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Essays On Political Economy

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Daniel Osvaldo Murgo

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To: Dean Kenneth Furton
College of Arts and Sciences

This dissertation, written by Daniel Osvaldo Murgo and entitled Essays on Political Economy, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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DEDICATION

I dedicate this dissertation to the memory of my parents. I hope that wherever they are, they are proud of me. I also dedicate it to my brother Juan, my sister-in-law Marta, and my nephew Fabián. Without their unwavering support I couldn’t have made it.

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ABSTRACT OF THE DISSERTATION

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The first chapter analizes conditional assistance programs. They generate conflicting relationships between international financial institutions (IFIs) and member countries. The experience of IFIs with conditionality in the 1990s led them to allow countries more latitude in the design of their reform programs. A reformist government does not need conditionality and it is useless if it does not want to reform. A government that faces opposition may use conditionality and the help of pro-reform lobbies as a lever to counteract anti-reform groups and succeed in implementing reforms.

The second chapter analizes economies saddled with taxes and regulations. I consider an economy in which many taxes, subsidies, and other distortionary restrictions are in place simultaneously. If I start from an inefficient laissez-faire equilibrium because of some domestic distortion, a small trade tax or subsidy can yield a first-order welfare improvement, even if the instrument itself creates distortions of its own. This may result in "welfare paradoxes". The purpose of the chapter is to quantify the welfare effects of changes in tax rates in a small open economy. I conduct the simulation in the context of an intertemporal utility maximization framework. I apply numerical methods to the model developed by Karayalcin. I introduce changes in the tax rates and quantify both the

impact on welfare, consumption and foreign assets, and the path to the new steady-state values.

The third chapter studies the role of stock markets and adjustment costs in the international transmission of supply shocks. The analysis of the transmission of a positive supply shock that originates in one of the countries shows that on impact the shock leads to an inmediate stock market boom enjoying the technological advance, while the other country suffers from depress stock market prices as demand for its equity declines. A period of adjustment begins culminating in a steady state capital and output level that is identical to the one before the shock. The the capital stock of one country undergoes a non-monotonic adjustment. The model is tested with plausible values of the variables and the numeric results confirm the predictions of the theory.

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I. VIABILITY OF CONDITIONAL ASSISTANCE PROGRAMS WITH ENDOGENOUS LOBBY FORMATION

I.I Introduction

Conditional assistance programs consist of financial and technical help that International Financial Institutions (IFI) provide to member countries in the face of major macroeconomic and structural disequilibrium. These programs require the interaction of two parties: an assistance-providing IFI and an assistance-receiving member country. The relationship is regulated in general by the charter of the IFI and in particular by the terms and conditions of each individual agreement. The process as a whole, however, is influenced by the domestic political dynamic in the receiving country. To study the IFI-country relationship is important to analyze the behavior of the different players involved. First I will briefly analyze the evolution of the IFIs approach to conditional lending. Then I will consider the domestic political dynamic in the assistance receiving country. And finally I will explain how these elements interact.

I.II The Evolution of Conditional Lending over time

Perhaps the two best known International Financial Institutions (IFIs) are the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development (IBRD), commonly known as the World Bank (WB). They were created in July 1944 as a result of the Bretton Woods Conference. At the time of their creation, "their purposes were clearly delineated: financial stabilization for the one and postwar reconstruction and economic development for the other."[1] Article I of the Articles of

[1] Broughton, James M., (2001), Chapter 20, p. 997.

Agreement sets out the Fund's main responsibilities: promote international monetary cooperation; facilitate the expansion and balanced growth of international trade; promote exchange stability; assist in the establishment of a multilateral system of payments; and make its resources available (under adequate safeguards) to members experiencing balance of payments difficulties. The Bank, on the other hand, must assist in the reconstruction and development of territories of members by facilitating the investment of capital for productive purposes; promote private foreign investment by means of guarantees or participations in loans and other investments made by private investors; promote the long-range balanced growth of international trade and the maintenance of equilibrium in balances of payments; arrange the loans made or guaranteed so that the more useful and urgent projects will be dealt with first; and conduct its operations with due regard to the effect of international investment on business conditions in the territories of members.

Both institutions impose conditions on the countries that receive financial help. Conditional lending did not change much for three decades. However, the oil crises of the 1970s and the debt crisis of the 1980s forced the Bank to move into structural adjustment lending.[2] The change towards structural adjustment lending intensified in the 1990s following the wave of economic restructuring undertaken by countries in Latin America, Eastern Europe, Russia and the members of the former Soviet Union, and Asia. "During the eleven years from 1979 through 1989, the world economy evolved in seemingly small but ultimately dramatic and profound ways. From a starting point at which the state was viewed as holding a primary responsibility for controlling economic development, the

[2] Salop, Joanne in Williamson (2001).

'third world' gradually diminished and even rejected that role in favor of privatization and reliance on market incentives."[3] The Fund also added structural reforms as a condition for lending. The habitual conditions imposed by the Fund on its lending continued as before. The need for economic adjustment leading to sound and sustainable macroeconomic policies was greater than ever. However, macroeconomic adjustment alone proved insufficient to solve the structural problems that affected newer borrowers. Throughout the 1980s, the Fund supplemented its requirements of monetary and fiscal discipline with demands for structural reform, as a way to fully integrate those reforms in the design of the adjustment programs." Although that process took hold only partially and only rather late in the decade, it did eventually succeed in encouraging and helping many countries to liberalize their economic policies."[4]

The Fund and the Bank have a long history of collaboration. The first formal agreement to coordinate their activities goes back to 1966. All subsequent agreements are based on that one. When the activities of the Fund and the Bank began to overlap in the 1980s it was necessary to clarify the role of each institution and delineate the primary responsibility of each one. All this led to the so called Concordat on Fund-Bank Collaboration of 1989 that established areas of primary responsibility, areas of common interests and mechanisms for consultations and resolution of potential disputes regarding the advice to give to member countries.

[3] Broughton, James M., (2000).

[4] Broughton, James M., (2000), p. 27.

The nature of conditional lending also changed. The experience gained in the 1990s convinced both institutions to redefine the concept of conditionality. Instead of imposing a predetermined solution on countries to solve their macroeconomic or structural programs, and risking a future policy reversal, they allowed countries more latitude in the design of their own programs. The concept of conditionality was complemented with that of ownership. The concept of ownership is based in three basic principles: a) the country must maintain a stable macroeconomic framework throughout the duration of the loan; b) countries are encouraged to design their own reform programs, but these programs have to be implemented in a manner satisfactory to the IFI; and c) countries also have to implement all the other policies and institutional actions that are considered critical for a successful execution and completion of the reform program.

The concept of ownership also implies the involvement of interested parties in the formulation of the reform program. As part of the domestic dialog, IFIs advice governments to consult with and engage the participation of key stakeholders in the country in the process of formulating the country's development strategy.[5] The consultation and engagement does not necessarily mean influence in the design or implementation of the program itself, but at least to take into account the opinions of interested parties, especially of those who might suffer losses from the reforms.

The primary and formal relationship exists between the IFI and the member country. However, it is fairly common for staff members to maintain contacts with different social groups (e.g., unions, business associations, NGO, etc.) during the design of assistance programs or even on routine missions to evaluate the macroeconomic

[5] The World Bank Operational Manual. Operational Policies, p. 2.

performance of the country. IFIs however cannot "interfere in the political affairs of any member; nor shall they be influenced in their decisions by the political character of the member or members concerned. Only economic considerations shall be relevant to their decisions, and these considerations shall be weighed impartially in order to achieve the purposes stated in Article I." [6]

I.III. Domestic Political Dynamic

In a neoclassical setting a country facing a macroeconomic or structural disequilibrium would simply choose the set of available policies that would maximize aggregate welfare and implement them. In a political-economy setting things are not so simple. Politicians do not only care about aggregate welfare and macroeconomic equilibrium. They have selfish motivations as well, namely obtaining and maintaining power. They also have to deal with different interest groups (IG) that try to influence government policies so that they benefit their particular objectives. This heterogeneity of interests creates a conflict that is typically resolved through the domestic political process. Politics is not simple either. Voters will not simply choose the "best" candidate and elect him or her. Politicians have to woo them. They need to convince the electorate that they are the best option. And for this they need financial resources. In other words, political activity is costly. The resources may come from various avenues: individual contributions by unorganized citizens with defined political preferences but little or no power, social or political organization willing to promote a specific agenda, or interested groups trying to obtain economic profits from their contributions. The activity of these

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[6] IBRD, Articles of Agreement IV, section 10.

interest groups has an important effect on the political process. Prospective and incumbent officials care about the general well-being, but they also want to access office or remain in it for their own selfish reasons. The resources received from individual citizens, and to some extent from social and political groups, supposedly finance the procurement of general welfare. Another important portion of the funds comes from interested parties. These political or economic groups can be a big or small constituency, but they have clear ideas about what they want from the political process. They are willing to help the incumbent or the challenger financially, but this help comes at a price. This price usually takes the form of legislation or regulations that promote or protect the interests of the lobby. The legislation or regulation, once enacted, usually creates distortions in the economy. It benefits the interested parties but hurts the society as a whole. An often cited example of this sort of groups are import-competing lobbies. Other groups affected by these policies may want to counteract forming lobbies whose purpose is to eliminate distortionary policies (e.g., export taxes or import subsidies.)

I.IV. IFIs and Government interaction.

An appropriate combination of conditionality and ownership may be useful in helping solve this conflict of interests. Governments typically do not change policies unless there is an acute economic imbalance or there is a change in their perception of the relative importance of aggregate welfare versus political support. In this sense conditionality and ownership produce different results depending on the government's attitude. A government that does not see the need for reform will not be influenced by conditional lending. They will probably sign an agreement, take the money and fail to implement any reforms. On the other hand, a reform-minded government who is able to design its own reform program probably will not need conditionality. The usefulness of conditionality may become apparent in situations in which the choices are not clear cut. A government may be determined to implement domestic reforms but face strong opposition from entrenched interest groups. In this particular case a combination of conditionality and ownership may help overcome this obstacle. A government that realizes the need for reform but faces the opposition of pro-status quo lobbies may enlist the help of potential interest groups that will benefit from reform. The government-designed program (ownership), the financial help of the pro-reform group, and the financial assistance provided by the IFI (subject to conditionality) may help solve the conflict of interests and result in successful reforms. Alternatively, if the government is not entirely persuaded of the need for reform, the IFI may exercise its influence to convince the authorities to give more weight to less distortionary policies (those promoted by pro-reform lobbies) and less weight to distortionary policies (those promoted by anti-reform groups.)

The purpose of this chapter is to show how such a situation can be modeled, and how the combination of external conditionality, ownership, and domestic political pressure can lead to successful reforms.

The existing literature covers this problem only partially. Drazen (2002) explores the relationship between conditionality and ownership. Mayer and Mourmouras (2005) show that under certain conditions conditional lending will fail. However, they only consider the possibility of one anti-reform lobby, whose existence is exogenously determined. The process of lobby formation in this chapter is endogenous, as shown by

Mitra (1999) and Krishna and Mitra (2004). The results obtained are different from those predicted by the Mayer and Mourmouras model.

I.V. Conditional Assistance with Multiple Lobbies

The generic conflict of interest presented in the introduction can be made more concrete by way of an example. Suppose there is an open economy. This economy is small enough so that it cannot influence the world capital markets. Instead it takes the world interest rate as given. I can distinguish several types of agents. Some, perhaps by virtue of the size of their endowments, have enough to finance their consumption and retain a surplus. The rest of the agents are in the opposite situation and have to borrow. If this economy is open agents will have no problem borrowing or lending in the world capital markets at the prevailing interest rate. This is tantamount to a competitive situation in which actors only make normal profits. But some of those with excess funds may find this situation to be not completely beneficial. Any government policy that would restrict borrowing from abroad would automatically benefit lenders by giving them some measure of control over the market. This group of lenders therefore will find that organizing themselves and lobbying for some restriction on foreign borrowing (a tax or a quota) will benefit them as a group. One way to achieve this is to "bribe" the government so that it passes legislation imposing the restriction. Governments care about aggregate welfare but they also need financial resources for their political activities, so it is highly likely that with enough political pressure and financial resources lenders will succeed in introducing regulations in their benefit. A portion of the borrowers may have the power and the resources to organize into a lobby and fight the tax. They can collect resource from the prospective members and make financial offers to the government. If they organize themselves they have the possibility of influencing the government to reduce or eliminate the tax. Their benefit will be lower or no taxes on borrowing and the costs will be the creation of an organization to collect and enforce contributions from its members. As long as the former is greater than the latter, the lobby will form and it will challenge the lenders' group. The rest of the members of the population may be borrowers or lenders. But the key issue is that they are so small that even if they were able to organize themselves they would not have enough power or resources to influence the government. This group is likely to remain unorganized.

The implications of a group being able to influence the government to impose taxes on the rest of the society are important for the domestic economy. Taxes are known to introduce inefficiencies. The fewer of them and the lower they are, the less distorted the economy will be. There may also be implications for long run growth. An undistorted economy has the potential to produce more and grow more. Also low and uniform taxes may create a favorable climate for FDI (higher returns), which can increase growth further.

Now I need to translate this example into a model, which is the task of the next subsection.

I.VI. The Model

Consider a small open economy that lasts for two periods. There is only one good that is consumed in both periods. I assume that all agents have the same preferences that can represented by an isoelastic utility function. The only difference between agents is their endowments: $Y_t^O \lesseqgtr Y_t^O \lesseqgtr Y_t^U$, $t = 1,2$, where O represents members of an organized lobby, P represents members of a potential lobby, and U represents agents that are unorganized[7], and *t* is the time period. The mass of the population $O + P + U$ is normalized to 1.

The consumer's problem is to maximize his lifetime utility function

$$U_1^i = u^i\left(Q_1^i\right) + \beta u^i\left(Q_2^i\right),\ 0 < \beta < 1,\ i = O,P,U \tag{1}$$

where u^i is the period utility function, Q_t^i is consumption of individuals *i* in period $t = 1,2$; and β is the subjective discount factor or time-preference factor (impatience). I assume that u^i is strictly concave so that $u'\left(Q^i\right) > 0$, and $u''\left(Q^i\right) < 0$. Additionally I impose the condition $\lim_{Q_t^i \to 0} u'\left(Q_t^i\right) = \infty$ to ensure that individuals always desire at least a little consumption in every period.

