great part on the loans they have accorded to firms, bankruptcies will negatively affect their income and force them to reduce consumption. In this way, bankruptcies will decrease welfare in an important way.

Under an open capital account the model has 5 endogenous variables:  $R_{t+1}$ ,  $P_{t+1}^{NT,h}$ ,  $P_{t+1}^{NT,l}$ ,  $w_{t+1}^h$  and  $w_{t+1}^l$ . It can be solved with the system of equations presented in Appendix C.

### 3 Simulating the model

#### 3.1 Methodology and parameter values

In this section we simulate the model and show how the performance of the economy under a closed capital account compares with that of the economy under an open capital account<sup>10</sup>. To simulate the evolution of the economy over time we proceed in the following manner: each period the system of equations given in Appendix A (for the closed capital account case) or in Appendix C (for the open capital account case) has to be solved numerically. This gives us the values of the endogenous variables for that period, which can be used to calculate all other variables. At each period we will need a realization of the state of nature and, for the open capital account case, of the shock to international financial markets. This is done using a random numbers generator. The equilibrium of a given period affects the next period's equilibrium via the domestic supply of funds (which equals last period's labor income).

Once we have the time path of consumption, welfare can be calculated as

$$W = \sum_{t=1}^T \frac{C_t^\alpha}{(1 + \delta)^{t-1}} \quad (3)$$

In our simulations we will use  $\rho = 1.25$  and  $v = 0.5$  for the composite consumption good defined in equation (2). The first value implies some degree of substitutability between tradable and non tradable goods and the second one says that if prices of non tradables and tradables are equal then the share of income attributed to each type of good would be one half. The number of tradable goods producers who are willing to invest is equal to 1 in a good state of nature and 0.7 in a bad one. In other words, the number of new ideas or projects in the tradable sector falls by 30 % in bad states of nature. The international risk-free interest rate is set at a level low enough to ensure that capital will flow into the country once the capital account is liberalized (we use  $R^* = 1.15$ ). For the production functions we use  $f_{NT} = L^{0.5}$  and  $f_T = 5 + L^{0.5}$ . The positive constant in the production function for tradables ensures that their profit will be positive. The distribution of the efficiency measure  $h_i$  among non tradable firms will be normal with parameters  $\mu = 2$  and  $\sigma = 0.5$ .

---

<sup>10</sup>All parameter values and functional forms that have been used in these simulations are presented in Appendix D.

### 3.2 The effects of a bad state of nature

We start by comparing the effects of a bad state of nature under a closed and an open capital account. Since consumption is the determinant of welfare in this model we will concentrate our attention on its evolution over time. Figure 5 shows the level of consumption for the two cases of interest over a 20-period interval where a bad state of nature takes place at periods  $t = 8$  and  $t = 16$ . This figure illustrates well the positive and negative consequences of opening the capital account. On the positive side we note that the economy with an open capital account enjoys a higher level of consumption in all periods where the state of nature is good. This is the product of the larger availability of investable funds, which allows firms to finance more projects. We note that this positive effect on consumption is a level -and not a growth- effect; in accordance with the empirical record reviewed at the beginning of the paper.

On the negative side we can note that consumption is more volatile under an open capital account, which is caused by the prevalent shocks to international financial markets that we have included in the model. A more serious problem is the fact that the fall in consumption that is observed in a bad state of nature is much larger when the capital account is open. It is on this aspect that the present model has been focused, the larger fall in consumption is explained by the bankruptcies that take place in the non tradables sector when the state of nature is bad.

Another way to look at the effects of a bad state of nature is to construct “impulse-response” functions showing the effect of a bad state of nature on an economy that is initially at its steady state<sup>11</sup>. Figure 6 shows such impulse-response functions under a closed and under an open capital account. Here the level of consumption at each period is given as a percentage of its steady-state value. It is noticeable that after a bad state of nature consumption falls by 12 % in the closed capital account case and by a heftier 33 % when the capital account is open. The recovery from such falls is not immediate because the fall in wage revenues in a bad state of nature reduces the domestic supply of funds, thus containing investment in the crisis period and production in the following period. The recovery when the capital account is open can be qualified as faster (since it rebounds from a lower point) and this is explained by the fact that the domestic supply of funds is less important when the country has access

---

<sup>11</sup>Under a closed capital account the economy does attain a steady state after a long enough series of good states of nature since there would be no shock hitting the economy. This is not the case under an open capital account because of the shocks to international capital markets. For the open capital account case we have calculated the impulse-response function by taking the average values over a large number of simulated episodes.



to funds from abroad.

The two figures just described make the point that an economy faces a trade off when it decides to open itself to international financial flows. On the one hand there is a well-understood positive effect on production stemming from the larger availability of investable funds. On the other hand there is an increase in the welfare cost of bad states of nature, caused by the loss of informational value of the interest rate. Explaining this last effect was the main point of the paper. In the following subsection we will try to evaluate the net welfare effect of opening the capital account focusing on the role of the probability of bad states of nature and the degree of risk aversion of the consumers.

