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THE INTERGENERATIONAL AND DYNAMIC EFFECTS OF OPENING THE CAPITAL ACCOUNT

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Abstract:

A basic theme in the theory of international trade has been to study welfare gains and income redistribution caused by trade liberalization. Using optimizing finite lives overlapping generations combined with long-term real assets and adjustment costs in accumulating capital, this paper establishes new current account and welfare redistribution results caused by financial liberalization.

After briefly describing the model for the closed economy case, we study the resulting evolution of the current account, the accumulation of capital, the real wage behavior and the adjustment of asset prices, when capital flows are allowed.

Under the mentioned framework, we are able to show that an unanticipated liberalization of the capital account can cause an overshooting or an undershooting in external debt behavior during the transition. Another consequence associated with the liberalization policy, is the creation of some transitional welfare losers, eventhough the welfare of steady state generations is improved.

By following appropriate compensatory policies, we can show that the country may achieve a Pareto welfare improvement for current and future generations. As a way of reducing the intergenerational redistributions induced by the opening of the capital account, we discuss the alternative of adopting more gradual strategies of liberalization.

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1. Introduction

A basic research topic in the theory of international trade has been the study of gains from free trade. Beginning with the Stolper-Samuelson analysis of the redistributive consequences of lifting trade barriers, a growing theoretical literature has developed.

Particularly, intertemporal trade theory in an optimizing framework has been studied extensively in influential papers by Buiter (1981), Dornbusch (1985), Fried (1980), Sachs (1982) and Svensson and Razin (1983). Using a different dynamic framework, this paper shares with that literature, the purpose of explaining international capital movements and studying short-run and long-run welfare implications of opening the capital account. Assuming optimizing finite lives overlapping generations and long-term real assets, the paper formally establishes new welfare and current account results associated to a financial liberalization. Rigorous derivations of the transition dynamics and welfare implications associated with opening the capital account in a small country are provided. Central attention is devoted to discuss the intergenerational redistribution effects and the resulting dynamics of asset prices, capital accumulation and the current account.

The modelling strategy followed in this paper takes into account that general equilibrium representative individual growth models are not suitable for analyzing the opening of the capital account. In fact, a long-run equivalence between the exogenous rate of time preference and the international interest rate is required, in order to insure a well-defined non-divergent solution[1].

Welfare gains from a liberalization experiment will arise only temporarily for the case of an initial capital stock lower than its steady state level. To solve the problem posed by the restriction on the foreign interest rate, some authors propose to endogenize the rate of time preference[2]. Here instead, we avoid this problem by using an overlapping generations model.

The article starts with a brief description of the basic structure of the model, which combines a standard Diamond (1965) overlapping generations economy with the presence of adjustment costs in accumulating capital. The framework developed here can be considered as an extension of the overlapping generations paradigm to the case of joint dynamics of asset pricing and capital accumulation.

Then we turn to open economy issues. Due to efficiency considerations from the view point of resource allocation, it is not unusual to find developing countries following a liberalization scheme for the capital account, as part of their policy agenda. In order to see its practical effects, we assume that an unexpected opening of the capital account is performed by a developing country which has a relatively low level of capital to start with when compared to the rest of the world. It is shown that either overshooting or undershooting in external debt are possible depending on the preference and technology parameters of the economy.

With respect to welfare, it is possible for some transitional generations to lose, eventhough there is an improvement in steady state welfare. Given that agents understand the effects of a liberalization, an important portion of the currently alived generations will oppose a laissez-faire policy not supported by redistributive schemes. However, for a small reduction in the interest rate, we show the feasibility of implementing redistribution policies that generate a Pareto improvement for the economy.

We also discuss the advantages and disadvantages of a gradual liberalization versus a cold turkey policy.

The paper is organized as follows: In section 2 we describe the basic model for the closed economy. In section 3 we perform the comparative dynamics experiment of opening the capital account for the small country. In sections 4, 5 and 6 we analyze the dynamics of asset prices, capital accumulation and the current account. Section 7 discusses the intergenerational welfare redistribution caused by this policy. Section 8 is devoted to analyze a transfer system to compensate transitional losers. In section 9, we discuss the effects of gradual versus cold turkey liberalizations. Finally we present some concluding remarks.

2. The Model

2.1. *Individual Behavior*

In this section we explicitly describe the decisions households and firms face. We begin with the household decisions. At any point in time one member of the old generation, owner of the firm, coexists with one member of the young generation, the worker. We assume that each agent has a maximum life-span of two periods. Welfare is solely derived from consumption in each period. The young maximizes his intertemporal utility function, while it is in the interest of the old to maximize the value of the firm. Furthermore we postulate that during youth, individuals are endowed with one unit of labor which they inelastically supply to the market. Retirement from the labor force occurs during the second period of life. At that time, consumption is financed through the deccumulation of previously built up savings. Individuals are competitive both in the labor and capital markets, so that they take as given wages and interest rates.