The consumer must face a lifetime budget constraint equal to

$$Q_1^i + \frac{Q_2^i}{1+r} = Y_1^i + \frac{Y_2^i}{1+r} \equiv W^i \tag{2}$$

where Y_t^i, $t = 1,2$ are the endowments in each period, W^i is the wealth of individual *i*, and *r* is the real interest rate for borrowing or lending in the world capital market at date 1. I assume that the consumer bases his or her decisions on perfect foresight of the future. The maximization problem yields the intertemporal Euler equation.

[7] These agents may remain unorganized probably because organization costs are too high relative to the potential benefits of lobby formation.

(3) $$\frac{\beta u'\left(Q_2^i\right)}{u'\left(Q_1^i\right)} = \frac{1}{1+r}$$

where the LHS represents the marginal rate of substitution of present consumption for future consumption, and the RHS represents the price of future consumption in terms of present consumption.

If I assume a period utility function of the form $u^i = \ln Q_t^i$ the expressions for the demand functions are:

$$Q_1\left(r,Y\right) = \frac{W^i}{1+\beta} = d_1\left(r,Y\right) \text{ and } Q_2\left(r,Y\right) = \frac{\beta\left(1+r\right)W^i}{1+\beta} = d_2\left(r,Y\right)$$

The only price in the economy is *r* and is determined in world capital markets.

Starting from the log utility function and replacing Q_2 by its equivalent from the budget constraint, I can express welfare as:

$$U_1 = \ln Q_1^i + \beta \ln\left[\left(1+r\right)\left(Y_1^i - Q_1^i\right) + Y_2^i\right]$$

Taking the derivative of U_1 with respect to r yields:

(4) $$\frac{dU_1}{dr} = \frac{\beta\left(Y_1^i - Q_1^i\right)}{Q_2^i} \lesseqgtr 0 \text{ if } Y^i \lesseqgtr Q^i$$

I.VII. The effects of government policy on the welfare of groups

Let assume that the only policy instruments available to the government are taxes or subsidies on foreign borrowing and lending. A tax or a subsidy introduces a distortion in the economy. I want to know which lobbies will benefit from a distortionary policy and which will gain from reforms.

Let assume, without loss of generality, that the members of the organized lobby have endowments such that $Y_1^O > Q_1^O$ This implies that they are lenders. They will benefit from any policy that restricts borrowing from abroad (i.e., taxes on foreign borrowing) **s**ince that will increase the interest rate at which they lend**.** Assume further that the lobby have succeeded in persuading the government to impose a tax τ on foreign borrowing. For members of the organized lobby the numerator in equation (4) is positive. The denominator is also positive. Therefore

$$\frac{dU_1^O}{dr} > 0.$$

Members of the organized lobby will try to influence the government to impose a tax on foreign borrowing. If one is already in place they will lobby to maintain or even increase it.

On the other hand members of the potential lobby have endowments such that

$$Y_1^P < Q_1^P.$$

This implies that they are borrowers. They will benefit from any policy that reduces taxes and therefore the interest they have to pay for borrowing from abroad. For members of the unorganized lobby I have

$$\frac{dU_1^P}{dr} < 0.$$

The intuition is that a borrower is hurt by an increase in the interest rate and benefits from a decrease in it. Members of the potential lobby, once organized will seek to influence the government to reduce or eliminate taxes.

I.VIII. The process of lobby formation

With a tax on foreign borrowing in place, borrowers will have an incentive to organize themselves into a lobby. Once the lobby is formed it will try to influence the incumbent government to reduce or eliminate the tax. This influence is usually exercised by way of financial contributions (campaign contributions, contributions to the ruling party, bribes, etc.). I will show how the number of lobbies is endogenously determined. The government, in this model, behaves like in Grossman and Helpman (1994), caring about political contributions $\left(C\right)$ and aggregate welfare. As stated before taxes or subsidies are the only policy instruments available to the government. The interest rate cum tax can be expressed as:

$$r^{\tau} = r + \tau \, .$$

Given these assumptions, I want to determine the political equilibrium of a three-stage non-cooperative game.

First Stage. In the first stage, agents with similar interests decide whether to contribute to finance the cost of forming a lobby. A lobby is an organization designed to reduce the cost of lobbing activity, coordinate and enforce the collection of political contributions, and communicate the political requests of the group to the government.

Second Stage. In the second stage, lobbies choose their political contribution schedules that *truthfully* reveal their preferences, taking into account the objective function of the government. Each lobby takes the contribution schedules of the other lobbies as given.

Third Stage. In the third stage the government sets policies to maximize it's Political Support Function (PSF), which is a weighted sum of political contributions and overall social welfare.

The problem is solved by backward induction. An equilibrium in this game is the number of lobbies formed $\left(n^{O}\right)$ and the interest rate cum tax on borrowing or lending on date one $\left(r^{\tau}\right)$.

In the third stage, the government solves the following problem:

(5) $$\max_{r^{\tau} \in R} U^{G}\left(r^{\tau}\right) = \sum_{i \in \Lambda} C^{i}\left(r^{\tau}\right) + \alpha U^{A}\left(r^{\tau}\right)$$

where Λ is the set of agents $\left(O, P, U\right)$, $U^{G}\left(r^{\tau}\right)$ is the objective function of the government (PSF), $U^{A}\left(r^{\tau}\right) = \sum_{i \in \Lambda} U_{1}^{i}\left(r^{\tau}\right)$ is aggregate welfare, $C^{i}\left(r^{\tau}\right)$ is the contribution schedule of the i^{th} lobby, and **R** is the set of after tax interest rates from which the government can choose. The set **R** is bounded between some minimum $r_{\min}^{\tau}$ and some maximum $r_{\max}^{\tau}$ Following Grossman & Helpman (1994), attention will be focused on equilibria that lies in the interior of **R**.

The parameter α in (5) is the weight the government attaches to aggregate welfare relative to political contributions. The higher α is the less the government cares about political contributions and the higher is the importance it assigns on aggregate welfare.

The truthful contribution schedule of each lobby $i \in \Lambda$ is given by

(6) $$C^{i}\left(r^{\tau}\right) = \max\left(0, U_{1}^{i}\left(r^{\tau}\right) - b^{i}\right)$$

where the net welfare anchors for the different lobbies (the b^{i} s) are determined in equilibrium. As in Grossman and Helpman, I focus on equilibria where lobbies make positive contributions. In the neighborhood of the equilibrium

(7) $$C^i\left(r^\tau\right) = U_1^i\left(r^\tau\right) - b^i$$

Substituting (7) into (5), I have

(8)

$$\max_{r\in\mathbf{R}} U^G\left(r^\tau\right) = \left[\sum_{i\in\Lambda}\left(U_1^i\left(r^\tau\right) - b^i\right) + \alpha U^A\left(r^\tau\right)\right] \Rightarrow \max_{r\in\mathbf{R}}\left[\sum_{i\in\Lambda} U_1^i\left(r^\tau\right) + \alpha U^A\left(r^\tau\right)\right]$$

I go back to the first stage and analyze the conditions under which potential (pro-reform) lobbies may form, taking the existing lobbies as organized. Let F^i be the fixed cost of lobby formation for the i^{th} group. Fixed costs can be heterogenous because groups differ in their organizational abilities. Also, groups that have formed associations for other purposes may find it cheaper to organize for political purposes than other groups. Organization costs may also be lower for groups that are more geographically concentrated.

Let $\widetilde{U}^K_{t,j}$ denote equilibrium gross welfare of the k^{th} sector when both the incumbent and challenger lobbies are in place. Let $\widetilde{U}^K_i$ denote equilibrium gross welfare of the k^{th} sector when only the incumbent lobby is in place. Also, let $\widetilde{C}$ be the equilibrium level of contributions by a representative lobby.

Taking the anti-reform lobby as organized, let the members of other group decide whether to form a lobby or remain unorganized. Nash interaction among group members is assumed in their contribution decisions towards the provision of the fixed cost of lobby formation. However, once the lobby is formed, the lobby machinery can enforce perfect coordination among the members of the group in the collection of political contributions. There are three possibilities:

Case (a): The benefit to any one individual within the potential lobby exceeds the cost of forming the lobby. In this case, contributing to the full financing of the fixed cost F^i is the only Nash Equilibrium outcome. The lobby is always formed.

$$\left[\widetilde{U}_{O,P}^{P} - \widetilde{U}_{O}^{P} - \widetilde{C}\right] / \, m > F^i \tag{9}$$

where *m* is the number of members in the group.

Case (b): The cost of lobby formation exceeds the benefits to any one individual but is less than the total benefit to the lobby.

$$\widetilde{U}_{O,P}^{P} - \widetilde{U}_{O}^{P} - \widetilde{C} > F^i > \left[\widetilde{U}_{O,P}^{P} - \widetilde{U}_{O}^{P} - \widetilde{C}\left(n\right)\right] / \, m \tag{10}$$

In this case, there are two possible Nash Equilibrium outcomes: either there is no contribution to the lobby formation, or the fixed cost F^i is fully financed. If I assume pre-play communication can take place then I can use communication based refinements such as coalition proof Nash, strong Nash and Pareto-dominance, and therefore group coordination becomes the likely outcome.[8]

Case (c): If the total benefit of lobby formation is less than the total fixed cost, then The Nash Equilibrium outcome is not providing the lobby.[9]

$$\widetilde{U}_{O,P}^{P} - \widetilde{U}_{O}^{P} - \widetilde{C} > F^i \tag{11}$$

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[8] See B. Douglas Bernheim et al. (1987), and Aumann (1959).

[9] If the cost of lobby formation is too high relative to the potential benefits we are in the case of those groups that remain unorganized.

From the analysis of the above three cases, the conclusion that emerges is that a lobby is formed under the following condition:

$$\widetilde{U}^{P}_{O,P} - \widetilde{U}^{P}_{O} - \widetilde{C} > F^{i}$$

I am interested in knowing how a reduction in the tax, and consequently in the interest rate, affects the welfare of the potential lobby. First I need to analyze how the net benefit of lobby formation is determined, and then asses the impact of changes (reduction) in the interest rate on aggregate welfare and the net benefit of the potential lobby. Let **NB** represent net benefit from lobby formation. The benefit **NB** is net of political contributions, but gross of fixed costs. This net benefit is given by

(12) $$\mathbf{NB}\left(r^{\tau}\right) = \widetilde{U}^{P}_{O,P}\left(r^{\tau}\right) - \widetilde{U}^{P}_{O}\left(r^{\tau}\right) - \widetilde{C}^{P}\left(r^{\tau}\right)$$

With truthful contributions, the equilibrium contribution level by a potential group when organized is given by

(13) $$\widetilde{C}\left(r^{\tau}\right) = \widetilde{U}^{P}\left(r^{\tau}\right) - \tilde{b}^{P}\left(r^{\tau}\right)$$

where $\tilde{b}^{P}\left(r^{\tau}\right) = \widetilde{U}^{P}\left(r^{\tau}\right) - \widetilde{C}\left(r^{\tau}\right)$ is the (net of contributions) welfare or payoff anchor (determined in equilibrium) of the contribution schedule of a potential lobby when organized.

Truthful contributions mean that once a lobby is formed it will have to pay the government an amount that makes it indifferent between treating the lobby as organized or as unorganized, given the contributions of the other lobbies. The potential lobby has to compensate the government for the reduction in the organized lobby's welfare and changes in overall welfare do to its entry. The contribution of the potential lobby is given by:

$$(14) \qquad \widetilde{C}^{P}\left(r^{\tau}\right)=\widetilde{U}_{O}^{O}\left(r^{\tau}\right)-\widetilde{U}_{O,P}^{O}\left(r^{\tau}\right)+\alpha\left[\widetilde{U}_{O}^{A}\left(r^{\tau}\right)-\widetilde{U}_{O,P}^{A}\left(r^{\tau}\right)\right]$$

Proposition *(Krishna & Mitra) With a pre-existing lobby in place, the net benefit (gross of fixed costs) to the net borrowers from forming a lobby is the sum of the changes in welfare created in the organized, the potentially organized, and the unorganized groups (appropriately weighted) that results from the creation of the potential lobby.*

I can see this by substituting equation (14) into (12). The net benefit to the potential lobby from forming can be express as:

(15)

$$\begin{aligned}\mathbf{NB}\left(r^{\tau}\right)&=\widetilde{U}_{O,P}^{P}\left(r^{\tau}\right)-\widetilde{U}_{O}^{P}\left(r^{\tau}\right)-\left\{\widetilde{U}_{O}^{O}\left(r^{\tau}\right)-\widetilde{U}_{O,P}^{O}\left(r^{\tau}\right)+\alpha\left[\widetilde{U}_{O}^{A}\left(r^{\tau}\right)-\widetilde{U}_{O,P}^{A}\left(r^{\tau}\right)\right]\right\}\\&=\left(1+\alpha\right)\left[\widetilde{U}_{O,P}^{A}\left(r^{\tau}\right)-\widetilde{U}_{O}^{A}\left(r^{\tau}\right)\right]\end{aligned}$$

What equation (15) is telling us is that the net benefit of lobby formation can be expressed as the change in aggregate welfare due to the formation of the lobby. Note that the net benefit of lobby formation is positive if and only if forming the lobby improves aggregate welfare. The intuition is that the equilibrium contribution of the lobby has to compensate the government for the loss of welfare of both the existing lobby and the existing unorganized groups that are harmed by the policies induced by the new lobby. This is a necessary but not sufficient condition, because **NB** also has to be greater than cost. This does not necessarily mean that lobby formation has to be Pareto improving. It only means that the members of the new lobby gain so much that they can compensate for all the los ses created and still retain a benefit.

Having established the impact of the formation of the potential (pro-reform) lobby on welfare I want to go back to our question of how changes in the interest rate affect aggregate welfare and the **NB** of the potential lobby. This is a task I undertake in following subsection.

