North-South International Mobility of Entrepreneurs*

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Abstract

We consider a world economy in which entrepreneurs from developed countries can choose to produce in their own country or to locate their production activities in one of many different developing countries. The model explicitly allows for heterogeneity in the productivity of each country and for differences in the productivity of the entrepreneurs from different countries. We also explore the diffusion of productivity from entrepreneurs in developed countries to those in developing countries.

Our main objective is to evaluate the welfare gains to developing countries of receiving entrepreneurs from developed economies. We consider policies in which countries impose taxes on profits of foreign firms. We explore the welfare implications of unilateral and global changes in those taxes in developing economies.

Preliminary results indicate that many developing countries will significantly improve their welfare if the barriers to foreign firms are reduced.

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*This draft is very preliminary and incomplete.

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1. Introduction

Recent years have witnessed a surge in flows of trade and international investment. Interestingly, the fastest growing item is the flow of foreign direct investment (FDI) from developed to developing economies. The increments on the flows have given place to also significant increments in the shares of foreign controlled capital in developing countries (see figure 1). While technology advances, especially in the information technology sector, may account for the increment in the flows, there is also evidence that the policy barriers have decreased significantly (also see figure 1). But, regardless of the reason for the forces at play, the increased presence of foreign controlled firms in developing countries is likely to have significant implications in their economies and for the world economy at large. As a matter of fact, the so called "globalization" has raised rather debates and resurrected protectionist sentiments, in developed and developing countries alike.

In this paper we construct a simple neoclassical growth model (multicountry version of Lucas' (1978) span of control model) with the objective of evaluating the welfare implications of international movement of entrepreneurs. Differences in the productivity of countries and in the quality of their entrepreneurs generate potential gains of reallocating workers, capital and entrepreneurs across countries. In this paper, we consider a model in which immigration barriers preclude the movement of workers but capital and entrepreneurs can move freely. One can envisage such an environment as one in which some countries have comparative advantage in providing entrepreneurial services and other have comparative advantage in providing workers' services. Given the barriers to the international movement of workers, the only mechanism in which these potential gains from input trade can accrue, is if some entrepreneurs establish their production location in a developing country, directly controlling workers and capital therein. We also extend the model to allow for technology diffusion from foreign to domestic entrepreneurs. Admittedly, our model abstracts from other forces that do not require the direct control by foreign entrepreneurs.

In our model, countries impose taxes on the profits of foreign firms. Our policy experiments consist of changing these taxes and computing the equilibrium implications for all the countries. After having calibrated the model, we use it to explore the effect of policy changes in the output, productivity and welfare of the countries. Having many countries, all of which with different initial positions, there are many different possible exercises, and unfortunately, is not clear which one is the most natural. In this version of the paper we report on a few of those experiments. In general, however, we classify the exercises in two types: (a) unilateral reduction of taxes, and (b) simultaneous (worldwide) reduction of taxes. After evaluating the implications on output and productivity, we lay out a set of additional assumptions that enable us to perform standard welfare calculations.

Our quantitative analysis is based on data for 16 developed countries and 41 developing countries. We find that the median output increase and welfare gain (measured as the equivalent variation in consumption) in developing countries associated to a unilateral reduction of taxes on foreign firms' income from 100% (i.e.: no entrepreneurial mobility) to 0%, are 5% and 17%, respectively. The median welfare gain can be as large as 40% if there is technology diffusion from foreign to local entrepreneurs in developed countries. In the case of a simultaneous reduction of taxes, the median welfare gain ranges from 1% to 20% , depending on the extent of technology diffusion from foreign to domestic entrepreneurs. These welfare gains are higher than those obtained in other related experiments such as a reduction of capital taxes or a shift from financial autarky to financial integration.

The remainder of the paper is organized as follows. In the next section we describe in detail the model economy. In the third section, we examine the equilibrium conditions in the model. We explore in detail the occupational choice problem within each country and the international allocation of entrepreneurs across developing countries and developed countries. We also discuss how to use the model to extract from the data the country and entrepreneur specific average productivities. In the fourth section we describe the experiments, we and describe the data and parameter values we use in our quantitative analysis. In the fifth section we present the quantitative results.

2. Connections with Existing Literature

Klenow and Rodriguez-Clare (1997), and Hall and Jones (1999) argue that differences in TFP go a long way in explaining cross-country income differences. In this paper we go a step beyond and decompose the observed aggregate TFP into two components: Country (unmovable) factors versus entrepreneur (movable) factors.. Doing so, we construct a model in which government policies change the quantity and the average quality of the entrepreneurs operating in the country. Therefore, in equilibrium, observed TFP can vary widely across countries. Moreover, changes of policies in one country affect TFP in other countries.

The recent growth in flows of FDI has motivated a significant number of theoretical papers. Among those, Markusen and Venables (2000), Brainard (1993), and Helpman, Melitz, and Yeaple (2004), study models of horizontal FDI. Horizontal FDI is the decision of a firm to locate its production within the territory of the country whose market it wants to serve, in order to avoid trade costs. Instead, we focus on vertical FDI, which is motivated by cost differences across countries. While much of the inward FDI inside developed countries is horizontally motivated, it can be argued that most of the recent surge of FDI from developed to developing countries is vertically motivated..

Our model is based on a multicountry version of Lucas's (1978) span-of-control-model. In the model, some countries have comparative advantage exporting managerial services while other have comparative advantage providing labor services. A similar idea is in Rauch (1991), who studies a 2-country, 2-good, version of Lucas's model to account for the pattern of trade and migration. In contrast, our model is a calibrated multi-country, dynamic quantitative model.

On the empirical front, much attention has been allocated to micro studies, such as Aitken and Harrison (1999). They study the productivity differences between domestic and foreign firms. The focus of those papers is to study the effect of foreign firms on the productivity of existing local firms. In this paper we focus on the implications of FDI on aggregate TFP. Using the equilibrium conditions of our model we can extract the relative country-specific productivity and entrepreneurial differences across countries. We we use our theoretical model and macro data to infer differences in productivity between domestic and foreign entrepreneurs. We then use the model to examine the implications of changes in different distortions in the economy.

In that respect, Desai, Foley, and Hines (2003) empirically examine the effect of changes in country-specific taxes (income and indirect taxes) on the location of output of US multinational firms. We use our general equilibrium model to examine the implications of government policies changes on the location decisions of firms in developed countries. A significant advantage of our approach is that we can perform welfare analysis, similar to that undertaken in recent work by Eaton and Kortum (2002 and 2003), and Alvarez-Lucas (2004) in the context of international trade.

3. The Model

3.1. Overview

Our model is a multicountry version of Lucas' (1978) span of control model. We consider an infinite horizon world economy composed of I countries. Countries are indexed by $i = 1, 2...., I$. Throughout the paper we take $i = 1$ to be a developed economy and $i = 2, ..., I$ to be developing economies. This distinction is elaborated below. We measure time in discrete periods and index each period by $t = 1, 2, 3, ...\infty$. There is only one consumption good and it can be freely traded across countries.

As in Lucas (1978), we consider economies in which production is organized in plants. Plants have decreasing returns to proportional increments in labor and capital services. Therefore, plants yield profits and those profits are the returns to the entrepreneur managing or controlling the plant. Also, we assume that individuals have equal ability as workers, but that they have different skills as managers. Therefore, managerial ability determines which agents become managers and which ones become workers.

We extend Lucas's model to allow entrepreneurs to choose among different countries to locate their operations. Interestingly, for almost all countries, and especially during the last few years, the presence of foreign firms has become much more common. As we will see, the characteristics of each country, including its policies, determine the mass of foreign managers controlling capital and labor. The quantity and the quality of the entrepreneurs operating in each country determine their aggregate total factor productivity and output. Therefore, output, productivity and welfare in each country will be affected by the policies of that country and the policies of all other countries in the world economy.

Our interest is this paper is restricted to the flows of managers from developed countries to developing countries. As we argued in the introduction, the flows of FDI indicates that the fraction of capital and labor in developing countries controlled by managers from developed countries has risen in the last years. While developed countries are still the host of most FDI in the world, there are two important considerations to have in mind. First, most inward-FDI in developed countries is originated as the outward-FDI from another developed country. In fact, as of 2001, of all the assets controlled by foreign affiliates in the US, almost 93% were owned by agents from other developed countries. For sales, gross product, employment and total employee compensation expenditures, the ratios are 89%, 88%, 89% and 89%, respectively. Second, most of the capital controlled by foreigners in developing countries is also owned by agents from developed countries. For most developing countries, the FDI from other developing countries is significantly lower than the FDI from developed countries. For instance, for Argentina, Peru and Costa Rica, approximately 80% of the FDI received in the 90s is originated from developed countries. In Mexico, that number is as high as 91% .

On the basis of these two facts we will abridge our model by considering only one developed country ($i = 1$). We further simplify the analysis by abstracting from the flows of entrepreneurs from a developing to another developing country and from developing to the developed country. Therefore, in the Section 3, we will characterize equilibria in which the managers from country $i = 1$, are allocated into many of the various developing countries .Our interest is in the effect of government policies that distort the allocation of managerial ability and the accumulation of physical capital. We set out a world economy in which the government of each country impose proportional taxes on the income of local and foreign entrepreneurs and on the income from capital. Specifically, we assume that each country i chooses three tax rates $\{ \tau^i_{D,t} , \tau^i_{F,t}, \tau^i_{K,t}\}$, applied to those income categories. In what follows, we describe in detail the economic environment and the economic decisions faced by each of the agents in it.

3.2. Households

In any time period, each country i has a population of L_t^i individuals. Countries may have different population sizes, but we will restrict the analysis to uniform population growth $n^i = n$ across all countries. Then, the population of country i in period t is $L_t^i = L_0^i(1+n^i)^t$.

Individuals of all countries have the same preferences, ranking individual consumptions streams $\{c_{t+j}^i\}$ according to:

$$E\left[\sum_{j=0}^{\infty}\beta^j \frac{\left(c_{t+j}^i\right)^{1-\sigma}}{1-\sigma}\right],$$

where $\beta \in (0,1)$ is a discount factor.

We assume complete markets within each country. Idiosyncratic risk will not affect individual consumption. To be sure, at time t all individuals alive in country i will be C_t^i/L_t^i, the aggregate consumption divided by the population. Equilibria can be characterized and computed using a representative agent construct for each country i, with preferences given by:

$$E\left[\sum_{t=0}^{\infty}\beta^t L_t^i \frac{(C_t^i/L_t^i)^{1-\sigma}}{1-\sigma}\right]$$

Individual agents take the policies as given, facing the following sequential budget constraint:

$$A_{t+1}^i + C_t^i + I_t^i = w_t^i N_t^i + \tilde{\Pi}_t^i + \left(1-\tau_{K,t}^i\right) r_t^i K_t^i + (1+r^*)\, A_t^i + T_t^i$$

Consumption (C_t^i), investment (I_t^i) and the purchase of foreign assets (A_{t+1}^i) is financed by aggregate returns to workers, entrepreneurs, and the stock of physical capital and financial assets. We let N_t^i denote the mass of workers in country i, and K_t^i denote the stock of physical capital. The variables w_t^i and r_t^i denote the wage rate, and the rental rate of capital, respectively. Capital income is taxed at a rate $\tau_{K,t}^i$. The variables $\tilde{\Pi}_t^i$ and T_t^i denotes total after-tax profits and lump-sum transfers from the government, respectively, received by the representative household. The law of motion for aggregate capital in country i is given by

$$K_{t+1}^i = (1-\delta)K_t^i + I_t^i \ ,$$

where δ denotes the depreciation rate.