### 3.3 Welfare analysis

As suggested in the preceding paragraph, the net welfare effect of opening the capital account can be positive or negative. Since the disadvantage of an open capital account comes from the steep falls in consumption during bad states of nature, the net welfare effect will depend crucially on the frequency of these bad states and on how important it is for consumers to bear such a risk. In other words, the parameters  $p$  (the unconditional probability of a bad state of nature) and  $\alpha$  (which gives the relative risk aversion of consumers,  $1 - \alpha$ ) will be two main determinants of the welfare changes.

In figure 7 we examine the role of  $p$ . This figure graphs the expected welfare (given by equation 3) for the closed and open capital account for different values of this parameter. Three aspects are noteworthy in this figure: first, for very low values of  $p$  welfare will be higher with an open capital account since the main problem linked to this policy -namely the bankruptcies during bad states of nature- will be almost absent. Second, while the welfare decreases with  $p$  for both economies, it decreases faster for the open capital account economy. This is the case because a bad state of nature is more damaging under an open capital account. Finally, for a high enough value of  $p$  we note that an open capital account is welfare decreasing. In the figure this value is around 0.10, but it will change with different parameter values. Summarizing, the larger the unconditional probability of bad states of nature, the more likely that an opening of the capital account will decrease welfare.

Figure 8 adds to the above analysis one dimension by considering the role of the parameter  $\alpha$ . Higher values of this parameter imply a lower level of relative risk aversion. The upper panel of figure 8 shows the percentage change

in welfare following an opening of the capital account as a function of both  $p$  and  $\alpha$ . The bottom panel shows us the contour lines of the three dimensional figure on the top.

Let us start by analyzing the bottom panel of figure 8. As can be seen, the change in utility is always a decreasing function of  $p$ , just as we have seen in figure 7. The value of  $p$  for which the change in welfare passe from positive to negative varies in this figure between 0.10 and 0.125. The second message of this figure is that opening the capital account might be welfare decreasing for consumers with strong risk aversion but welfare increasing if risk aversion is low. This happens when the probability of having bad states of nature is in an “intermediate” level. As the figure shows, when this probability is low enough, opening the capital account will increase welfare for any value of  $\alpha$ . Similarly, if  $p$  is high enough then welfare will decrease whatever the level of risk aversion. It is when the probability of bad states of nature takes values in the 0.10 to 0.12 interval that the level of  $\alpha$  changes the sign of the welfare effect. For low values of  $\alpha$  (high risk aversion) the net welfare effect would be negative while for high enough values (low risk aversion) the effect turns out to be positive.

It is important to note here that the actual magnitude of the change in welfare cannot be compared since utility is an ordinal -and not a cardinal- measure. In other words we cannot say that consumers with low risk aversion would be “more eager” to accept an opening of the capital account than consumers with high risk aversion because their increase in utility would be larger. Having said this, we can now explain the shape of the surface in the upper panel of figure 8.

In this figure, the percentage change in Welfare is an increasing function of  $\alpha$  for low values of  $p$  while it becomes a decreasing function of  $\alpha$  when  $p$  is large enough (passing through an intermediate zone where the relationship is actually U-shaped). This can be explained by recalling that  $\alpha$  is also the elasticity of utility with respect to consumption. In our model, when a country opens its capital account it “exchanges” a pair of consumption levels (good state - bad state of nature) against another pair where the good level is higher but the bad level is lower. The welfare effect of this change will depend on the probability of having bad states of nature. Now, for a given value of this probability, how would the welfare change be affected when  $\alpha$  increases? Since  $\alpha$  is the elasticity of the utility function, a larger  $\alpha$  will increase the gains (and the losses) in utility that consumers experience during good (resp. bad) states of nature. Thus, a larger  $\alpha$  increases the welfare gain of an event that takes place with probability  $1 - p$  while it also increases the loss of an event that takes place with probability  $p$ . If  $p$  is low enough the net effect will be positive;

after a certain value of  $p$  the net effect will be negative.

Moreover, the bigger is  $\alpha$ , the less concave is the utility function; which implies that the positive welfare effect increases in size with respect to the negative one. This is why the net changes in welfare become larger and larger as we increase  $\alpha$  for a given value of  $p$ .

## 4 Conclusion and policy implications

We have presented a model where an opening of the capital account increases the incidences of bankruptcies in the non tradables sector during economic slowdowns. The reason is that when the capital account is open the interest rate becomes a less informative signal for non tradable producers. This implies that they will be less efficient at predicting future slowdowns of domestic demand and will find themselves in an excess supply situation that will drag into bankruptcy the more vulnerable among them. The interest rate becomes a more noisy signal when the capital account is open because it reflects not only the conditions of the domestic market for loanable funds but also the changes taking place in international capital markets.

This negative side of an open capital account has to be weighted against its positive side, namely the fact that production will be higher thanks to the larger availability of investable funds. We have studied the welfare implications of an opening of the capital account numerically and have argued that the net welfare change will tend to be positive when the probability of having slowdowns is smaller and when the risk aversion of consumers is small.

