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Sovereign Risk, FDI Spillovers, and Growth

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Abstract

This paper studies the effect of sovereign risk on capital flows from rich to poor nations in the context of a two-country model, where Foreign Direct Investment (FDI) creates positive externalities in domestic production. We show that if externalities are large, a developing country never expropriates foreign assets, and behaves as under perfect enforcement of foreigners' property rights, jumping to the steady state in one period. If externalities are absent, a developing country always expropriates foreign assets and, then, there are no capital flows in equilibrium, as occurs in autarky. If externalities are of a medium size, our model can account for scarce capital flows from rich to poor nations, as well as other key features of the data, such as rising-over-time patterns of foreign capital and FDI in developing countries. In addition, the model offers an economic rationale for the FDI restrictions observed across nations.

1. Introduction

At least since the work of Lucas (1990), it is well known that the standard neoclassical growth theory has difficulties in explaining the observed patterns of capital flows across countries. To be precise, the theory predicts that as soon as a small developing economy is opened to the rest of the world, it should experience so large inflows of foreign capital that it instantaneously jumps to a steady state. In the data, however, capital flows from rich to poor nations are relatively scarce. Many empirical studies advocate a hypothesis that the capital flows are scarce because of investing in developing economies is subject to sovereign risk.[1] For example, Williams (1975, p. 265) reports that about 20% of FDI made in low-developed countries during the 1956–72 period was expropriated without compensation. More recently, Schmidt (2002) finds that the quality of institutions that guarantee property rights is essential for explaining a high concentration of foreign capital flows in Eastern Europe.

The theoretical literature has already analyzed the above hypothesis. Authors such as Eaton and Gersovitz (1981, 1984), Cohen and Sachs (1986), Marcet and Marimón (1992), and Thomas and Worrall (1994), conclude that sovereign risk can indeed reduce capital flows from rich to poor nations, and significantly retard economic development.[2] One empirically relevant feature of international capital flows that might affect this conclusion of the literature is the associated technological spillovers from foreign firms to domestic firms. Indeed, a large fraction of capital flows from rich to poor countries is composed of Foreign Direct Investment (FDI) typically performed by multinational corporations.[3] Technologies brought in by multinational corporations are, in general,

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superior to those available in developing countries, and generate positive spillovers in a host nation.[4] Given that expropriation of foreign assets can lead to a loss of spillovers, the domestic country is less tempted to expropriate. The purpose of this paper is to investigate how the introduction of technological spillovers from foreign to domestic producers can affect the implications of growth models with sovereign risk.

Apart from the assumption of externalities, our setup is standard. We consider a two-country growth model, where a domestic (developing) country has a lower capital stock than a foreign (developed) country. Both domestic and foreign agents can invest their capital in the domestic economy, but foreigners' property rights are not perfectly enforceable. Hence, when deciding on the amount of capital to invest, foreigners should procure that their decisions are compatible with incentives of the domestic country not to expropriate foreign assets (i.e., incentive compatible). If the domestic country expropriates foreign assets, it switches to autarky and remains there forever. We focus on the transition of the domestic economy from a low initial capital stock to the steady state.

An important result of the previous literature on sovereign risk is that isolating a country in financial autarky is not a sufficient threat for preventing this country from expropriating foreign assets (Eaton and Fernandez, 1995). In order to generate non-trivial capital flows, it is necessary to introduce some additional mechanism (penalty) for enforcing debt repayment. Several alternatives have been suggested in the literature. Eaton and Gersovitz (1984) and Cohen and Sachs (1986) assume that debt repudiation is accompanied by a permanent loss of productive efficiency of the defaulting country. Marcet and Marimon (1992) prevent expropriation by assuming that risk-averse domestic agents have strong preferences for consumption smoothing, while risk-neutral foreign agents are willing to absorb random shocks affecting the domestic economy. In the model by Thomas and Worrall (1994), foreigners own all capital in the domestic economy, and transfer a part of the profit to domestic agents in exchange for non-expropriating their capital.[5]

In our setup, the penalty comes from the permanent loss of externalities after the expropriation. The externality size plays a crucial role in the properties of equilibrium. To be specific, in the absence of externalities, expropriation always occurs, while in the presence of very large externalities, expropriation never occurs, so that sovereign risk completely disappears. In an intermediate case, when externalities are not too large, a fear of losing externalities by the domestic country can sustain a certain amount of capital trade in equilibrium.

We investigate the implications of the model in the case of intermediate-size externalities when sovereign risk is still present. Our key findings are as follows. First, sovereign risk reduces capital flows from rich to poor countries, and induces a much slower convergence path compared to the case when property rights of foreigners are perfectly enforceable. Second, incentives to expropriate foreign capital are the highest at the beginning and they decrease over the process of economic development. Thus, the optimal strategy of foreign investors is to increase over time their holdings of capital in the domestic country. In fact, the latter result indicates that foreign investors can reduce the threat of expropriation by showing their commitment to constantly raise their presence in the domestic country. An increasing pattern of foreign capital makes the expropriation more costly, because the expropriating country loses not only current, but also ever-growing future externalities. Third, when preferences for current consumption relative to future consumption are strong enough, not only foreign capital stock but also FDI flows rise over time, as the data suggest.[6] Finally, we show that the presence of technological spillovers from foreign to domestic producers has non-trivial implications for consumers' welfare.[7]

2. The Model

In this section, we develop a two-country growth model. The domestic country is small and low-developed, whereas the foreign country is large and high-developed. We assume that the domestic country has no effect on prices in the foreign country. Time is discrete, and the horizon is infinite.