The representative household of each country can borrow or lend at the international risk free rate r^*[1]. We impose the no-Ponzi game condition:

$$\lim_{t\to\infty} \frac{A_{t+1}^i / \left(1+n\right)^{t+1} / \left(1+g\right)^{\frac{t+1}{1-\alpha\nu}}}{(1+r^*)^t} = 0,$$

where g is the exogenous growth rate of productivity as discussed below.

In our quantitative exercises we also consider the opposite case of financial autarky, imposing $A_t^i = 0$ at all times.

3.3. Technologies

All countries have the same raw technology. Their productivities could differ for three reasons. On one hand, countries have inherent characteristics like weather, infrastructure, regulations, etc. that make them more or less productive for all entrepreneurs. On the other hand, countries have pools of entrepreneurs that can vary in their average quality. Finally, we also allow for asymmetries in production between local and foreign entrepreneurs in a given country. These correspond to differences in language, cultural and local knowledge, and local connections that

[1] We are currently working on endogeneizing the world interest rate.

can affect the operations of foreign relative to domestic managers. The model will allow us to disentangle the first from the latter two factors in the data.

Production is organized in plants (or projects). Each plant requires the services of one manager and positive amounts of labor n and capital k services. If we denote by z^i the productivity of country i, then the output from a plant managed by an entrepreneur with ability x is given by:

$$z^i x \left[k^\alpha n^{1-\alpha}\right]^v \text{ , if the entrepreneur is local, and}$$
$$\theta^i z^i x \left[k^\alpha n^{1-\alpha}\right]^v \text{ , if the entrepreneur is a foreigner.}$$

Here, $v \in (0,1)$ is the "span of control" parameter and yields decreasing returns on (n,k). The parameter $\alpha \in (0,1)$ governs the relative output shares of capital and labor. The parameter θ^i denotes country-specific asymmetries in production between local and foreign entrepreneurs.

Before-tax returns of a local manager with ability x, operating in country i at time t, are:

$$\pi_t^i(x) = \max_{k,n} \left[z_t^i x \left(k^\alpha n^{1-\alpha}\right)^v - w_t^i n - r_t^i k\right]$$

Before-tax returns of a foreign manager with ability x, operating in country i at time t, are:

$$\pi_{F,t}^i(x) = \max_{k,n} \left[\theta^i z_t^i x \left(k^\alpha n^{1-\alpha}\right)^v - w_t^i n - r_t^i k\right].$$

3.4. Occupational Choice

Individuals can either be workers or managers. Each period individuals learn a realization of their ability as a manager. Conditional on that ability they decide whether to become entrepreneurs or workers. All workers earn the same wage w_t^i, whereas the return to managers depends on the realized managerial ability.

We specify our model as follows. In each period, the average quality of the (potential) manager in country i is x_t^i. Each individual draws a random variable e from a time-invariant distribution, that indicates his ability relative to the average of his country of origin. Therefore, his actual ability is ex_t^i. We assume that in country 1, a fraction ω of the population draws an ability $e = 1$, and the remaining fraction $(1 - \omega)$ draws an ability $e = 0$. For countries $i = 2, ..., I$ the support of e is $[0, \infty)$ and $F^i()$ denotes the cumulative distribution function, where $\int edF^i(e) = 1$. Cross-country differences in the pool of the managers differences are traced by the behavior of $\{x_t^i\}$.

In any country, should an agent decide to become a manager in his own country, his pre-tax earnings would be $\pi_t^i(x_t^i e)$ .Facing taxes $\tau_{D,t}^i$ on the returns of managing a plant, an agent will prefer to become a manager over being a worker if $\left(1 - \tau_{D,t}^i\right) \pi_t^i(x_t^i e) > w_t^i$. It can be shown easily that $\pi_t^i(x_t^i e)$ is increasing in e. Then, if any, only the most skillful individuals will become active entrepreneurs. Below we characterize the threshold $\bar{e}_t^i$ that indexes the local entrepreneur with the lowest ability in each country $i \neq 1$, which is defined by the condition:

$$\left(1 - \tau_{D,t}^i\right) \pi_t^i\left(x_t^i \bar{e}_t^i\right) = w_t^i \ .$$

3.5. Location Choice for Entrepreneurs

Workers of all countries are internationally immobile and only managers from country $i = 1$ have the option to operate in any of all the other countries $i \neq 1$. Each country impose a proportional tax to foreign entrepreneurs' profits, denoted by $\tau_{F,t}^i$ Then, when contemplating whether to locate their production abroad, entrepreneurs from country 1 examine the vector $\left\{(1 - \tau_{F,t}^i)\pi_{F,t}^i\right\}_{i=1,...,I}$

of net profits, where we defined $\pi^i_{F,t} = \pi^i_{F,t}(x^1_t)$. They decide to stay locally if the maximum of that vector is less than the net-of-taxes return $\left(1-\tau^1_{D,t}\right)\pi^1_t$ attainable producing domestically, where we defined $\pi^1_t = \pi^1_t(x^1_t)$. If they leave, they choose foreign countries according to the highest net return attainable. Let m^i_t denote the fraction of active entrepreneurs from country 1 that are managers in country i at time t, where $\sum_{i=1}^I m^i = 1$.

The optimal location choice by entrepreneurs in country 1 is fully characterized by the conditions:

$$\begin{aligned}
\left(1-\tau^1_{D,t}\right)\pi^1_t &= \left(1-\tau^i_{F,t}\right)\pi^i_{F,t} \quad \text{if} \quad m^i_t > 0, \\
\left(1-\tau^1_{D,t}\right)\pi^1_t &> \left(1-\tau^i_{F,t}\right)\pi^i_{F,t} \quad \text{if} \quad m^i = 0, \\
\left(1-\tau^1_{D,t}\right)\pi^1_t &< \left(1-\tau^i_{F,t}\right)\pi^i_{Ft} \quad \text{if} \quad m^i = 1
\end{aligned} \tag{3.1}$$

These conditions are sufficient since in equilibrium there will always be a positive amount of entrepreneurs from country 1 operating there.

3.6. Law of Motion of Productivity and Entrepreneurial Skills

In our model the world economy will eventually be growing at a constant rate and relative income differences will be described by a stable distribution. The engine of growth is the exogenous improvement in the productivities z^i_t of all countries, which grow at the rate $g > 0$.

$$z^i_t = z^i_{t-1}(1+g) = z^i_0(1+g)^t$$

Clearly, within the limits of our model, the relative country productivities are not allowed to change. However, we will consider endogenous movements in the average entrepreneurial skills in each country. Workers and entrepreneurs exposed to an average entrepreneurial ability of $\hat{x}_t$ at time t, will draw a random ability of $\hat{x}^i_t e$ at time $t+1$. Then the average skill in $t+1$ is $x^i_{t+1} = \hat{x}^i_t E(e) = \hat{x}^i_t$. In the case both local and foreign (from country 1) entrepreneurs operate in country i, we assume that the average $\hat{x}^i_t$ entrepreneurial skills applied in country i is a weighted average of the skills of the two groups. Letting s^i_t be the fraction of capital managed by foreign entrepreneurs, we assume that

$$x^i_{t+1} = \left(x^1_t\right)^{\zeta s_t} \left(x^i_t\right)^{1-\zeta s_t}$$

This is a simple way to allow for the diffusion of productive skills from the more advanced entrepreneurs to the local ones. Here $\zeta \in [0,1]$ measures the extent of technology diffusion. If $\zeta = 1$, foreign firms fully transfer their knowledge to the host economy. If $\zeta = 0$, there are no transfers at all. We also explore intermediate cases.

3.7. Government Policy and Budget Constraints

Governments tax capital income and profits of local and foreign entrepreneurs. Specifically, we assume that each country i chooses three tax rates $\left\{\tau^i_{K,t}\ ,\ \tau^i_{D,t}\ ,\ \tau^i_{F,t}\right\}$, applied to the aforementioned income categories. No cross-border taxation or cross-country transfers are considered. The amount T^i_t of collected taxes is rebated to households of country i. Given that governments run a balanced budget every period, households receive a lump-sum transfer of:

$$T^1_t = r^1_t \tau^1_{K,t} K^1_t + \tau^1_{D,t} L^1_t \pi^1_t$$

$$T^i_t = r^i_t \tau^i_{K,t} K^i_t + \tau^i_{D,t} L^i_t \int_{\bar{e}^i_t}^{\infty} \pi^i_t \left(x^i_t e\right) de + \tau^i_{F,t} L^1_t \omega^1_t m^i_t \pi^i_{F,t}\ ,\ i = 2, ..., I$$

4. Analysis of Equilibria.

Given the array policies $\left\{\ \tau^i_{D,t}\ ,\ \tau^i_{F,t}, \tau^i_{K,t}\right\}_{i\in I,\ t\geq 0}$ and the initial conditions $\left\{K^i_0, z^i_0, x^i_0,\right\}_{i\in I}$ an equilibrium is a price system $\left\{\ w^i_t, r^i_t\right\}_{i\in I,\ t\geq 0}$ and an allocation $\left\{C^i_t, I^i_t, \overline{e}^i_t, m^i_t\right\}_{i\in I,\ t\geq 0}$

such that markets clear, and, given policies and prices, individual decisions are optimal. In the previous section we described in detail each of the individual decisions. We now combine the market clearing with the optimality conditions to characterize equilibria in the economy.