I.IX. The effects of changes in *r* on aggregate welfare

I first look at the effect of changes in r^{τ} on aggregate welfare. To asses this effect I start with equation (15) and decompose it to reflect the impact on the three sectors of the economy. I need to sign

(16)

$$\frac{d}{r^{\tau}}NB\left(r^{\tau}\right)=\frac{d}{r^{\tau}}\left[\widetilde{U}_{O,P}^{P}\left(r^{\tau}\right)-\widetilde{U}_{O}^{P}\left(r^{\tau}\right)\right]-\left[\widetilde{U}_{O,P}^{P}\left(r^{\tau}\right)-\widetilde{U}_{O}^{P}\left(r^{\tau}\right)\right]-\alpha\left[\widetilde{U}_{O}^{A}\left(r^{\tau}\right)-\widetilde{U}_{O,P}^{A}\left(r^{\tau}\right)\right]$$

Starting form equation (4)

$$\frac{dU_1}{dr}=\frac{\beta\left(Y_1^i-Q_1^i\right)}{Q_2^i}\lesseqgtr 0 \text{ if } Y^i\lesseqgtr Q^1.$$

I assume for simplicity that β is the same for all groups. Given our assumption that the potential lobby is a net borrower I have that $\frac{dU_1}{dr^{\tau}}<0$. The welfare of the potential lobby before the reform, and with only the incumbent lobby organized, can be expressed as $U_O^P=f\left(Y,r_1^{\tau}\right)$, where r_1^{τ} is the pre-reform interest rate cum tax. The welfare of the the potential lobby after the reform, with both lobbies organized is $U_{O,P}^{P} = f\left(Y, r_2^{\tau}\right)$, where r_2^{τ} is the post-reform interest rate cum tax. If the potential lobby has been able to organize it must be the case that $r_1^{\tau} > r_2^{\tau}$. Also since U^{P} is decreasing in r^{τ} this implies that $\frac{d}{dr^{\tau}}\tilde{U}_{O,P}^{P} > \frac{d}{dr^{\tau}}\tilde{U}_{O}^{P}$, therefore the first term in equation (16) is positive.

The organized lobby is a net lender, therefore $\frac{dU_1}{dr^{\tau}} > 0$. The welfare of the incumbent lobby when it is the only one organized is $U_{O}^{O} = f(Y, r_1^{\tau})$. When both the organized and potential lobby are present welfare is $U_{O,P}^{O} = f\left(Y, r_2^{\tau}\right)$. Given $r_1^{\tau} > r_2^{\tau}$ it must be the case that $\frac{d}{dr^{\tau}}\tilde{U}_{O}^{O} < \frac{d}{dr^{\tau}}\tilde{U}_{O,P}^{O}$, therefore the second term of equation (16) is negative.

The welfare of the unorganized part of the population depends on whether they are net borrowers or lenders. I have two possible cases.

a) The unorganized part of the population is a net borrower. In this cases $\frac{dU_1}{dr^{\tau}} < 0$ and $\frac{d}{dr^{\tau}}\tilde{U}_{O}^{A} < \frac{d}{dr^{\tau}}\tilde{U}_{O,P}^{A}$ therefore the third term in equation is positive. Assuming that the mass (P + A) > O and α is sufficiently close to one, I have that $\frac{d}{dt^{\tau}}\mathbf{NB}\left(r^{\tau}\right) > 0$.

b) The unorganized part of the population is a net lender. In this cases $\frac{dU_1}{dr^\tau} > 0$, and $\frac{d}{dr^\tau}\tilde{U}_O^A > \frac{d}{dr^\tau}\tilde{U}_{O,P}^A$ therefore the third term in equation is negative. Assuming that the mass (O + A) > P and α is sufficiently close to one, I have that $\frac{d}{dt^\tau}\mathbf{NB}\left(r^\tau\right) < 0$.

I can summarize the results as follows: if the unorganized members of the population are net borrowers, as are the members of the potential lobby, a decrease in interest rate will increase aggregate welfare. If the unorganized members of the population are net lenders, as are the members of the incumbent lobby, a decrease in the interest rate will decrease welfare. The unorganized group does not have political power, but it will support the lobby whose interests are aligned with its own.

Lastly, I want to see the effects of changes in the interest rate on the **NB** of lobby formation of the potential lobby. The **NB** of lobby formation of the potential lobby (equation 12) can be shown in Figure I.1. Net benefits (**NB**) (gross of fixed costs) is decreasing in r^τ and is represented by the downward sloping **NB(*r*)** schedule in the graph. Given the fixed cost *F*, any interest rate $r^\tau \leq r_0$ will result in NB ≥ *F*, therefore the lobby will form. What the lobby wants from the political process is not only a reduction in the interest rate cum tax, but also that the level of r^τ is no higher that r_0. An increase in the interest rate cum tax beyond r_0 will render the potential lobby not viable.

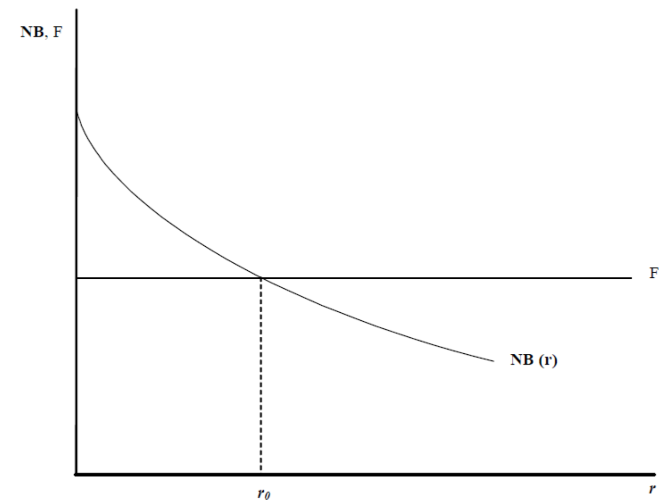


Figure I.1

I.X. IFI Conditional Assistance and Government Policy

I have assumed throughout the chapter that the only policy instrument available to the Government is taxation of foreign borrowing or lending. Taxes introduce inefficiencies in the economy that affect long term growth. An economy that grows at a slower pace has the potential of being less able to repay its debts in the future. This element of uncertainty may add a measure of risk premium to the interest rate paid by domestic agents on foreign loans. This will worsens the welfare of domestic borrowers. If the IFI and the government agree on a Conditional Assistance Program they can induce changes in the interest rate in two ways: a) a program backed by an IFI gives the country a "Seal of Approval." Experience shows that this type of agreements tend to reduce the risk premium charged by foreign lenders. b) The reform, if successful, will induce the elimination of taxation on foreign borrowing.

A decrease in the interest rate in this model is a change in the relative price of future consumption in terms of present consumption. This will benefit borrowers and hurt lenders. The members of the anti-reform lobby are lenders, therefore are going to be hurt by the reform and fight it. The members of the potential lobby are borrowers and will benefit from a reduction in r^T, therefore they will favor the reform. The country and the IFI can agree on a reform program with the right combination of conditionality (tax elimination) and ownership (domestic program design.) If the IFI, through the conditional program, succeeds in fostering the creation of a pro-reform lobby, the new lobby will be able to pay the government contributions at least as large as the ones paid by the anti-reform lobby. The government being indifferent to the source of the contributions, and since it has agreed with the IFI to reform the economy, will accept the contributions of the new lobby and implement the reform (eliminate the tax.) The anti-reform lobby will loose its source of revenue and will see its influence greatly reduced or may even disappear.

I.XI. Conclusions

Conditional Assistance Programs provided by IFIs have the potential to help countries reform their economies. In order to be successful they need a domestic government that is convinced that reform is necessary, and is willing to design and implement its own program. The domestic political dynamic plays and important role in the reform process. If a reforming government faces the opposition of strong pro-status quo groups, reforms may be harder to implement. In this case the decision of the government needs to be supported by domestic interest group that clearly benefit from the reform. I have shown that given the appropriate conditions these groups will from, and their actions will improve aggregate welfare. A domestically designed conditional assistance program, the welfare improving actions of pro-reform lobbies, and their political contributions may result in successful reform. A reformed economy will have less distortions and the potential to grow at higher rates. The changes in relative prices that result from the reform process may also turn the country into an attractive target for foreign direct investors.

II. WELFARE EFFECTS OF TAXES IN A SMALL OPEN ECONOMY

II.I. Introduction

Conventional tax incidence analysis tells us that increases in taxes will lead to a decrease in welfare. This analysis usually starts from a Pareto-optimal, competitive equilibrium, and frequently only one distortion is introduced at a time. According to Dixit[10] this is not a realistic approach. "The problem is that in reality I never find an economy that is pristine except for the one problem in which I am interested." Usually many taxes, subsidies, and other distortionary restrictions are in place simultaneously. Dixit uses the example of international trade theory concerned with "the need to find the best policy to counter the distortions or constraints..." For example, if I start from an inefficient laissez-faire equilibrium because of some domestic distortion, a small trade tax or subsidy can yield a first-order welfare improvement, even if the instrument itself creates distortions of its own. This may result in "welfare paradoxes", namely taxes that improve long-run welfare rather than reduce it. The subject has been studied theoretically by Karayalcin (1995) in the context of a small economy open to international asset trade . He studies the effects of various capital income tax policies. He shows that welfare paradoxes may exist if increases in tax instruments improve welfare. The purpose of this chapter is to quantify the welfare effects of changes in tax rates in a small open economy. I conduct the simulation in the context of an intertemporal utility maximization framework. The paper applies numerical methods to the model developed by Karayalcin. I introduce changes in the tax rates and quantify both the impact on welfare, consumption and foreign assets, and the path to the new steady-state values. Section II lays out the

[10]Dixit, Avinash, Whither Greenwald-Stiglitz?, mimeo, Princeton University, 2003.

model, Section III shows the equilibrium of the model, Sections IV summarizes the theoretical results, Section V presents the calibration of the model, and Section VI concludes.

II.II The Model

I start with a small open economy populated by a constant number of identical and infinitely-lived households with perfect foresight. For the sake of simplicity I normalize the size of the households to one. This economy is also home of perfectly competitive firms that produce a single good that can be used either for consumption or investment. A detailed analysis of households and firms follows.

Households

Each household supplies exactly one unit of labor at a wage rate w_t per unit of time. They also receive interest income from their non-human wealth a_t. Interest income is defined as $r\left(1-\tau_r\right)a_t$, where *r* is the wold real rate of interest and τ_r is personal tax on interest income. I assume that the world interest rate is constant. Households have variable rates of time preference as in Epstein and Hayes (1983) and they maximize lifetime welfare *U* over the consumption path *C*. The maximization problem is:

(1) $$U\left(C =\right) - \int_0^\infty \exp\left(-z_t\right)\exp\left[-\left(1-r_\tau\right)rt\right]dt$$

subject to

(2) $$\dot{z}_t = u\left(c_t\right) - \left(1-\tau_r\right)r,$$

(3) $$\dot{a} = \left(1-\tau_r\right)r_t + w_t - c_t + \tau_t,$$

(4) $$z_0 = 0,$$

where $u\left(c\right) > 0$ is the felicity function with $u'\left(c\right) > 0,\ u''\left(c\right) < 0$, and τ_t is a lump-sum government transfer. I assume the government runs a balanced budget so that the lump-sum transfer is equal to the net tax revenue.

The lifetime welfare function *U* differs from the conventional time-additive utility functions because it is recursive. This implies that the marginal rate of substitution between times *t* and *s (s > t)* is independent of consumption before *t* but no after *s*. This gives rise to a variable rate of time preference Ω at time *s*:

(5) $$\Omega_s = \left\{\int_0^{\infty} \exp\left[-\int_s^t u\left(c\right)d\tau\right]dt\right\}^{-1}.$$

Ω at *s* is the following function of the utility function *U(C)*

(6) $$\Omega\left(\phi_s\right) = -\phi^{-1},\ \phi_s = U\left({}_sC\right),$$

where ${}_sC$ stands for that part of the consumption path *C* beyond time *s*, and ϕ_s denotes lifetime welfare at time *s*. When the consumption path is globally constant, as in long-run equilibrium, $U\left({}_sC\right) = -1 / u\left(c\right)$, and the rate of time preference is given by

(7) $$\Omega^*\left(\phi^*\right) = u\left(c^*\right),$$

where the stars indicate long-run equilibrium.

The assumption $u'\left(c\right) > 0$ implies that Ω is increasing in the consumption path *C*. This assumption is known as "increasing marginal impatience" (see Lucas and Stokey, 1984). There are several arguments in support of it. For us is sufficient to say that local stability would fail to obtain in the absence of that assumption.

The felicity function can be expressed as

(8) $$u\left(c_t\right) = \omega + \ln c_t,$$

where ω is a parameter measuring generalized time preference.

It can be shown that with equation (8) the solution to the lifetime welfare maximization problem yields

(9) $$\dot{c} = \left[\left(1 - \tau_r\right)r - \Omega\left(\phi\right)\right]c.$$

The equation of motion of lifetime welfare ϕ is obtained by differentiating (1) with respect to time:

(10) $$\dot{\phi} = 1 + u\left(c\right)\phi.$$

Firms

Firms in the model are perfect competitors that employ capital, *k*, and labor, *l*, to produce a single good using a constant returns to scale production technology. New investment is financed by issue of corporate bonds, b^c, and by retained earnings. Profits not used to finance investment, net of corporate income tax, are paid to shareholders as dividends. Firms deduct interest payments on outstanding debt as well as adjustment costs T associated with investment when determining taxable corporate profits. Total dividends before personal tax, π, are given by

(11) $$\pi \equiv \left[f\left(k\right) - w - rb^c - T\right]\left(1-\tau_c\right) + \dot{b}^c - \left(\left(1-\tau_l\right)i\right),$$

where τ_c is the corporate income tax and τ_l is the rate of investment credit. The function $f\left(k\right)$ is a constant returns to scale production function that satisfies the standard Inada conditions.