The Domestic Country

The producer side of the domestic economy is composed of a continuum of identical firms with their names uniformly distributed on the interval [0, 1]. Each firm owns a production technology that allows it to generate output from capital and labor. We assume that capital is completely mobile across countries, but that FDI can be directed only to already existing domestic firms (*joint ventures*). Thus, capital employed by each domestic firm, k_t, includes capital of domestic investors, k_{dt}, and that of foreign investors, k_{ft}, i.e., $k_t = k_{dt} + k_{ft}$. Foreign capital induces positive production externalities whose size depends on the total amount of foreign capital in the domestic country, K_{ft}, and which cannot be internalized by competitive firms. Further, we assume that labor is entirely immobile, so that labor used by each domestic firm, n_t, is supplied only by domestic consumers. Output produced by a domestic firm, y_t, is given by

$$y_t = \varphi(K_{ft})\, f(k_t, n_t), \tag{1}$$

where φ is strictly increasing, continuously differentiable with $\varphi(0) = 1$, and f has constant returns to scale, is strictly increasing in both arguments, strictly concave, continuously differentiable and satisfies the appropriate Inada conditions.[8] Due to the presence of externalities, the production function (1) has increasing returns to scale.[9] This specification implies that foreign capital affects the Total Factor Productivity (TFP) of the domestic firm.[10] Note that according to (1), output can be produced in the absence of foreign capital.[11]

A domestic firm chooses demand for capital and labor to maximize period-by-period profits,

$$\max_{k_t, n_t} \{\varphi(K_{ft})\, f(k_t, n_t) - r_t k_t - w_t n_t\}, \tag{2}$$

where r_t and w_t are the domestic rental rates of capital and labor, respectively. Since in our setup, externalities cannot be internalized, from the individual firm's viewpoint, the production function displays constant returns to scale, so that the equilibrium rental prices are equal to the corresponding marginal products. Our assumption of a continuum of identical domestic firms uniformly distributed on the interval [0, 1] implies that $K_{ft} = k_{ft}$. Moreover, we assume that workers supply labor inelastically and normalize n_t to unity, $n_t = 1$. Thus, the rental prices are

$$r_t = \varphi(k_{ft})\, f_1(k_t, 1), \tag{3}$$

$$w_t = \varphi(k_{ft})\, f_2(k_t, 1), \tag{4}$$

where f_i is the first-order partial derivative of f with respect to ith argument.

The consumer side of the economy consists of an infinitely-lived representative agent who makes the consumption-savings decisions to maximize lifetime utility. At each point of time, the agent considers the possibility of expropriating foreign capital. We assume that if the agent expropriates foreign capital, the domestic country will lose all

the externalities resulting from foreign capital, and will stay in autarky forever.[12] The problem of the domestic agent is

$$\max_{\{c_t, k_{dt+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \delta^t u(c_t) \tag{5}$$

subject to

$$c_t + k_{dt+1} = (1 - d + r_t) k_{dt} + w_t, \tag{6}$$

$$\text{expropriate if the ICC is not satisfied,} \tag{7}$$

with the ICC being the incentive compatibility constraint

$$\text{ICC:} \quad \sum_{n=0}^{\infty} \delta^n u(c_{t+n}) \geq V^A(k_{dt} + k_{ft}), \tag{8}$$

where $k_{d0} > 0$ and $\{k_{ft}\}_{t=0}^{\infty}$ are given. Here, c_t is consumption; $\delta \in (0, 1)$ is the discount factor; $d \in (0, 1]$ is the depreciation rate of capital; and $V^A(k_{dt} + k_{ft})$ is the value function in autarky. The momentary utility function $u(c)$ is continuously differentiable, strictly increasing, strictly concave and satisfies $\lim_{c \to 0} u'(c) = \infty$. The ICC determines an expropriation point, namely, the domestic country will expropriate foreign capital and go to autarky if the life-time utility of doing so, $V^A(k_{dt} + k_{ft})$, is larger than the life-time utility under the non-expropriation strategy.

The Foreign Country

The foreign country has the same fundamentals (including the discount factor, δ, and the depreciation rate of capital, d) as the domestic country does. We assume that the foreign country is so developed that it is situated in the steady state, with the gross interest rate, R_{ss}, being equal to

$$R_{ss} = 1 - d + r_{ss} = 1/\delta, \tag{9}$$

where r_{ss} is the net interest rate in the steady state. The foreign country will be interested in investing in the domestic country as long as the gross rate of return on capital in the domestic country, R_t, is higher than that in the foreign country, $R_t > R_{ss}$, and as long as its capital is not expropriated, i.e., the ICC (8) is satisfied. Formally, the problem of foreign investors is therefore to maximize period-by-period profits by choosing supply of capital to the domestic country

$$\max_{k_{ft}} [R_t - R_{ss}] k_{ft} \quad \text{subject to (8)}, \tag{10}$$

with R_t being defined by

$$R_t = \begin{cases} 0 & \text{if expropriation occurs,} \\ 1 - d + r_t & \text{otherwise,} \end{cases} \tag{11}$$

where k_{dt} and $\{c_{t+n}\}_{n=0}^{\infty}$ are given.