4.1. Aggregation and Resource Constraints

Given any $\left\{\bar{e}_t^i, m_t^i\right\}_{i\in I,\ t\geq 0}$, we can compute the output and the aggregate resource constraints in each country as well as the market clearing in the local capital and labor markets. Aggregate output Y_t^i, is the sum of output from local and foreign (from country 1) firms operating in country i

$$\begin{aligned} Y_t^i &= z_t^i x_t^i L_t^i \int_{\bar{e}_t^i}^{\infty} e\left[k_t^i(e)\right]^{\alpha\nu}\left[n_t^i(e)\right]^{(1-\alpha)\nu} dF^i(e) + \\ &\quad \theta_t^i z_t^i x_t^1 m_t^i \omega L_t^1 \left(k_{F,t}^i\right)^{\alpha\nu}\left(n_{F,t}^i\right)^{(1-\alpha)\nu} \ , i = 2 \ , \ldots \ , I \end{aligned}$$

Here $k_t^i(e), n_t^i(e)$ are the capital and labor services hired by a manager with relative ability $e > \bar{e}_t^i$. Also, $k_{F,t}^i$, $n_{F,t}^i$ are the capital and labor hired by each of the $m_t^i\omega L_t^1$ foreign managers operating in country i. Since in country $i = 1$ only local firms operate, output in that country is given by

$$Y_t^1 = \left(m_t^1\omega L_t^1\right) z_t^1 \left(k_t^1\right)^{\alpha\nu}\left(n_t^1\right)^{(1-\alpha)\nu}$$

The aggregate supply of capital, K_t^i must equal the demand. These conditions imply that

$$K_t^i = L_t^i \int_{\bar{e}_t^i}^{\infty} k_t^i(e)\, dF^i(e) + m_t^i\omega L_t^1 k_{F,t}^i \ , i = 2 \ , \ldots \ , I$$

$$K_t^1 = m_t^1\omega L^1 k_t^1, \text{ for } i = 1$$

Given that all individuals with $e > \bar{e}_t^i$ are entrepreneurs, the aggregate supply of workers is given by:

$$N_t^i = F(\bar{e}_t^i) L_t^i \ , \ i = 2, ..., I$$

$$N_t^1 = (1 - \omega) \, L_t^1.$$

Then, labor market equilibrium requires that:

$$N_t^i = L_t^i \int_{\bar{e}_t^i}^{\infty} n_t^i(e) \, dF^i(e) + m_t^i \omega L_t^1 n_{F,t}^i \ , \ i = 2 \ , ... \ , \ I$$

$$N_t^1 = m_t^1 \omega L_t^1 n_t^1$$

The representative household receives the after-tax profits of managers. These are given by:

$$\tilde{\Pi}_t^1 = \omega L_t^1 \left(\left(1 - \tau_{D,t}^1\right) m_t^1 \pi_t^1 + \left(1 - \tau_{F,t}^i\right) \sum_{i \neq 1} m_t^1 \pi_{F,t}^i \right)$$

$$\tilde{\Pi}_t^i = \left(1 - \tau_{D,t}^i\right) L_t^i \int_{\bar{e}_t^i}^{\infty} \pi_t^i \left(x_t^i e\right) de \ , \ i = 2, ...I$$

Finally, the resource constraints are:

$$A_{t+1}^i + C_t^i + K_{t+1}^i - (1 - \delta) \, K_t^i = Y_t^i - \left(1 - \tau_{F,t}^i\right) \omega L_t^1 m_t^i \pi_{F,t}^i + (1 + r^*) \, A_t^i \ , \ i = 2, ..., I \ ,$$

and

$$A_{t+1}^1 + C_t^1 + K_{t+1}^1 - (1 - \delta) \, K_t^1 = Y_t^1 + \sum_{i \neq 1} \left(1 - \tau_{F,t}^i\right) \omega L_t^1 m_t^i \pi_{F,t}^i + (1 + r^*) \, A_t^i$$

Given $\{\bar{e}_t^i\}_{i=2}^I$ and $\{m^i\}_{i=1}^I$, the problem of the consumer is standard. We will focus our attention in characterizing the equilibrium determination of $\{\bar{e}_t^i\}_{i=2}^I$ and $\{m^i\}_{i=1}^I$. Since those decisions are intratemporal, to save on notation we will omit time subindices.

4.2. Occupational choice in country i

It can be shown that the equilibrium wage rate in country i is given by:

$$w^i\left(\bar{e}^i, m^i\right) = (1-\alpha)\,\nu z^i \left(\left(x^i\right)^{\frac{1}{1-\nu}} \int\limits_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF\left(e\right) + \left(\theta^i\right)^{\frac{1}{1-\nu}} m^i \omega \frac{L^1}{L^i} \right)^{1-\nu} \left(K^i/L^i\right)^{\alpha\nu} F(\bar{e}^i)^{\nu(1-\alpha)-1} ,$$

and before-tax profits for the active entrepreneur with lowest ability in country i are:

$$\pi^i\left(\bar{e}^i, m^i\right) = (1-\nu)\frac{z^i\left(\bar{e}^i\right)^{\frac{1}{1-\nu}}\left(x^i\right)^{\frac{1}{1-\nu}}\left(K^i/L^i\right)^{\alpha\nu}\left[F\left(\bar{e}^i\right)\right]^{(1-\alpha)\nu}}{\left(\left(x_i\right)^{\frac{1}{1-\nu}} \int\limits_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF\left(e\right) + \left(\theta^i\right)^{\frac{1}{1-\nu}} m^i \omega L^1/L^i \right)^{\nu}}.$$

Fixing everything else, the wage rate $w^i\left(\bar{e}^i, m^i\right)$ is decreasing in $\bar{e}^i$ as more workers and less managers enter the labor market. Note that $\pi^i\left(\bar{e}^i, m^i\right)$ is also increasing in $\bar{e}^i$. This is the result of the direct effect of a higher ability on the marginal entrepreneur and the general equilibrium effect inducing lower factor prices because of fewer entrepreneurs (given decreasing returns to scale). Also, notice that $w^i\left(\bar{e}^i, m^i\right)$ is increasing and $\pi^i\left(\bar{e}^i, m^i\right)$ decreasing in m^i. The presence of foreign firms increase the price of labor and reduce the returns of local managers.

The marginal entrepreneur $\bar{e}^i$ is determined by the condition:

$$w^i\left(\bar{e}^i, m^i\right) = \left(1-\tau^i_{D,t}\right)\pi^i\left(\bar{e}^i, m^i\right) \tag{4.1}$$

The opposite signs in the slope of these two functions directly imply that for a given m^i, there is a unique equilibrium $\bar{e}^i$. Since $\lim_{\bar{e}^i\to\infty} w^i\left(\bar{e}^i, m^i\right) = \infty$, the two lines cross, ensuring existence. This also imply that it is not possible to have a corner equilibrium in which no individual is a worker in country i. However, it is possible to have the other corner equilibrium in which local individuals are workers and only foreign entrepreneurs are active in that country.

Notice that $\tau^i_{D,t}$ distorts the occupational choice in favor of becoming workers, reducing the amount of entrepreneurs and equilibrium wages. Also, note that $\bar{e}^i$ is increasing in m^i. The presence of more foreign entrepreneurs increase the wage in the country, reducing the returns to all active entrepreneurs and inducing some of them to become workers.

4.3. Location Choice for Entrepreneurs from Country 1

First, note that it will always be the case that $m^1 > 0$. Say, if almost all the entrepreneurs from country 1 leave to operate abroad, then the remaining entrepreneurs will enjoy arbitrarily large profits since wages would be very low. This fact considerably simplifies our analysis. To compute equilibria we simply need compare $\pi^i_F(\bar{e}^i, m^i)$ (profits attainable in country i) with $\pi^1\left(\{m^i\}_{i=1}^I\right)$ (profits when remaining in country 1). Define $\bar{\pi}^1(m^i) \equiv \pi^1\left(m^i, \{m^i\}_{j\neq i}\right)$ to be the individual profits in country 1 as a function of m^i, taking $\{m^i\}_{j\neq i}$ as given. The comparison of these two functions characterizes the optimality of locating in i versus 1. It can be shown that those functions are

$$\pi^i_F\left(\bar{e}^i, m^i\right) = (1-\nu)\frac{\left(\theta^i\right)^{\frac{1}{1-\nu}} z^i \left(K^i/L^i\right)^{\alpha\nu}\left[F\left(\bar{e}^i\right)\right]^{(1-\alpha)\nu}}{\left(\left(x^i\right)^{\frac{1}{1-\nu}}\int\limits_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF(e) + \left(\theta^i\right)^{\frac{1}{1-\nu}} m^i \omega L^1/L^i\right)^{\nu}}$$

and

$$\bar{\pi}^1\left(m^i\right) = (1-\nu)\, z^1 \left(\frac{1}{\left(1-\sum_{j>1\ ,\ j\neq i} m^j - m^i\right)\omega\cdot}\right)^{\nu} \left(K^1/L^1\right)^{\alpha\nu}\left(1-\omega^1\right)^{(1-\alpha)\nu}.$$

It can be seen that $\pi^i_F\left(\bar{e}^i, m^i\right)$ is decreasing in m^i (more foreign entrepreneurs increase factor prices in country i), and $\bar{\pi}^1(m^i)$ is increasing in m^i (with less entrepreneurs in country 1, factor prices are lower). The equilibrium m^i, is determined by the condition:

$$\left(1-\tau_D^1\right)\bar{\pi}^1\left(m^i\right) \geq \left(1-\tau_F^i\right)\pi_F^i\left(\bar{e}^i, m^i\right) \tag{4.2}$$

Given the opposite sign in the slopes of this curves, there exists a unique equilibrium $0 \leq m^i < 1$, for a given $\overline{e}^i$. Note that m^i is increasing in $\overline{e}^i$. Everything else equal, countries with higher entrepreneurial activity are less attractive to foreign entrepreneurs.

Given $\{K^i, L^i, z^i, x^i\}$, the equilibrium sequence $\{\bar{e}^i\ ,\ m^i\}_{i=2}^I$ is defined when conditions 4.1 and 4.2 are simultaneously satisfied. While existence of an equilibrium is not problematic to verify, as of now we do not have a general proof of uniqueness. Within the limits of our calibration, our computed equilibrium was unique.

At this point it is convenient to step back and examine the forces that explain why an entrepreneur from country 1 would want to move to another country to produce. Obviously, an entrepreneur would like to move to another country if his profits there will be higher then that at home:

$$\left(1-\tau_F^i\right)\pi_F^i > \left(1-\tau_D^1\right)\pi^1$$

Producing elsewhere may entail a trade-off. On one hand, it is quite possible that labor and even capital can be cheaper in a developing country. But on the other hand, it is quite likely that the productivity of the developing country is lower and moreover, there can be taxes and other barriers to be faced by a foreign firm in that country. Using the expressions for $\pi^{F,i}$ and π^1, we find that an entrepreneur from the developed country will want to move production activities to a developing country i if:

$$\frac{\left(w^i\right)^{\nu(1-\alpha)}\left(r^i\right)^{\nu\alpha}}{\left(w^1\right)^{\nu(1-\alpha)}\left(r^1\right)^{\nu\alpha}} < \left(\frac{1-\tau_F^i}{1-\tau_D^1}\right)^{1-\nu}\frac{z^i\theta^i}{z^1}$$

While very intuitive, the previous condition has the limitation of linking wages and rental rates between two countries, which are endogenous variables. We want to obtain a relationship between exogenous and predetermined variables. Perhaps, the simplest and most intuitive way to explore this issue is to situate the analysis in a situation with no international mobility of entrepreneurs (i.e.: $m^i = 0$ and $m^1 = 1$). This is analogous to analyzing the patterns of trade using autarkic prices. Given the factors of production available at the beginning of the period in countries 1 and i, and substituting for the wages and the rental rate on capital, the previous condition becomes:

$$\left(\frac{1-\tau_F^i}{1-\tau_D^1}\right)^{\frac{1}{\nu}} \left[\left(\theta^i\right)^{\frac{1}{1-\nu}} \frac{z^i}{z^1}\right]^{\frac{1}{\nu}} \left[\frac{K^i/L^i}{K^1/L^1}\right]^{\alpha} \left[\frac{F\left(\bar{e}^i\right)}{1-\omega^1}\right]^{(1-\alpha)} \frac{\omega^{1.}}{\left(x^i\right)^{\frac{1}{1-\nu}} \int\limits_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF\left(e\right)} > 1$$

Therefore, an individual entrepreneur from country 1 would like to move to country i if: (a) taxes to foreign firms τ_F^i are not too high relative to taxes in country 1, (b) the country productivity $\theta^i z^i / z^1$ is high enough, (c) the capital/population in country i is relatively high, (d) the relative abundance of labor in country i is high enough, and (e) the competition of entrepreneurs in i is low enough with respect to the competition in country 1, as expressed by the last term in the previous expression. If the resulting balance among these forces is not favorable, entrepreneurs from country 1 will not flow into country i.

