DEPARTMENT OF ECONOMICS

UNIVERSITY OF MILAN - BICOCCA

WORKING PAPER SERIES

Occupational Choice, Financial Market Imperfections and Development

Emilio Colombo, Ákos Valentinyi

No. 49 - April 2002

Occupational Choice, Financial Market Imperfections and Development[*]

Emilio Colombo
University of Milan - Bicocca

Ákos Valentinyi
University of Southampton & CEPR

January 2002

Abstract

We develop a simple model of occupational choice under financial market imperfections, in the presence of technological convexities. The aim is to analyze the quantitative effect of these imperfections on the level of income. We find that although their effect is relatively large, financial market imperfections alone are not able to explain the observed cross country difference in income. However, when interacted with the issue of mobility, those imperfections become much more relevant, to the point of pushing the economy into a development trap.

1   Introduction

Explaining economic growth has been in the forefront of economic research for a long time. In particular, growth theory experienced a revival since the early 1980s when better data became available leading to the refinement of old theories and inducing new ones. The old theories on physical and human capital accumulation have witnessed new developments, and new theories of R&D based on monopolistic competition have emerged (Lucas (1988), Romer (1986) as the frontrunners). Several models investigated how financial market imperfections influence economic development [see Bencivenga and Smith (1991), Boyd and Smith (1992) and Greenwood and Jovanovic (1990) among others]. Moreover, the empirical evidence also supports the view that financial markets matter for growth [see King and Levine (1993)]. However, little effort has been made to quantify the effects of financial market imperfections on the level of income[1]. This question can only be answered if one calibrates a general equilibrium model in order to assess the effect of financial market imperfections on development. The aim of the present work is to do this in the context of the interaction between wealth distribution and financial market imperfections. There are several papers which analyze qualitatively the relationship between growth, distribution and financial markets [see Aghion and Bolton (1997), Banerjee and Newman (1993, 94), Galor and Zeira (1993), Loury (1981), and Piketty (1997)]. This work follows a line similar to theirs, but we focus on the quantitative instead of the qualitative implications.

   In our model agents can engage in two different activities: they can either become *workers*, earning a competitive wage, or they can become *entrepreneurs*, hiring capital and labour in competitive markets and obtaining an income determined by the difference

---

[1] We agree with Parente and Prescott (2000) who stress that " ... relative income levels rather than growth rates are the key to understanding the problem of development."

between the revenues from selling the output and the cost of production factors. More-over, agents are assumed to be heterogeneous in two respects: they have different wealth levels (initial or inherited from their parents) and they differ in terms of productivity. The distribution of wealth is determined endogenously in the model while the distribution of productivity is exogenously given, and invariant over time. Productivity matters for earnings of both workers and entrepreneurs. *Ceteris paribus* the more productive the agents, the higher their earnings. In the absence of financial market imperfections there is a threshold productivity level such that all individuals below that threshold find it optimal to become a worker, while above that level they find it optimal to become an entrepreneur. However, in the presence of financial market imperfections, some individuals may not be able to borrow the amount necessary to become entrepreneurs. Since more productive individuals typically wish to borrow more as entrepreneurs, imperfections in financial markets are more likely to prevent the more productive individuals to become entrepreneurs. Therefore, if financial markets are imperfect there are less entrepreneurs and more workers in equilibrium than otherwise, determining lower equilibrium output. The present work also assess this effect quantitatively. We find that imperfections, alone, do matter but also that they can explain only part of the cross country differences in income levels. What seems to be relatively more important is the distribution of agents' productivity (or opportunities), and mostly the *interaction* between the degree of mobility within the distribution of abilities and the level of financial market imperfections. In particular we find that, in the presence of low mobility, increasing the level of imperfections can push the economy into a development trap.

From the theoretical point of view the paper contains some interesting results as well. We provide a characterization of the equilibrium in the presence of financial market imperfections, wealth distribution and technological convexities. The paper can be

considered an evolution of Lucas (1978) who provides a static analysis in absence of financial market imperfections, and also of Evans and Jovanovic (1989) who introduce financial market imperfections in a similar framework but who have some technological non-convexities (the wage rate is fixed and not derived endogenously) and who limit themselves to a static analysis.

The remainder of the paper is organized as follows. Section 2 describes the model economy. Section 3 characterizes the equilibrium, while section 4 describes the equilibrium dynamics and presents the numerical results. Finally, Section 5 concludes.

2   Economic Environment

Time is discrete, we consider a small open economy with perfect capital mobility which is populated by a continuum of agents of measure one. The interest rate in the world capital market is r. There is one good that can be used for investment and consumption. Each agent lives for one period in which she chooses an occupation, invests and works. At the end of the period she decides how much to consume of her income, and how much to leave as bequest to her offspring. The population is stationary, that is each agent has one child to take care of.

2.1   Preferences

Agents are assumed to be risk neutral and to have preferences over consumption and bequest.

$$U(c_t, b_{t+1}) = c_t^{1-s} b_{t+1}^s, \tag{1}$$

where c_t and b_{t+1} denote consumption and bequest, respectively. At the beginning of each period individuals receive bequest, invest their wealth, and choose an occupation.

At the end of the period they receive labour income and interest earnings on their investments, and choose consumption and bequest so as to maximize utility. Write ω_t for the total revenues of an individual at the end of the period. Given this simple utility function, optimal consumption and bequest are a constant fraction of total revenues, thus,

$$b_{t+1} = s\omega_t \tag{2a}$$

$$c_t = (1-s)\omega_t. \tag{2b}$$

The indirect utility function now is given by $U(\omega_t) = s^s(1-s)^{1-s}\omega_t$. It follows that rational individuals maximize their total income otherwise they would not maximize consumption.