Equilibrium

We restrict attention to a recursive Markov equilibrium, where all the decisions are made according to time-invariant policy functions of the current state. There is only one

state variable in our model, which is the domestic capital stock, k_{dt}. The foreign capital stock, k_{ft}, is not a state variable because it is decided on period-by-period basis according to (10), (11). Therefore, we define an equilibrium by two policy functions, the consumption function and the foreign capital function,

$$c_t = q(k_{dt}) \quad \text{and} \quad k_{ft} = g(k_{dt}), \tag{12}$$

respectively, such that:

(i) the sequence $\{k_t\}_{t=0}^{\infty}$ solves the profit-maximization problem of the domestic firm (2), given the normalization for labor, $n_t = 1$ for all t, and the sequences for prices, $\{r_t, w_t\}_{t=0}^{\infty}$, and for externalities, $\{k_{ft}\}_{t=0}^{\infty}$;
(ii) the sequence $\{c_t, k_{dt+1}\}_{t=0}^{\infty}$ solves the utility-maximization problem (5)–(8), given the sequences for foreign capital, $\{k_{ft}\}_{t=0}^{\infty}$, and for prices, $\{r_t, w_t\}_{t=0}^{\infty}$;
(iii) the sequence $\{k_{ft}\}_{t=0}^{\infty}$ solves the profit maximization problem of the foreign investors (10), (11), given the sequences for the domestic variables $\{r_t, c_t, k_{dt}\}_{t=0}^{\infty}$;
(iv) all markets clear; and
(v) non-negativity constraints are satisfied, $c_t \geq 0$, $k_{dt+1} \geq 0$ and $k_{ft} \geq 0$ for all t.

Alternative FDI Strategies

The specific FDI strategy adopted by the foreign country, $k_{ft} = g(k_{dt})$, will depend on the expropriation policy chosen by the domestic country and on the rate of return on capital in the domestic country relative to that in the foreign country. To gain intuition into how these two factors affect equilibrium, we consider four alternative environments.

Environment 1: Autarky The autarkic case can be obtained within our framework by disregarding the ICC (8) in the problem of the domestic consumer (5)–(8), and by assuming that the domestic country expropriates foreign capital independently of whether it is beneficial from the economic point of view or not. Since $R_t = 0 < R_{ss}$, the solution to (10), (11) is

$$k_{ft} = g(k_{dt}) = 0, \tag{13}$$

i.e., given that foreign capital is always expropriated, FDI is never supplied to the domestic country.

Environment 2: Perfect Enforcement This is the case when foreign capital is never expropriated meaning that the ICC (8) is again disregarded. In the absence of expropriation, the solution to (10), (11) is to supply FDI to the domestic country until the rates of return to capital in both countries are equalized, $R_t = R_{ss}$, which together with (3) implies

$$\varphi(g(k_{dt}))\, f_1(k_{dt} + g(k_{dt}), 1) = r_{ss}. \tag{14}$$

Equation (14) implicitly defines the function $g(k_{dt})$.

Environment 3: Incentive Compatibility This corresponds to our main setup where the domestic country makes decisions about expropriation of foreign capital by following the utility maximizing strategy (7), i.e., by expropriating whenever the ICC (8) is not satisfied. Since foreign investors are aware of the possibility of expropriation, they

always choose FDI, which satisfy the ICC (8). Taking into account that the domestic country starts below the steady state, and assuming that it monotonically converges to the steady state in the limit (which was the case in all our numerical experiments), we have $R_t > R_{ss}$ for all $t < \infty$. Thus, the optimal strategy of foreign investors is to invest up to the point where the ICC holds with equality, i.e.,

$$\sum_{n=0}^{\infty} \delta^n u(c_{t+n}) = V^A[k_{dt} + g(k_{dt})]. \tag{15}$$

That is, given the expropriation break-point of the domestic country, foreigners choose such FDI that expropriation never occurs, and given the amount of FDI chosen, the domestic country has no incentives to expropriate. Condition (15) implicitly defines the function $g(k_{dt})$.

Environment 4: Capital Controls This is the case when the domestic country imposes explicit capital controls by restricting the amount of foreign capital in the economy, $k_{ft} \le \bar{g}$ for all t. As in Environment 3, we assume that the equilibrium choices satisfy the ICC (8). Clearly, the outcome of the capital controls crucially depends on the size of $\bar{g}$. In particular, if $\bar{g}$ is very small, we are close to the autarkic environment, while if $\bar{g}$ is sufficiently large, we get the incentive-compatible environment (as the restriction $k_{ft} \le \bar{g}$ never binds). We restrict attention to one specific value of $\bar{g}$, which is the largest constant foreign capital satisfying the ICC (8) for all t:

$$\bar{g} = \arg\max_{g} \left\{ \sum_{n=0}^{\infty} \delta^n u(c_{t+n}) \ge V^A(k_{dt} + g) \right\}_{t=0}^{\infty}. \tag{16}$$

Condition (16) endogenously determines the exact value of $\bar{g}$. Note that in Environment 4, it could be that, in some periods, constraint (16) holds with equality, whereas in other periods, it holds with a strict inequality.