4.4. Foreign Firms and Output

It is instructive to see how the presence of foreign firms affect output and total factor productivity (TFP) of country i. Foreign and local firms face the same local prices for inputs. Since z^i affects both of them equally and the relative productivity of locals versus foreigners is a neutral shift, both firms will have the same factor intensities. GDP in country i is the sum of the output produced by local and foreign firms. Given equal factor intensities, aggregate output can be written as:

$$Y^i = z^i \left(\left(\theta^i\right)^{\frac{1}{1-\nu}} \omega^1 m L^1 + \left(x^i\right)^{\frac{1}{1-\nu}} \int_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF\left(e\right) L^i \right)^{1-\nu} \left(K^i\right)^{\alpha\nu} \left(F(\bar{e}^i) L^i\right)^{(1-\alpha)\nu}$$

The share of total capital (=share of total labor) controlled by foreign firms in country i is given by:

$$s^i = \frac{\left(\theta^i\right)^{\frac{1}{1-\nu}} \omega^1 m L^1}{\left(x^i\right)^{\frac{1}{1-\nu}} \int_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF\left(e\right) L^i + \left(\theta^i\right)^{\frac{1}{1-\nu}} \omega^1 m L^1}$$

Using this expression, we can rearrange terms and express output in terms of s^i to obtain:

$$Y^i = z^i x^i \left(\frac{1}{1-s^i} \int_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF\left(e\right) L^i \right)^{1-\nu} \left(K^i\right)^{\alpha\nu} \left(F(\bar{e}^i) L^i\right)^{(1-\alpha)\nu}$$

The higher is s^i, the higher is the observed productivity of an economy, because a larger fraction of the factors of productions is controlled by more, and perhaps also more productive entrepreneurs. Using the optimality condition for the mass of foreign entrepreneurs in country 1 we can show that :

$$s^i = \max \left\{ 0, 1 - \left[\frac{\left(1-\tau_D^1\right)\pi^1}{\left(1-\tau_F^i\right)\left(1-\nu\right) z^i} \right]^{\frac{1}{\nu}} \left(\frac{\left(\frac{x^i}{\theta^i}\right)^{\frac{1}{1-\nu}} \int_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF\left(e\right)}{\left(K^i/L^i\right)^{\alpha} \left(F(\bar{e}^i)\right)^{(1-\alpha)}} \right) \right\}$$

Using this expression, and assuming an interior equilibrium,i.e. $0 < s^i < 1$, we can re-arrange terms and obtain

$$Y^i = \left(\frac{\left(z^i \theta^i\right)^{\frac{1}{1-\nu}} \left(1-\tau_F^i\right)\left(1-\nu\right)}{\left(1-\tau_D^1\right)\pi^1} \right)^{\frac{1-\nu}{\nu}} \left(K^i\right)^{\alpha} \left(F(\overline{e}^i) L^i\right)^{(1-\alpha)} ,$$

This equation has important implications. First, the total factor productivity (TFP) in each country depends on the equilibrium profits in the developed world. Those profits are determined as part of the equilibrium in the global economy and can be affected by developments in other developing countries. For example, suppose that country j reduces τ_F^j. In the new equilibrium, π^1 will be higher. The results in a reduction of output and TFP of all the other countries i, including $i = 1$. Second, this equation makes very clear that, everything else constant, a higher tax rate on foreign firms' profits, τ_F^i, decreases TFP and output. Finally, if everything else is constant (including $\overline{e}^i$) , an increment in x^i leaves out Y^i unchanged. But s^i will fall, so the fraction of output obtained by nationals of country i increases, increasing their consumption and welfare.

Note that in the absence of international entrepreneurial mobility, x and z operate in the same way. That is, the only relevant variable for a country's welfare is xz. Under entrepreneurial mobility, x and z operate very differently. Suppose that countries i and j are such that $z^i x^i = z^j x^j$, with $z^i > z^j$. Assume that these countries are identical with respect to the other parameters. Under no entrepreneurial mobility, these two countries will look exactly the same. However, with entrepreneurial mobility, country i will receive a higher share of foreign entrepreneurs, and will thus have a higher output level. A higher x reduces the share of foreign entrepreneurs, whereas a higher z increases this share.

Finally, we can use the expressions above to simplify country i's resource constraint:

$$A_{t+1}^i + C_t^i + I_t^i = \left[1 - \left(1 - \tau_{Ft}^i\right)\left(1-\nu\right) s_t^i\right] Y_t^i + \left(1 + r^*\right) A_t^i \text{ , } i = 2, ..., I$$

Note that a higher share s_t^i increases current output but also raises the share of output that is extracted by foreign entrepreneurs.

4.5. A Simple Experiment

As a useful benchmark, we can easily compute the change in output across balanced growth paths due to a change in τ_F and τ_K. In this benchmark, we take as given the foreign interest rate and profits earned by foreign firms in country 1. The change in output is given by:

$$\frac{Y'}{Y} = \left(\frac{1-\tau'_K}{1-\tau_K}\right)^{\frac{\alpha}{1-\alpha}} \left(\frac{1-\tau'_F}{1-\tau_F}\right)^{\frac{1-\nu}{\nu(1-\alpha)}} \frac{1-F(\bar{e}')}{1-F(\bar{e})}$$

Note that the change in output is independent of the initial value of τ_F, for a given change in τ_F. For illustrative purposes, let's assume that $\nu = 0.85$, $\alpha = 1/3$ and $\bar{e}$ remains unchanged across policies. Then, a reduction in τ_F from 0.2 to 0 increases output 6% and the same reduction in τ_K increases output by 11.8%. Finally, the welfare effects are more complicated because we need to deal with transitional dynamics. We now move to the quantitative analysis of the model to deal with this.

4.6. Using the Model to Separate $\left\{z^i, x^i/\theta^i\right\}$

At time 0, we use data on $\{Y_t^1, L_t^1, Y_t^i, L_t^i, K_t^i, s_t^i, \tau_F^i, \tau_D^i : i = 2, ...I\}$ to infer z^i and x^i/θ^i. We assume that the world interest rate is given at r^*. Again, we normalize $x^1 = 1$, so x_t^i must be interpreted as the ratio with respect to x_t^1.

Our algorithm proceeds as follows. We first guess m^1. Then we assume that country 1 is in a balanced growth path, so we can solve for K^1 using:

$$\frac{\alpha\nu Y^1}{K^1} = \frac{(r^* + \delta)}{1-\tau_K^1}$$

Alternatively, we could have used data on K^1 instead of assuming a balanced growth path in country 1. We can then determine z^1 from:

$$z^1 = \frac{Y^1}{\left(m^1 \omega^{1\cdot} L^1\right)^{1-\nu} \left(K^1\right)^{\alpha\nu} \left(\left(1-\omega^1\right) L^1\right)^{(1-\alpha)\nu}}$$

Then, we can solve for profits of entrepreneurs in the developed country:

$$\bar{\pi}_1^1 = (1-\nu)\, z^1 \left(\frac{1}{m^1 \omega^{1\cdot}}\right)^{\nu} \left(K^1/L^1\right)^{\alpha\nu} \left(1-\omega^1\right)^{(1-\alpha)\nu}$$

Then we take Y^i/L^i and K^i/L^i from the data, and we can solve for z^i:

$$Y^i/L^i = \left(z^i \theta^i\right)^{\frac{1}{\nu}} \left(\frac{\left(1-\tau_F^i\right)(1-\nu)}{\left(1-\tau_D^1\right)\pi_1^1}\right)^{\frac{1-\nu}{\nu}} \left(K^i/L^i\right)^{\alpha} \left(1-\omega^i\right)^{(1-\alpha)}$$

We will assume a value of $\bar{e}^i$ such that the fraction of entrepreneurs in country i is ω^1. We can then solve for $\frac{x^i}{\theta^i}$:

$$\left(\frac{x^i}{\theta^i}\right)^{\frac{1}{1-\nu}} = \left(1-s^i\right) \frac{\left(1-\tau_F^i\right)(1-\nu)}{\left(1-\tau_D^1\right)\pi_1^1} \frac{Y^i}{L^i} \frac{1}{\int\limits_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF(e)}$$

Finally, we compute $\{m^i\}_2^N$ from:

$$m^i = \frac{s^i}{1-s^i} \left(\frac{x^i}{\theta^i}\right)^{\frac{1}{1-\nu}} \int\limits_{\bar{e}^i}^{\infty} e^{\frac{1}{1-\nu}} dF(e) \frac{L^i}{\omega^1 L^1}$$

We will update m^1 until $\sum_i m^i = 1$.

5. Quantitative Analysis

5.1. The Experiments

Starting at $t = 0$ we consider permanent, and exogenous changes in foreign income taxes τ_F^i at $t = 1$. We consider two cases:

1. Unilateral changes: Country i reduces the tax rate from $\tau^i_{F,0}$ to $\tau^i_{F,1}$,

2. Simultaneous changes: All countries simultaneously reduce their tax rate from $\tau^i_{F,0}$ to $\tau^i_{F,1}$.

We also consider the case where every country except country j reduces τ^i_F from $\tau^i_{F,0}$ to $\tau^i_{F,1}$. For small countries, this is very similar to assuming that π^1_1 remains constant.

In our benchmark experiments we assume financial integration., i.e. countries can borrow and lend freely at the internationally given interest rate. We take the initial period ($t = 0$) to be 1998.

We use the algorithm derived from the equilibrium conditions to map the model to the data for the base year, $t = 0$. Fixing a value for θ^i we derive the values of $\{z^i, x_i\}$ for which the model's predicted values for output, capital/labor ratios, and the share of foreign-controlled capital in each country coincides with to those in the data. Moreover, we assume that country 1 is in a balanced growth path at $t = 0$, given the policy variables in that period. Most of the other countries have a capital/labor ratio that is below the steady state values.

We compare the welfare gains of reducing τ^i_F with two other benchmark experiments. We compute the resulting equilibrium dynamics and compare the utility of the representative agent with the one that would have obtained under an unchanged policy. We use the concept of equivalent variation as the metric to compare welfare. The equivalent variation is the percentage change in consumption such that utility under the initial policy is equalized to the one under the new policy.

We later compare the results with two other experiments. The first involves setting $\tau^i_K = 0$ for all countries. The second experiment corresponds to comparing the welfare gains under financial integration and financial autarky.