2.2   Technology

Agents are endowed with a level of ability which determines their productivity when they undertake any economic activity. We assume that in each period the ability level a_t is determined by two factors. The first factor (a_{t-1}) refers to the parental level of ability, as it intends to capture the importance (documented by Becker and Tomes (1986) and Coleman (1966)) of the parental effect in the transmission of skills. The second factor (g) is idiosyncratic and is randomly drawn from a distribution D for each generation.

Assumption 1 $D(\cdot) : [0, \bar{g}] \rightarrow [0, 1]$ *is exogenously given, time invariant, has finite mean and a continuous positive density function* $d(\cdot)$.

We assume similar properties for the initial parental distribution

Assumption 2 $H_0(\cdot) : [0, \bar{h}] \rightarrow [0, 1]$ *is exogenously given, has finite mean and a continuous positive density function* $h(\cdot)$.

Let $F(\cdot)$ be the joint distribution of D and H. To keep the analysis simple we assume that in each period the ability level of each individual is a simple weighted average of the two factors explained above:

$$a_t = \theta a_{t-1} + (1 - \theta) g_t \tag{3}$$

The specification of the ability distribution expressed by (3) deserves a more detailed explanation. Firstly, as stressed above, it allows to capture two different and realistically important channels of transmission of abilities and skills. The terms a_{t-1} and g in fact capture two different effects: the former identifies a local (home) effect, while the latter identifies what can be called an *institutional* effect. The term "institutional" may not seem completely adequate, but it is so if we interpret the distribution of a_t as the *set of opportunities* that individuals face. From this point of view there are some opportunities that derive from the local (home) environment while others depend on the institutional structure of the economy.

Secondly the two components, a_{t-1} and g exert two different effects on the dynamic evolution of a_t: the local component a_{t-1} gives *persistence* to the initial ability distribution, while the "institutional" component g redistributes abilities between periods. Moreover, since, as we shall see, our model does not have a stochastic production function[2], the redistribution of abilities between periods is the only channel of mobility between classes.

---

[2]From this point of view the model differs from Aghion and Bolton (1997), Banerjee and Newman (1993) and Piketty (1997).

Therefore, varying the parameter θ in equation (3) one can change the degree of mobility within the model. Since this does not affect the results of the analytical part, without loss of generality we will initially assume $\theta = 0$, i.e. each member of the new generation receives an ability draw independent of the previous generation. The effect of a change in θ will be addressed in section 4.1.

Agents can engage in two different activities. An individual can choose to become a *worker*. In this case an individual with ability level a_t supplies a_t efficiency unit of labour, and earns a competitive wage w_t per efficiency unit. Alternatively, she may choose to become an *entrepreneur*. In this case she hires capital and labour on competitive markets, and her income is determined by the difference between the revenues from selling the output and the costs from renting production factors.[3] We assume that if an entrepreneur manages k_t units of homogeneous capital, and l_t efficiency units of labour, her firm produces y_t units of output where

$$y_t = a k_t^\alpha l_t^\beta \qquad \alpha + \beta < 1. \tag{4}$$

Entrepreneurs and workers are treated as complementary factors in this setup because firms do not produce without workers, and in turn firms are not set up without entrepreneurs. Therefore, we must observe both entrepreneurs and workers in any equilibrium with positive production.

Assuming perfect competition between entrepreneurs, the marginal products of capital and labour equal factor prices

---

[3]The model is a variant of that of Lucas (1978).

$$r = \alpha a k_t^{\alpha-1} l_t^{\beta} \tag{5a}$$

$$w_t = \beta a k_t^{\alpha} l_t^{\beta-1}, \tag{5b}$$

implying the standard demand function for the production factors:

$$k_t = k(w_t, a) = \left[\left(\frac{\alpha}{r} \right)^{1-\beta} \left(\frac{\beta}{w_t} \right)^{\beta} a \right]^{\frac{1}{1-\alpha-\beta}} \tag{6a}$$

$$l_t = l(w_t, a) = \left[\left(\frac{\alpha}{r} \right)^{\alpha} \left(\frac{\beta}{w_t} \right)^{1-\alpha} a \right]^{\frac{1}{1-\alpha-\beta}} \tag{6b}$$

It is important to note that factor demands also depend on individuals' type. In particular, individuals with higher productivity will run larger firms.

2.3 The structure of the credit market

Each individual born at time t inherits an amount b_t from her parent. We assume that b is distributed as a distribution function $G_t(\cdot)$ at time t. Write $g_t(\cdot)$ for the corresponding density function. Our assumptions later will ensure that $G_t(\cdot)$ has finite mean and support $[0, \bar{b}]$ for all t.[4]

To bring financial markets into the model, we assume that individuals deposit their inherited wealth at competitive banks, and the banks lend the deposits to entrepreneurs. Assuming costless intermediation and perfect competition in the banking sector, both the lending and the borrowing rate must equal the marginal product of capital.

---

[4]Our assumption about the dynamics will ensure that the level of wealth is bounded.