In the absence of uncertainty I cannot adequately account for the differences in the forms of financing. Therefore I assume that the representative firm finances a fraction ε of new investment from retained earnings, and a fraction $(1 - \varepsilon)$ of it issuing corporate bonds. Thus,

(12) $$b^c = \left(1-\varepsilon\right)k,\ \dot{b}^c = \left(1-\varepsilon\right)\dot{k}$$

Installing investment goods is costly. It takes $i\left[1+T\left(i/k\right)\right]$ units of output to increase the stock of capital by i units. The installation-cost function T has the following properties:

(13) $$T\left(0\right) = 0,\ T'\left(\bullet\right) > 0,\ 2T' + \left(i/k\right)T'' > 0,$$

Corporate bonds, b^c, foreign bonds, b^f, and equities are perfect substitutes in the portfolio of households. If E denotes the market value of outstanding equity then the arbitrage condition can be stated as:

(14) $$r\left(1-\tau_r\right) = \frac{\pi}{E} + \frac{\left(1-\tau_g\right)\dot{E}}{E}$$

where τ_g stands for the tax rate on accrued capital gains. This arbitrage condition must hold at all times. The term on the left hand side of (14) represents the after-tax return on foreign bonds, while the expression on the right hand side denotes the after-tax return on equity. This expression is the after-tax sum of current yield and capital gains. Using (11) and (12) in (14) and integrating, I obtains the market value of equity at time 0:

$$E = \int_0^\infty \theta_g^{-1} \pi \exp\left(-r\theta_r \theta_g^{-1} t \right) dt, \ \theta_j \equiv 1 - \tau_j, \ j = c, g, r. \tag{15}$$

The representative firm chooses the time path of investment by maximizing the market value of E subject to the constraint $i = k$. This yields

$$\dot{q} = \theta_r \theta_g^{-1} - \theta_c \theta_g^{-1} \left[f'\left(k\right) - r\left(1 - \varepsilon\right) - \left(\frac{i}{k}\right)^2 T'\left(\frac{i}{k}\right) \right], \tag{16}$$

$$q = \theta_g^{-1} \left\{ \left(\varepsilon - \tau_l \right) + \theta_c \left[T + \left(\frac{i}{k}\right) T'\left(\frac{i}{k}\right) \right] \right\}, \tag{17}$$

$$w = f\left(k\right) - f'\left(k\right) k, \tag{18}$$

where q denotes the shadow value of capital and can be easily shown to be equal to the stock market price of one unit of equity relative to the replacement cost of capital (that is to say, q of Tobin's Q). Substituting (17) into (16), this last equation is an arbitrage equation setting the after-tax rate of return on foreign bonds to the after-tax rate of return on equity. Equation (18) is the familiar condition that requires that the marginal productivity of labor be equal to the real wage rate. Equation (17) implies that the rate of investment, i/k, is the following function of q

$$\frac{i}{k} = \frac{\dot{k}}{k} = \varphi\left(q\right), \ \varphi'\left(q^*\right) > 0, \tag{19}$$

which states that the rate of investment is an increasing function of "Tobin's Q". The most prominent feature of (16) and (19) is that neither q nor investment depends on the consumption and savings decisions of households. Equations (16) and (19) constitute a system of two autonomous differential equations in q and k.

The current account

To obtain the dynamics of the current account I use equations (3), (11)-(19), $a = b^f + qk + b^e$, and recall the assumption of balanced government budget to obtain

(20) $$\dot{b}^f = rb^f + f(k) - i(1-T) - c,$$

The current account is equal to output plus interest earnings on foreign assets minus consumption and investment spending.

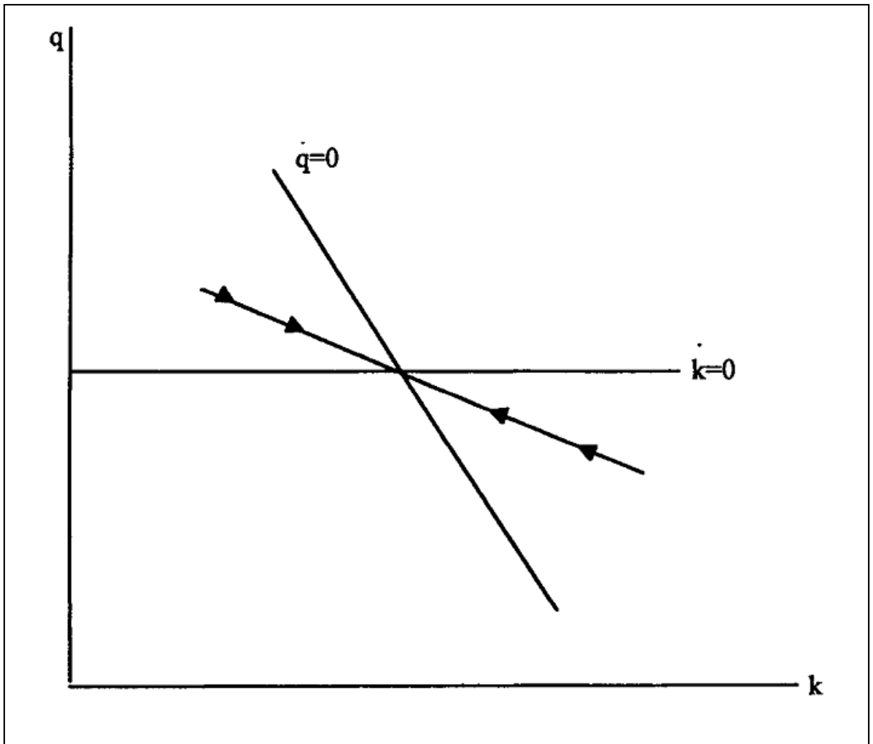


Figure II.1. The adjustment of q and k.

II.III. Equilibrium

The model has five differential equations: (9), (10), (16), (19) and (20). To obtain the steady-state value of $x = x\left(q, k, c, \phi, b\right)$ set these equations to zero. This yields

(21) $$q^* = \theta_g^{-1}\left(\varepsilon - \tau_l\right),\ q^* = \bar{q}\left(\tau_g, \tau_l\right),\ \bar{q}_1 > 0,\ \bar{q}_2 < 0,$$

(22) $$f'\left(k^*\right) = r\left[\left(1-\varepsilon\right) + \theta_r \theta_c^{-1} \theta_g^{-1}\left(\varepsilon - \tau_l\right)\right] = \tilde{r},\ \ k^* = \bar{k}\left(\tau_g, \tau_c, \tau_r, \tau_l\right),$$
$$\bar{k}_i < 0\ \ \left(l = 1,2\right),\ \ \bar{k}_j > 0\ \ \left(j = 3,4\right),$$

(23) $$rb^{f^*} + f\left(k^*\right) = c^*,\ \ \bar{b}\left(\tau_g, \tau_c, \tau_r, \tau_l\right),$$
$$\bar{b}_i > 0\ \ \left(i = 1,2\right),\ \ \bar{b}_j < 0\ \ \left(j = 3,4\right),$$

(24) $$u\left(c^*\right) = r\theta_r, c^* = \bar{c}\left(\tau_r\right),\ \ \bar{c}'\left(\tau_r\right) < 0,$$

(25) $$\phi^* = -\left(r\theta_r\right)^{-1},\ \ \phi^* = \bar{\phi}\left(\tau_r\right),\ \ \bar{\phi}' < 0,$$

I assume in (21) that $\varepsilon > \tau_l$ so that the equity price q is positive in the steady state. Equation (22) shows that capital income taxes and the investment tax credit drive a distortionary wedge between the marginal productivity of capital $f'(k)$ and the world real interest rate r. Whether this wedge causes the marginal productivity of capital to exceed the world interest rate or not depends on the values of the tax rates τ_g, τ_c, τ_r, and the investment tax credit τ_l:

(26) $$f'\left(k^*\right) \lesseqgtr r \Leftrightarrow \left\{1 - \frac{\tau_l}{\varepsilon} + \frac{\theta_c \theta_g}{\theta_r}\right\} \lesseqgtr 0$$

If income taxes are uniform $\left(\tau_g = \tau_r\right)$, the corporate tax rate is fully integrated $\left(\tau_c = 0\right)$, and there is no investment credit $\left(\tau_l = 0\right)$, it then follows form (22) that

$f'(k) = r$. In other words, income tax is neutral with regards to investment. Additionally, (17) indicates that in the absence of the investment credit and the tax on capital gains $q = \varepsilon$. Therefore, in this case, the market value of equity $E - qk = \varepsilon k$ equals the equity-financed portion of the accumulated investment of firms. However, actual tax systems do not generally have fully integrated corporation taxes, nor are the rates of investment tax credit set equal to zero. It is therefore useful to look at some representative tax rates for countries such as Canada, Sweden, and the Netherlands, which are generally considered to be small open economies, to have an understanding of the difference between $f'(k^*)$ and r as implied by the rates in (26). The effective average rates are roughly: $\tau_r = 0.45, \tau_c = 0.25, \tau_l = 0.10, \tau_g = 0.27$; in addition $\varepsilon = 0.75$. These values imply that $f'(k^*) < r$ for the economies in question.

Notice from equations (23)-(25) that the variable rate of time preference implies well-defined long-run levels of target utility, consumption and wealth.

At any point in time, given the parameters and steady-state level of $x = x(q, k, c, \phi, b)$ the five differential equations solve for *x*. Equation (18) determines the wage rate.

The dynamic system ((9), (10), (16), (19), (20)) possesses two negative (λ_1 and λ_2) and three positive eigenvalues, which (given the two predetermined variables *k* and b^f) render a stable saddle path. Its motion along the convergent saddle-path is characterized by

(27) $$k_t - k^* = (k_0 - k^*)\exp(\lambda_1 t),$$

(28) $$q_t - q^* = \left[\lambda_1 / k^* \varphi'\left(\bar{q}\right)\right]\left(k_t - k^*\right),$$

(29) $$c_t - c^* = \left(r - \lambda_2\right)\left[\left(b_0^f - b^{f*}\right) + \mu\left(k_0 - k^*\right)\right]\exp\left(\lambda_2 t\right),$$

(30) $$\phi_t - \phi^* = \beta\left(c_t - c^*\right),$$

(31) $$b_t^f - b^{f*} = -\mu\left(k_0 - k^*\right)\exp\left(\lambda_1 t\right) + \left[\left(b_0^f - b^{f*}\right) + \mu\left(k_0 - k^*\right)\right]\exp\left(\lambda_2 t\right),$$

where

$$\mu \equiv \left[f'\left(k^*\right) - \lambda_1\right]\left[r - \lambda_1\right]^{-1} > 0, \quad \beta \equiv \left[rc^* \theta_r \left(r\theta_r - \lambda_2\right)\right]^{-1} > 0.$$

In the perfect foresight, intertemporal-equilibrium framework adopted in this chapter the dynamics of the variables are determined by the long-run changes they go through. By this token, (27) indicates that along the convergent path the dynamics of investment are uniquely determined by its speed of adjustment and the long-run change in the domestic capital stock, while (31) shows that the dynamics of the current account depends on long-run changes in both foreign assets and the domestic capital stock, as well as the adjustment speed of both.

Straightforward manipulation of (27) and (31) yields

(32) $$\dot{k} = \lambda_1\left(k_t - k^*\right),$$

(33) $$\dot{b}^f = \mu\left(\lambda_2 - \lambda_1\right)\left(k_t - k^*\right) - \lambda_2\left(b_t^f - b^{f*}\right).$$

It follows from (32) and (33) that if $\lambda_1 < \lambda_2$ the capital stock, *k*, will adjust faster than the foreign assets holdings, b^f. In other words, the current account will be more persistent than domestic investment. This, however, contradicts the findings of recent studies. Consequently, I will concentrate on the case $\lambda_1 > \lambda_2$.

Further, since $\beta > 0$, (29) and (30) indicate that consumption c and lifetime welfare ϕ always rise and fall together along the convergent path shown in Figure II.2.

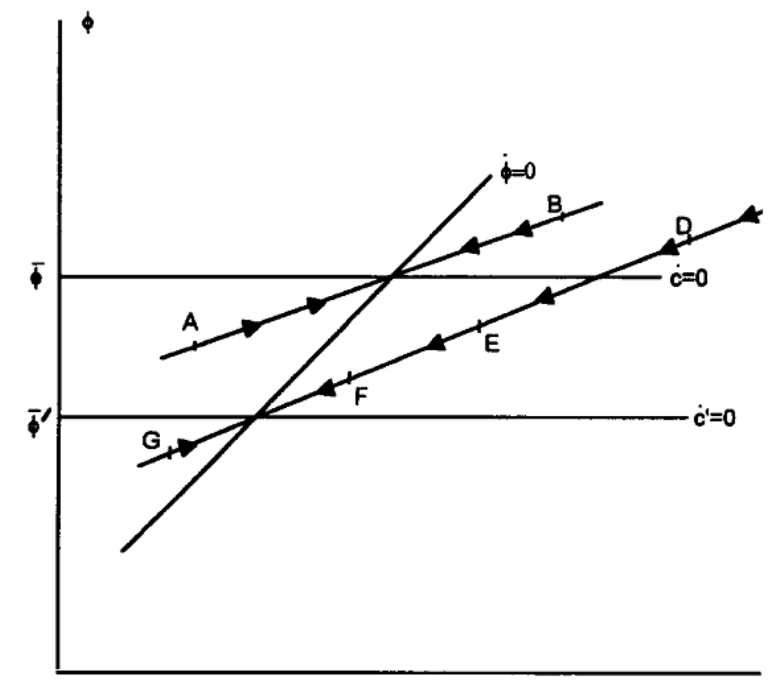


Figure II.2. The adjustment of consumption and lifetime welfare.

II.IV. The effects of taxation

I now need to put the model to work to assess the effects of changes in the tax rates. First I will briefly present the expected results from the theoretical model. Later, in Section V, I will calibrate the model to evaluate the effects of changes in tax instruments on welfare. I start analyzing the effects of changes in the investment tax credit τ_I, in the tax rates on capital gains τ_g, and on corporate income τ_c. They are treated jointly because changes in these rates do not affect the long-run target utility of households (equation (24)), and, therefore, do not have any effects on the long-run level of consumption.