5.2. Data and Parameter Values

Our quantitative analyses are based on publicly available data. We define two sets of countries. The first set is country 1, which is defined as an aggregate of 15 developed countries: Australia, Austria, Belgium, Canada, Switzerland, Denmark, Finland, France, Great Britain, Italy, Japan, Netherlands, Norway, Sweden, and US. The second set, is the set of developing countries $i = 2,..., 42$ and is given by the following countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Peru, Paraguay, El Salvador, Uruguay, Venezuela, China, Egypt, Indonesia, India, Israel, Jordan, South Korea, Malaysia, Pakistan, Philippines, Singapore, Syria, Thailand, Botswana, Morocco, Tunisia, Spain, Greece, Ireland, Iceland, New Zealand, Portugal, Turkey.

Data on GDP, physical investment, and labor force for each country was obtained from The Penn World Tables, Version 6.1. Capital stocks are constructed using a permanent inventory scheme. Such method is widely used (e.g. Bernanke and Gürkaynak (2001)). We assume an annual depreciation rate of 6%. We use the stocks of foreign controlled capital constructed by Lane and Milesi-Ferreti (2001) to measure the share of the capital controlled by foreigners. Those measures are based on cumulative FDI flows including reinvested profits.

Table 1
Parameter Values

β	0.96
n	0.74%
g	0.86%
r^*	5.4%
δ	6%
σ	1
α	0.33
ν	0.85
θ	1

Table 1 displays the parameter values in the benchmark calibration of the model. As in Gourinchas and Jeanne, we calibrate n, g, and β to replicate the main long run growth features of the US economy. The world interest rate r^* is chosen so that

$$(1+g)^{\frac{-\sigma}{1-\alpha\nu}}\beta\left(1+r^*\right)=1 \tag{5.1}$$

which is the only value compatible with equilibrium asymptotically. The resulting value is 5.4%.

We choose a Gamma distribution for F^i. Such distribution family is very flexible and tractable. Since we are normalizing $E(e) = 1$, there is only one parameter left to calibrate. We choose the parameter so that the initial fraction of entrepreneurs over the labor force is 12% in all countries. This is consistent with the management occupations as a fraction of total employment in the US in 2000 as reported in the Current Population Survey. This value is also consistent with calibrations in Gentry and Hubbard (2000), Quadrini (2000), and Chari, Golosov and Tsyvinski (2002).

We choose $\alpha = 1/3$, a value commonly used for this parameter. We set $v = 0.85$ to replicate the key features of the size distribution of firms. Here we follow the arguments in Atkeson, Kahn, and Ohanian (1996), and Atkeson and Kehoe (2002). This parameter is very important in determining the output and welfare effects of entrepreneurs international mobility. Given that, we also ran our experiments with $\nu = 0.70$.

Given the lack of direct evidence, we set $\theta = 1$. Interestingly, we show that the value of this parameter is not important when $\zeta = 0$, i.e. when there is no diffusion of technologies from foreign to local firms. In addition to $\zeta = 0$ we also experiment with two other values $\zeta \in \{0.5, 1\}$.

Finally, we calibrate the taxes $\left\{ \tau^i_{D,t} , \tau^i_{F,t}, \tau^i_{K,t} \right\}$ as follows. We choose the tax rate on capital income so that the steady state investment/GDP ratio for each country is equal to the average in the data between 1990 and 1998. Table 2 reports the resulting value of τ^i_K for each country. For some countries the resulting tax rate is negative. Clearly, this tax measure is capturing many distortions that are reflected in cross-country differences in investment rates. As we report below, those distortions have interesting and complex interactions with the other taxes.

We choose corporate taxes, τ^i_D, using data from Ernst and Young's *Worldwide Corporate Tax Guide* for the year 2001. For country 1 (average of 15 developed countries), we set $\tau^1_D = 0.3$. We use the Bureau of Economic Analysis (BEA) surveys of US Direct Investment between 1982 and 2001 to obtain effective foreign income tax rates, τ^i_F. We follow Desai, Foley, and Hines (2003) and compute this tax rate by taking the ratio of the sum of foreign income taxes to the sum of net income and foreign income taxes for all affiliates in each country. For the countries in our sample for which BEA does not report affiliates information (Bolivia, El Salvador, Uruguay, Nicaragua, Paraguay, Pakistan, Syria, Botswana, Egypt, Jordan, Morocco, Tunisia, and Iceland), we use an average of the countries in the geographic regions for which BEA does report information. We then assume that countries from other developed countries face the same effective tax rates as

US affiliates. An important caveat on our measure is that for some countries like US, firms face the same corporate tax rate for all worldwide income. So, in that case, the foreign income tax rate is irrelevant if it is higher than the domestic corporate tax rate. While we understand that this is a serious limitation of our measure for some countries in our sample, we think that the effective tax rates we compute are an informative measure of the barriers on international mobility of entrepreneurs. Table 2 reports the values of τ_D^i and τ_F^i for each country in our sample.

We wish to emphasize that while we view our baseline parametrization as a plausible benchmark, we also acknowledge substantial uncertainty about all individual parameter values. Thus, we ran numerous experiments to test the sensitivity of the model. We report only a subset to conserve on space.

6. Quantitative Results

- Table 2 displays, and figure 2 plots the values of $\left(x^i/\theta^i\right)/x^1$ and z^i/z^1 for 1998 that we infer from the model. We observe a positive relation between x^i/θ^i and z. Also, z is more dispersed than x.

- We first focus on a specific change in τ_F^i, and then we investigate how the output and welfare gains depend on the size of the change in τ_F^i.

- Table 3 reports the response of several variables to a unilateral decrease in τ_F^i such that $(1-\tau_F^i)$ increases by 25%. That is, $\left(1-\tau_{F,1}^i\right) = 1.25\left(1-\tau_{F,1}^i\right)$[2]. We first study the case with no technology diffusion from foreign to domestic entrepreneurs. The median share of capital controlled by foreign

[2] We chose this experiment, as opposed to many other alternatives, because as a useful benchmark we know that the change in output is proportional to the change in $1-\tau_F^i$. So, we think that the welfare calculations are not so sensitive to the *initial* value of τ_F^i.

entrepreneurs in developing countries increases from an initial level of 12% by a median ratio of 3.3 across balanced growth paths. The median output increase across balanced growth (relative to the output change under no policy change) is 5.9%. The median welfare gain for each country, measured as equivalent variation in consumption, is 2.1%. The gains differ considerably across countries, ranging from a loss of -1.2% to 3.4%.[3] In table 4 (where we consider the case with $\theta^i = 0.75$) we can see that output and welfare gains are quite insensitive to θ^i. This suggests that in the case of no technology diffusion, welfare gains depend on x^i/θ^i, and not so much on θ^i.[4]

- The welfare gains increase considerably with technology diffusion from foreign entrepreneurs to domestic entrepreneurs. Concretely, when ζ is equal to 0.5 and 1, the median welfare gain is 5.8% and 14.0%, respectively. Note that, as x starts to grow, the share of capital controlled by foreign entrepreneurs eventually falls to 0. This exercise points out to the importance of diffusion of foreign organizational capital in evaluating the welfare gains of removing barriers to international mobility of entrepreneurs.[5]

- If all countries reduce τ_F^i simultaneously (in the same magnitude as under the unilateral change described above), the median output increase is 2.91% and the median welfare gain is 0.34%. The gains are considerably smaller than under a unilateral reduction in τ_F^i. This is because countries face more competition from other countries, thus increasing profits earned by firms in country 1. So, the share of capital controlled by foreign entrepreneurs

[3] There could be several reasons for which a country might suffer a welfare loss after a unilateral reduction in τ_F^i. One of those reasons is that the country is lose part of the revenues from taxing foreign firms.

[4] In our calibration, the resulting values of $\bar{e}^i$ are very insensitive to policy changes.

[5] We can see that assuming a lower value of θ^i increases the output and welfare gains substantially. Given the shares s^i a lower θ^i implies a lower x^i (in order to keep the initial s^i constant), and the *growth* rate of x^i is decreasing on the initial value of x^i.

increases, but only by a factor of 1.87 (versus 3.3 in the unilateral case). Assuming technology diffusion, the median welfare gains is larger (5.11% and 7.38% under $\zeta = 0.5$ and $\zeta = 1$, respectively).

- In the developed region (country 1), output falls by 3% across balanced growth paths. Given the other taxes, the country experience a welfare loss of 0.19%.

- The welfare loss in country 1 seems counterintuitive, but it is closely related to the interaction of the reduction in τ_F^i with other distortions in the economy (i.e.: the presence of corporate and capital income taxes). In table 4 we can see that, assuming capital and corporate tax rates equal to zero, then a simultaneous reduction in τ_F^i increases welfare by 0.38%.

- The median welfare loss of not reducing τ_F^i when all the other countries do, is 0.85%. Countries that do not reduce τ_F^i when others do suffer a reduction in the number of foreign entrepreneurs that move to countries where policy conditions have improved.

- We redid the experiments assuming that $\nu = 0.7$. The median output and welfare gain increase substantially. Under a unilateral reduction in τ_F^i, the median output and welfare gain under $\zeta = 0$ ($\zeta = 1$) are 14.3% and 3.1% (31.2% and 34.2%), respectively. Assuming a simultaneous decrease in τ_F^i by all countries, the median output and welfare gain under $\zeta = 0.5$ ($\zeta = 1$) are 6.9% and 0.6% (17.3% and 17.3%), respectively.

- We now focus on changes in τ_F^i of different magnitudes.

- Figures 3 and 4 display the median gain in output and welfare for developing countries to unilateral changes in taxes, for different values of b, where $\tau_{F,1}^i =$

$b\tau^i_{F,0}$. When τ^i_F is reduced from the actual 1998 value to 0 (i.e.: $b = 0$), the median output and welfare gain are 9% and 1.5%, respectively, when $\zeta = 0$ (19.8% and 20.7%, respectively, when $\zeta = 1$). With a high enough value of b ($b = 2$ in this case), the share of foreign entrepreneurs falls to 0 after the policy change. When τ^i_F is doubled starting from the actual 1998 value, the median output and welfare loss are 4.8% and 1.6%, respectively, when $\zeta = 0$ (9.4% and 8.3%, respectively, when $\zeta = 1$).

- Table 5 reports output and welfare gains of moving from zero mobility to no tax-barriers to mobility. We consider both, global and unilateral changes. We do these exercises as follows. First, we calibrate the initial x^i and z^i as described above, using the actual values of Y^i , K^i , s^i , τ^i_K , and τ^i_D in 1998. Then, with the values of$\{x^i, z^i\}$ thus obtained, we set $\tau^i_{F,0} = 1$ and assume that all the countries are initially in the balanced growth path.. Then, examine the both unilateral and global permanent reductions in τ^i_F from 1 to 0.

- Consider first unilateral reductions in τ^i_F. With no diffusion, i.e. assuming $\zeta = 0$, the median output and welfare gain for countries $2, ..., I$ are 5.1% and 17.3%. With full technology diffusion ($\zeta = 1$), the output and welfare gains are 36.6% and 39.5%, respectively.