However, we do not rule out the possibility of credit market imperfections. There may be entrepreneurs who wish to borrow at the prevailing interest rate, but banks are not willing to lend to them. We generate imperfections in a very simple way by assuming that a borrower may run away with the output of the project before repaying the loan to the bank. Nevertheless, the bank is always able to seize a fraction π of the output. The borrower repays its debt if the benefit from repaying the debt exceeds the benefit from defaulting on it, thus, if[5]

$$ak_t^\alpha l_t^\beta - w_t l_t - r_t(k_t - b_t) \geq (1 - \pi)ak_t^\alpha l_t^\beta \tag{7}$$

If an individual is not credit constrained, she is going to make an optimal investment and employment decision by equating the marginal product of capital and labour to their respective rental price. In this case we can use equations (5a) and (5b) for the factor prices, and obtain that an individual has no incentive to renege on the contract, given her optimal investment and employment plan, if

$$k_t \leq \frac{\alpha}{\alpha + \beta - \pi} b_t \equiv \lambda b_t, \tag{8}$$

that is, the investment plan cannot exceed an amount proportional to the individual's wealth. Moreover, it is also easy to see that if the optimal level of investment exceeds λb_t, then the incentive compatibility constraint holds for $k_t = \lambda b_t$. Note also that nobody

---

[5]We assume that each individual can always recover the deposit at the bank. This assumption implies that in each period total savings are equal to the capital stock. Alternatively one could assume that there is a 100% depreciation in which case in equation (7) r equals one plus the interest rate. Minor modifications would be needed to accomodate for this change. Finally an even simpler representation of the credit market could assume that credit market imperfections allow each agent to borrow up to an amount that is proportional to her wealth, the factor of proportionality being $\pi - 1$. This assumption would yield the same conclusions as equation (8) with the factor of proportionality being πb instead of λb.

can invest in a firm more than her wealth if $\pi \in [0, \beta]$ and nobody is credit constrained if $\pi \in [\beta + \alpha, 1]$.

2.4 Occupational choice

Individuals choose their occupation optimally. Since individual's utility is monotonically increasing in income, an individual chooses to become an entrepreneur if and only if the return on being an entrepreneur exceeds the return on being a worker.

The entrepreneurial income Π depends on whether the individual is credit constrained or not. If she is not credit constrained, then she chooses both investment and employment optimally by equating the marginal products of their respective rental price. The Cobb-Douglas technology ensures that the entrepreneurial income for an unconstrained individual is $(1 - \alpha - \beta)y_t$. In contrast, if an individual is credit constrained, she invests the maximum amount she can (λb_t) and hires workers optimally by equating the marginal product of labour to its rental price. Since the marginal product of capital is higher than its marginal product due to the credit constraint, the entrepreneurial income for a credit constrained individual becomes $(1 - \beta)y_t - r\lambda b_t$. In summary, the entrepreneurial income is given by

$$\Pi = \begin{cases} (1 - \alpha - \beta)ak_t^\alpha l_t^\beta & \text{if an individual is not} \\ & \quad \text{credit constrained} \\ (1 - \beta)a(\lambda b_t)^\alpha l_t^\beta - r\lambda b_t & \text{if an individual is credit} \\ & \quad \text{constrained.} \end{cases} \tag{9}$$

The occupational choice of an individual depends on whether Π exceeds the the market wage w_t or not.

3 Competitive Equilibrium

Since we are considering a small open economy, the only concern is the labour market equilibrium. The supply and demand of labour depend on how many individuals choose to become an entrepreneur and how much labour they demand. We proceed by deriving the demand for capital and labour of each type of individuals as a function of a cut-off ability level A_t where no individual with $a < A_t$ chooses the become an entrepreneur. The level of investment and employment together with the credit constraint determines who chooses to become an entrepreneur among those individuals with $a \geq A_t$. This allows us to define the competitive equilibrium in term of A_t.

Our first statement concerns the existence of the threshold ability level A_t.

Lemma 1 *If*

$$\lambda \bar{b} > \left[\frac{\beta}{1 - \alpha - \beta} \right]^{\frac{\beta}{1-\alpha}} \left(\frac{\alpha}{r} \right)^{\frac{1}{1-\alpha}} \bar{a}^{\frac{(1+\beta)}{1-\alpha}} \tag{10}$$

then there is a unique A_t such that some individuals of type A_t are not credit constrained, and those individuals are indifferent between becoming a worker and an entrepreneur.

Proof. Suppose that an individual of type A_t is unconstrained. It follows from (9) that such an individual is indifferent between becoming a worker or an entrepreneur if and only if

$$(1 - \alpha - \beta) A_t k_t^\alpha l_t^\beta = A_t \beta A_t k_t^\alpha l_t^{\beta-1}$$

where we used the fact the the market wage equals the marginal product of labour in efficiency units. Using the labour demand of an unconstrained entrepreneur from

11

equation (6b), this can be rewritten as

$$\left[\left(\frac{\alpha}{r}\right)^{\alpha}\left(\frac{\beta}{w_t}\right)^{1-\alpha}\right]^{\frac{1}{1-\alpha-\beta}} A_t^{\frac{\alpha+\beta}{1-\alpha-\beta}} = \frac{\beta}{1-\alpha-\beta} \tag{11}$$

which has a unique solution in A_t.

It remains to be proved whether there is an unconstrained individual with ability level A_t. Combining condition (11) with equation (6a), we obtain that the optimal unconstrained investment level of an individual of type A_t is

$$k_t = \left[\frac{\beta}{1-\alpha-\beta}\right]^{\frac{\beta}{1-\alpha}}\left(\frac{\alpha}{r}\right)^{\frac{1}{1-\alpha}} A_t^{\frac{(1+\beta)}{1-\alpha}}.$$

Condition (10) ensures that one can find unconstrained individuals even among the most productive entrepreneurs implying the existence of unconstrained individuals for any $A_t \leq \bar{a}$. □

No individuals with ability $a < A_t$ choose to become an entrepreneur by construction. However, an individual with $a \geq A_t$ may or may not find it profitable to become an entrepreneur depending on whether she is credit constrained or not. Equation (9) shows that the entrepreneurial income is increasing in the firm size. Therefore, an individual may be so poor, and consequently, her investment would be so low, that her entrepreneurial income falls short of the market wage.