Let us start by analyzing the effects of an unanticipated permanent increase in the corporation tax rate $\left(\tau_c\right)$. On impact this reduces dividends and the rate of return on equity. The consequent incipient excess stock demand for foreign assets leads to an immediate drop in the price of equity *q* (and to expectations of capital gains), which starts a process of capital decumulation. The process continues until the decline in the capital stock pushes the marginal productivity of capital and the dividends up sufficiently enough so that, in the absence of expectations of capital gains on it, the rate of return on equity equals the rate of return on foreign bonds.

Likewise, an unanticipated permanent increase in the tax rate on capital gains $\left(\tau_g\right)$ reduces the long-run stock of capital. This raises the steady-state marginal productivity of capital and dividends, therefore the long run equity price *q* must also rise to ensure the equality of assets yields. The short-run adjustment of the forward looking equity-price *q* is driven by the long-run changes in *k* and *q*. This puts opposing pressures on *q* and as a consequence the impact effect of the increase in τ_g on *q* is ambiguous. However, regardless of whether it drops or jumps on impact, along the convergent path, *q* will rise towards its higher steady-state level (equation (28)).

On the contrary, an unanticipated permanent increase in the investment tax credit τ_I also increases the long-run stock of capital by reducing the effect of the replacement cost of capital. The resulting decrease in the marginal productivity of capital and dividends requires a long-run fall in q to raise the rate of return on equity and to ensure the equality of assets yields. As in the case of the rise in τ_g, the opposing pressures these long-run changes have on q may result in a drop or jump of the equity price on impact. However, q unambiguously falls in the medium-run along the adjustment path.

To see the consequences of these policies on consumption and lifetime welfare I use (22) and (23) in (29) and (30) and set $t = 0$ to obtain

(34) $$\phi_0 - \phi^* = \beta\left(c_0 - c^*\right),$$

(35) $$c_0 - c^* = \left(-\lambda_1\right)\left(r - \lambda_2\right)\left(r - \lambda_1\right)^{-1}\bar{k}_j\left[f'\left(k^*\right) - r\right], \quad j = 1,2,4,$$

which show the changes in consumption and lifetime welfare on impact. It is important to remember that the long-run levels of c and ϕ remain the same. Note that ϕ_0 is the present discounted value of the future felicity stream at time $t = 0$ and ϕ^* is unaffected by these policies. Therefore the sign of $\phi_0 - \phi^*$ directly measures the welfare effects of the policies under consideration. Additionally, since $\beta > 0$, the sign of $\phi_0 - \phi^*$ is the same as the sign of $c_0 - c^*$.

To understand the changes in consumption c on impact recall that households try to attain the target utility level $u(c^*)$, which is not affected by the two policies under consideration. The implication is that the long-run level of consumption and the level of wealth and income required to support it also remain constant. Faced with these policies, foreward-looking households choose transition paths that allow them to attain the original target utility level.

I will now consider the effects of the increase of the tax rate on corporate income τ_c. This decreases the economy's capital stock (22) and GDP. To attain the original level of utility households must increase their long-run holdings of foreign assets (23). On impact, the long-run decrease in the domestic capital stock makes a short-run consumption binge possible. But the required long-run increase in the foreign assets holdings demands an immediate increase in savings and a drop in consumption on impact. If the long-run effect of the decrease in the stock of capital is such that $f'(k^*) > 0$ holds, then consumption must drop on impact which implies that $c_0 - c^* < 0$ in equation (35). Consumption is at point A in Figure II.2. In the opposite case c will jump on impact to point B in Figure II.2. Welfare (ϕ) follows consumption (c_0), so if consumption jumps on impact lifetime welfare will jump too. There is an alternative and useful way of looking at this result. As I showed, the direction of the change in lifetime welfare do to a change in τ_c depends on the sign of $f'(k^*) - r$. I know that the difference between the marginal productivity of capital and the world real interest rate is caused by the presence of distortionary taxes. If $f'(k^*) > r$ initially, the fall in the stock of capital caused by the increase in τ_c will accentuate the distortion and reduce lifetime welfare by increasing the marginal productivity of domestic capital. On the other hand, if $f'(k^*) < r$ initially, the same policy will reduce the distortion and increase lifetime welfare.

The increase in τ_g has similar long-run effect on the domestic stock of capital and the foreign assets holdings (22), (23) as the increase in τ_c, therefore it will have similar consequences for consumption and lifetime welfare for the same reason.

The increase in the investment tax credit $\left(\tau_l\right)$ has the opposite consequences for k^* and b^{f*}: it increases the long-run domestic stock of capital and reduces the long-run foreign asset holdings (22), (23). Thus, if initially $f'\left(k^*\right) > r$, the increase in τ_l will decrease the marginal productivity of domestic capital, reduce the distortion, and rise lifetime welfare. However, given the tax rates I have considered, I will have $f'\left(k^*\right) < r$, and a reduction in lifetime welfare will seem more plausible.

I now analyze the effects of an increase in the tax rate on personal interest income $\left(\tau_r\right)$. Unlike the former policies this one changes the long-run target level of utility. An anticipated permanent increase in τ_r reduces the rate of return on foreign bonds. On impact, this creates an incipient excess stock demand for equity, which is eliminated by an immediate jump in the price q of equity that lowers the yield on it. The subsequent rise in investment in the medium run will increase the domestic stock of capital, and decrease its marginal productivity until the equity price q and the rate of investment return to their initial levels in the long-run.

It is also worth noting that, given the increase in the domestic stock of capital and the decrease in their long-run target utility level, the rise in τ_r will lead forward-looking households to decrease their foreign asset holdings (23) across steady-states.

Finally I briefly discuss the motion of the current account along the convergent path. Since the underlying logic is basically the same as in all the exercises presented above, I will focus on the effects of an increase in the tax rate on capital gains $\left(\tau_g\right)$. Although the foreign asset holdings of households rise in the long run, initially the economy runs a current account deficit. To see why, consider the following. On impact, the drop in the equity price *q* leads to an immediate decrease in investment, which by itself would give rise to a current account surplus. However, I also saw that consumption *c* may jump or drop on impact. If *c* jumps sufficiently enough to outweigh the drop in investment, domestic absorption may in fact initially rise, causing a current account deficit. As the economy increases its long-run holdings of foreign assets, it must, however, run a current account surplus later. This implies a non-monotonic adjustment of the current account. On the other hand, if *c* drops on impact, or if the jump in *c* is outweighed by initial domestic capital decumulation, the economy will run a current account surplus on impact, and will adjust monotonically.

II.V. Calibration of the Model

With the theoretical model in place, I proceeded to numerically calibrate it. Table II.1 summarizes the information about the starting values of the main variables.

τ_r	τ_c	τ_g	τ_l	r
0.45	0.25	0.27	0.10	0.06
$\theta_r = (1-\tau_r)$	$\theta_c = (1-\tau_c)$	$\theta_g = (1-\tau_g)$	ε	ω
0.55	0.75	0.73	0.75	-0.59

Table II.1

To estimate *GDP* I use a *CES* production function of the form

$$f(k,l) = A\left[\delta k^{-\rho} + (1-\delta)l^{-\rho}\right]^{-\frac{1}{\rho}}$$

where the values of the parameters are: $A = 1.10746$; $\delta = 0.4$ and $\rho = 0.5$. The size of the labor force l is normalized to one. The value of A comes from equation (22), $f'(k^*) = \tilde{r}$, and δ, ρ, and r are calibrated to fit stylized facts and to deliver a meaningful steady state.

With the starting values and the equilibrium equations stated in (21)-(25) I obtain the following steady-state value of $x^* = x^*(q^*,k^*,c^*,\phi^*,b^{f*})$

q^*	k^*	c^*	ϕ^*	b^{f*}
0.89411	7.24145	1.86451	-30.303	-1.85744

Table II.2

In order to calculate the saddle-path equilibrium I start with the system of equations (9), (10), (16), (19), and (20). Once linearized, the system yields the following result:

$$\dot{x} = M\left(x - \bar{x}\right) \tag{36}$$

where

$$M = \begin{bmatrix} r\theta_r\theta_g^{-1} & -\theta_c\theta_g^{-1}f''\left(k^*\right) & 0 & 0 & 0 \\ k\varphi'\left(q\right) & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -c\left(r\theta_r\right)^2 & 0 \\ 0 & 0 & -\left(rc\theta_r\right)^{-1} & r\theta_r & 0 \\ -k\varphi'\left(q\right) & f'\left(k\right) & -1 & 0 & r \end{bmatrix}$$

and $x = x(q,k,c,\phi,b^f)$. From M I can calculate the eigenvalues of the system. There are three positive and two negative values. The negative eigenvalues are:

$$\lambda_1 = \left(\frac{1}{2}\right)\left\{r\theta_r\theta_g^{-1} - \sqrt{\left(r\theta_r\theta_g^{-1}\right)^2 - 4f''\left(k\right)k\varphi'\left(q\right)\theta_c\theta_g^{-1}}\right\} \tag{37}$$

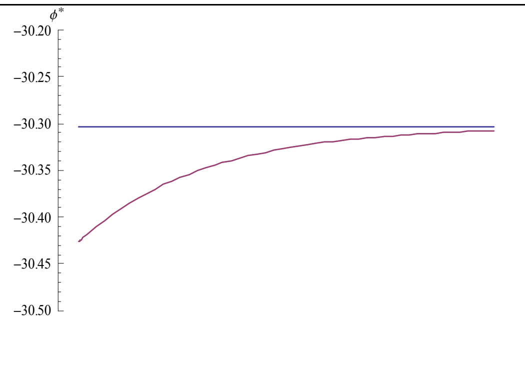
$$\lambda_2 = \left(\frac{1}{2}\right)\left\{r\theta_r - \sqrt{\left(r\theta_r\right)^2 + 4r\theta_r}\right\}$$

The values of the negatives eigenvalues corresponding to x^* are respectibly $\lambda_1 = -1.78214$ and $\lambda_2 = -0.165907$

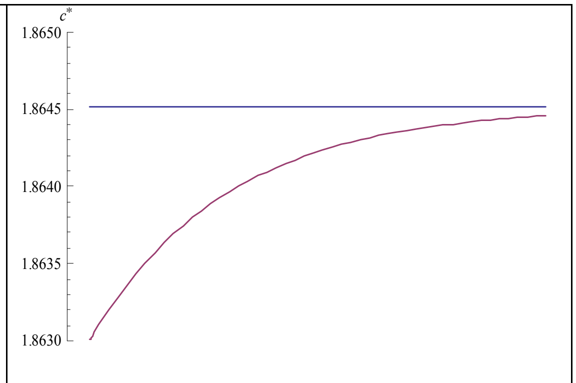
II.V.1. The impact of changes on tax rates on welfare

Now I investigate the effect that changes in different taxes have on welfare. I consider both the change on impact and the new steady-state values

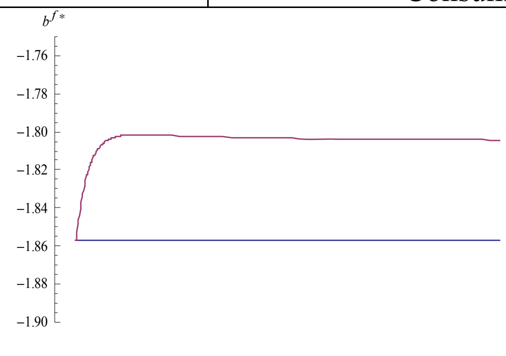
II.V.1.1 Increase in corporate tax rate



Welfare



Consumption

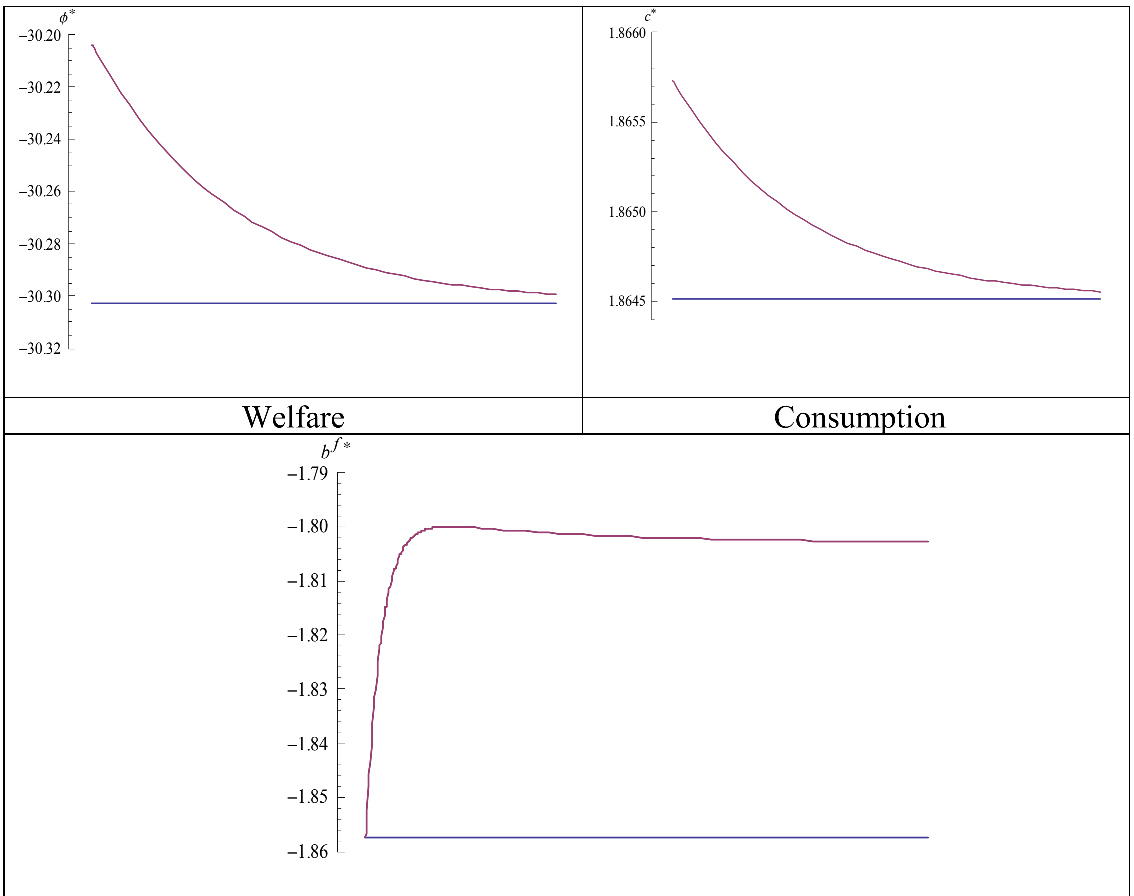


Foreign Assets

I now consider the effects of an increase in the tax rate on corporate income (τ_c). Whether the rise in τ_c increases lifetime welfare or not depends on the sign of $f'(k^*) - r$. Recall that the difference between the marginal productivity of capital and the world real interest rate is caused by the presence of distortionary taxes. If initially $f'(k^*) > r$, the fall in the stock of capital caused by the rise in τ_c will accentuate the distortion and reduce lifetime welfare. On the other hand, if $f'(k^*) < r$ initially the same policy will reduce the distortion and increase lifetime welfare. The results of the experiment do not exactly match the predictions of the theory. Consumption and welfare do jump on impact in response to an increase of one percentage point in the tax (0.064%

and 0.32% respectivly), but since the long-run level of consumption required to support the target utility level $u(c^*)$ is not affected by this tax policy, eventually both consumption and welfare drift towards theirs initial values. Foreign assests on the other hand improve by 2.85%.