There is no uncertainty and individuals have perfect foresight. Each young solves the following optimization problem by choosing a consumption profile (c_t^y, c_{t+1}^o) which maximizes utility U:

$$\underset{(c_t^y,\, c_{t+1}^o)}{\text{Max}} \left\{ U(c_t^y, c_{t+1}^o) + \lambda_t \left\{ w_t - c_t^y - c_{t+1}^o / R_{t+1} \right\} \right\} \tag{1}$$

where U is twice continuously differentiable, increasing in each of its arguments (U_1, $U_2 > 0$) and strictly concave ($U_{11}\, U_{22} - (U_{12})^2 > 0$).

The solution of the problem is a time invariant saving function which depends on the wage level w_t and the interest factor R_{t+1}:

$$s(w_t, R_{t+1}) = \underset{s_t}{\text{Argmax}} \left\{ U(w_t - s_t, R_{t+1} \cdot s_t) \right\} \tag{2}$$

Furthermore, assuming that consumption is a normal good in both periods and that consumption when young and when old are gross substitutes, the behavior of the saving function must fulfill the following restrictions:

$$0 < \partial s/\partial w_t = s_w < 1, \text{ and } \partial s/\partial R_{t+1} = s_R > 0.$$

2.2. *The Firm's Optimization*

We assume that there exists one representative infinitely lived firm which maximizes the present value of its cash flows[3]. Funding is raised by the issuance of equity sold to the households. Production takes place with one period lag when compared to investment, and requires the use of labor and capital. The sale proceeds generated are assigned to finance labor expenses, investment expenditures and dividend payments.

The firm has perfect knowledge of future factor prices and behaves competitively in both capital and labor markets. Capital accumulation is subject to linearly homogeneous, increasing and convex cost of adjustment[4]. Due to its constant returns to scale nature, the adjustment cost function can be rewritten conveniently as follows:

$$\Phi(K_{t+1} - K_t, K_t) = \phi \left[\frac{K_{t+1} - K_t}{K_t}\right] \bullet K_t$$

Monotonicity and convexity of the cost function imply $\phi' > 0$ and $\phi'' > 0$, respectively. Moreover, it is assumed that $\phi > 0$ whenever $K_t \neq K_{t+1}$ and $\phi(0) = \phi'(0) = 0$.

The production function in turn is restricted to exhibit strict concavity, linear homogeneity and monotonicity in both productive factors. Concavity and linear homogeneity of the production function imply that F_{KK} and $F_{LL} < 0$.

Coherent with the owner's objective, the firm has to maximize the present value of dividends[5]. The one period firm's cash flow V_i can be defined mathematically as:

$$V_i = F(K_{t+i}, L_{t+i}) - w_{t+i} L_{t+i} - K_{t+i+1} + (1-\delta) K_{t+i} - \phi \left[\frac{K_{t+i+1} - K_{t+i}}{K_{t+i}}\right] \bullet K_{t+i} \quad (3)$$

Taking into account the cash flow definition, it is possible to define the firm's optimization problem as:

$$PV_t = \text{Max} \left[V_0 + \sum_{i=1}^{\infty} \frac{V_i}{\prod_{k=1}^{i} R_{t+k}} \right] \quad (4)$$

A maximum value of the firm's objective function is obtained by choosing an optimal sequence of capital stock $\{K_{t+i}\}$ and labor services $\{L_{t+i}\}$.

Defining q_t as $1 + \phi'_t = 1 + \phi'([K_{t+1} - K_t]/K_t)$, and using the fact that ϕ'' is > 0, we can deduce an investment function directly related to asset prices, i.e. $(K_{t+1} - K_t)/K_t = h(q_t - 1)$.

The first order necessary conditions for an optimal choice of capital and labor, can be written as:

$$q_t = \{F_{K_{t+1}} + q_{t+1} + (q_{t+1} - 1) \bullet h(q_{t+1} - 1) - \phi(h(q_{t+1} - 1)) - \delta\}/R_{t+1}$$
$$w_t = F_{L_t} \quad (5)$$

The first equation above states that the marginal benefit of investing an additional unit of capital should be equal to the marginal cost of investing today. The marginal benefit is defined to be the discounted value of the sum of next period net marginal product plus next period value of capital plus the reduction in the marginal cost of installing a unit of investment due to the increase in the capital stock. The second condition equates wages with the marginal product of labor. In addition to the necessary first order conditions, a sufficient condition for optimality is the transversality condition:

$$\lim_{n \to \infty} q_{t+n} \bullet K_{t+1+n} / \prod_{k=1}^{n} R_{t+k} = 0 \quad (6)$$

3. General Equilibrium in the Closed Economy

Equilibrium in this economy means that aggregate savings, which are only generated by the young generation, must be allocated to the unique outside asset, the ex-dividend value of the firm. Under our setup the value of the firm is equivalent to the marginal value of capital times the capital stock, a well-known property established by Hayashi (1982) when production and adjustment costs are homogeneous of degree one. This model differs substantially from the traditional one sector growth model where the relative price of capital has no meaning.