Next we make this intuition more precise. Note that entrepreneurial income depends on firm size. We start by deriving the demand for capital and labour, and the entrepreneurial income both for the credit constrained and unconstrained individuals.

Equation (11) can be solved for the real wage w_t per efficiency unit of labour,

12

$$w_t = w(A_t) = \beta \left[\left(\frac{1-\alpha-\beta}{\beta} \right)^{1-\alpha-\beta} \left(\frac{\alpha}{r} \right)^\alpha \right]^{\frac{1}{1-\alpha}} A_t^{\frac{\alpha+\beta}{1-\alpha}}. \tag{12}$$

This equation tells us that the more an individual find it attractive to become a worker, i.e. the higher is A_t, the higher is the real wage. This condition allows us to write the demand of each class of individuals as a function of A_t.

We first derive the factor demand functions of a *credit constrained* entrepreneur. A credit constrained individual will borrow the maximum amount she possible can

$$k_c(b_t) = \lambda b_t, \tag{13a}$$

which we obtain from equation (8). The demand for labour is determined by the marginal condition (5b)

$$l_c(a, A_t, b_t) = \left(\frac{\beta a (k_c(b_t))^\alpha}{w(A_t)} \right)^{\frac{1}{1-\beta}}. \tag{13b}$$

Using the demand functions, we can derive the income of a credit constrained entrepreneur

$$\Pi_c(a, A_t, b_t) = (1-\beta)a[k_c(b_t)]^\alpha [l_c(A_t, b_t, a)]^\beta - rk_c(b_t). \tag{13c}$$

We then derive the factor demand functions in terms of A_t for an *unconstrained* entrepreneur. Again, substituting equation (12) into the factor demand functions (6a) and (6b) leads to

$$k_u(a, A_t) = \left(\frac{\beta}{1-\alpha-\beta} \right)^{\frac{\beta}{1-\alpha}} \left(\frac{\alpha}{r} \right)^{\frac{1}{1-\alpha}} a^{\frac{1}{1-\alpha-\beta}} A_t^{-\frac{\beta}{1-\alpha}\frac{\alpha+\beta}{1-\alpha-\beta}} \tag{14a}$$

$$l_u(a, A_t) = \frac{\beta}{1-\alpha-\beta} a^{\frac{1}{1-\alpha-\beta}} A_t^{-\frac{\alpha+\beta}{1-\alpha-\beta}}. \tag{14b}$$

Using equation (9), the demand for capital and labour (14a) and (14b), we obtain the entrepreneurial income for an unconstrained entrepreneur

$$\Pi_u(a, A_t) = (1 - \alpha - \beta)a[k_u(a, A_t)]^\alpha[l_u(a, A_t)]^\beta \qquad (14c)$$

It is easy to check that $\Pi_u(a, A_t) \geq \Pi_c(a, A_t, b_t)$.

Once we have the factor demand functions for each type of entrepreneurs, we can derive the threshold level of wealth which determine the occupational choice for individuals with $a > A_t$.

Lemma 2 *There are unique $\underline{B}(a, A_t) \leq \bar{B}(a, A_t)$ such that an individual with ability a and*

(i) with wealth $b \in [0, \underline{B}(a, A_t))$ chooses to become a worker,

(ii) with wealth $b \in \left[\underline{B}(a, A_t), \bar{B}(a, A_t)\right)$ chooses to become an entrepreneur, and she is credit constrained, and

(iii) with wealth $b \in \left[\bar{B}(a, A_t), \bar{b}\right]$ chooses to become an entrepreneur, and she is not credit constrained.

Moreover, the derivatives of $\underline{B}(a, A_t)$ and $\bar{B}(a, A_t)$ with respect to A_t satisfy

$$\frac{\partial \underline{B}(a, A_t)}{\partial A_t} > 0 \qquad \frac{\partial \underline{B}(a, A_t)}{\partial a} < 0 \qquad (15a)$$

$$\frac{\partial \bar{B}(a, A_t)}{\partial A_t} < 0 \qquad \frac{\partial \bar{B}(a, A_t)}{\partial a} > 0 \qquad (15b)$$

Proof. First, we show the existence of $\underline{B}(a, A_t)$. A credit constrained individual is indifferent between becoming a worker or an entrepreneur if the entrepreneurial income

14

equals wage earnings, that is, if

$$\Pi_c(a, A_t, b_t) = aw(A_t).$$

Inspecting equations (13c) and (12) reveals that the entrepreneurial income is increasing in b_t while the wage is independent of it, therefore the previous equation has a unique solution in terms of the wealth $\underline{B}(a, A_t)$. It follows that the market wage exceeds the entrepreneurial income for an individual with $b_t < \underline{B}(a, A_t)$ implying that no such an individual chooses to become an entrepreneur.

Moreover, $\Pi_c(a, A_t, b_t)$ is decreasing while $w(A_t)$ increasing in A_t implying that a higher A_t is associated with a higher b_t for which the above equation holds with equality. Furthermore, inspecting (14c) reveals that $\Pi_c(a, A_t, b_t)/a$ is increasing in a. It follows that a higher ability level a is associated with a lower b_t satisfying the above equation with equality. This proves our claims about the partial derivatives given in (15a).