3. Numerical Analysis

To carry out simulations, we assume that the momentary utility function in (5) is of the constant elasticity of substitution type,

$$u(c_t) = \frac{c_t^{1-\gamma} - 1}{1-\gamma}, \quad \gamma > 0. \tag{17}$$

Furthermore, we assume that the production function (1) takes the form

$$y_t = \left(1 + \mu k_{ft}^{\beta}\right) k_t^{\alpha} n_t^{1-\alpha}, \quad \alpha \in (0,1), \quad \mu, \beta \ge 0. \tag{18}$$

Most parameter values employed in the simulation are standard. In the benchmark case, we assume the discount factor of $\delta = 0.96$, the depreciation rate of $d = 0.1$, the capital share of $\alpha = 0.36$, and the risk-aversion coefficient of $\gamma = 1$. As far as the externality parameters μ and β are concerned, we do not have any empirical estimates available. We, therefore, explore the role of externalities in equilibrium by considering a number of alternative values for (μ, β). As one can reasonably expect, when externalities become small (i.e., μ and β become close to zero), our incentive-compatible Environments 3 and 4 converge to *autarky* (Environment 1), whereas when externalities are getting large, they approach *perfect-enforcement* (Environment 2). To illustrate these tendencies, we consider three alternative pairs $(\mu, \beta) \in \{(0.01, 0.1), (0.03, 0.3),$

(0.036, 0.36)} referred to as "small," "medium," and "large" externalities, respectively. When we compute a numerical solution to the model and infer the amount of foreign capital, k_{ft}, we obtain that these three parameterizations increase the technology level in (18) under Environments 2, 3, and 4, by around 1%, 3%, and 5%, respectively.[13] The middle pair corresponds to our benchmark parameterization, and allows us to clearly see the effect of externalities on equilibrium. Regarding the initial condition, in the benchmark case, we assume that the domestic country starts with 60% of its steady-state capital stock, k_{ss}, i.e., $k_0 = 0.6k_{ss}$, and in addition, we run a sensitivity experiment $k_0 = 0.2k_{ss}$. Finally, we complete our analysis by studying the robustness of the model's implications with respect to the parameters α and γ.

To compute the equilibrium, we use a numerical method that solves the Euler equation on a grid of prespecified points. A description of the method used is provided in the Appendix. After computing the optimal policy rules, we simulate 50-periods time series for key variables. The results are shown in Figures 1 and 2.

Figure 1 illustrates the equilibrium transitional dynamics of the four environments considered. In columns 1, 2 and 3, we present the results for the cases of medium, small, and large externalities, respectively. As we see, the externality size affects quantitatively, but not qualitatively the model's predictions, so that we observe the same regularities in all three columns of the figure.

Initially, the domestic country has a lower capital stock than does the foreign country, which creates a relatively large interest rate differential between the two countries. (Compare $r_0 \approx 10\%$ in the *autarkic* case and $r_0 \approx 4\%$ in the *perfect-enforcement* case, where the latter coincides with the steady state interest rate in the foreign country). Because of this differential, the domestic country starts receiving FDI once it opens its capital market to the foreign country. The amount of FDI, however, differs substantially across environments. Under *perfect enforcement*, FDI is the largest among all the environments considered, and is sufficient for the domestic country to jump to a steady state in one period. Under *incentive compatibility*, FDI is reduced because of the threat of expropriation. Finally, under *capital controls*, FDI is reduced even further, because in addition to the ICC, FDI should satisfy the upper-bound restriction. Thus, similar to the previous literature (Cohen and Sachs, 1986; Marcet and Marimon, 1992; Thomas and Worrall, 1994), our model suggests that sovereign risk can be important for explaining why so little FDI goes to low-developed countries, even though such countries have many investment opportunities.

The figure shows that in the *incentive-compatible* case, the amount of foreign capital held in the domestic country displays an increasing pattern. To gain intuition into this result, we shall recall that the domestic agents have diminishing marginal utility of consumption. The consequence is that as the economy grows and its consumption level rises, the marginal incentives to expropriate foreign capital decline. Since foreign investors behave in a manner consistent with the ICC (8), they raise their capital stock held in the domestic country whenever the expropriation incentives decrease. The rising pattern of foreign capital produced by our model is in line with empirical evidence documented in Gertler and Rogoff (1990), that the level of foreign debt in developing economies is positively correlated with their GNP.

Note that in the *incentive-compatible* case, foreign investors can hold a higher capital stock without being expropriated than in the *capital-controls* case. In fact, this result is related to the previously discussed implication about an increasing pattern of foreign capital in the *incentive-compatible* case. Specifically, if foreign capital increases over time, a country that expropriates foreign capital loses not only current, but also substantial future externalities that foreigners would bring otherwise. As a result,