It is important to stress that the result that an open capital account can decrease welfare is the product of several market imperfections that the present model implicitly assumes. These imperfections are mainly related to the financial market, which suggest that our model should be used to think of problems that can be encountered in emerging economies where financial markets are underdeveloped. The first of these imperfections is the inexistence of stock financing, which forces all firms to finance their investment by debt. Stock financing has the particularity of not demanding any compulsory payment, in particular in periods where the firm's finances are weak. Thus, if part of the firms' investments were financed by stocks the number of bankrupt firms would be reduced. A well functioning stock market is arguably more difficult to put in place than simply allowing domestic firms and banks to borrow from abroad. As a consequence, capital flows to developing countries have taken the form of bank lending and bond issuance much more often than equity placements; leaving stock markets relatively underdeveloped (see Stiglitz 2000

for data on this). Our analysis suggest that countries should take the time to develop an adequate market for equity before liberalizing all capital flows.

Another implicit assumption that can be identified to a lack of development in the financial sector is the fact that lenders (which could be domestic or foreign banks) are unable to distinguish between borrowers with different levels of efficiency. In other words, banks are very bad at screening their clients. This could be the case if the banking sector is inexperienced or if the supervision that is exerted on it is poor and allows banks to take irresponsible behavior. Banks will never be able to perfectly recognize their lenders' abilities, but it is reasonable to think that they can get better at it and in this way diminish the number of bankruptcies in the economy. It is then in the interest of the country to ensure that its banking sector is mature enough and can screen lenders reasonably well before opening the capital account.

Thus, the present paper is not advocating emerging markets to keep their economies closed to international financial flows. The paper should be regarded as a qualified warning of some possible dangers that can arise in countries with an underdeveloped financial system who chose to open their capital account. In this we join the general idea expressed in papers like Aghion et al. (2004), Edwards (2001) or earlier by McKinnon (1991), namely that capital account openness is not bad per se but that it should be put in place under the right conditions.

## References

- [1] Aghion, P. , Bacchetta, P. and A. Banerjee 2004, Financial development and the instability of Open Economies, *Journal of Monetary Economics* 51 (6), p. 1077-1106.
- [2] Arteta, C., B. Eichengreen and C. Wyplosz, 2001, When does capital account liberalization helps more than it hurts?, NBER WP 8414
- [3] Bacchetta, P. and Espinosa, M. P. 1995, Information sharing and tax competition among governments, *Journal of International Economics* 39, p. 103 - 121.
- [4] Bhagwati, J. 1998, Why free capital mobility may be hazardous to your health: lessons from the latest financial crisis, presented at the NBER conference on capital controls in Cambridge, Mass., Nov. 7 1998
- [5] Bordo, M., B. Eichengreen, D. Klingebiel and M.S. Martinez-Peria 2001, Is the crisis problem growing more severe? , *Economic Policy*, April 2001.
- [6] Demirgüç-Kunt, A. and Detragiache, E. 2001, Financial Liberalization and financial fragility, in: Caprio, G., Honohan, P. and Stiglitz, J., *Financial Liberalization*, Cambridge.
- [7] Edison, H., R. Levine, L. Ricci and T. Slok, 2002, International financial integration and economic growth, *Journal of international money and finance*, vol. 21, pp. 749-776
- [8] Edwards, S., 2001, Capital mobility and economic performance: are emerging economies different?, NBER WP 8076
- [9] Eichengreen, B. 2003, *Capital flows and crises*, MIT press.
- [10] Gourinchas, P.O. and O. Jeanne, 2003, The elusive benefits from international financial integration, NBER WP 9684
- [11] Kaminsky, G. and Reinhart, C. 1999, The twin crisis: the causes of banking and balance of payments problems, *American Economic Review* 89(3) p. 473-500
- [12] Kindleberger, C.I. 1989, *Manias, Panics, and Crashes. A History of Financial Crises*, Second Edition, Macmillan, London.
- [13] Kose, M.A. , Prasad, E. and Terrones M.E. 2003, Financial integration and macroeconomic volatility, *IMF Staff papers* 50 p.119-142
- [14] McKinnon, R.I., 1991, *The order of economic liberalization*, John Hopkins University Press.
- [15] Persson, T. and G. Tabellini 1992, The politics of 1992: Fiscal Policies and European integration, *Review of Economic Studies* 59, p. 689 - 702.
- [16] Prasad, E. , Rogoff K. , Wei, S. and Kose M. A. 2003, Effects of financial globalization on developing countries: some empirical evidence, mimeo IMF

- [17] Rivera-Batiz, F. L. 2001, International Financial Liberalization, Corruption and Economic Growth, *Review of International Economics* 9 (4), p. 927 - 937.
- [18] Stiglitz, J. 2000, Capital market liberalization, economic growth and instability, *World Development* 28(6) p.1075-1086
- [19] Stiglitz J. 2002, *Globalization and its discontents*, Norton
- [20] Williamson, J. 1999, Whether and when to liberalize capital account and financial services, WTO ERAD working paper 99-03
- [21] Wilson, D. 2004, The IMF and capital account liberalization, in Vines D. and Gilbert C. L. (eds.), *The IMF and its Critics*, Cambridge University Press.