Next, we show the existence of $\bar{B}(a, A_t)$. Any unconstrained individual with $a > A_t$ finds it optimal to engage in entrepreneurial activity by definition. The optimal level of investment of such an individual is given in equation (14a). Hence, an individual with wealth b_t and with $a > A_t$ is unconstrained if and only if

$$\lambda b_t \geq \left(\frac{\beta}{1-\alpha-\beta}\right)^{\frac{\beta}{1-\alpha}} \left(\frac{\alpha}{r}\right)^{\frac{1}{1-\alpha}} a^{\frac{1}{1-\alpha-\beta}} A_t^{-\frac{\beta(\alpha+\beta)}{1-\alpha}\frac{1}{1-\alpha-\beta}}.$$

Clearly, there is a unique wealth level $\bar{B}(a, A_t)$ for which the equation holds with equality, i.e. all entrepreneurs with $b_t \geq \bar{B}(a, A_t)$ are not credit constrained. It is also easy to see that the partial derivatives of $\bar{B}(a, A_t)$ satisfy (15b). $\qquad\square$

The results are displayed on Figure 1. The population of individuals sorted by ability

Figure 1: Selection of individuals into occupation
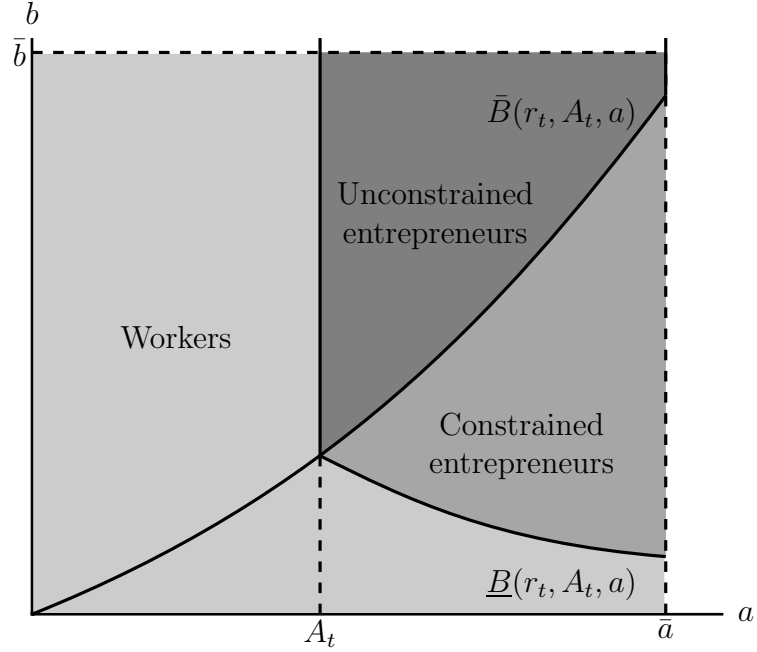
and wealth (a, b) is selected into three groups in each period: worker, unconstrained and constrained entrepreneurs.

It is now possible to define the equilibrium for this economy.

Definition 1 *A competitive equilibrium in period t is a cut-off ability level A_t such that*

(i) *firms maximize profit,*

(ii) *the occupation choice is optimal,*

(iii) the labour market clears

$$\int_0^{A_t} a\,dF(a) + \int_{A_t}^{\bar{a}} \int_0^{\underline{B}(a,A_t)} a\,dG_t(b)\,dF(a) =$$

$$\int_{A_t}^{\bar{a}} \int_{\underline{B}(a,A_t)}^{\bar{B}(a,A_t)} l_c(a, A_t, b)\,dG_t(b)\,dF(a) + \int_{A_t}^{\bar{a}} \int_{\bar{B}(a,A_t)}^{\bar{b}} l_u(a, A_t)\,dG_t(b)\,dF(a) \tag{16}$$

Proposition 1 *There is an A_t such that firms maximize profits, the occupational choice of each individual is optimal, and labour market clears.*

Proof. Let $Z(A_t)$ be the excess demand for labour given by the difference between the right and the left hand side of equation (16). First, observe that $A_t = 0$ implies nobody wishes to work as a worker implying that there is an excess demand for labour, thus, $Z(0) > 0$. Second, if $A_t = \bar{a}$, then $F(A_t) = 1$, i.e. nobody wants to become an entrepreneur implying an excess supply of labour, thus, $Z(\bar{a}) < 0$. Since the excess demand function is continuous, there is an A_t^* such that $Z(A_t^*) = 0$. □

4 The equilibrium dynamics

The equilibrium dynamics of the economy is given by the following transition functions

$$b_{t+1} = \begin{cases} s[(1+r)b_t + \Pi_u(a, A_t)] & \text{if } a \geq A_t \text{ and } b_t \geq \bar{B}(a, A_t) \\ s[(1+r)b_t + \Pi_c(a, A_t, b_t)] & \text{if } a \geq A_t \text{ and } b_t \in \left[\underline{B}(a, A_t), \bar{B}(a, A_t)\right) \\ s[(1+r)b_t + aw(A_t)] & \text{otherwise} \end{cases} \tag{17}$$

17

The transition function describes the change in the wealth of a family with wealth b_t between period t and $t+1$. An individual receives interest earnings regardless of her occupation, and enjoys entrepreneurial or worker income depending on her occupation, and on her ability.

The next assumption ensures that the wealth is bounded.

Assumption 3 $1 > s(1+r)$

One can easily see that both an unconstrained, and a constrained entrepreneurs', and a workers' wealth has an upper bound, namely,

$$b_t \leq \frac{s\Pi_u(a, A_t)}{1 - s(1+r)} \qquad b_t \leq \frac{s\Pi_c(a, A_t)}{1 - s(1+r)} \qquad b_t \leq \frac{saw(A_t)}{1 - s(1+r)}$$

The transition functions are monotone in b_t. Moreover, since each member of a new generation receives an ability draw independent of the previous generation, there is always positive probability that an individual will face different opportunities than her parent, i.e. there is mobility in the model. This ensures the existence of a unique stationary distribution, [see Futia (1982) and Hopenhayn and Prescott (1992)]. Since it is impossible to analyse the dynamic equilibrium of the model analytically, we rely on numerical analysis in the remaining part of the paper.