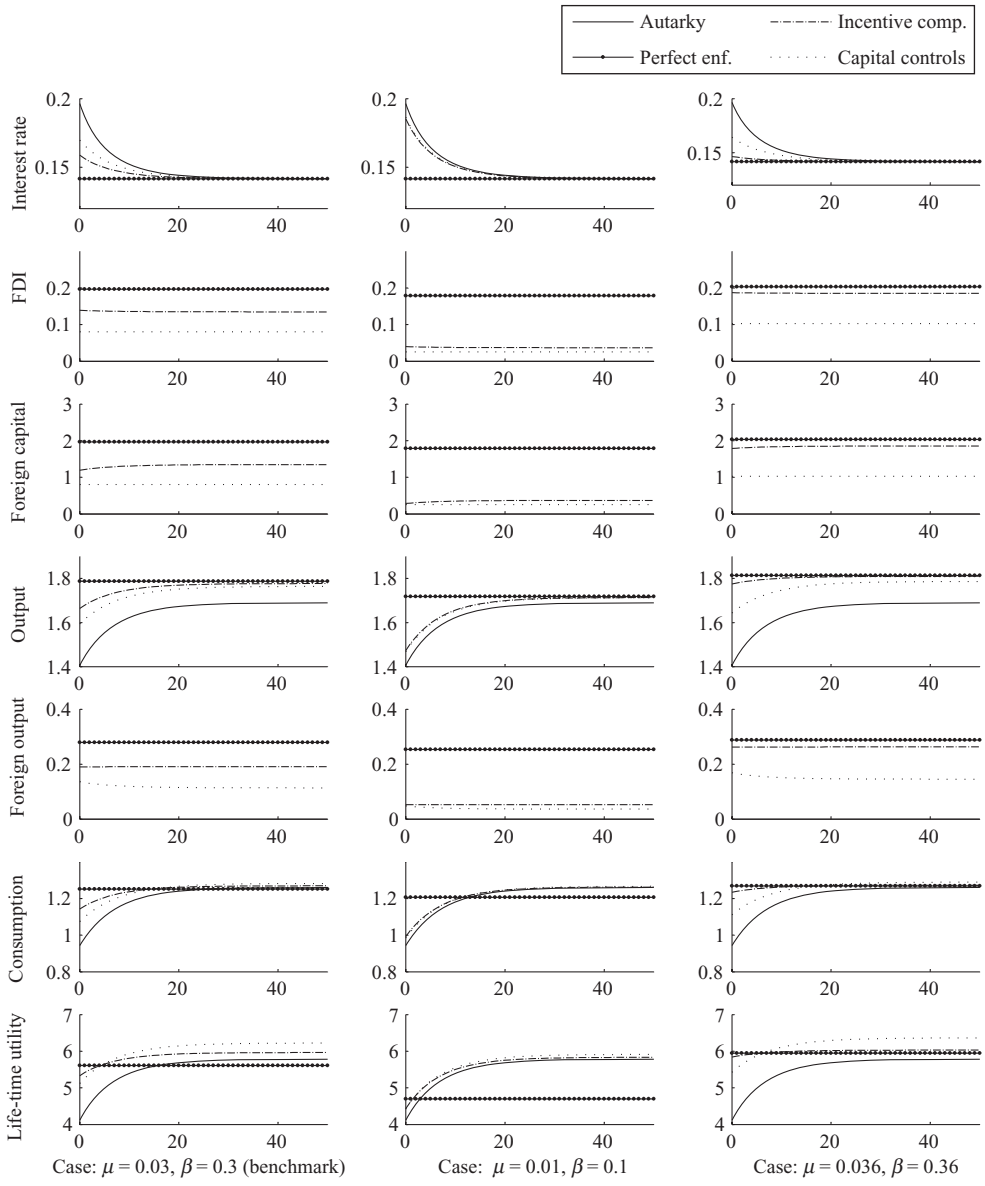

Figure 1. Transitional Dynamics for Four Environments: The Sensitivity with Respect to μ and β

domestic agents have less incentives to expropriate foreign capital under an increasing profile than under a constant profile. Our analysis has, therefore, an important policy implication: foreign investors can reduce the threat of expropriation by showing their commitment to increase FDI in the future.[14]

We now turn to the welfare implications of the model. We can distinguish three effects of foreign capital on the domestic economy. First, the arrival of foreign capital results in an immediate increase in the capital stock used in domestic production.