Considering the resource constraint of this economy, production net of depreciation and adjustment costs should be assigned either to consumption of the old, consumption of the young or to net investment. Moreover, normalizing the number of firms and individuals in each generation to be one, using the fact that the production function has constant returns to scale and defining the labor supply, the per capita capital stock and production per head as $L_t = 1$, $k_t = K_t / L_t$ and $F(K_t / L_t, 1) = f(k_t)$ respectively, we can express the resource constraint of the economy in per capita terms:

$$c_t^{\,o} + c_t^{\,y} = f(k_t) - \phi_t \bullet k_t + (1-\delta)k_t - k_{t+1} \quad (7)$$

Assuming that the transversality condition for the firm's problem is met and knowing that in each period the old sells his shares to the young generation and uses the proceeds for consumption purposes, we get:

$$c_t^{\,o} = R_t q_{t-1} k_t = f(k_t) - w_t + (1-\delta)k_t - k_{t+1} - \phi_t \bullet k_t + q_t k_{t+1} \quad (8)$$

For the young generation instead, consumption can be defined as labor income minus savings:

$$c_t^{\,y} = w_t - s_t \quad (9)$$

Considering the firm's labor choice and the labor supply, equilibrium in the labor market implies that $w_t = w(k_t)$. In turn, the good market equilibrium for the closed economy implies that aggregate savings must equal the value of the capital stock that the economy is actually investing:

$$s(\{f_{k_{t+1}} + q_{t+1} - \delta + (q_{t+1} - 1)\, h(q_{t+1} - 1) - \phi(h(q_{t+1} - 1))\}/q_t, w(k_t)) = q_t k_{t+1} \qquad (10)$$

In addition, from the production side of the economy we also have:

$$q_t = 1 + \phi'([k_{t+1} - k_t]/k_t) \qquad (11)$$

Equilibrium requires the transversality condition of the firm to hold, which prevents the occurrence of inefficient steady states[6]. Therefore, we will confine ourselves to the case of efficient economies.

In summary, expressions (10) and (11) describe the dynamics of the closed economy. In particular, they help define the steady state[7].

4. The Opening of the Capital Account

Suppose the country is small in the international markets, and the opening of the capital account comes as a complete surprise. Assume also that the international interest rate opens opportunities of intertemporal trade for the country as a whole. In other words, the exogenous foreign interest rate, now relevant to the economy, differs from the resulting steady state rate obtained under capital account restrictions[8]. Furthermore, the model is developed under the assumption that the capital stock is immobile across borders and completely owned by domestic residents. Therefore, financial movements take place through accumulation or deccumulation of a one period foreign bond, a security different from internal shares on capital. We let households decide on their portfolio, specifically on whether to reduce external finance or accumulate extra shares.

As a result of the liberalization experiment, investment and consumption become completely unrelated decisions as stated by the Fisher separation Theorem. Now asset prices behave according to the characteristics of the production and adjustment cost functions[9]. On impact, asset prices jump upwards. An expansion of consumption of the old generation is the response to the favorable increase on the resale value of the firm (old saving), given that the decision of capital holdings (or share holdings) was decided the period before. The young generation reacts by augmenting his current consumption level in the face of a drop in interest rates, given the gross substitutability assumption. This implies a reduction in national saving which combined with the initial increase in the total value of capital leads to a jump in foreign debt to a positive level[10]. In what follows, we analyze the subsequent dynamics of the current account, asset prices and capital accumulation. We also describe intergenerational welfare effects.

5. Dynamics of Asset Prices and Capital Accumulation

Under freedom of international financial flows, the national income identity between national savings and investment need not hold. Instead, interest parity between rates of return of assets in different locations must hold.

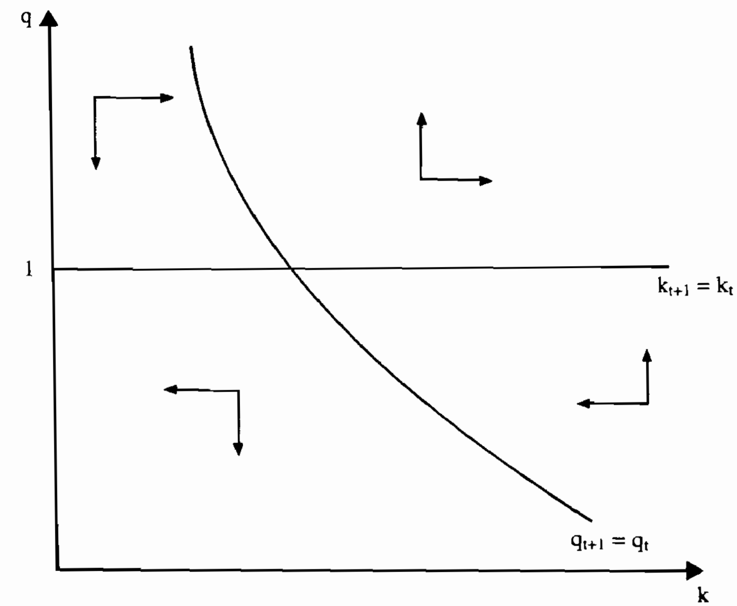
The first order conditions of the firm's maximization problem remain the same, but now aggregate conditions are such that the domestic interest rate is determined by the world level R. The basic two equations that describe the dynamics of asset prices and capital accumulation are now:

$$q_t = 1 + \phi'(k_{t+1}/k_t - 1) \qquad (12)$$

$$f_{k_{t+1}} + q_{t+1} - \delta + (q_{t+1} - 1) \bullet h(q_{t+1} - 1) - \phi(h(q_{t+1} - 1)) = R \bullet q_t \qquad (13)$$

Under perfect capital mobility, the dynamic system becomes equivalent to the q partial equilibrium model. As shown by the phase diagram drawn in Figure 1, the economy displays a monotonic downward sloping saddle path[11].