4.1 Numerical Results

The numerical analysis allows us to establish the properties of the steady state and also to conduct some comparative dynamics exercises; in particular in what follows we will analyse the effects on the steady state aggregate income levels of the degree of financial market imperfections and of features of the distribution of abilities a. This will be done in three steps: firstly we will analyse the effect changes in the degree of financial market

18

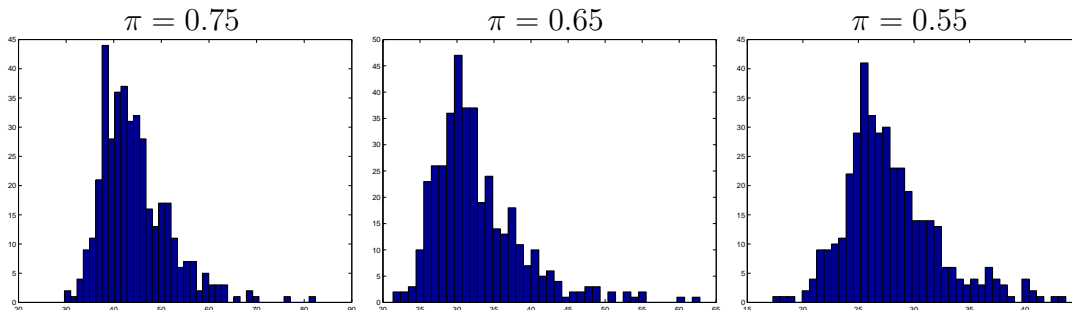Table 1: Financial market imperfection and the level of income

π	Relative output level
0.75	1.864
0.65	1.252
0.55	1.000

imperfections on the level of equilibrium level of income. Secondly we will analyse the effects of changes in the distribution of a; finally we will investigate the effect of the interaction between financial market imperfections and the degree of mobility within the distribution of a.

The model was simulated as follows: first we started with an initial distribution of agents in terms of wealth and ability. The initial distribution gives an initial A_0. We then derived the demand functions for the two classes of entrepreneurs which in turn allows us to determine the wage rate and A_t. The process is then repeated until convergence.

We set the technological parameters in the following values: $\alpha = 0.3$ and $\beta = 0.5$. This allows for a 0.2 entrepreneurial share in output. We set $s = 0.6$ and $r = 0.066$ which are similar to those used by Owen and Weil (1998). We have chosen for the distribution of abilities, the normal distribution $N(5, 1)$ trunctated at zero; the wealth distribution has been taken as lognormal as the majority of the studies do. To asses the quantitative effect of financial market imperfections on the level of aggregate output, we varied the parameter π. Setting it to 0.75 would correspond to a rather mild imperfection on the financial markets where potential borrowers may carry out an investment project which requires six times more capital than their own wealth. Similarly, if financial market imperfections are severe, i.e. $\pi = 0.55$, implies that an entrepreneur can invest an amount which is only 20% higher that her own wealth.

19

Figure 2: The distribution of wealth

Proposition 2 *The numerical analysis suggests that financial market imperfections can induce differences in relative income level up to a factor of 2.*

Table 1 presents the results. With an induced twofold difference in relative income level financial market imperfections do matter for the long run development of an economy. However, this difference is at least a magnitude lower than the income difference between developed and less developed countries. This result indicates that even if financial market imperfections play a role in generating differences in income across countries, they play only a minor role in explaining cross country differences in per capita income.

One might wonder how sensitive these results are to the specific functional forms adopted and in particular to the production function which displays decreasing returns to scale, giving rents to entrepreneurs. As table 2 shows the results are indeed sensitive to the degree of returns to scale: as $\alpha + \beta$ approach 1, entrepreneurial rents decrease and so do the effects of financial market imperfections on the level of income. However the basic message remains unchanged, i.e. financial market imperfections, alone, can explain only a limited fraction of differences in income levels.

We next compare the effect of financial market imperfections with the other important element of our paper: the distribution of abilities.

20

Table 2: Effect of financial market imperfections on the level of income for different degrees of returns to scale

	$\alpha + \beta = 0.8$	$\alpha + \beta = 0.85$	$\alpha + \beta = 0.9$	$\alpha + \beta = 0.95$
$\pi = 0.55$	100.00	100.00	100.00	100.00
$\pi = 0.65$	124.22	119.28	117.21	117.1
$\pi = 0.75$	183.52	157.55	146.16	142.6

Table 3: Effect of the distribution of abilities on the level of income. The mean of the distribution has been normalized to 100

	Mean of a		
	100	118.2	136.36
$\pi = 0.55$	100	138.84	187.21
$\pi = 0.65$	100	139.42	186.41
$\pi = 0.75$	100	140.02	186.74

As we shall see there are many ways in which the distribution of a can affect the level of income; here we investigate the most direct link, i.e. a change in the *mean* of the distribution. In order to compare the effect on the level of income of a change in the distribution with a change in the degree of financial market imperfections, we increase the mean of the distribution of a by the same proportion as the change in the parameter π; note that doing this we are overestimating the effect of financial market imperfections as π has a multiplicative effect on the level of credit constraints λ (a 18.2% increase in π from 0.55 to 0.65 determines in fact an increase in credit constraints of 66.67% from 1.2 to 2).

Table 3 shows that, compared to the degree of financial market imperfections, changes in the distribution of abilities have a stronger impact on relative income levels.