- Consider now a simultaneous reduction in τ^i_F by all developing countries, from 1 to 0. Assuming first $\zeta = 0$, the median output and welfare gain for countries $2, ..., I$ are smaller then in the unilateral case, and equal to 7.1% and 1.1%, respectively (20.2% and 20.3%, respectively, when $\zeta = 1$). In the developed country ($i = 1$), when $\zeta = 0$ output and welfare fall by 9.7% and 0.7%, respectively.[6] World output increases by 0.4% when $\zeta = 0$, and by

[6] We can see in Table 5 that if we eliminate the other distortions ($\tau^i_K = \tau^i_D = 0$), country 1

18.2% when $\zeta = 1$.

- Recognizing the interaction of other distortions, we also conducted the last two experiments imposing $\tau_K^i = \tau_D^i = 0$. Again, we obtained the values of $\{x^i, z^i\}$ obtained with the actual values of Y^i, K^i, s^i, τ_K^i, and τ_D^i in 1998. Then, forcing all the countries to be in the balance growth path with $\tau_K^i = \tau_D^i = 0$ and $\tau_F^i = 1$, we examine the implications of unilateral and global movements to $\tau_F^i = 0$. Needless to say, the initial output and consumption levels for each country are higher in this experiment than in the previous ones. The results are shown in the last three columns of Table 5. We find that for most developing countries, the welfare and output gains are significantly lower. It seems that eliminating the distortions in the developed country reduces the gains for developing countries to eliminating the barriers to foreign firms. More interestingly, country 1 now has a positive gain, even when there is diffusion. Clearly, the distortions introduced by τ_K^1, τ_D^1 account for the welfare loss of country 1 in the previous experiments.

- It is useful to compare the welfare gains from changes in the other taxes. For instance, assuming $\zeta = 0$, there is median welfare gain of 2.5% if countries unilaterally reduce capital taxes from their original value to 0% . . Also, the median welfare gain for each country of individually shifting from financial autarky to financial integration, given unchanged τ_F^i, is 0.3%. These gain is comparable to that computed by Gourinchas and Jeanne (2004), and stems from the fact that under financial integration countries reach the balanced growth path faster. If countries also reduce τ_F^i, then the median welfare gain of moving to financial integration is 0.5%. The gains are higher now because the balanced growth path capital stock under lower foreign profit taxes is

experiences a gain of 0.7%.

even larger. Borrowing is valuable because it allows the economy to reach this higher capital level faster. Note that the gains from these alternative experiments are all considerably smaller relative to the ones from unilateral reductions in τ_F^i from 1 to 0, even in the absence of technology diffusion.

7. Conclusion

- To be added.

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Figure 1: FDI and Tax Rate on Foreign Firms Income

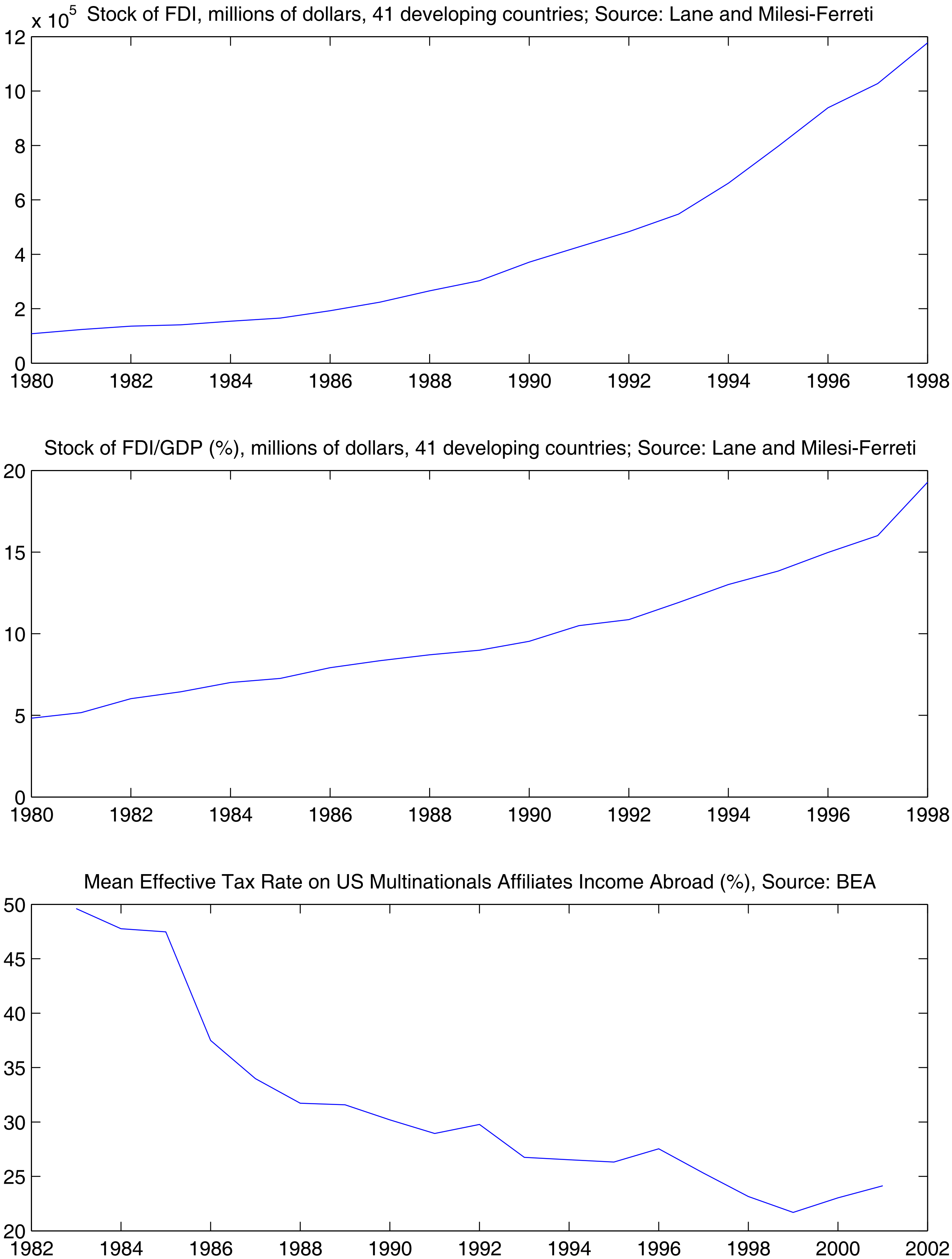


Figure 2: zi/z1 (x-axis) vs. xi/theta/x1 (y-axis)

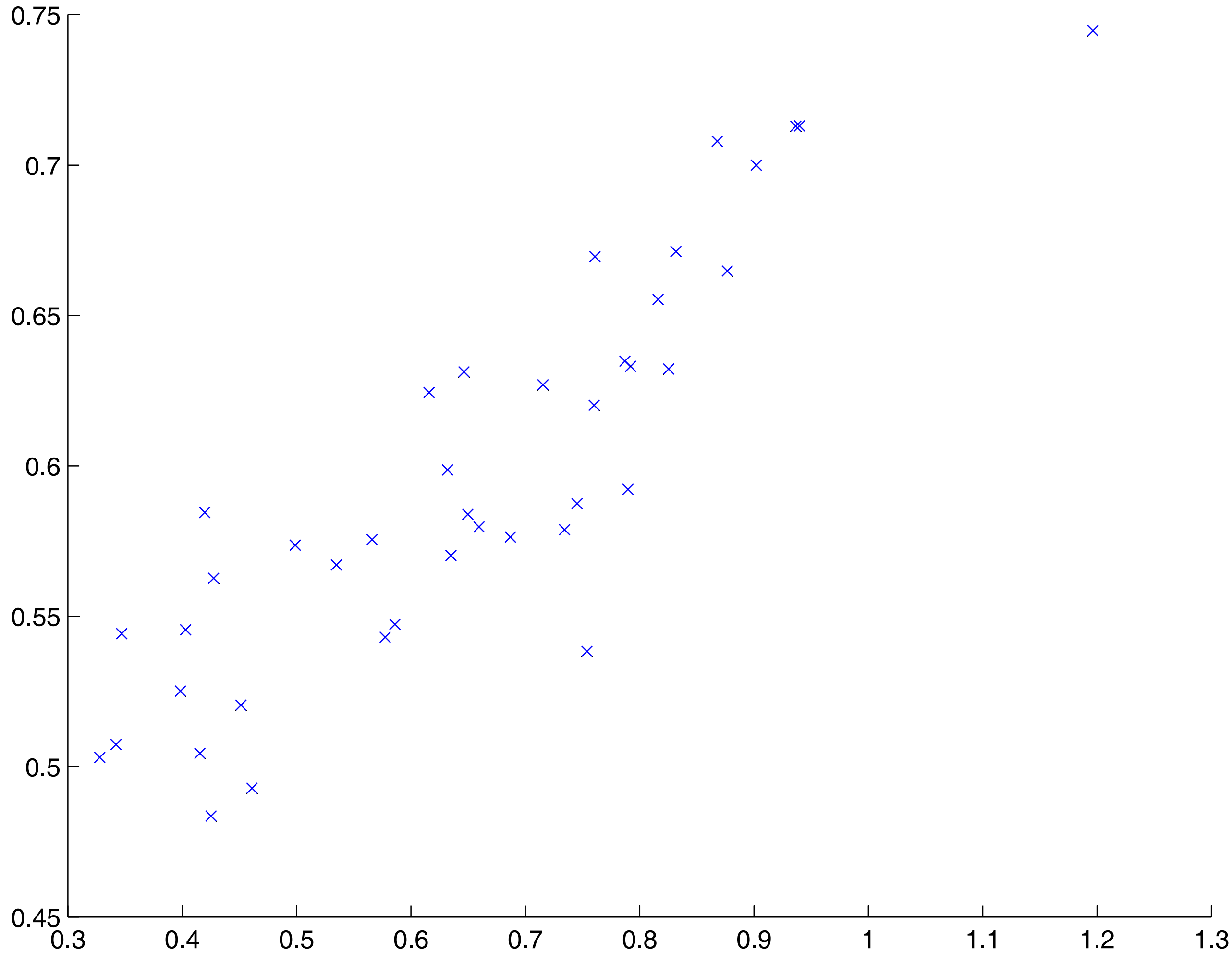
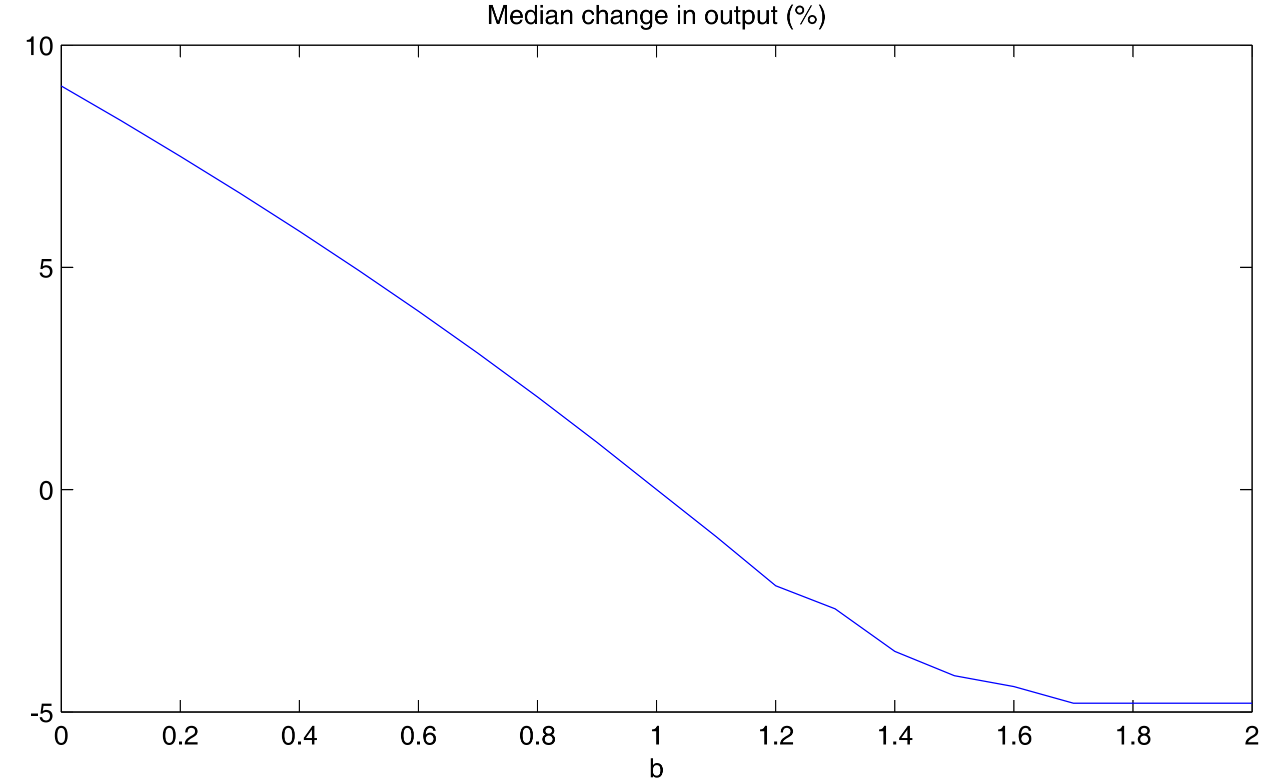