FIGURE 1



6. Current Account and External Debt Behavior

When external debt D is allowed, the following are the restrictions for portfolio allocation and consumption of the old and young generations:

$$c_t^o = R.q_{t-1} \bullet k_t - R.D_t \qquad (14)$$

$$c_t^y = w_t + D_{t+1} - q_t \bullet k_{t+1} \qquad (15)$$

Adding (14) and (15) and using the fact that $c_t^y = w_t - s_t$ and that $c_t^o = R \bullet s_{t-1}$, we can obtain an expression for the level of external debt of the country:

$$D_{t+1} = q_t \cdot k_{t+1} - s(R, w(k_t)) \qquad (16)$$

In order to explain the evolution of external debt after liberalizing the capital account, we have to consider the initial conditions of the economy. In particular, we know that the opening of the country's capital account came as a complete surprise at time t = 1. One instant before t = 1, at t = 1– we know that, $D_{1-} = 0$, $q_{1-} = 1$ and $q_{1-}\, k_{1-} = s(R_{1-}, w(k_{1-}))$, i.e. at the initial steady state the capital stock was financed uniquely through internal savings, with no external debt financing.

Therefore, at the time of the policy switch t = 1, $D_1 = q_1 \cdot k_{1-} - s(R, w(k_{1-})) > 0$, as $q_1 > q_{1-}$ and $R < R_{1-}$. As a result, the value of capital rises while savings fall, leading to a jump in the stock of external debt owed by the country. Equation (16) can be rewritten so that the evolution of external debt will be given by:

$$D_{t+1} = q_t \cdot (1+h(q_t - 1)) \cdot k_t - s(R, w(k_t)) \qquad (17)$$

Along the saddle path we know that capital is increasing, while asset prices are falling, generating undetermined effects on the dynamic behavior of the total value of capital. On the other hand, as capital tends to increase, so do wages and savings. Thus, foreign debt could rise or fall while the economy accumulates capital. Using a linear approximation around the steady state and taking into account the saddle path equation, we get the following equation describing debt behavior[12]:

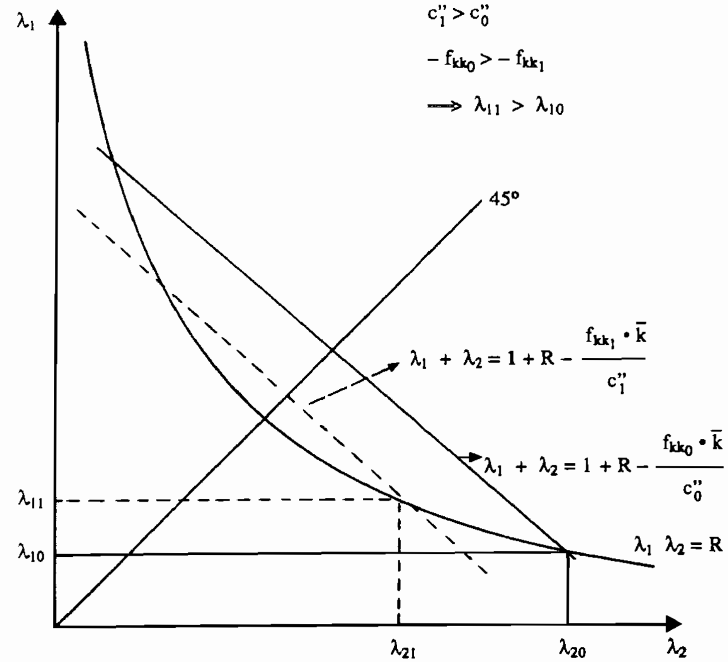
$$\check{D}_{t+1} = [\lambda_1 - (\phi'') \cdot (1-\lambda_1) + s_w \cdot f_{kk} \cdot \bar{k}] \cdot \check{k}_t \qquad (18)$$

Note that R, δ and k are left constant for the purpose of the present analysis given that we are working in a neighborhood of the steady state capital stock.

Here we clearly distinguish the opposite effects on foreign debt behavior of capital accumulation, increasing savings and decreasing asset prices. In order to accumulate debt or, equivalently, for a continuous current account deficit, we require an economy with low propensity to save and low concavity of the production function, i.e high elasticity of substitution among productive factors. An additional factor that can contribute to generate a current account deficit is the existence of a stable eigenvalue close to one. This can be obtained in the case of a highly convex cost of adjustment, or when the production function has very slow diminishing marginal returns. Figure 2 shows graphically the determination of the eigenvalues of the Jacobian matrix associated to our dynamic system. The intersection of the equilateral hyperbola which represents the determinant of the Jacobian matrix together with the straight line which represents the trace of the Jacobian matrix allows to determine the eigenvalues. Given that the system displays saddle point stability, we only consider as solution the lower of both eigenvalues. Therefore an increase in the convexity of the adjustment cost function or a more concave production function can be reflected in a downward movement of the straight line, which tends to raise the value of the relevant eigenvalue.