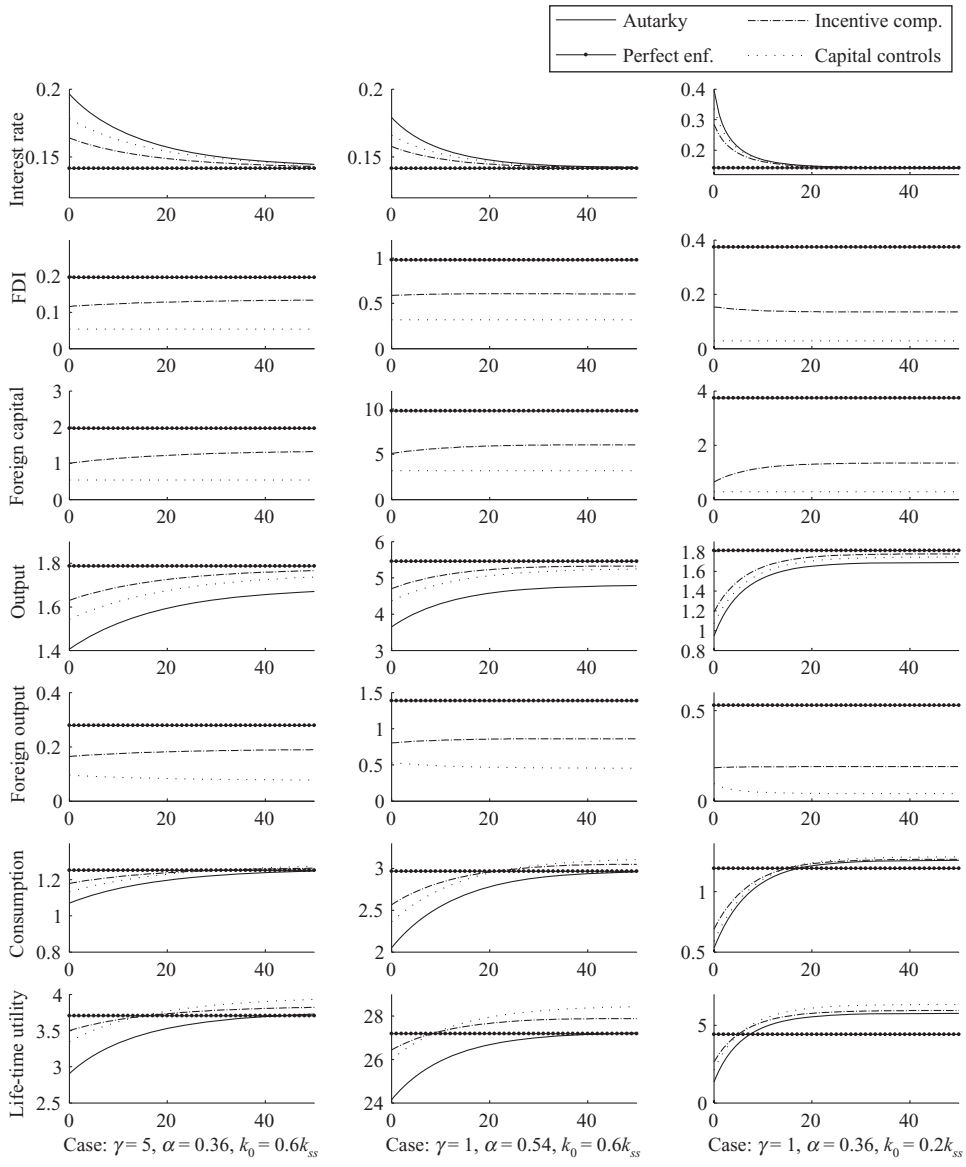

Figure 2. Transitional Dynamics for Four Environments: The Sensitivity with Respect to γ, α and k_0

Second, foreign investors bring spillovers that raise domestic TFP. Third, foreigners take away from domestic agents a fraction of the output produced. The first two effects increase domestic consumption and welfare, while the last effect reduces them. In the short run, the first effect is the most important one: the domestic country has always the highest welfare under *perfect enforcement*, where it reaches the steady state instantaneously, and it has the lowest welfare under *autarky*, where foreign capital is not available. In the long run, only the second and the third effects matter, and the direction of the net effect depends on which of these two dominates. For example, in the

benchmark case (see column 1), the third effect dominates the second one, so that the domestic economy has a higher welfare under *autarky* than it does under *perfect enforcement*. In sum, at the beginning of transition, when the country is low-developed, the arrival of foreign capital is always beneficial, however, as the country develops, the presence of foreigners can become detrimental. In particular, in the extreme case of *perfect enforcement*, foreigners take away all investment opportunities from domestic agents in the very first period, making the domestic economy remain forever at the same level, as it was at the beginning of transition.

An important finding in the figure is that the effect of FDI on the domestic agents' long-run welfare is non-linear: going from *autarky* (with no FDI) to the *incentive-compatible* and the *capital-controls* environments (with some FDI) increases welfare, whereas going from the latter environments to the *perfect-enforcement* one (with much FDI) reduces welfare. This indicates that there is some amount of FDI that maximizes the steady-state welfare of domestic agents, and that such an amount is lower than FDI in the *incentive-compatible* case. The latter result follows from the fact that in the long run, the *capital-controls* environment with less FDI always implies a higher welfare than does the *incentive-compatible* environment with more FDI. That is, unless the government of a developing country controls the entry of FDI, the domestic country will end up with a larger amount of foreign capital than it is socially desirable.[15]

We shall now describe how the externality size affects the properties of the equilibrium. When externalities are small (see column 2), foreigners increase TFP relatively little, but they take away much of the investment opportunities from the domestic agents. As a result, the domestic country has strong incentives to expropriate foreign capital. In the limit, when externalities are zero, any positive amount of foreign capital violates the ICC and, hence, is expropriated. Thus, our environments with a lack of commitment, namely, the *incentive-compatible* and the *capital-controls* ones, deliver transition paths that are close to those in *autarky*, and lead to much higher levels of long-run welfare than the *perfect-enforcement* environment. In contrast, when externalities are large (see column 3), foreigners increase TFP significantly, so that the domestic country has little incentives to expropriate foreign capital. In the limit now, when externalities are very large, expropriation never occurs because even the *perfect-enforcement* environment satisfies the ICC. The consequence is that the *perfect-enforcement* environment always offers a larger level of welfare than *autarky*. Also, the *incentive-compatible* paths are located close to those under *perfect-enforcement* and far from those under *autarky*.

Moreover, the externality size affects the country's incentives to practice capital controls. To see this point, let us look at the differences in long-run welfare under the *incentive-compatible* and the *capital-controls* environments. If externalities are weak, *incentive-compatible* FDI is small, so that restricting it further has little effect on the equilibrium. In contrast, if externalities are strong, then a relatively large amount of FDI is consistent with the ICC. As we can see in Figure 1, by restricting the amount of FDI, the domestic country can significantly increase long-run welfare. Thus, we have the following surprising and apparently contradictory result: the higher is the potential gain from the presence of foreign capital, the more incentives has the domestic country to control FDI flows.

We next study the robustness of the model's predictions to variations in the parameters γ and α, which are the inverse of the intertemporal elasticity of substitution of consumption and the capital share in income, respectively.[16] The corresponding results are shown in Figure 2, columns 1 and 2. An increase in γ reduces the consumers' willingness to sacrifice present consumption for future consumption and, therefore,

reduces domestic investment. An increase in α also makes domestic investment less attractive, because it leads to weaker diminishing returns to capital accumulation. The consequence is that the speed of convergence goes down. One finding here is particularly remarkable: in both cases, FDI displays an increasing pattern, which contrasts with a weakly decreasing pattern observed under the previously considered parameterizations. To gain intuition into this result, we shall recall that when an economy is low developed, incentives to expropriate foreign capital are very strong because an expropriation makes it possible to instantaneously increase consumption, however, as the economy becomes more developed, consumption increases and incentives to expropriate foreign capital reduce. As we see in the figure, an increase in γ or α can make the FDI pattern become increasing, because it accentuates the above effect to such an extent that it dominates the other opposing effect that drives FDI, which is diminishing capital returns. This implication of our model agrees with the empirical evidence on transition economies (Claessens et al., 2000).