II.V.1.2. Increase in the rate on accrued capital gains

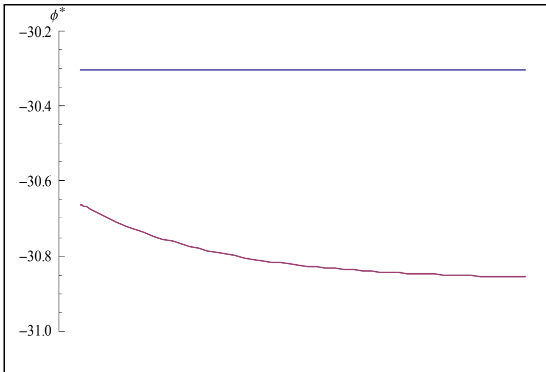


Welfare | Consumption

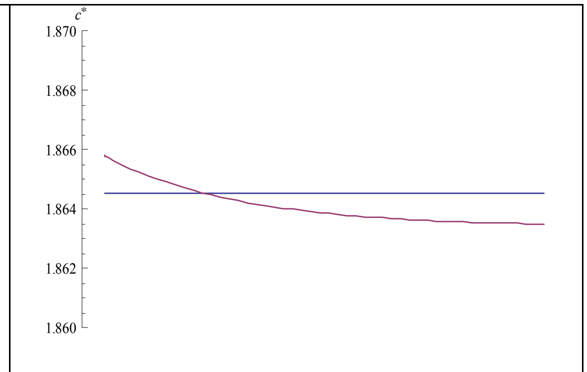
Foreign Assets

An increase in τ_g has similar long-run effects on the domestic stock of capital and the foreign assets holdings ((22) and (23)) as an increase in τ_c. Therefore it will have similar effects on consumption and lifetime welfare for the same reasons. Welfare jumps on impact 0.33% do to an increase of one percentage point in the tax policy rate. Consumption also jumps on impact, but only 0.065%. However both return to the initial steady-state level as the tax under consideration does not affect the long-run target utility level and welfare. Foreign assets find a new steady-state 2.93% above the original level.

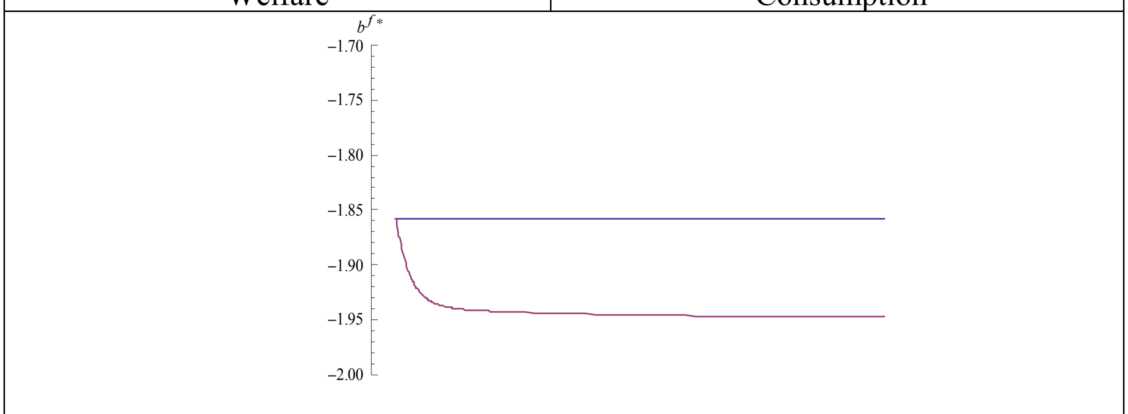
II.V.1.3. Increase in personal income tax rate



Welfare



Consumption



Foreign Assets

The theoretical model tells us that an increase in the tax rate on personal interest income $\left(\tau_r\right)$ changes the long-run target level of utility. With the increase in τ_r households' long-run utility target falls and consequently they have to reduce their long-run consumption. To see the effect of this policy on households' lifetime consumption and welfare I can rewrite equations (34) and (35) incorporating the long-run changes in c and ϕ:

$$(38) \qquad c_0^+ - c_0^- = (-\lambda_1)(r-\lambda_2)(r-\lambda_1)^{-1}\bar{k}3\left[f'(k^*) - r\right] - \lambda_2 c^*,$$

$$(39) \qquad \phi_0^+ - \phi_0^- = \beta\left\{(-\lambda_1)(r-\lambda_2)(r-\lambda_1)^{-1}\bar{k}3\left[f'(k^*) - r\right] + (r-\lambda_2)c^*\right\}$$

$$-\left(\theta_r^n\theta_r\right)^{-1}\left(\tau_r^n - \tau_r\right),$$

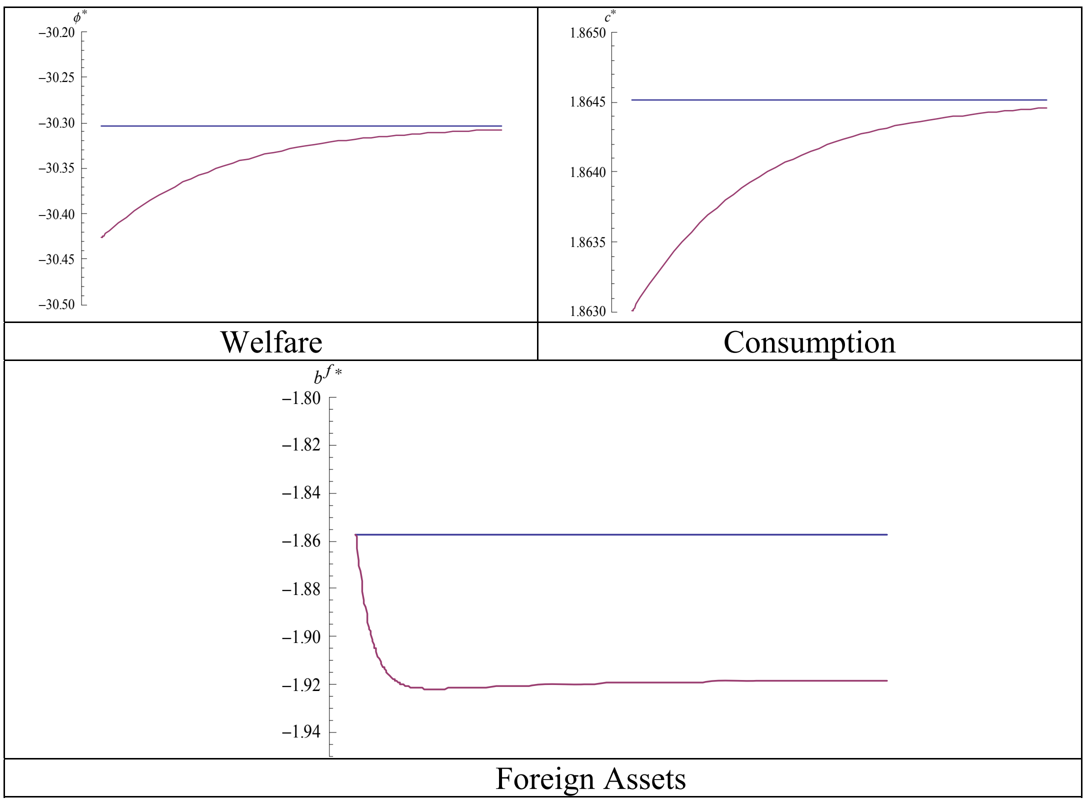
where superscripts (-) and (+) refer to the values of the variables before and after the discrete change on impact and superscript *n* denotes the new levels of τ_r and θ_r. Equation (38) tells us that if initially the marginal productivity of capital exceeds the world real interest rate (*r*), consumption will jump on impact. However I cannot infer from the jump that lifetime welfare increases. The reason is that although an initial jump in *c* increases welfare, consumption decreases across steady-states and as a consequence the new long-run level of welfare must be lower. Still, as equation (38) indicates, $f'(k^*) > r$ is a necessary but not sufficient condition for welfare to improve. For small changes in the tax rate, the reduction in the distortion implied by an initial $f'(k^*) > r$ and the rise in the capital stock will raise lifetime welfare. In the empirically more plausible case, consumption and lifetime welfare may drop on impact.

The results of the simulation broadly coincide with what the theory predicts. Nevertheless there are some paradoxes. Although I have $f'(k^*) < r$ before and after[11] the increase in τ_r, consumption jumps 0.07% on impact in response to an increase of one

[11]The values of $f'(k^*)$ before and after are respectively 0.054 and 0.053.

percentage point in the tax rate. Eventually the new long-run level of consumption drifts towards a value below the initial steady-state by 0.06%. Welfare on the other hand drops on impact 1.19% and continues to decrease until it reaches its new steady-state level, 1.85% below the initial one. Foreign assests do not jump or drop on impact. They drift to a new steady-state value, 4.87% below the initial one.

II.V.1.4. Increase in the rate of investment credit



I now consider the effects of an increase in the investment tax credit τ_l. I can apply the same logic as in the case of an increase in τ_c, only this time the effects are reversed. Whether the rise in τ_l increases lifetime welfare or not also depends on the sign of $f'(k^*) - r$. As I mentioned before, the difference between the marginal productivity of capital and the world real interest rate is caused by the presence of distortionary taxes. If initially $f'(k^*) > r$, the increase in the stock of capital caused by the rise in τ_l will reduce the distortion and increase lifetime welfare. On the other hand, if $f'(k^*) < r$ initially, the same policy will increase the distortion and decrease lifetime welfare. The numerical values of our exercise tell us that our case is the latter. Consumption and welfare drop on impact by 0.08% and 0.41% respectively. They increase afterwards and eventually reach theirs original steady-state level. Foreign assets find a new steady-state level 3.27% below the original one.

II.VI. Conclusions

I presented a model of a small open economy where households have endogenous time preferences and investment is subject to adjustment costs. I used the theoretical model to predict the effects of changes in various tax rates considered. Later I calibrated the model selecting a set of plausible values for the variables and running numerical simulation to estimate the effects of different tax policies. The quantitative results generally coincide with the prediction of the theory. These results are affected by differences between the marginal productivity of capital and the world real interest rate. Depending on the sign of the difference between the two, increase in taxes may lead to decreases or increase in lifetime welfare, giving way to welfare paradoxes. This results stem from the fact that the economy is distorted by the presence of taxes. Increases in taxes may sometimes counteract some of those distortions resulting in a welfare increase instead of the expected decrease. Hence the welfare paradox.

III. STOCK MARKETS, ADJUSTMENT COSTS AND THE INTERNATIONAL TRANSMISSION OF SHOCKS. A CALIBRATION EXERCISE.

III.I. Introduction

In an integrated world economy with capital mobility disturbances that originate in one country are rapidly transmitted to other countries. The model presented in this chapter describes a two-country model in an integrated world economy. Each country has infinitely lived households that maximize lifetime welfare, and competitive, profit maximizing firms that choose investment subject to adjustment costs. Equities issued by firms in both countries are perfect substitutes in the portfolio of households. In the chapter I will assess numerically the role of stock markets in the transmission of supply shocks. I will also focus on the long run determinants of external indebtedness, the dynamics of capital accumulation, equity prices and the current account.

It is interesting to analyze the transmission of a positive supply shock that originates in either of the countries under consideration. On impact, the shock leads to an immediate stock market boom in the country where the shock takes place[12]. The stock market of the other country suffers the opposite effects: there is a decline in the demand for equities and as a consequence prices fall. This triggers a process of capital decumulation over time. But as the stock of capital declines, its productivity increases leading to an appreciation of the price of its equity. Once the price is above the unitary replacement cost of capital, a period of capital accumulation ensues. The resulting steady-state level of capital and output is identical to the one before the shock. The adjustment of

[12] For example: a technological breakthrough that improves overall productivity in the country where the shock takes place.

the capital stock in this country therefore is non-monotonic. In the economy that initially experiences the positive technological shock the continuous accumulation of capital lowers its productivity and the price of equities along the adjustment path. But because of the technological improvement this economy reaches a new steady state with higher capital stock and output level. Moreover, as the increase in productivity renders the equities issued by local firms relatively more attractive, holdings of foreign equities decline monotonically.

The adjustment path described above differs from the one that would result from a model without adjustment costs. In that type of model it would be possible to transfer capital instantaneously on impact from the low productivity economy to the high productivity one. Capital accumulation would show a monotonical behavior and stock markets and asset prices would play no role in the international transmission of the shock.