However, what proves to be really important is the *interaction* between the distribution of a and the degree of financial market imperfections. To be more precise, *within*

Figure 3: Income dynamics: a) $\theta = 0$, b) $\theta = 1$

(a)   (b)
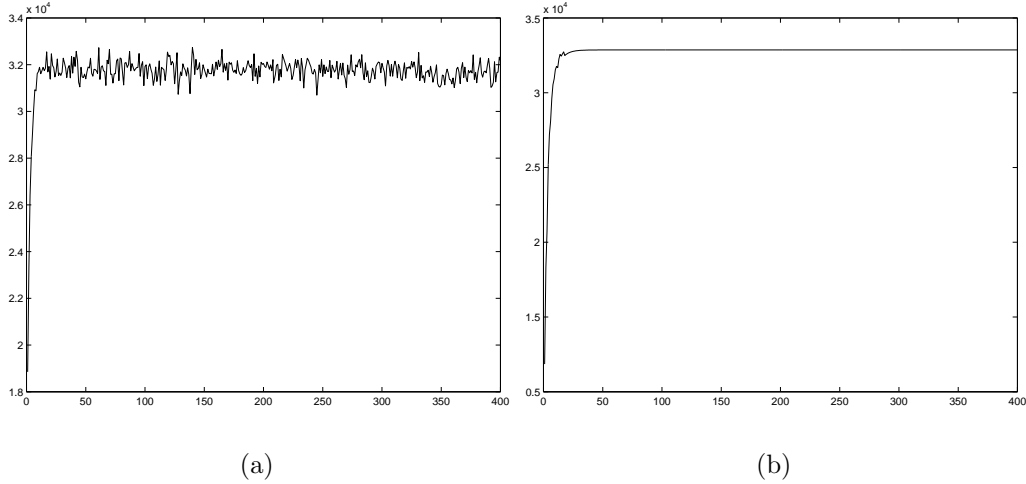
the distribution of a a crucial role is played by the parameter θ that gives the weight between the parental effect and the institutional effect in the transmission of abilities. θ plays a crucial role because it regulates the degree of *mobility* between classes. As we have already stressed, in our model the only way in which there can be mobility between classes is through the redistribution of abilities from one period to another.

Figure 3 explains the point clearly: there we have represented the dynamic behaviour of total output with $\theta = 0$ (maximum mobility) and with $\theta = 1$ (no mobility). With $\theta = 1$ the evolution of aggregate output does not display fluctuations, since the absence of movements within the distribution replicates over time the same ability distribution and the same structure of occupational choices.

The effect on relative output levels exercised by changes in the degree of mobility is explained by table 4 and by figure 4.

Two effects emerge clearly from the observation of the table and the figure: firstly, *ceteris paribus*, a reduction in the degree of mobility reduces total output. This is true independently of the level of financial market imperfections. In fact, even with

22

Table 4: Effects of financial market imperfections under different mobility regimes

	$\pi = 0.55$	$\pi = 0.65$	$\pi = 0.75$
$\theta = 0$	100.00	124.22	183.52
$\theta = 0.1$	100.00	124.51	183.85
$\theta = 0.2$	100.00	125.06	185.74
$\theta = 0.3$	100.00	125.80	185.77
$\theta = 0.4$	100.00	130.49	193.54
$\theta = 0.5$	100.00	141.59	210.39
$\theta = 0.6$	100.00	233.49	352.19
$\theta = 0.7$	100.00	$100.74e^1$	$159.64e^1$
$\theta = 0.8$	100.00	$470.40e^2$	$131.04e^4$
$\theta = 0.9$	100.00	$144.63e^4$	$287.17e^6$

very mild imperfections ($\pi = 0.75$) the aggregate output level with very little mobility ($\theta = 0.9$) is 10% lower than aggregate output with maximum mobility ($\theta = 0$), see figure 4. There is a simple intuitive explanation for this result: a typical outcome of this class of models that analyse the interaction between financial market imperfections and distributional effects, is that redistributive policies are always welfare improving. The reason is that total output is maximized when the number of entrepreneurs is maximized. In this model we can achieve this goal in two ways: either by redistributing wealth from entrepreneurs to workers, or by redistributing abilities (opportunities) from entrepreneurs to workers. Both policies would achieve the same result that is to allow more people to pass the double threshold (ability and wealth level) that discriminates between workers and entrepreneurs. As θ increases, the probability of a change in the distribution of a from one period to the next, becomes less and less likely and therefore this channel of redistribution is progressively shut down.

Secondly, the simultaneous presence of low mobility and financial market imperfections can bring the economy in a development trap in which too few individuals can start an entrepreneurial activity. This result is shown in figure 4 in which with very