The model also defines a steady state concept for foreign debt. If we assume the same properties of the saving function than in the Diamond model and uniqueness of the closed economy steady state equilibrium, we can derive exactly the long-run value of external debt with $\bar{D} = \bar{k} - s(R, w(\bar{k})) > 0$ if $\bar{k} > k$, $\bar{k}$ being the steady state capital stock for the open economy and k the steady state capital of the closed economy. Thus, we conclude that opening the capital account will lead both to an increase in the stationary external debt level and in the capital stock of the economy.

FIGURE 2



During the transition, the dynamics of the current account is described by:

$$CA_t = s(R, w(k_t)) - s(R, w(k_{t-1})) - \{q_t \cdot k_{t+1} - q_{t-1} \cdot k_t\} \qquad (19)$$

As we have seen above, on impact the opening of the capital account causes an upward jump of the country's external debt, which is exactly matched by an initial current account deficit. During the adjustment path we can observe either a positive or negative current account, depending on the qualitative nature of the parameters of the economy. Thus, either overshooting or undershooting are possible in the behavior of foreign debt[13].

On the other hand, we know that in the transition path of the open economy, wages increase since the economy accumulates capital while the interest rate continues to be given by the international credit markets. In fact if both period consumptions are normal goods, we should see consumption growing over time for all future generations.

7. Welfare Effects

Now we are ready to study the transitional and steady state welfare changes that occur due to the liberalization policy. First, let us compute the steady state welfare effects brought by the liberalization policy, that allows the small open economy to operate under smaller interest rates than in autarky. In order to do that, we use the indirect utility function $V(w_t, R_{t+1})$, that depends on the wage and the interest rate:

$$dV/dR = \partial V/\partial w \bullet \partial w/\partial R + \partial V/\partial R \quad (20)$$

Using duality, we know that the indirect utility function should be equal to the utility function evaluated at the optimal consumption choice:

$$V(R_{t+1}, w_t) = U(c^y_t, c^o_{t+1}) \quad (21)$$

Totally differentiating equation (21) with respect to wages and interest rates, we get:

$$\partial V/\partial w = \partial U/\partial c^y \bullet \partial c^y/\partial w + \partial U/\partial c^o \bullet \partial c^o/\partial w \quad (22)$$

$$\partial V/\partial R = \partial U/\partial c^y \bullet \partial c^y/\partial R + \partial U/\partial c^o \bullet \partial c^o/\partial R \quad (23)$$

Moreover, using equations (24) to (27) derived from the optimization of the consumer, total differentiation of the budget constraint and the factor price frontier, we obtain expression (28).

$$\partial U/\partial c^o = (\partial U/\partial c^y)/R \quad (24)$$

$$\partial c^y/\partial R + (\partial c^o/\partial R)/R = c^o/(R^2) \quad (25)$$

$$\partial c^y/\partial w + (\partial c^o/\partial w)/R = 1 \quad (26)$$

$$\partial w/\partial R = -k \quad (27)$$

$\partial V/\partial R = \partial U/\partial c^y(-k + (k/R)) < 0$ as $R > 1$, so that in our case

$$(\partial V/\partial R) \bullet \partial R > 0 \quad (28)$$

The main results indicate that there is an improvement in steady state welfare, assuming that the previous closed economy equilibrium was efficient. As the economy tends to get closer to the golden rule, steady state welfare approaches its maximum.

During the transition, capital adjusts slowly in response to the reduction of the interest rate, generating a deterioration in welfare for some generations. The sluggish adjustment in the capital stock causes a slow increase in wages. Temporarily at least, the rise in wages may not compensate the welfare deterioration brought by the reduction in interest rates.

In our model, the old individual who initially owns the firm, is favored by the reduction in interest rates as the resale value of the firm jumps upwards. Remember that the gross return of the owner of the firm is given by the following expression:

$$PV_t = [f_{k_t} - \delta + q_t + (q_t - 1) \bullet h(q_t - 1) - \phi(h(q_t - 1))] \bullet k_t \quad (29)$$

The unanticipated capital account opening generates an increment in the value of the firm which reflects the incentive to invest that lower interest rates provide. The state variable represented by the current capital stock remains at the same original level. Therefore the change in welfare of the contemporary old is positive and given by:

$$dV = \partial U/\partial c^o \bullet \partial c^o/\partial q \bullet dq = \partial U/\partial c^o \bullet k \bullet dq, \quad (30)$$

where $dq > 0$ when $dR < 0$.

In the case of the contemporary young, the reduction in the interest rate works against his welfare. Moreover, his wage stays constant at the previous autarkic level because the capital stock is a state variable that cannot jump. Therefore, the reduction in welfare can be calculated as:

$$dV/dR \bullet dR = \partial U/\partial c^y \bullet c^o/(R^2) \bullet dR < 0, \quad (31)$$

as $dR < 0$ and $dV/dR > 0$.