# Figures

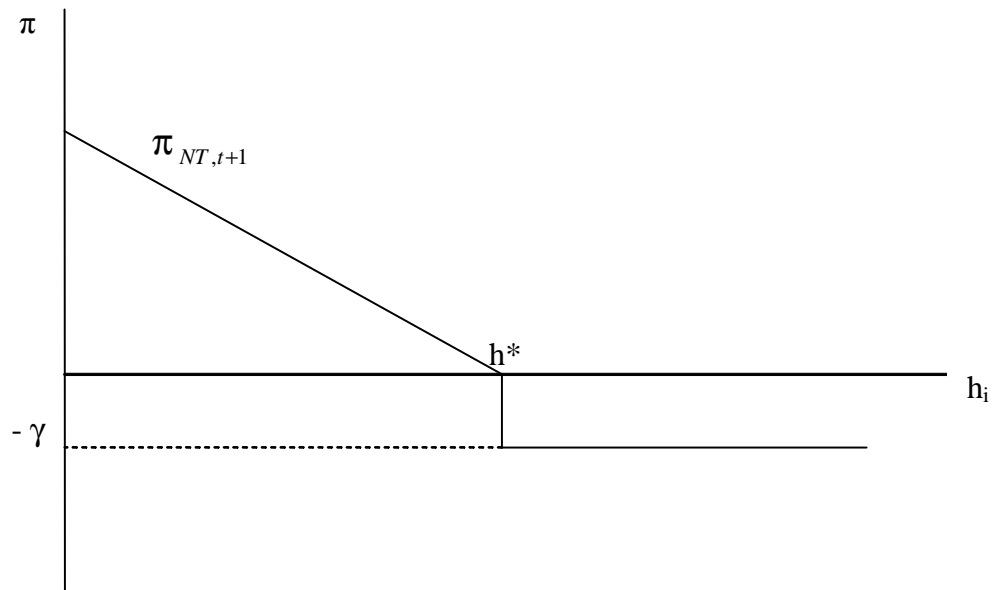


Figure 1: Profit function, closed capital account case.

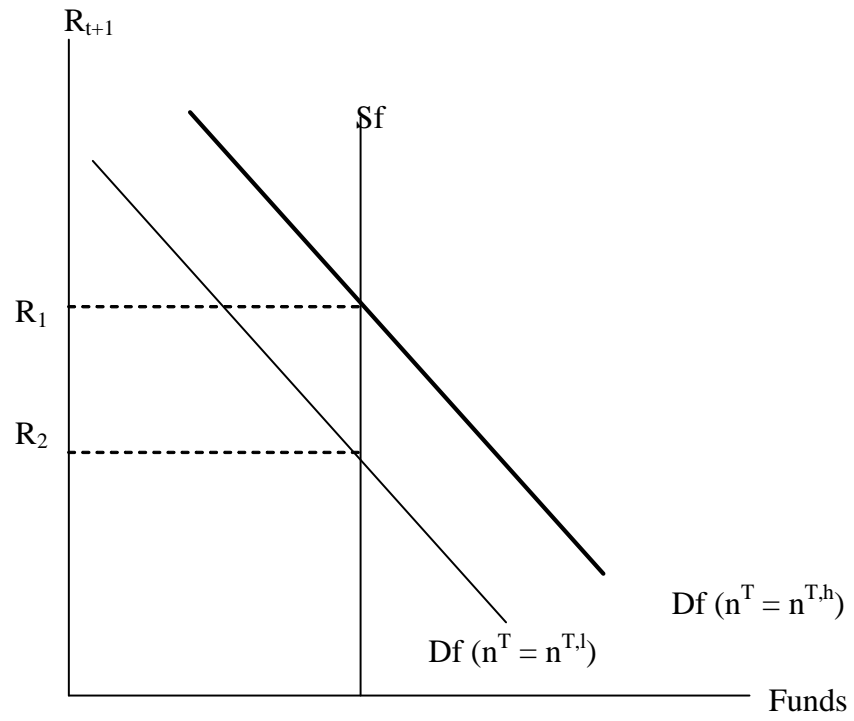


Figure 2: Market for loanable funds with a closed capital account.