In the absence of adjustment costs, capital stocks adjust faster than the current account. On the other hand, when there are adjustments costs, investment and the current account adjust at the same speed.

The chapter is organized as follows. Section II describes the theoretical model. Section III studies the international transmission of supply shocks for different sets of parameters. Section VI contains summary and conclusions.

III.II. The Model

The integrated world economy consists of two large countries known as “home” and “foreign”. Both countries have the same number of infinitely lived households. The number is constant and normalized to one. Firms in each country produced the same good that can be used for production or consumption. The price of the good serves as the numeraire.

Households

Infinitely lived households with perfect foresight consume, save and supply one unit of labor inelastically per unit of time. Saving is the accumulation or decumulation of equities issued by home and foreign firms. Equities issued by firms in both countries are perfect substitutes in the portfolio of households. They yield a common rate of return ρ. Home and foreign households have the same and constant rate of time preference,

(1) $$\Omega = \Omega^*.$$

The asterisks indicate the foreign country.

The nonhuman wealth, $a^{(*)}$, of any household is given by

(2) $$a \equiv qk + q^* b, \qquad a^* \equiv q^* k^* - q^* b,$$

where q and q^* represent the price of an ownership claim on physical capital stocks k and k^*, and b represents ownership claims of non-domestic capital. For the sake of simplicity the analysis will be restricted to those parameter configurations that render the home country as the net creditor in the initial and final steady state.

Households, both home and foreign, take the rate of return on equity ρ, and the wage rate, w, as given and maximize lifetime welfare $U(C)$ over the consumption path C:

(3) $$\max U(C) = \int_0^\infty u(c)\exp(-\Omega dt)$$

subject to

$$\dot{a}(t) = \rho(t)a(t) + w(t) - c(t) \tag{4}$$

where c is consumption and u is the instantaneous utility function with $u > 0, u' > 0$ and $u'' < 0$. It is convenient to adopt a specific form for the instantaneous utility function, namely the logarithmic form,

$$u\left[c(t)\right] = \ln\left[c(t)\right]. \tag{5}$$

The solution of the lifetime welfare maximization problem (3)-(5) of the home household is, in addition to (4),

$$\dot{c} = (\rho - \Omega)c \tag{6}$$

as the law of motion of consumption, c, of home households.

The dynamic behavior of foreign households' wealth, consumption and lifetime utility along an optimal path are described by the following conditions:

$$\dot{a}^* = \rho^* a^* + w^* - c^* \tag{7}$$

$$\dot{c}^* = (\rho^* - \Omega^*)c^* \tag{8}$$

Firms

Firms that are identical and competitive use capital and labor to produce the single good in both countries. For the sake of simplicity the depreciation rate is set equal to zero. When firms adjust capital stocks there are internal costs. Suppose it takes home firms $i\left[1 + T(i/k)\right]$ units of output to accumulate capital, k, by i units. T denotes the installation technology. Assuming that the installation cost function is linearly homogeneous in *i* and *k*, and satisfies

$$(9) \qquad T = T(i/k), \quad T(0) = 0, \qquad T'(.) > 0, \qquad 2T'(.) + (i/k)T''(.) > 0,$$

then maximization of the present value of the firm's cash flow $\delta g(k) - i(1+T)$ [13] implies setting the shadow value of *q* of investment equal to 1 plus the marginal cost of investment. The same concept translated into a function gives,

$$(10) \qquad q = 1 + \left[T(.) + (i/k)T'(.)\right].$$

This implies that the rate of growth of the *per capita* capital stock. *i/k*, is positively related to the Tobin's *q* – the excess of equity price over the unitary replacement cost of capital.

$$(11) \qquad \frac{i}{k} = \frac{\dot{k}}{k} = \phi(q), \qquad \phi'(q) > 0, \qquad \phi(1) = 0,$$

where the last equality indicates that when $q = 1$ investment is zero[14].

In addition to (10), present-value maximization by firms yields

$$(12) \qquad w = \delta\left[g(k) - g'(k)k\right].$$

If the only technological difference between countries is captured by the productivity terms, δ and δ^*, the foreign equivalents of (11) and (12) are given by

$$(13) \qquad \frac{i^*}{k^*} = \frac{\dot{k}^*}{k^*} = \phi(k), \qquad \phi'(q^*) > 0, \qquad \phi^*(1) = 0,$$

[13] $\delta g(k)$ stands for *per capita* home output, with $g'(k) > 0$ and $g''(k) < 0$.

[14] When $q = 1$ the shadow value of capital equals the unitary replacement cost of physical capital.

(14) $$w^* = \delta^*\left[g\left(k^*\right) - g'\left(k^*\right)k^*\right],$$

where it is assumed that the installation technology $T(.)$ is the same in both countries.

Markets and prices

Three markets are of interest for our analysis: the world stock market, the world capital market, and the world output market.

The world stock market makes sure that at any point in time households are satisfied with the *stock* composition of their portfolios. This requires that the expected rate of return on home and foreign equities, ρ and ρ^*, be the same at all times. This implies

(15) $$\rho^* \equiv \left[\left(\pi^* + q^* i^*\right)/q^* k^*\right] + \dot{q}^*/q^* = \left[\left(\pi + qi\right)/qk\right] + \dot{q}/q \equiv \rho,$$

where the terms in square brackets denote an equity's current yield, and $\dot{q}/q$ and $\dot{q}^*/q^*$ represent expected and actual capital gains (perfect foresight is assumed). The current yield terms follow from the assumption that total current payout by home firms (or foreign firms) to equity-holders has two components: cash dividends and the value of equity dividends. Cash dividends, denoted (in the case of home firms) by $\pi \equiv \delta g\left(k\right) - i\left(1+T\right) - w$, reflect the assumption that firms finance investment exclusively by retained earnings. Equity dividends are denoted by qi.

It helps to rewrite (15) in the following slightly different form, i.e.,

(16) $$\theta = (\theta / q)\left[(\pi + qi)/k - (\pi^* + \theta q i^*)/\theta k^*\right],$$

$$\theta \equiv q^*/q,$$

where θ is the relative equity price.

For the world output market to clear it is required that the world supply of output, $\delta g(k) + \delta^* g(k^*)$, be equal to the sum of the world consumption demand, $c + c^*$, and world investment demand, $i(1+T) + i^*(1+T^*)$

(17) $$\delta g(k) + \delta^* g(k^*) = c + c^* + i(1+T) + i^*(1+T^*).$$

This can be solved for *q:*

(18) $$q = q(k, k^*, \theta, c, c^*, \delta, \delta^*), \quad q_i > 0 \ (i = 1,2,6,7), \quad q_j < 0 \ (j = 3,4,5).$$

Ceteris paribus, increases in k^*, δ^* and decreases in θ (because it reduces q^* and, therefore, foreign investment) and c^* create an excess world supply of output. This is eliminated by a fall in the price of current output relative to current home capital stock, $1/q$.

The analysis of world capital market equilibrium will help determine the rate at which home households accumulate foreign equity. This is the market in which *flows* of equity of uniform yield are traded, using current output as a means of payment. For the world capital market to be in equilibrium, net world household saving must be equal to zero. It follows from (2), (4) and (15) that world capital market equilibrium requires

(19) $$\dot{b} = (q^*)^{-1}\left[\delta g(k) - i(1+T) + (\pi^* + q^* i^*)(b/k^*) - c\right].$$

This completes the description of the dynamic system. Using (18) in (6), (8) and (15) solves for the point-in-time real interest rate of the economy,

$$\rho = \rho\left(k, k^*; \delta, \delta^*\right), \qquad \rho_1 = \rho_2 < 0, \quad \rho_i > 0 \qquad \left(i = 3, 4\right). \tag{20}$$

The intuition underlying the partial derivatives is the following. *Ceteris paribus,* a rise in k, or k^*, creates a world excess supply of output, which is eliminated by a decrease in the price of current output relative to future output, ρ. Increases in productivity, that is in δ or δ^*, raise profits and thus the rate of return on equity, ρ.

Equilibrium and dynamic adjustment

The evolution of the economy over time is described by the differential equations (6), (8), (11), (13), (16) and (19) in conjunction with equations (18) and (20). This system can be simplified first by noting that (6) and (8) yield $\dot{c}/c = \dot{c}^*/c^* = \rho - \Omega$, from which it immediately follows that

$$c^* = \bar{\mu} c. \tag{21}$$

That is, the foreign consumption level is proportional to the home level, where the proportionality factor $\bar{\mu}$ remains constant along optimal paths being determined by steady-state conditions.

Second, observe from (6), (11), (13) and (16) that they form a dynamic subsystem independent of (19). Using standard methods on this subsystem yields the following solution for the dynamics of the two capital stocks k and k^*:

(22) $$\dot{k} = \frac{1}{2}\left[k(t) - \bar{k}\right](\gamma_1 + \gamma_2) + \frac{1}{2}\left[k^*(t) - \bar{k}^*\right](\gamma_1 - \gamma_2)$$

(23) $$\dot{k}^* = \frac{1}{2}\left[k(t) - \bar{k}\right](\gamma_1 - \gamma_2) + \frac{1}{2}\left[k^*(t) - \bar{k}^*\right](\gamma_1 + \gamma_2),$$

where $\gamma_1 > \gamma_2$.

To determine the adjustment of net foreign assets along the optimal path, I now linearize (19) using (18), (22), (23) and the conventional intertemporal solvency condition $\lim_{t\to\infty} b\exp(-\rho t) = 0$ to obtain

(24) $$b(t) - \bar{b} = \frac{1}{2}\beta\left[k(t) - \bar{k}\right] - \frac{1}{2}\left[k^*(t) - \bar{k}^*\right]\beta^*$$

and

(24') $$b(0) - \bar{b} = \frac{1}{2}\beta(0)\left[k(0) - \bar{k}\right] - \frac{1}{2}\left[k^*(0) - \bar{k}^*\right]\beta^*(0),$$

where

$$\beta \equiv -\gamma_2 / (\gamma_2 - \Omega)\exp(\gamma_2 t) - \alpha / (\gamma_1 - \Omega)\exp(\gamma_1 t),$$

$$\beta^* \equiv -\gamma_2 / (\gamma_2 - \Omega)\exp(\gamma_2 t) + \alpha / (\gamma_1 - \Omega)\exp(\gamma_1 t),$$

$$\alpha \equiv -\Omega\left[2g(k) - \bar{b}(\Omega - \gamma_1)\right] / 2g(k).$$

Along an optimal path, β and β^* measure the effects of changes in the home capital stock k and the foreign capital stock k^* on the net foreign asset holdings b. To see the implications of expression β, for instance, note the following. The term $-\gamma_2 > 0$ describes the effect, *ceteris paribus,* of an increase in k on the current account through changes in the relative asset price θ. A rise in the home capital stock reduces its marginal productivity, driving the relative price of foreign equity θ up. This raises the current yield on foreign equity and results in an increasing current account balance if the home country is a net creditor, as I have assumed. The term $-\alpha$ describes the effect of an increase in k on the current account, with θ being held constant. This operates through two channels. First, the rise in k increases home output and thus the current account. Second, it pushes up home consumption c and lowers the rate of interest ρ and the current account. For realistic values of output and the net foreign assets, the term α is seen to be negative.

I now turn to the characterization of the steady state. First, observe from (11), (13) and the definition of θ that in the steady state

$$\bar{q} = \bar{q}^* = \bar{\theta} = 1. \tag{25}$$

Using the definitions of π and π^*, and setting (6), (8), (22) and (25) equal to zero, yields

$$\Omega = \bar{\rho} = \delta g'\left(\bar{k}\right) = \delta^* g'\left(\bar{k}^*\right). \tag{26}$$

At the steady state, the world real rate of interest coincides with the marginal productivity of capital in the two countries and the common pure rate of time preference Ω. The capital stocks in each country are determined only by their respective technologies and the rate of time preference.

The steady-state levels of the other variables are then determined by

(27a) $$\delta g\left(\bar{k}\right)+\delta^{*}g\left(\bar{k}^{*}\right)=\bar{c}+\bar{c}^{*}$$

(27b) $$\Omega\bar{b}=\bar{c}-\delta g\left(\bar{k}\right)=\delta^{*}g\left(\bar{k}^{*}\right)-\bar{c}^{*}$$

and (24'). The two national capital stocks being determined by (26), the world output market equilibrium condition (27a) determines steady-state world consumption, $\bar{c}+\bar{c}^{*}$. Equation (24') then yields the steady-state net foreign asset holdings, $\bar{b}$ which depends on the initial stocks of *k, k** and *b.* This well-known result is due to the integration of the capital markets of the home and foreign countries, the households of which possess identical pure rates of time preference. One important consequence of this is that the adjustment of the world economy is hysteretic: temporary shocks will have permanent effects. Turning to the determination of the steady-state levels of *c* and c*, I find from (27b) that these equal domestic output plus net interest income from holdings of nondomestic equities. The ratio of $\bar{c}^{*}$ to $\bar{c}$ yields $\bar{\mu}$.

III.III. A Supply Shock

Suppose now that initially the world economy is in steady-state equilibrium with $\delta = \delta^{*}$. The question I wish to answer is how does the integrated world economy adjusts in response to an unanticipated, permanent, positive supply shock at $t = 0$ that increases δ.

Across steady states, given *k* and *k*,* the rise in the productivity of home capital creates an excess stock demand for home equity, the elimination of which requires an increase in the home capital stock. Since foreign productivity remains unchanged, so does the foreign capital stock. The increase in world output enables the world economy to raise its consumption, $c + c^*$. One can also show that both c and c^* rise; i.e. the benefits of the home productivity shock are shared with the foreign country. Finally, net foreign asset holdings of home households decrease across steady states (Figure A.III.3). Intuitively, this conclusion follows from the increased productivity of the home capital stock which makes equities issued by home firms more attractive relative to those of foreign firms, and which thus directs world savings to the home country.

To give a better idea I will start the exercise with the initial values of the variables involved in the exercise. Table III.1 summarizes those values.