Notice that the highest decline in welfare is suffered by the contemporary young generation because wages start to increase only in response to capital accumulation. Successive generations will obtain decreasing welfare losses until eventually getting an improvement in welfare for a sufficiently high wage[14]. Welfare changes for transitional generations are given by the following equation:

$$dV_{t+1} = \partial U_{t+1}/\partial c^y \bullet \{-k_{t+1} \bullet f_{kk_{t+1}} \bullet dk_{t+1} + s(w(k_{t+1}) \bullet dR/R\} \quad (32)$$

In summary, the starting old generation benefits from the policy switch, while the contemporary young is punished in welfare terms. Over time each generation obtains decreasing welfare losses until eventually getting increasing improvements. Once the long-run equilibrium is reached, each generation gets the same welfare improvement. Figure 3 presents this welfare result.

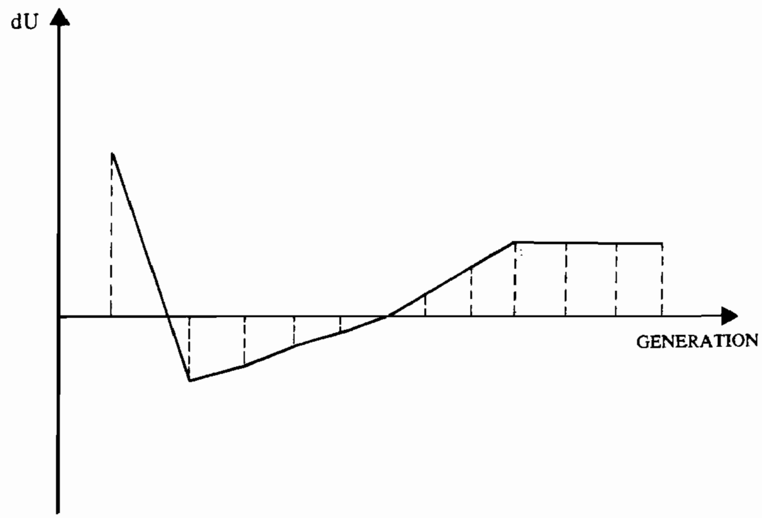
Let us compare these results with those of Buiter (1981) and Dornbusch (1985). Buiter (1981) uses a Diamond framework with production where the unique store of value is the capital stock. The model is similar to ours except that he does not allow adjustment costs. One of the cases he analyzed, relevant to our discussion, was the case of an efficient economy that opens trade in securities with the rest of the world, by facing a lower interest rate abroad than the autarkic one. As the current capital stock is a state variable that cannot jump, the liberalization policy does not affect the current old. Thus, the old generation still gets the same return from his capital stock.

The contemporary young instead suffers a deterioration in welfare because of the downward movement in the interest rate. In the following period, the capital stock is adjusted to its new steady state level in order to accomplish arbitrage between foreign and domestic assets. An improvement in steady state welfare is obtained for all future generations because of the increase in the stationary capital stock generated by the opening of the capital account.

In the case of the Dornbusch model, the author works with an endowment economy where a government consol is the unique store of value. An opening to trade in securities with an explicit lower foreign interest rate generates capital and welfare gains to the old. However, the reduction in the interest rates at home hurts the young generation.

The resulting redistribution between entrepreneurs and workers in the case of opening to trade in a static two sector model is, in some sense, reproduced here under a dynamic overlapping generations model with adjustment costs when free capital

FIGURE 3



inflows are allowed. Redistribution here arises because of the adjustment cost and the different behavior by age. In a static model it arises because of different factor intensities in the two sectors.

We now turn to the issue of existence of lump-sum redistribution policies that might result in a Pareto improvement of welfare for this economy. Later on, we analyze the effects of a gradual liberalization.

8. The Existence of a Pareto Improving Redistribution Policy

Here we will make use of the government budget constraint and its ability to borrow from abroad at a given interest rate, lower than the autarkic one.

For the case of a small change in the interest rate, we investigate the existence of a dynamic lump-sum Pareto improving redistribution policy that does not neutralize the dynamic effects brought by the opening of the capital account. We will take into account all benefits and losses that every generation will incur under the liberalization experiment.

Under our setup, the change in real income for the first old generation can be written as:

$$dY_{t-1} = k/R \cdot dq \qquad (33)$$

Using equation (5), we can obtain an expression for the windfall gain received by the old due to the jump in asset prices:

$$dq = \sum_{i=0}^{\infty} \left[f_{kk}\, dk_{t+1+i} + \phi'' \cdot d((k_{t+1+i} - k_{t+i})/k_{t+i})\right]/R^{i+1} - dR/(R-1) \qquad (34)$$

Similarly, for all current and future young generations, the change in real income is such that:

$$dY_{t+i} = -k \cdot f_{kk} \cdot dk_{t+1+i} + k.dR/R,\ \forall i \geq 0 \qquad (35)$$

Adding the changes in real income for all current and future young generations in present value terms, we obtain:

$$k/R \cdot \left[-dR/(R-1) \cdot \sum_{i=0}^{\infty} (R-1)/R^{i+1}\right] +$$

$$k/R \cdot \sum_{i=0}^{\infty} \left[\{f_{kk} \cdot dk_{t+1+i} + \phi'' \cdot d(\iota_{t+i}/k_{t+i})\}/R^{i+1}\right] +$$

$$\sum_{i=0}^{\infty} \{-k \cdot f_{kk} \cdot dk_{t+1+i} + k \cdot dR/R\}/R^{i+1} \qquad (36)$$

where ι is defined to be such that: $\iota_t = k_{t+1} - k_t$. Evaluation of expression (36), lead us to the following proposition.