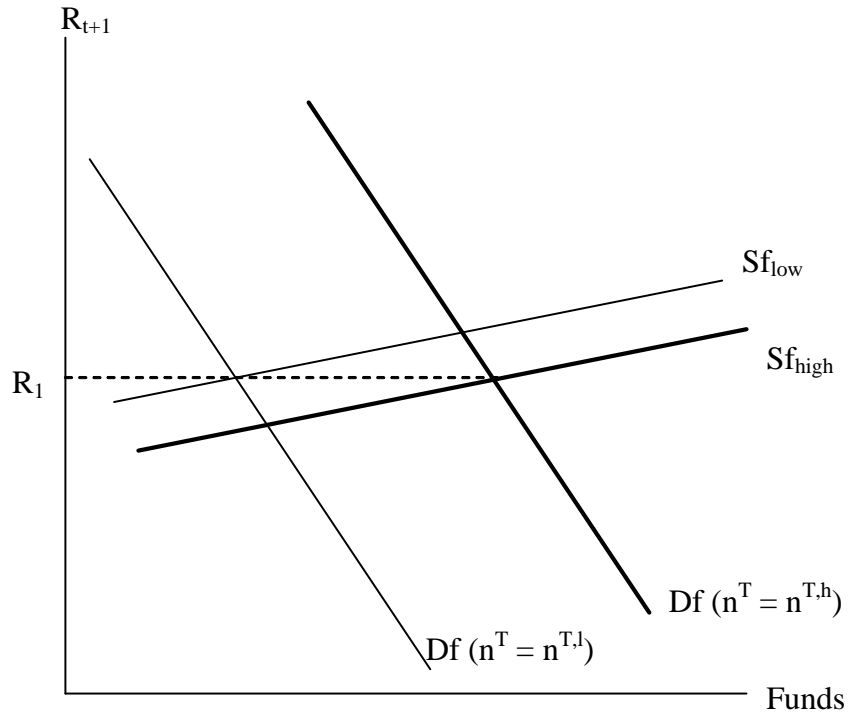


Figure 3: Market for loanable funds with an open capital account.

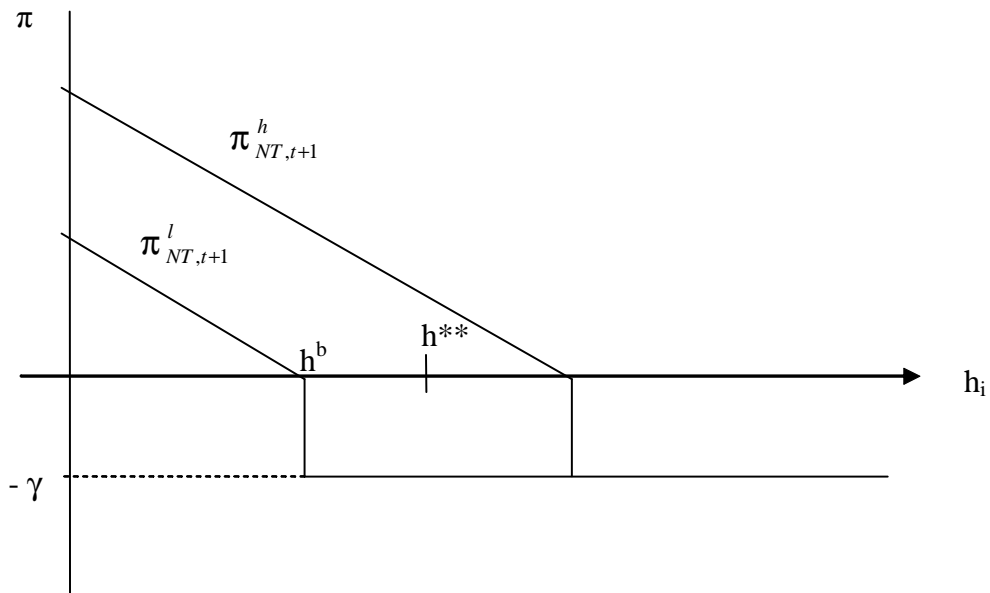


Figure 4: Profit functions under an open capital account.

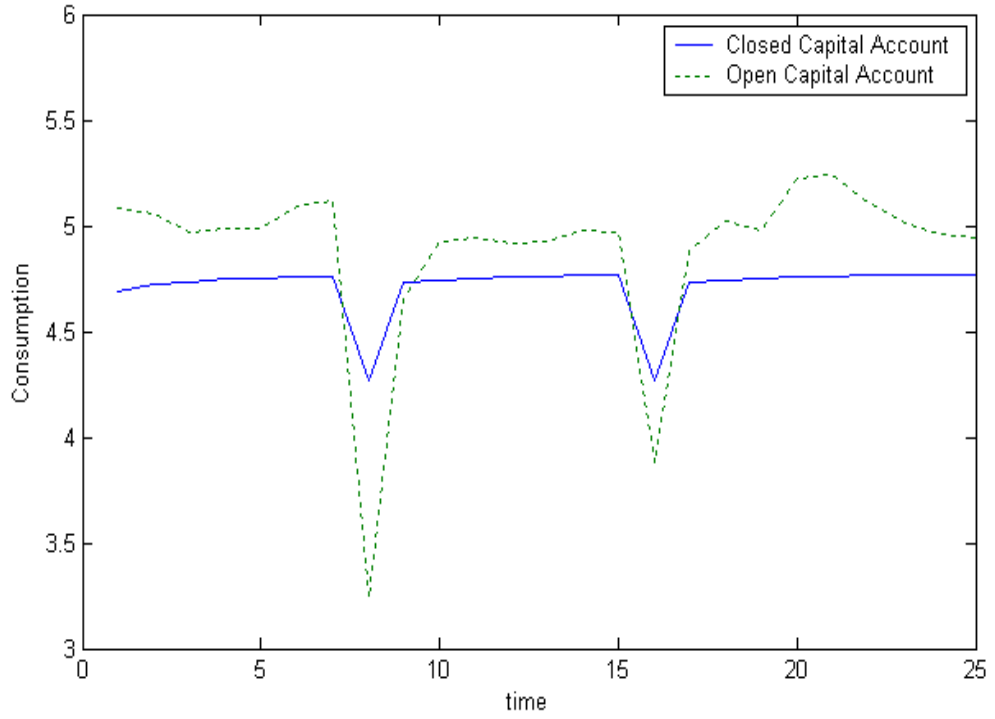


Figure 5: Consumptions paths. Closed and Open Capital Account.