Figure 4: Relative output levels under different mobility regimes
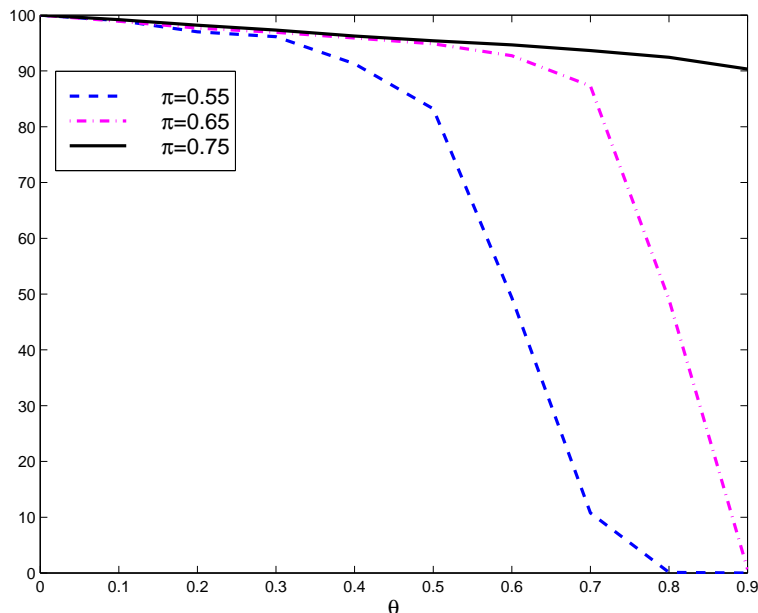
low mobility ($\theta = 0.8$) for high values of credit constraints ($\pi = 0.55$) no one is able to become entrepreneur and equilibrium aggregate output falls to zero. Reducing the amount of credit constraints ($\pi = 0.65$) only few (88 out of 1000 agents) constrained entrepreneurs can operate in the economy, while with mild imperfections ($\pi = 0.75$) the economy is able to get out of the development trap. The intuition for this results is again provided by the fact that in our model there is a double threshold both in terms of ability and in terms of wealth that has to be passed in order to become entrepreneur. Severe forms of financial market imperfections increase the threshold level of wealth necessary to become entrepreneur; a low redistribution of abilities makes this effect more and more persistent leading the economy into a development trap.

It seems therefore that the real challenge that developing countries face at present is to accompany the removal of imperfections in their financial markets with the appropriate institutional reforms. Those reforms reforms need to address not only the

24

improvement of the set of opportunities that individuals face (i.e. changes in the mean of the distribution of a) but also and more crucialy, the issue of (upward) mobility between classes. Albeit a discussion of those aspects is beyond the scope of this paper, we can mention not only the use of redistributive (tax) policies but also other reforms related to the educational system, the labour market and the level of infrastructure, which should be aimed at reducing the weight of the family or social background in the determination of the opportunities that each agent faces, favouring in this way more mobility between classes.

5 Conclusions

We studied a simple model of occupational choice under financial market imperfections. The aim of the paper was to analyze the quantitative effect of these imperfections on the level of income. We have found that although their effect is relatively large, financial market imperfections alone are not able to explain the observed cross country difference in terms of income. However, when analysed jointly with the issue of mobility, these imperfections become much more relevant, to the point of pushing the economy into a development trap. We therefore conclude that the removal of financial market imperfections has to be accompanied by appropriate institutional reforms that can increase the level of (upward) mobility both in terms of wealth and in terms of opportunities that each agent face.

References

Aghion, Philippe and Patrick Bolton, "A Theory of Trickle-Down Growth and Development with Debt-Overhang," *Review of Economic Studies*, 1997, *64*, 151–172.

Banerjee, Abhijit and Andrew F. Newman, "Poverty, Incentives, and Development," *American Economic Review Papers and Proceedings*, 1994, *84*, 211–215.

Banerjee, Abhijit V. and Andrew F. Newman, "Occupational Choice and the Process of Development," *Journal of Political Economy*, 1993, *101* (2), 274–298.

Becker, Gary S. and Nigel Tomes, "Human Capital and the Rise and Fall of Families," *Journal of Labour Economics*, 1986, *4* (3), S1–S39.

Bencivenga, Valerie and Bruce Smith, "Financial Intermediation and Endogenous Growth," *Review of Economic Studies*, 1991, *58*, 195–209.

Boyd, John H. and Bruce D. Smith, "Intermediation and the Equilibrium Allocation of Investment Capital," *Journal of Monetary Economics*, 1992, *30*, 409–432. macro.

Coleman, J.S., *Equality of Educational Opportinity*, US GPO, 1966.

Evans, David and Boyan Jovanovic, "An Estimated Model of Entrepreneurial Choice under Liquidity Constraints," *Journal of Political Economy*, 1989, *97*, 802–827.

Futia, Carl A., "Invariant Distributions and the Limiting Behavior of Markovian Economic Models," *Econometrica*, 1982, *50* (2), 377–408.

Galor, Oded and Joseph Zeira, "Income Distribution and Macroeconomics," *Review of Economic Studies*, 1993, *60*, 35–52.

Greenwood, Jeremy and Boyan Jovanovic, "Financial Development, Growth and the Distribution of Income," *Journal of Political Economy*, 1990, *98*, 1076–1107.

Hopenhayn, Hugo A. and Edward C. Prescott, "Stochastic Monotonicity and Stationary Distributions for Dynamic Economies," *Econometrica*, 1992, *60* (6), 1387–1406.

King, Robert G. and Ross Levine, "Finance and Growth: Shumpeter May Be Right," *Quarterly Journal of Economics*, 1993, *108*, 717–737. macro.

Loury, Glenn C., "Intergenerational Transfers and the Distribution of Earnings," *Econometrica*, 1981, *49* (4), 843–867.

Lucas, Robert E., Jr., "On the Size Distribution of Business Firms," *The Bell Journal of Economics*, 1978, *9*, 508–523.

——, "On the Mechaniccs of Economic Development," *Journal of Monetary Economics*, 1988, *22*, 3–42.

Owen, Ann L. and David N. Weil, "Intergenerational Earnings, Mobility, Inequality and Growth," *Journal of Monetary Economics*, 1998, *41* (1), 71–104.

Parente, Stephen L. and Edward C. Prescott, *Barriers to Riches*, MIT Press, 2000.

Piketty, Thomas, "The Dynamics of the Wealth Distribution and the Interest Rate with Credit Rationing," *Review of Economic Studies*, 1997, *64*, 173–189.

Romer, Paul, "Increasing Returns and Long Run Growth," *Journal of Political Economomy*, 1986, *94*, 1002–1037.