Proposition

The present value of changes in real income of all the generations is positive under a local analysis, so that for small changes in interest rates it is feasible to implement a redistribution policy that can make everybody better off.

The proof is presented in the Appendix 2.

The compensation policy requires the use of the intertemporal government budget constraint, so that at any point in time the government can accumulate assets or issue public debt.

In fact, the behavior of external debt will differ from the laissez-faire case. At the beginning, the government will collect the capital gains obta ned by the jump in asset prices and will pay a transfer to the initial young. One would expect initially a surplus in the public sector budget in the form of asset accumulation. The private sector however, will probably react by having a lower initial current account deficit when compared to the laissez-faire case. During the transition the government will run down assets and probably start to issue debt in order to finance the compensation required for subsequent generations. There will be increases in production and consumption of the young. However, investment will be falling during the transition. When compared to the laissez-faire case, there will be a lower surplus or higher deficit in the private current account. Once the needs for transfers are extinguished, the government can levy enough taxes on benefited generations to pay back its debt. This also will affect the external debt behavior.

9. Gradual Liberalization

This section discusses the effects of an unanticipated liberalization with anticipated gradualism. Suppose the government liberalizes but wants to control the domestic interest rate by imposing a tariff on the "imports" of financial flows from overseas. The tariff f is defined by $R^d = R \bullet (1+f)$. We know that if the domestic rate falls in several steps, the initial jump in q is lower than in the cold turkey case. Moreover the deterioration in welfare is smaller for the initial young generation as R falls by just a bit[15]. The initial owner still benefits from the increase in q, which is lower than in the case of no gradualism. Some of the future young generations can improve with respect to the cold turkey case as the continuous fall in R may be compensated by the continuous increase in wages. This effect can be reinforced if the government start by redistributing the surplus that may be generated in its budget.

One can conjecture that the macroeconomic authority will choose more gradualism if the social welfare function cares a lot about the transitional deviation from the initial steady state welfare. If there is impatience for getting to the steady state, governments will have a greater tendency to apply a cold turkey policy[16].

10. Concluding Remarks

This paper has provided a full characterization of the dynamics that follow a liberalization experiment of the capital account.

Secondly, it has also analyzed the intergenerational welfare redistributions caused by the opening of the capital account. From a political economy point of view, an important portion of currently alived generations will oppose that type of policy. However, we show the possibility of implementing Pareto improving redistribution policies so as to make every single generation better off. A key message is that liberalization policies alone do not provide higher welfare for all individuals. Moreover, we show that transitorily, we can see transitional generations being hurt by this laissez-faire policy.

An attractive alternative strategy discussed was the possibility of introducing a gradualist policy which can reduce the intensity of redistributions.

Appendix 1

LOCAL DYNAMICS OF THE SMALL OPEN ECONOMY

Using a linearized version of the same equations used for the global dynamic analysis, we obtain the following pair of linearized first order difference equations for the equilibrium motion of the capital stock and asset prices:

$$\check{k}_{t+1} = \check{k}_t + (\bar{k}/(\phi'')) \bullet \check{q}_t \qquad (a)$$

$$\check{q}_{t+1} = (R - f_{kk} \bullet \bar{k}/\phi'') \bullet \check{q}_t - f_{kk} \bullet \check{k}_t \qquad (b)$$

where the Jacobian matrix of first derivatives

$$\begin{bmatrix} \partial\check{k}_{t+1}/\partial\check{k}_t & \partial\check{k}_{t+1}/\partial\check{q}_t \\ \partial\check{q}_{t+1}/\partial\check{k}_t & \partial\check{q}_{t+1}/\partial\check{q}_t \end{bmatrix} =$$

$$\begin{bmatrix} 1 & \dfrac{\bar{k}}{(\phi'')} \\ -f_{kk} & R-(f_{kk} \bullet \bar{k})/(\phi'') \end{bmatrix}$$

where we have that:

$$Tr = \lambda_1 + \lambda_2 = 1 + R - (f_{kk} \bullet \bar{k})/(\phi'') > 2 \qquad (c)$$

$$Det = \lambda_1 \bullet \lambda_2 = R > 1 \qquad (d)$$

Combining equations (c) and (d), we can determine the stability nature of the system:

$$(1-\lambda_1) \bullet (1-\lambda_2) = \frac{f_{kk} \bullet \bar{k}}{(c'')} < 0 \qquad (e)$$

Using conditions (c),(d) and (e), we know that $0 < \lambda_1 < 1$ and $\lambda_2 > 1$. Of course we obtain a saddle path, with the following solutions for the characteristic roots:

$$\lambda_{1,2} = 1/2 \left[1 + R - f_{kk} \bullet \bar{k}/\phi'' \pm \sqrt{\{1 - R - (f_{kk} \bullet \bar{k})/\phi''\}^2 - 4 \bullet R \bullet f_{kk} \bullet \bar{k}/\phi''} \right] \qquad (f)$$