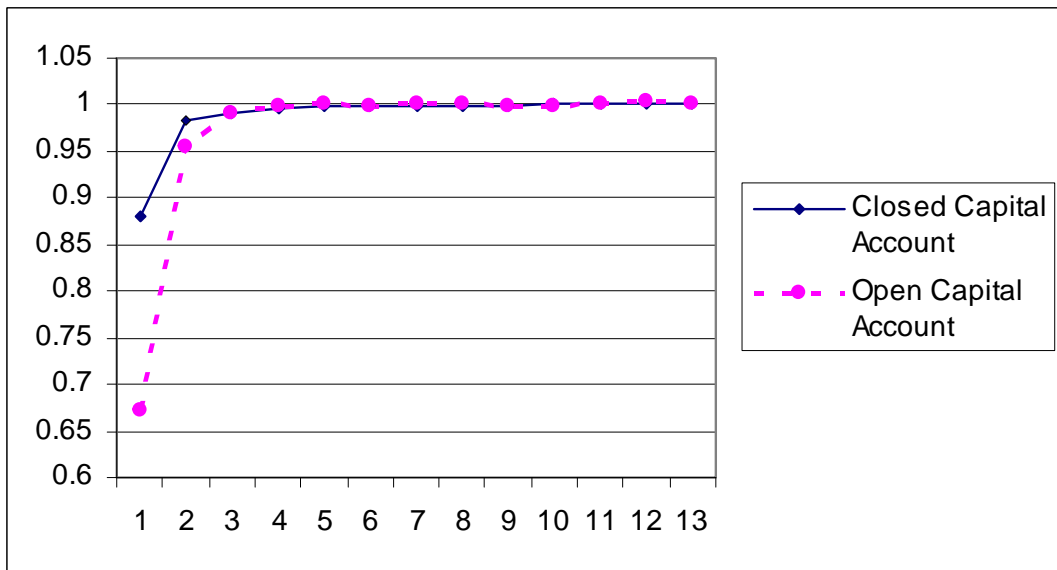


Figure 6: Impulse-response functions of consumption to a bad state of nature.

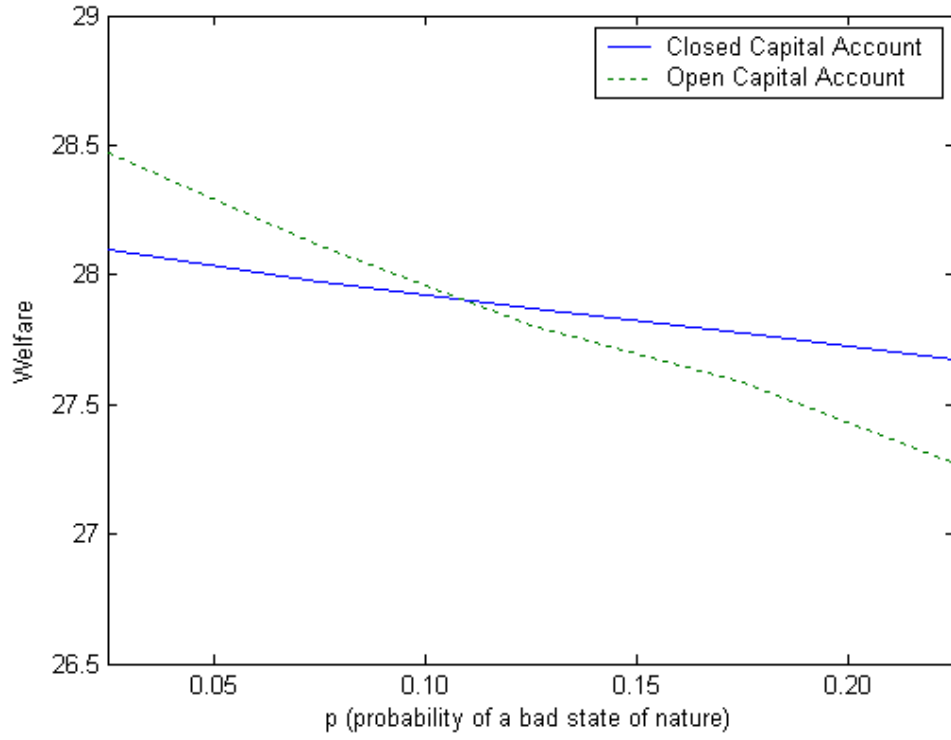


Figure 7: Welfare as a function of  $p$ .