We finally explore the role of initial conditions in the equilibrium dynamics by starting the simulation from an initial capital stock equal to 20% of its steady-state value, instead of 60% in the benchmark case (see column 3 in Figure 2). We observe that a lower initial capital stock results in stronger incentives to expropriate foreign capital in initial periods—note that the *incentive-compatible* amount of foreign capital is about 1.1 in the benchmark case, and it is about 0.7 in the current experiment. A lower initial capital stock leads to a lower participation of domestic capital in production under *perfect enforcement*, because in this environment foreign capital makes the domestic economy go to a steady state in one period. Consequently, the long-run difference in the level of welfare between the *perfect enforcement* environment and the other cases visibly increases with a reduction in the initial capital stock (compare the *life-time utility* paths in Figure 1, column 1, and in Figure 2, column 3). In this respect, the impact of a lower initial capital stock on equilibrium is similar to the one of a weaker external effect (see column 2 in Figure 1).

4. Conclusion

We conclude by summarizing the key welfare implications of the model. In the very beginning, the arrival of foreign capital is always beneficial for a developing economy: it instantaneously increases the productive capital and brings positive spillovers to production, which leads to an immediate increase in consumption and welfare. As a result, in the short-run, the economy has the highest welfare under perfect enforcement, when it reaches a steady state in one period, and it has the lowest welfare under autarky, when no external financing is available. In the long run, welfare depends on two opposing effects. The positive effect is that foreigners bring spillovers, which boost production, and the negative one is that they take away investment opportunities from domestic agents. When externalities are large, the first effect dominates the second one, while when they are small, the opposite is true.

A certain presence of foreigners is always beneficial for a developing country. Indeed, our two incentive-compatible environments generating positive capital trade are Pareto superior to the autarkic environment, both in the short and long run. This does not always mean, however, that the more foreign capital arrives into a domestic country, the better off such a country is. In fact, the highest level of the long-run welfare is obtained in our capital-controls environment, where the presence of foreigners is artificially restricted by the government. Surprisingly, when externalities are larger, and thus potential benefits from opening the country are higher, incentives to impose

capital controls also augment. This is because externalities of a larger size mean that larger amount of foreign capital can be brought into the country without being expropriated, which consequently implies a larger loss in the long-run consumption and welfare of domestic agents. Consequently, our model provides an economic rationale for the FDI restrictions, which are commonly practiced by developing countries.[17]

5. Appendix

This appendix describes the Euler equation method that we used for solving the model. Since expropriation of foreign assets never occurs in our model, then the solution to the problem (5)–(7) parameterized by the utility function (17) satisfies the standard Euler equation

$$c_t^{-\gamma} = \delta (c_{t+1})^{-\gamma}(1-d+r_{t+1}). \tag{19}$$

We parametrize the asset demand of the domestic country by a function of the current asset holdings, $k_{dt+1} = h(k_{dt})$. The grid for asset holdings consists of 100 equally spaced points in the range $[k_d^{\min}, k_d^{\max}]$. To evaluate the asset function outside the grid, we use a linear interpolation.

By combining Euler equation (19) and budget constraint (6), we obtain

$$k_{dt+1} = (1-d+r_t)k_{dt} + w_t - \{h(k_{dt})(1-d+r_{t+1}) + w_{t+1} - h(h(k_{dt}))\}[\delta(1-d+r_{t+1})]^{-1/\gamma}, \tag{20}$$

where r_t and w_t follow from (3) and (4), respectively, under the assumption of the production function (18),

$$r_t = \alpha\left(1+\mu(g(k_{dt}))^{\beta}\right)(k_{dt}+g(k_{dt}))^{\alpha-1},$$

$$w_t = (1-\alpha)\left(1+\mu(g(k_{dt}))^{\beta}\right)(k_{dt}+g(k_{dt}))^{\alpha-1},$$

with $k_{ft} = g(k_{dt})$ being the optimal decision rule for foreign investors.

We then implement the following iterative procedure:

- *Step* 1. Fix some asset function on the grid, $h(k_{dt})$.
- *Step* 2. Use the function $h(k_{dt})$ to calculate the right side of Euler equation (20) in each point of the grid. The left side of (20) defines the new asset function, $\tilde{h}(k_{dt})$.
- *Step* 3. Compute the asset function for next iteration $\tilde{\tilde{h}}(k_{dt})$ by using updating:

$$\tilde{\tilde{h}}(k_{dt}) = \eta\tilde{h}(k_{dt}) + (1-\eta)h(k_{dt}), \quad \eta \in (0,1].$$

  For each point of the grid, for which $\tilde{\tilde{h}}(k_{dt})$ does not belong to $[k_d^{\min}, k_d^{\max}]$, set $\tilde{\tilde{h}}(k_{dt})$ at the corresponding boundary value.

- Iterate on *Steps* 1–3 until we achieve $\tilde{\tilde{h}}(k_{dt}) = h(k_{dt})$ with a given precision, $\left\|\tilde{\tilde{h}}(k_{dt}) - h(k_{dt})\right\| < 10^{-9}$, where $\|\cdot\|$ is the L^2 distance.