Under the assumptions of strict concavity of the production function and strict convexity of the adjustment cost function the saddle path solution for this economy is the only transition nature possible under perfect capital mobility. One can verify that the discriminant in equation (f) is always positive so that no cycles are possible in this economy. Using the technique of matrix diagonalization, one can obtain the equation for the saddle path between capital and asset prices:

$$\check{k}_t = - \frac{\bar{k}}{(\phi'')} \bullet \frac{1}{(1 - \lambda_1)} \bullet \check{q}_t \qquad (g)$$

Appendix 2

PROOF OF PROPOSITION

Adding the expression for the windfall obtained by the initial old and the present value of the changes in real income for all current and future young generations we have:

$$k/R \bullet [-dR/(R-1) \bullet \sum_{i=0}^{\infty} (R-1)/R^{i+1}] +$$

$$k/R \bullet \sum_{i=0}^{\infty} [\{f_{kk} \bullet dk_{t+1+i} + \phi'' \bullet d(\iota_{t+i}/k_{t+i})\}/R^{i+1}] +$$

$$\sum_{i=0}^{\infty} \{-k \bullet f_{kk} \bullet dk_{t+1+i} + k \bullet dR/R\} / R^{i+1} =$$

$$k/R [\sum_{i=0}^{\infty} \{f_{kk} \bullet (1-R) \bullet dk_{t+1+i} + \phi'' \bullet d(\iota_{t+i}/k_{t+i})\}/R^{i+1}] > 0$$

This expression is positive because $R > 1$, dk and d (ι/k) are all > 0. This is so because we are computing the changes with respect to the original steady state values.

Q.E.D.

Notes

1 Abel and Blanchard (1983) and Blanchard and Fischer (1989) present growth models with non-trivial investment decisions for closed and open economies, respectively.

2 Obstfeld (1981) has used the endogenous rate of time preference in a model with optimal money holdings and foreign asset accumulation. He assumes that the rate of time preference depends positively on the current instantaneous utility level. Unfortunately this leads to the conclusion that higher international interest rates improves welfare of his economy independent of the initial net foreign asset position.

3 In the Diamond model without adjustment costs we can have either an infinitely-lived firm or a sequence of firms with a relevant horizon of two periods. The infinitely lived firm solves the following problem:

$$\max -K_{t+1} + \{F(K_{t+1}, L_{t+1}) - w_{t+1} L_{t+1} + (1-\delta) K_{t+1} - K_{t+2}\} / R_{t+1} + \dots$$

Instead, in the case of a sequence of firms with short horizons, each firm maximizes:

$$\max -K_{t+1} + \{F(K_{t+1}, L_{t+1}) - w_{t+1} L_{t+1} + (1-\delta) K_{t+1}\} / R_{t+1}$$

In either case the same first order conditions hold:

$F_{L_{t+1}} = w_{t+1}$ and $F_{K_{t+1}} + 1 - \delta = R_{t+1}$, for every period.

However, in the case of the infinitely lived firm, a transversality condition on the discounted value of the capital stock in the very far future is required. Note that under both models, the same equilibrium is obtained, provided the economy is efficient. Otherwise the transversality condition for the infinitely lived firm is not satisfied.

4 It seems natural to talk about an infinitely-lived firm in the context of adjustment costs, considering that in the case of short-lived firms, adjustment costs would play a role similar to an externality inherited from decisions of preceding firms.

5 In order to maximize his last period consumption, the old will desire to maximize the value of the firm.

6 To avoid inefficiency in the Diamond economy we can include an infinitely-lived consumer, or, alternatively an intrinsically useless asset. For our economy, an asset bubble can solve the problem. More detailed arguments are given in Azariadis (1988), Budnevich (1991) and Tirole (1985).

7 In an extended version of the paper we gave a proof of existence and uniqueness of the steady state and a characterization of dynamics. It was possible to prove that in a neighborhood of the steady state, the dynamic system displays saddle path stability.

8 For our local analysis, we assume that the international interest rate is just barely lower than the domestic rate.

9 Under perfect financial flows, investment decisions are completely unrelated from consumption decisions, though over time and in general equilibrium, savings and consumption in this framework will depend upon the accumulation of capital.

10 In the case where savings are insensitive to interest rate changes, there will still be a jump in the external debt level. Obviously the jump will be lower in magnitude.

11 For a formal proof see Hayashi (1982) and Appendix I.

12 In Appendix 1 we show the derivation of the eigenvalue.

13 For the case of a classical economy, where the endowment of labor comes in the final period of life, a reduction in the international interest rate will normally imply undershooting for external debt. The motion for debt will be given by the following equation: $D_{t+1} = q_t K_{t+1} + c^y_t (w(K_{t+1}), R)$, with c^y_t increasing with w and decreasing with R. Here, equilibrium in the closed economy requires government credit to the private sector.

14 For the case of a classical economy a liberalization experiment will improve the welfare of all the generations.

15 Gradualism also brings smoother acquisition of external debt than the case of cold turkey.

16 In fact it would be interesting to know how the velocities for adjusting to the new steady state differ between a cold turkey policy and a policy of gradual liberation. It would also be appealing to study whether or not it is possible to design a gradual adjustment policy that reduces the variation of welfare changes and yet not prolong significantly arriving at the new steady state. However to get definite answers to those questions, it seems more appropriate to use numerical simulations rather than the dynamic approach taken in the paper.

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