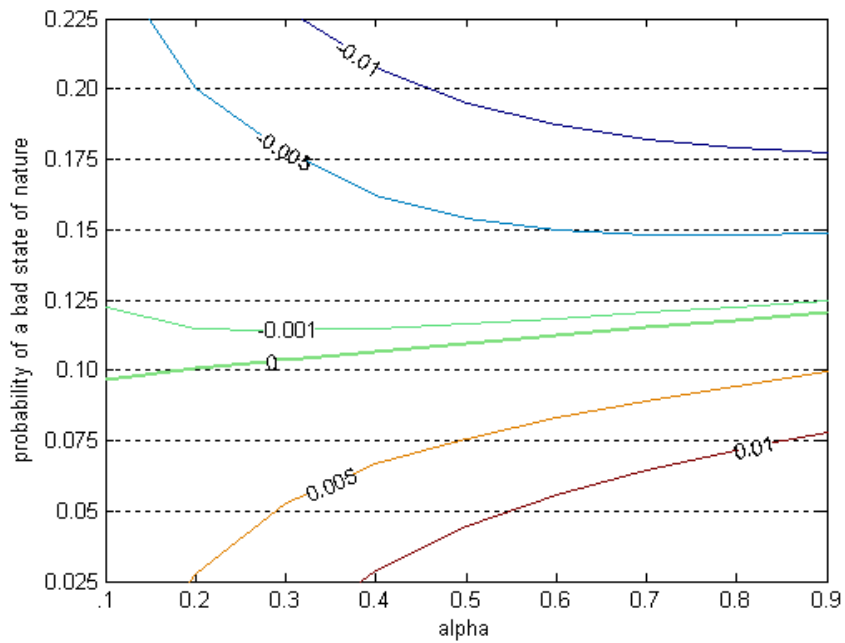
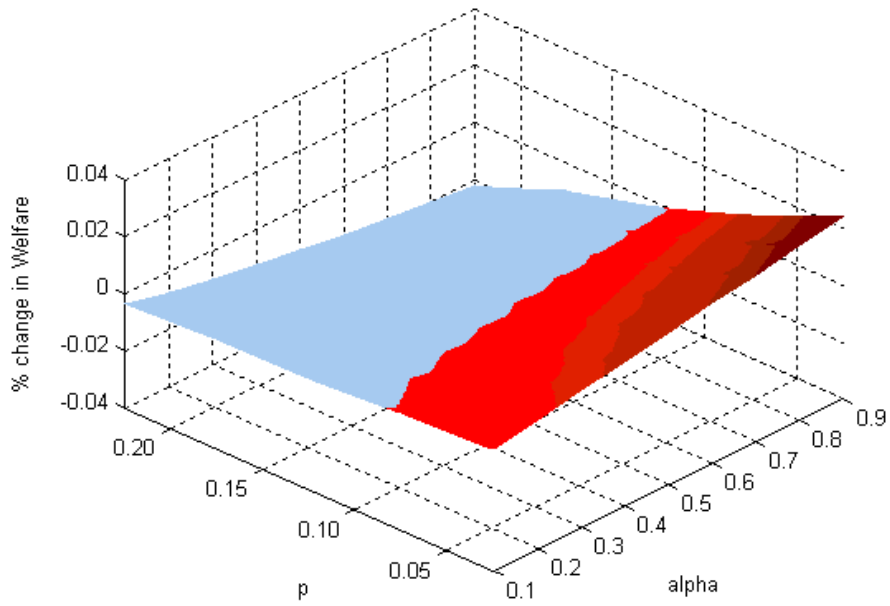


Figure 8: Percentage change in Welfare after opening the Capital Account. Upper panel: Welfare changes as a function of  $p$  and  $\alpha$ . Lower panel: contour curves of the upper surface.

# Appendix

## A Equilibrium in the closed capital account case

Equations (4), (5) and (6) can be used to calculate the equilibrium of the model when the capital account is closed.

Market for loanable funds:

$$w_t \bar{L} = n_t^T + \bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i \quad (4)$$

Labor market:

$$\bar{L} = n_t^T L_{j,t+1} + n_t^{NT} L_{i,t+1} \quad (5)$$

Market for NT goods:

$$(1 - v) \left( \frac{P_{t+1}^{NT}}{P_{t+1}} \right)^{-\rho} C_{t+1} = y_{t+1}^{NT} n_t^{NT} \quad (6)$$

where:

$$C_{t+1} = w_{t+1} \bar{L} R_{t+1} + n_t^T \pi_{t+1}^T + \sum_i \pi_{t+1}^{NT,i}$$

and

$$\sum_i \pi_{t+1}^{NT,i} = n_t^{NT} \left( y_{t+1}^{NT} \frac{P_{t+1}^{NT}}{P_{t+1}} - w_{t+1} L_{i,t+1} \right) - R_{t+1} \bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i$$

## B Foreign supply of funds

As discussed in the main text, we consider an upward-sloping foreign supply of funds. To derive it we can consider that international risk-neutral investors will drive expected returns at home and abroad to equality. Thus the following interest rate parity condition will hold:

$$(1 - p)R_{t+1} + p(1 - q_t)R_{t+1} - \eta(F_t^*) = (R^* + \varepsilon_t)$$

Recalling that  $p$  is the probability of a bad state of nature and that in a bad state of nature a proportion  $q_t$  of all bonds will be defaulted we can recognize that  $(1 - p)R_{t+1} + p(1 - q)R_{t+1}$  is the expected return on investment in the domestic economy.  $R^* + \varepsilon_t$  is the return that can be obtained in the

international financial markets and  $\eta(F_t^*)$  is the costs to international investors of investing an amount of  $F_t^*$  in the domestic economy. This cost of investing abroad has been used, for instance, by Bacchetta and Espinosa (1995) and Persson and Tabellini (1992). In the same vein as in Persson and Tabellini (1992), we can interpret them as the extra costs associated with obtaining information about the country; like its legal and macroeconomic environment.