Figure 3: Unilateral change in taoF ; taoF1 = b * taoF0, Diffusion=0



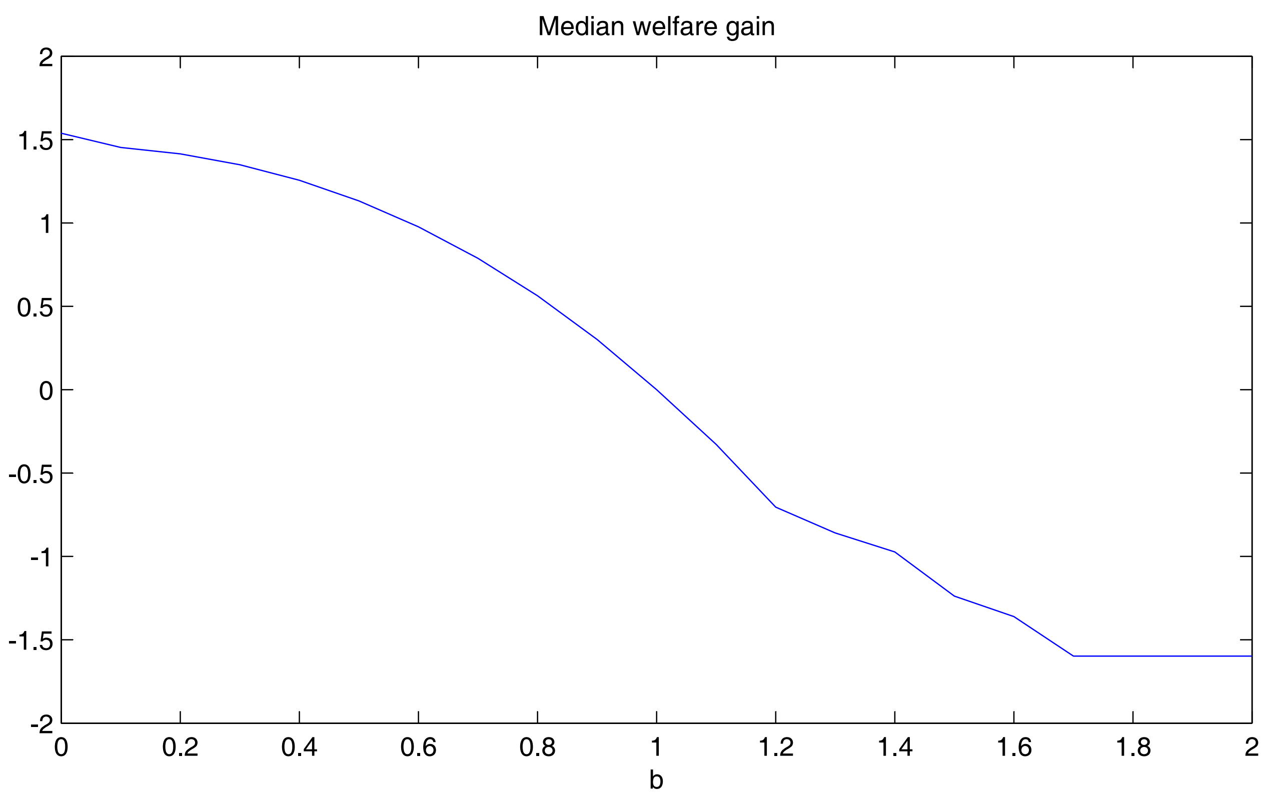
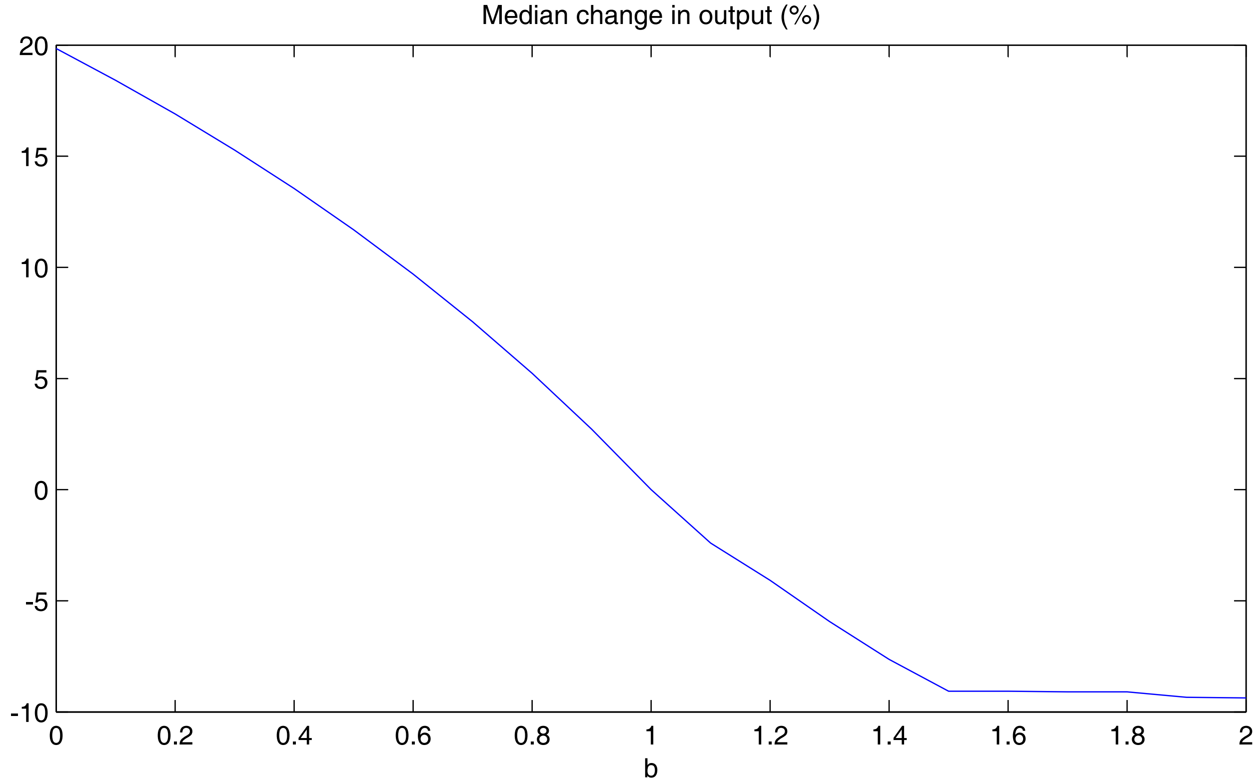