For the *autarkic* and *perfect-enforcement* environments, the function $g(k_{dt})$ is known from the beginning: in the former case, we have $g(k_{dt}) = 0$, and in the latter case, we can approximate $g(k_{dt})$ by solving equation (14) numerically for each point of the grid.

For the *incentive-compatible* and the *capital-controls* environments, $g(k_{dt})$ is not known beforehand and is to be approximated simultaneously with $h(k_{dt})$. Specifically, we define some function $g(k_{dt})$ on the grid, compute the domestic asset function $h(k_{dt})$,

as discussed above, solve for the corresponding value function and check the ICC (8) in each point of the grid. For the *incentive-compatible* environment, we iterate on the grid-values of the function $g(k_{dt})$ until we find ones that make the ICC (8) to be satisfied with equality in each point of the grid. For the *capital-controls* environment, we iterate on the value of g until we find $\bar{g}$ satisfying (16).

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Notes

1. Obstfeld and Rogoff (1996, p. 349) define sovereign risk as any situation in which a government defaults on loan contracts with foreigners, expropriates foreign assets located within its borders, or prevents domestic residents from fully meeting obligations to foreign creditors. A singularity of this risk is that a sovereign country cannot be forced by international law to honor a contract signed with foreign investors.
2. Other suggested explanations for the low degree of capital mobility across countries are differentials in human capital (Lucas, 1990), differentials in financial intermediation costs (Imrohoroglu and Kumar, 2004), foreign capital rationing (Barro et al., 1995), and imperfect information (Boyd and Smith, 1997).
3. Thomas and Worrall (1994) report that almost a half of total private capital flows from developed to developing nations in 1986 was in the form of FDI. Also, Claessens et al. (2000) estimate that FDI was the largest component of private capital flows to Eastern Europe during the 1992–96 period.
4. Empirical studies on technology spillovers from multinational firms are highly controversial, however, there are more attempts showing their existence rather than otherwise (Görg and Strobl, 2001).
5. See Eaton and Fernandez (1995) for a review of the literature on sovereign risk. Related recent papers are Cole and Kehoe (1998) and Kraay et al. (2000).
6. The experience of Eastern European and the former Soviet Union countries is particularly relevant here: these countries were virtually closed to FDI before 1990, and they experienced increasing FDI flows during the 1990s (Claessens et al., 2000).
7. The existing literature on sovereign risk does not analyze welfare issues except of Marcet and Marimon (1992). The results of the last paper are not directly comparable to ours, as in their case, the debt repudiation is prevented by risk-sharing between domestic and foreign agents, a mechanism which is absent in our case.
8. Although we have that $k_t = k_{dt} + k_{ft}$, foreign and domestic capital are not perfect substitutes because foreign capital additionally induces positive production externality. If we assume that k_{dt} and k_{ft} are aggregated into k_t according to the CES function, a replacement of foreign capital with domestic capital will become more difficult. We will have another mechanism for preventing expropriation. This mechanism would act in the same direction as does the assumption of production externalities, depending on the elasticity of substitution between foreign and domestic capital, it would decrease the incentives to expropriate or even entirely prevent the expropriation. Consequently, our results will be just reinforced in the sense that we will need less externalities to prevent expropriation.
9. It is well known in the literature that the assumption of increasing returns to scale can lead to multiplicity of equilibrium (Matsuyama, 1991). To rule out the multiplicity, we shall assume that the externalities are not too large.
10. The idea that efficiency of a backward economy is positively affected by the level of activity of more technological advanced foreign firm goes back to Findlay (1978). Like us, he proxies this level of activity by the amount of foreign capital.
11. We assume that FDI from poor to rich countries does not bring externalities, so that such FDI is never observed in equilibrium.
12. This assumption is in line with Eaton and Gersovitz's (1984) one. They argue that FDI brings not only tangible, but also intangible capital, e.g., superior managerial skills. If expropriation occurs, foreigners leave the country, and intangible capital is no longer available and cannot be replaced.
13. These sizes of spillovers in our model are in line with estimates of empirical literature. For example, Haskel et al. (2002) find that a 10% increase in foreign presence in a UK industry raises the productivity of that industry by about 0.5%. Given that in our model, foreigners can own up to 80% of domestic capital, the above estimate implies up to 4% increase in technology, which is consistent with the values of 1%, 3%, and 5%, obtained in the calibrated version of the model.

14. Thomas and Worrall (1994) reach the same conclusion in the context of a dynamic bargaining game between the domestic and foreign countries. In their model, the domestic country does not expropriate foreign capital today, because it has an option to expropriate much larger amount of foreign capital in the future. In contrast, our mechanism relies on benefits from future spillovers, which increase over time.

15. Notice that the long-run welfare implications of the model cannot be inferred by looking at total output produced in the domestic economy. Indeed, the *perfect-enforcement* economy has larger total output than do both the *incentive-compatible* and *capital-controls* economies, which in turn have larger total output than does the autarkic economy. As we see, this output ordering differs from the one according to the level of long-run welfare. The reason is that the fraction of output that goes to foreigners (and thus, does not contribute to domestic consumption and welfare) differs among the four environments considered, see variable "foreign output" in Figures 1 and 2.

16. A larger value of α can be justified by interpreting capital input in the model to be a composite of physical and intangible capital inputs in the data. To make this interpretation consistent with the reasoning in note 12, we shall assume that the intangible foreign capital is more productive than the domestic capital.

17. See Mattoo et al. (2004) for some empirical evidence.