Using the above interest rate parity condition we derive the foreign supply of funds as an increasing function of  $R_{t+1}$  :

$$F_t^* = \eta^{-1}((1 - pq)R_{t+1} - (R^* + \varepsilon_t))$$

Of course, we could also have used a perfectly elastic foreign supply of funds (this would be the case if  $\eta(F_t^*) = 0$ ). In this case the domestic interest rate will not react at all to changes in the demand for funds and therefore would loose all its informational content. To avoid the impression that the results of the model depend on that particular shape of the foreign supply of funds we have chosen to treat the more general case when the foreign supply of funds is not perfectly elastic.

## C Equilibrium in the open capital account case

Equations (7) to (11) can be used to calculate the equilibrium of the model under an open capital account:

Market for loanable funds:

$$w_t \bar{L} + \eta^{-1}((1 - p_t^l q_t)R_{t+1} - (R^* + \varepsilon_t)) = n_t^T + \bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i \quad (7)$$

Labor market, good state of nature:

$$\bar{L} = n^{T,h} L_{j,t+1}^h + n_t^{NT} L_{i,t+1}^h \quad (8)$$

Labor market, bad state of nature:

$$\bar{L} = n^{T,l} L_{j,t+1}^l + n_t^{NT} L_{i,t+1}^l \quad (9)$$

Market for NT goods, good state of nature:

$$(1 - v) \left( \frac{P_{t+1}^{NT,h}}{P_{t+1}^h} \right)^{-\rho} C_{t+1}^h = y_{t+1}^{NT,h} n_t^{NT} \quad (10)$$

Market for NT goods, bad state of nature:

$$(1 - v) \left( \frac{P_{t+1}^{NT,l}}{P_{t+1}^l} \right)^{-\rho} C_{t+1}^l = y_{t+1}^{NT,l} n_t^{NT} \quad (11)$$

where:

$$C_{t+1}^h = w_t L_t R_{t+1} + n_t^{T,h} \pi_{t+1}^{T,h} + \sum_i \pi_{t+1}^{NT,i,h}$$

$$C_{t+1}^l = (1 - q_t) w_t L_t R_{t+1} + n_t^{T,l} \pi_{t+1}^{T,l} + \sum_i \pi_{t+1}^{NT,i,l}$$

$$\sum_i \pi_{t+1}^{NT,i,h} = n_t^{NT} \left( y^{NT} \frac{P_{t+1}^{NT,h}}{P_{t+1}^h} - w_{t+1}^h L_{i,t+1}^h \right) - R_{t+1} \bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i$$

$$\sum_i \pi_{t+1}^{NT,i,l} = \bar{n} G(h_t^b) \left( y^{NT} \frac{P_{t+1}^{NT,l}}{P_{t+1}^l} - w_{t+1}^l L_{i,t+1}^l \right) - R_{t+1} \bar{n} \int_{-\infty}^{h_t^b} h_i g(h_i) dh_i$$

$$q_t = \frac{\text{total amount defaulted}}{\text{total loans}} = \frac{\bar{n} \int_{h_t^b}^{h_t^*} h_i g(h_i) dh_i}{n_t^T + \bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i}$$

and  $\varepsilon_t^l$  and  $\varepsilon_t^h$ , defined as the values of the shock to the international financial markets under each state of nature such that the domestic interest rate would be the one observed are given by:

if  $n_t^T = n^{T,h}$  then:

$$\varepsilon_t^l = \varepsilon_t$$

$$\varepsilon_t^h = (1 - p_t^l q) R_{t+1} - R^* - \eta(n^{T,l} + \bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i - w_t L_t)$$

if  $n_t^T = n^{T,l}$  then:

$$\varepsilon_t^l = (1 - p_t^l q) R_{t+1} - R^* - \eta(n^{T,h} + \bar{n} \int_{-\infty}^{h_t^*} h_i g(h_i) dh_i - w_t L_t)$$

$$\varepsilon_t^h = \varepsilon_t$$

## D Simulations

In the simulations presented in section 3 of the paper we have used the following parameter values:  $\rho = 1.25, v = 0.5, \bar{n} = 2, \bar{L} = 5, p = 0.10, n^{T,h} = 1, n^{T,l} = 0.7, R^* = 1.15$ .

For the production functions we have used  $y^i = c^i + a^i L^{\alpha^i}$   $i = T, NT$  and  $a^T = a^{NT} = 1, \alpha^T = \alpha^{NT} = 0.5, c^T = 5, c^{NT} = 0$ .

As for the  $\eta()$  function we have  $\eta(F^*) = k(F^*)^b$  with  $k = 1, b = 1$ .

Finally,  $h_i$  is distributed among all NT entrepreneurs according to a Normal distribution with parameter values  $\mu = 2$  and  $\sigma = 0.5$ .