Parameters	Values
Ω	0.05
$\bar{\rho}$	Ω
δ	0.28
δ^*	0.28
α	1/3

Table III.1

I will assign a specific form to the production function in both countries such that: $g(k) = \delta k^\alpha$ and $g(k^*) = \delta^* k^{*\alpha}$, where δ and δ^* are the productivity parameters of home and foreign country respectively and α is the share of capital in total output, the same for both countries. With these values of the parameters I can calculate the values of the variables previous to the productivity shock. They are summarized in Table III.2.

Variables	Pre-Shock Values
k	2.55035
k^*	2.55035
c	0.382553
c^*	0.382553
y	0.382553
y^*	0.382553
$\phi_1^{'} = \chi$	0.9
t	0
b	0
ρ_1	-0.00560147
γ_1	-0.15
γ_2	-0.0225869
β	-0.56117
β^*	-0.0611704

Table III.2

Now assume there is an unanticipated, permanent, positive supply shock in home country such that now $\delta > \delta^*$. Let us assume further that the shock is exactly 1% so that δ is know 0.2828. The change initially affects production and consumption in the home country but the variables in foreign country remain unchanged. Table III.3 summarizes the changes in capital stock, consumption, net foreign assets (b), wages and the rate of return on capital (ρ), both on impact and the steady state values. For comparison purposes the table contains the pre-shock values. Initial values are indicates with "(0)" and steady state values with "(∞)".

Value of $\delta = 0.28$		Value of $\delta = 0.2828$ (1% positive productivity shock. $\chi = 0.9$)	
Short Run	Steady State	Shorty Run	Steady State
k(0) = 2.55035	$k(\infty)$ = 2.55035	k(0) = 2.55035	$k(\infty)$ = 2.5887
k*(0) = 2.55035	$k^*(\infty)$ = 2.55035	K*(0) = 2.55035	$k^*(\infty)$ = 2.55035
c(0) = 0.382553	$c(\infty)$ = 0.382553	c(0) = 0.377683	$c(\infty)$ = 0.38756
c*(0) = 0.382553	$c^*(\infty)$ = 0.382553	c*(0) = 0.377792	$c^*(\infty)$ = 0.38756
b = 0	b = 0	b = -0.317615	b = 0.0149153
w(0) = 0.255035	$w(\infty)$ = 0.255035	w(0) = 0.258870	w*(0) = 2.55035
ρ = 0.05	ρ = 0.05	ρ = 0.0502148	ρ = 0.05

Table III.3

As mentioned before, across steady states, the rise in the productivity of home capital creates an excess stock demand for home equity, the elimination of which requires an increase in the home capital stock. Since foreign productivity remains unchanged, so does the foreign capital stock. The increase in world output enables the world economy to raise its consumption, $c + c^*$. Simultaneously solving equations (24), (27a), and (27b) gives us the new values of c, c^* and b which along with the new value of k give us y and y^*.

I can trace the time path of k and k^* as shown by Figure A.III.1 in the Appendices.

The process of convergence of the stock of capital to the new steady state values is slow both at home and in the foreign country. A simple visual inspection shows that convergence occurs after more than a hundred years in both countries.[15] The stock of capital shows a monotonic adjustment process until it reaches its new steady state equilibrium. Capital in the foreign country behaves differently. The country suffers from depressed stock market prices as demand for its equity declines. The country undergoes a [short] period of capital decumulation. As the stock of capital decreases its productivity increases which leads to an appreciation of the price of its equity. The price eventually rises above the unitary replacement cost of capital which leads to a period of capital accumulation culminating in a steady-state capital and output level that is identical to the one before the shock. The whole process follows a non-monotonic adjustment process, as shown in Figure A.III.1 in the Appendices.

Consumption

I can also trace the path of consumption both at home at abroad. Figure A.III.2 in the Appendices show the evolution of consumption over time. Consumption immediately begins to grow monotonically until it reaches its new steady state value determined by the system of equations (24), (27a) and (27b). The speed of convergence is faster than in the case of capital.[16]

Foreign consumption follows the same pattern. It grows monotonically until it reaches its new steady state. The speed of convergence is similar as in the case of home consumption and faster than the speed of convergence of foreign capital.

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[15] More than a 140 years at home an even longer abroad.

[16] It takes approximately thirty year for consumption to reach the new steady state level.

Net Foreign Assets

Figure A.III.3 in the Appendices shows that Net Foreign Assets (b) show a non-monotonic adjustment. There is a decrease on impact. Then it recovers to reach the new steady-state in a non-monotonic fashion.

Wages

Because of the change in productivity in the home country wages are expected to rise. An increase of 1% in productivity increases wages by 1.5%.

Elasticities

In order to explain the effects of the shock further it is convenient to calculate some key elasticities. I have calculated elasticities for capital, consumption, wages (W), welfare (WF) and the return on capital (ρ) both for the home and foreign country (denoted with a star). They are shown in Table III.4 below. As the numbers show, a positive productivity sock elicits a more than proportional response in all the variables, except for return on capital (ρ)

δ = 0.2828 (Productivity shock 1%)	
Short Run	Steady State
$\varepsilon_{k,\delta} = 0$	$\varepsilon_{k,\delta} = 1.50372$
$\varepsilon^*_{k,\delta} = 0$	$\varepsilon^*_{k,\delta} = 0$
$\varepsilon_{c,\delta} = -1.194867116$	$\varepsilon_{c,\delta} = 1.386735956$
$\varepsilon^*_{c,\delta} = -1.244533437$	$\varepsilon^*_{c,d} = 1.308838252$
$\varepsilon_{W,\delta} = 1.510380928$	$\varepsilon_{W,\delta} = 1.510380928$
$\varepsilon_{WF,\delta} = 1.333139069$	$\varepsilon_{WF,\delta} = 0$
$\varepsilon^*_{WF,\delta} = 1.302958715$	$\varepsilon^*_{WF,\delta} = 0$
$\varepsilon_{\rho,\delta} = 0.4296$	$\varepsilon_{\rho,\delta} = 0$
Table III.4	

Welfare effects of the supply shock

Finally it is interesting to investigate the welfare effects of changes in productivity. Since the positive productivity shock increases production and hence consumption at home, an increase in welfare is expected. This is what happens in the short run. Once the economy reaches the new steady state the levels of welfare go back to their original values.

III.IV Conclusion

The numerical exercise confirms the prediction of the theoretical model. The presence of adjustment costs shows the process of physical relocation of capital and shiftability of ownership claims in a new light. The process is not instantaneous and for certain variables is not even monotonic.

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APPENDICES

Appendix 1: Elasticities Chapter 2

Steady-state values of the variables in the model after an increase of 1% in each tax rate.

Variables	Φ*	k*	q*	c*	b^{f*}	λ_1	λ_2
Initial Values	-30.303	7.2415	0.8904	1.8645	-1.8573	-1.7821	-0.1659
1% increase in τ_r	-30.864	7.3216	0.8904	1.8634	-1.9449	-1.7716	-0.1645
1% increase in τ_c	-30.303	7.1831	0.8904	1.8645	-1.8045	-1.7902	-0.1659
1% increase in τ_l	-30.303	7.3091	0.8767	1.8645	-1.9182	-1.7729	-0.1659
1% increase in τ_g	-30.303	7.1815	0.9028	1.8645	-1.8030	-1.7901	-1.659

Effects of tax policies on welfare, consumption and foreign assets

a) One percentage point increse in personal tax rate income τ_r

Variables	Initial Value	Jump in impact	%Δ	New Steady-State	%Δ
Welfare	-30.303	-30.6626	1.19	-30.8642	1.85
Consumption	1.8645	1.8658	0.069	1.8634	-0.06
Foreign assets	-1.8574	-1.8574	0	-1.9479	4.87

b) One percentage point change in corporate tax rate τ_c

Variables	Initial Value	Jump on impact	%Δ	New Steady-State	%Δ
Welfare	-30.303	-30.2063	-0.32	-30.303	0
Consumption	1.8645	1.8657	0.064	1.8645	0
Foreign assets	-1.8574	-1.8574	0	-1.8044	-2.85

c) One percentage point change in investment tax credit $\left(\tau_l\right)$

Variables	Initial Value	Jump on impact	$\%\Delta$	New Steady-State	$\%\Delta$
Welfare	-30.3030	-30.4262	0.41	-30.303	0
Consumption	1.8645	1.8630	-0.08	1.8645	0
Foreign assets	-1.8574	-1.8574	0	-1.9182	3.27

d) One percentage point change in tax on accrued capital gains τ_g

Variables	Initial Value	Jump on impact	$\%\Delta$	New Steady-State	$\%\Delta$
Welfare	-30.303	-30.2038	-0.33	-30.303	0
Consumption	1.8645	1.8657	0.065	1.8645	0
Foreign assets	-1.8574	-1.8574	0	-1.8030	-2.93

Appendix 2: Graphs Chapter 3

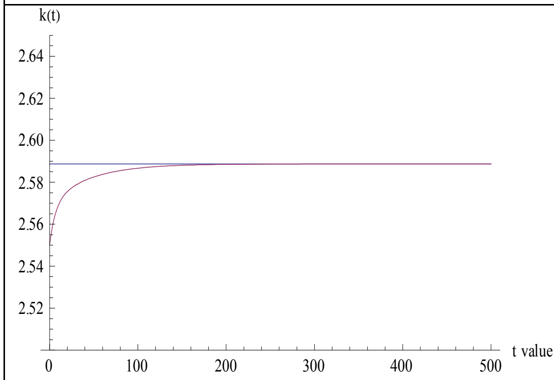
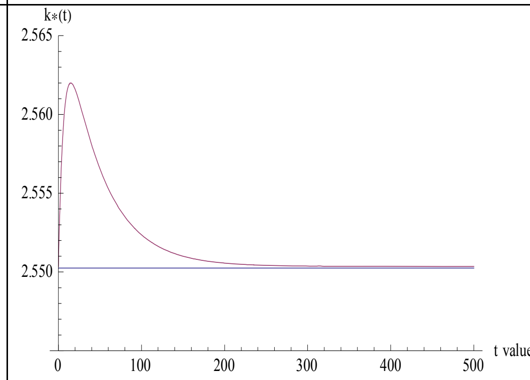
Time path of capital in the home country.	Time path of capital in foreign country
	

Figure A.III.1

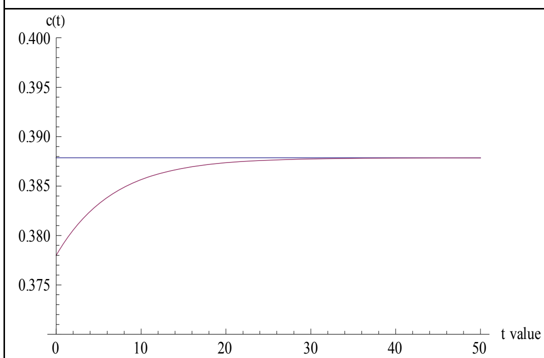
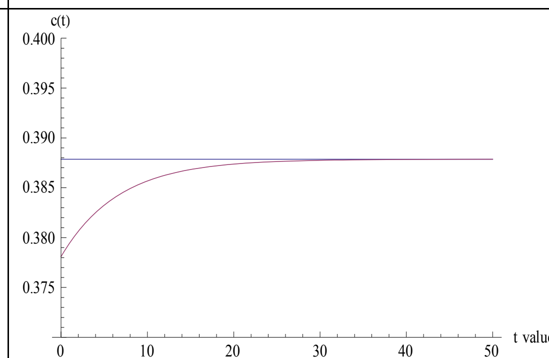
Time path of consumption at home	Time path of consumption in foreign country
	

Figure A.III.2

Time path of net foreign assets (b)

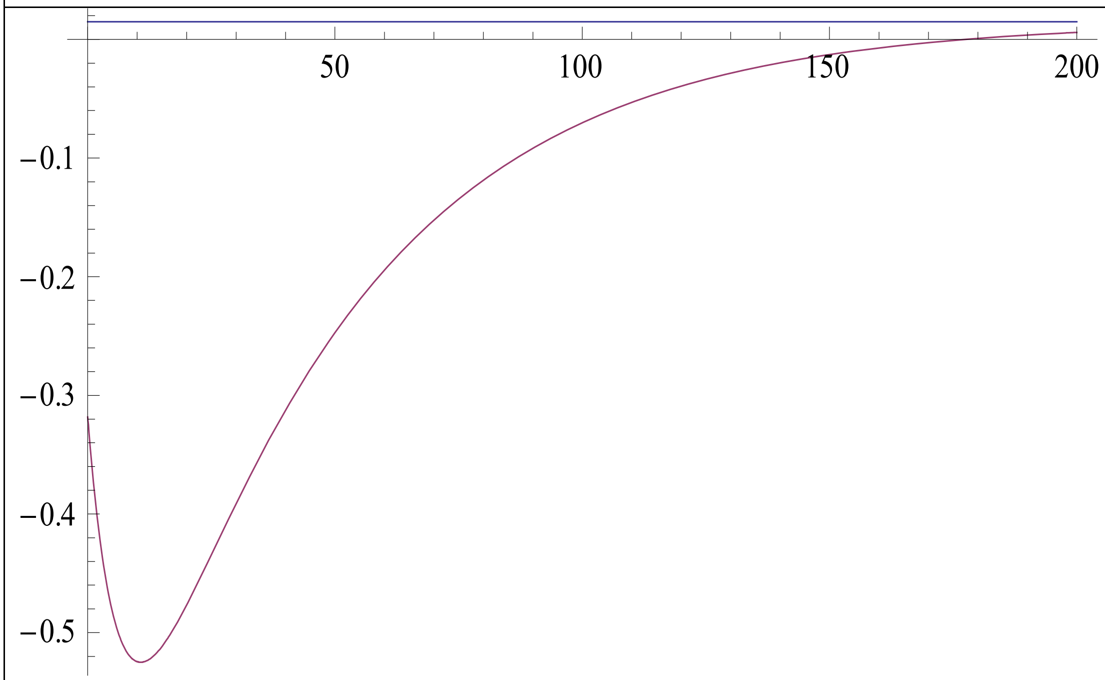


Figure A.III.3

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