Figure 4: Unilateral change in taoF ; taoF1 = b * taoF0, Diffusion=1



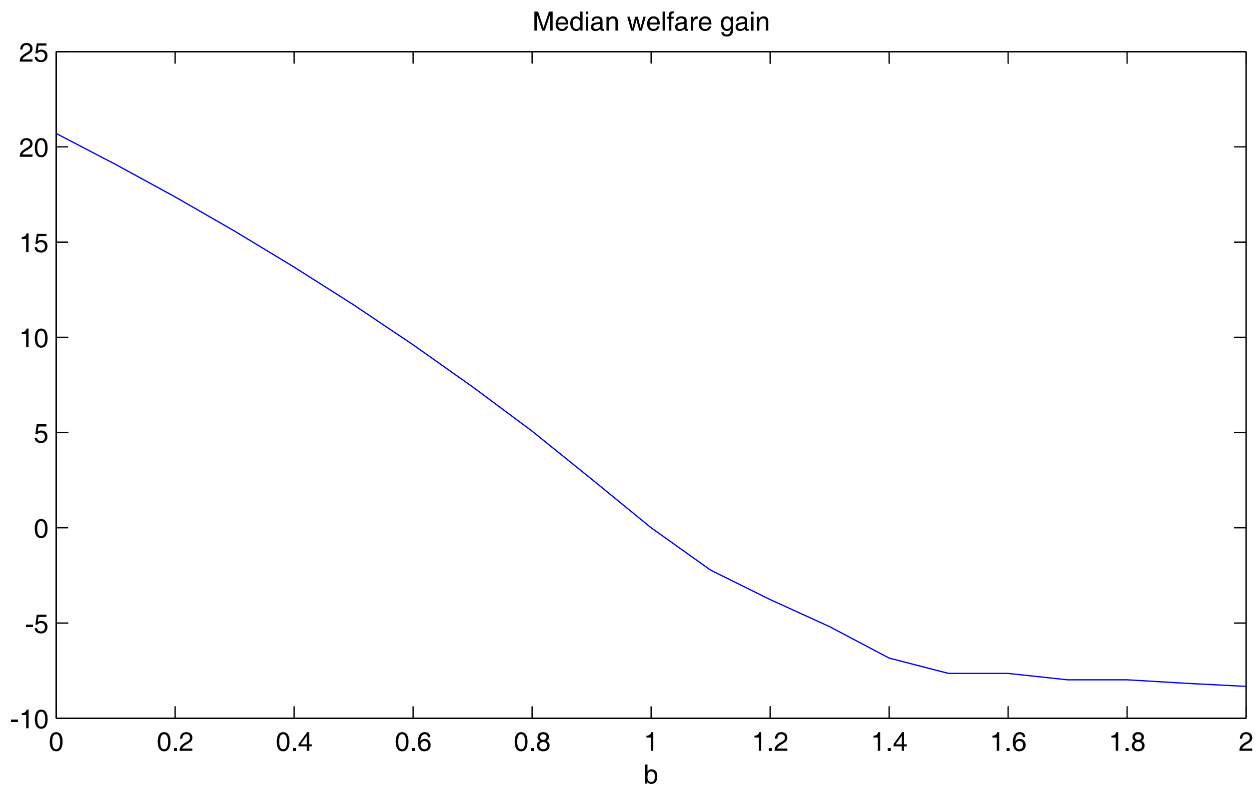


TABLE 2: Calibration and Mapping, t=0 1998

	s^i	τ_K^i	τ_F^i	τ_D^i	z^i	x^i/θ^i
ARG	7.58	18.98	43.38	35.00	0.83	0.63
BOL	35.55	47.28	28.17	31.38	0.42	0.50
BRA	7.23	15.84	21.11	34.00	0.62	0.62
CHL	23.97	-7.60	23.24	16.00	0.79	0.63
COL	18.44	38.12	47.32	35.00	0.58	0.54
CRI	25.86	16.67	25.58	30.00	0.57	0.58
DOM	23.32	31.84	10.59	25.00	0.63	0.60
ECU	14.25	24.12	28.17	25.00	0.50	0.57
GTM	20.04	58.89	19.21	31.00	0.65	0.58
HND	7.28	14.63	34.43	30.50	0.40	0.53
JAM	18.41	0.42	13.91	33.33	0.35	0.54
MEX	13.59	-0.20	29.95	35.00	0.72	0.63
NIC	11.99	32.41	33.51	25.00	0.33	0.50
PER	9.52	2.00	28.17	30.00	0.43	0.56
PRY	14.95	40.62	29.04	30.00	0.53	0.57
SLV	13.05	55.54	33.51	28.83	0.69	0.58
URY	6.58	41.51	29.04	30.00	0.79	0.63
VEN	10.81	30.68	18.89	51.00	0.65	0.63
CHN	18.93	-7.74	24.29	30.00	0.34	0.51
EGY	35.01	74.12	44.14	40.00	0.75	0.54
IDN	17.65	9.46	45.77	30.00	0.45	0.52
IND	3.98	36.96	56.43	35.00	0.43	0.48
ISR	4.12	-45.96	21.70	36.00	0.94	0.71
JOR	11.92	15.93	44.14	35.00	0.66	0.58
KOR	2.31	-83.31	31.50	37.00	0.76	0.67
MYS	36.33	-38.24	25.95	28.00	0.76	0.62
PAK	9.21	45.73	56.43	45.00	0.46	0.49
PHL	12.10	24.34	22.85	32.00	0.40	0.55
SGP	22.30	-28.16	8.58	24.50	0.87	0.71
SYR	4.07	53.44	44.14	35.00	0.75	0.59
THA	8.88	-68.61	19.51	30.00	0.42	0.58
BWA	13.13	27.01	47.93	25.00	0.79	0.59
MAR	11.14	40.23	47.93	35.00	0.59	0.55
TUN	17.92	31.56	47.93	35.00	0.73	0.58
ESP	8.36	-21.36	25.47	35.00	0.90	0.70
GRC	4.87	-6.09	41.64	35.00	0.82	0.66
IRL	13.84	-1.25	8.82	16.00	1.20	0.74
ISL	3.10	-18.19	20.92	18.00	0.94	0.71
NZL	22.64	-7.67	30.65	33.00	0.88	0.66
PRT	8.87	-23.64	27.16	40.00	0.83	0.67
TUR	2.80	-3.52	52.21	40.00	0.63	0.57
Median	12.10	15.93	29.04	32.00	0.65	0.58

TABLE 3: Benchmark Calibration

	diffusion=0	*v=0.85, theta=1* *Actual taoD, taoK* *diffusion=0.5*	*diffusion=1*
UNILATERAL CHANGE			
Welfare			
Median (countries 2,…,I)	1.48	5.75	14.02
Mean (countries 2,…,I)	1.43	6.13	13.34
Max (countries 2,…,I)	3.44	10.24	21.58
Min (countries 2,…,I)	-1.22	3.72	4.11
Level (country 1)	n.a.	n.a.	n.a.
GDP			
Median (countries 2,…,I)	5.91	6.48	14.08
Mean (countries 2,…,I)	5.91	6.53	13.59
Max (countries 2,…,I)	5.91	10.35	20.69
Min (countries 2,…,I)	5.91	3.84	4.58
Level (country 1)	n.a.	n.a.	n.a.
Share of factors controlled by foreign entrepreneurs			
Share (t=1) / Share (t=0) , median	2.68	2.68	2.68
Share (t=10) / Share (t=0) , median	3.34	0.00	0.00
UNIFORM CHANGE			
Welfare			
Median (countries 2,…,I)	0.34	5.11	7.38
Mean (countries 2,…,I)	0.31	5.00	7.04
Max (countries 2,…,I)	1.49	5.66	11.80
Min (countries 2,…,I)	-1.09	3.21	-2.22
Level (country 1)	-0.19	-0.07	-0.01
GDP			
Median (countries 2,…,I)	2.91	5.84	7.82
Mean (countries 2,…,I)	2.86	5.56	7.42
Max (countries 2,…,I)	2.91	5.91	11.85
Min (countries 2,…,I)	1.36	3.26	-2.82
Level (country 1)	-3.00	-0.01	0.00
Share of factors controlled by foreign entrepreneurs			
Share (t=1) / Share (t=0) , median	1.96	1.96	1.96
Share (t=10) / Share (t=0) , median	1.87	0.00	0.00

TABLE 4: Some Perturbations to Benchmark Model

	v=0.85 , theta=1 *taoK=taoD=0*		*v=0.85, theta=0.75* *Actual taoD, taoK*		*v=0.70 , theta=1* *Actual taoD, taoK*	
	diffusion=0	*diffusion=1*	*diffusion=0*	*diffusion=1*	*diffusion=0*	*diffusion=1*
UNILATERAL CHANGE						
Welfare						
Median (countries 2,…,I)	1.23	14.70	1.48	22.55	3.06	34.20
Mean (countries 2,…,I)	1.35	13.67	1.43	22.34	2.92	32.94
Max (countries 2,…,I)	3.10	21.24	3.44	34.61	8.41	54.71
Min (countries 2,…,I)	-0.14	-3.44	-1.21	10.78	-4.44	11.80
Level (country 1)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GDP						
Median (countries 2,…,I)	5.91	14.81	5.91	22.19	14.34	31.19
Mean (countries 2,…,I)	5.84	13.86	5.91	21.86	14.34	30.41
Max (countries 2,…,I)	5.91	20.93	5.91	31.35	14.34	45.83
Min (countries 2,…,I)	4.19	-4.29	5.91	11.94	14.34	12.17
Level (country 1)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Share of factors controlled by foreign entrepreneurs						
Share (t=1) / Share (t=0) , median	2.68	2.68	2.68	2.68	2.98	2.98
Share (t=10) / Share (t=0) , median	3.47	0.00	3.31	0.00	3.68	0.00
UNIFORM CHANGE						
Welfare						
Median (countries 2,…,I)	0.24	9.04	0.32	12.20	0.55	17.26
Mean (countries 2,…,I)	0.33	7.74	0.31	11.18	0.47	16.98
Max (countries 2,…,I)	1.44	13.41	1.49	16.97	3.47	28.23
Min (countries 2,…,I)	-1.01	-10.77	-1.08	-2.61	-3.14	-0.65
Level (country 1)	0.38	0.01	-0.20	-0.01	-0.25	-0.04
GDP						
Median (countries 2,…,I)	3.48	9.49	2.91	12.59	6.90	17.32
Mean (countries 2,…,I)	3.21	8.04	2.86	11.44	6.82	16.93
Max (countries 2,…,I)	3.48	13.75	2.91	16.61	6.90	26.24
Min (countries 2,…,I)	0.00	-12.72	1.29	-3.69	4.01	-1.32
Level (country 1)	-2.43	0.00	-3.00	0.00	-7.44	0.00
Share of factors controlled by foreign entrepreneurs						
Share (t=1) / Share (t=0) , median	2.10	2.10	1.96	1.96	2.14	2.14
Share (t=10) / Share (t=0) , median	2.42	0.00	1.86	0.00	2.27	0.00

TABLE 5: taoF0=1 to taoF1=0, starting in BGP

	taoF0=1 , taoF1=0 *v=0.85, theta=1* *Actual taoD, taoK*			taoF0=1 , taoF1=0 *v=0.85, theta=1* *taoD=taoK=0*		
	diffusion=0	*diffusion=0.5*	*diffusion=1*	*diffusion=0*	*diffusion=0.5*	*diffusion=1*
UNILATERAL CHANGE						
Welfare						
Median (countries 2,…,I)	5.08	18.85	39.49	2.13	13.59	29.20
Mean (countries 2,…,I)	5.64	20.53	45.04	3.09	14.68	32.81
Max (countries 2,…,I)	14.92	40.82	99.41	14.51	36.53	88.01
Min (countries 2,…,I)	-1.39	8.69	15.64	0.00	0.00	0.00
Level (country 1)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GDP						
Median (countries 2,…,I)	17.30	19.16	36.60	11.85	14.53	29.07
Mean (countries 2,…,I)	17.95	20.61	40.06	12.33	15.16	30.28
Max (countries 2,…,I)	29.33	36.92	73.84	33.36	35.07	70.13
Min (countries 2,…,I)	9.11	10.02	17.13	0.00	0.00	0.00
Level (country 1)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
UNIFORM CHANGE						
Welfare						
Median (countries 2,…,I)	1.09	15.87	20.30	0.48	10.72	16.98
Mean (countries 2,…,I)	1.89	17.21	27.18	1.40	11.99	22.45
Max (countries 2,…,I)	7.64	31.48	73.62	9.89	34.33	72.08
Min (countries 2,…,I)	-1.60	8.21	12.05	0.00	0.00	0.00
Level (country 1)	-0.70	-0.09	-0.05	0.73	0.02	0.02
GDP						
Median (countries 2,…,I)	7.57	17.29	20.28	5.47	11.86	17.93
Mean (countries 2,…,I)	8.24	18.00	26.11	6.94	12.73	21.76
Max (countries 2,…,I)	19.61	29.67	59.33	26.98	33.36	60.53
Min (countries 2,…,I)	0.00	9.10	13.53	0.00	0.00	0.00
Level (country 1)	-9.73	-0.01	0.00	-6.38	0.00	0.00
Level (country 1 + country 2)	0.41	10.16	18.18	1.49	8.13	16.09