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Spiros Bougheas is Lecturer, School of Economics, University of Nottingham

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Optimism, Education, and Industrial Development*

Spiros BOUGHEAS
The University of Nottingham
Economics Division
University Park
Nottingham, NG7 2RD
e-mail: spiros.bougheas@nottingham.ac.uk
tel.: 0044-(0)115-8466108

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Abstract

When the equilibrium of the economy depends on the coordination of actions of a large number of agents the level of optimism can become a deciding factor. We propose an equilibrium selection process where the level of optimism is endogenously determined. The method is used to provide a novel explanation for the low literacy rates in LCDs. It is suggested that a country's politico-socio-economic environment influences the state of confidence of economic agents, thus, not only affecting the decisions of young persons to seek educational opportunities but also the decisions of entrepreneurs to invest in new technologies.

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1 Introduction

According to the fast growing literature on coordination failures the level of confidence of agents is crucial for the determination of the equilibrium level of output. When there are positive externalities to higher output the economy can have more than one equilibrium and its final resting place will depend on the coordination of all agents expectations. Either a high or a low level of output can be a self-fulfilling equilibrium of the economy.

A potential source of positive externalities can be the presence of increasing returns where production becomes profitable only when the level of aggregate activity is sufficiently high. This idea has been explored in Murphy, Shleifer and Vishny (1989), (hereafter MSV), who interpret the industrialization stage of an economy as a move from a low to high output equilibrium.[1] They show that even if industrialization of a single sector of the economy is unprofitable, simultaneous industrialization by all sectors can be sustainable. They develop a number of models to support their argument. One of these models stresses the significance for economic development of various kinds of infrastructure projects that require a substantial demand to break-even. MSV use education as one of their examples of "soft" infrastructure: "*A worker will invest in such education only if a broad range of different industries offer employment, so that he can take advantage of his skills. But a broad range of industries is less likely to develop in the first place if the labor force is uneducated*" (MSV, p.1023).[2] While this offers one possible explanation for the low literacy rates in LDCs compared to those in industrialized economies, the strict interpretation of industrialization as a self-fulfilling equilibrium suggests that the process of development is a historical coincidence; in other words, it is unpredictable.[3]

In this paper, we argue that each country's history has played a crucial

[1]For other macroeconomic examples of coordination failures due to increasing returns the reader is refered to Blanchard and Kiyotaki (1987), Chatterjee and Cooper (1988), Hart (1982), Shleifer and Vishny (1989), and Weitzman (1982). A comprehensive literature review is provided in Cooper (1998).

[2]The link between education investments and multiple equilibria has also been examined by Azariadis and Drazen (1990), where the education technology displays positive threshold externalities, and by Acemoglu (1997) and Redding (1996), where there is a complementarity between education and R&D investments.

[3]The lack of predictability in coordination games is stressed in Fudenberg and Tirole (1991): "*...it is hard to see just what the right prediction might be, because there is no obvious way for the players to coordinate their expectations,*" (p.19).

role in the determination of the coordination outcome. It is hard to imagine that Great Britain during the Industrial Revolution and United States at the turn of the century were in the same political, social and economic environment as the one prevailing today in most less developed countries. Therefore, we propose an equilibrium selection process where the confidence level (optimism) in the economy is endogenously determined and depends on parameters influenced by the country's politico-socio-economic profile.

When the equilibrium outcome is determined by the coordination of actions of a large number of players, each player's optimal strategy depends on his expectation about the proportion of players choosing its action. In symmetric two action games there exists a critical value such that when a player's expectation matches this value he is indifferent between the two actions.[4] Put differently, the critical value defines the minimum number of players required to choose an action before this action becomes optimal. Our main postulate is that a player's expectation (optimism) depends on that critical value. More specifically, we argue that it is more likely for players to choose an action which leads to a Pareto-dominant outcome, if the proportion of players required to choose this action, before it becomes optimal, is low. In our model, the critical value, and hence the level of optimism, is endogenously determined through the interaction of a number of variables that depend on the politico-socio-economic environment.

The idea that history can play a crucial role in resolving the choice among multiple equilibria has already been suggested and investigated by Arthur (1989) and Krugman (1991). These authors formally define a dynamic process which depending on the initial conditions (i.e. history) might converge to one of two possible final stable equilibria.[5] In our model, history indirectly decides the coordination outcome through its long-term influence on the politico-socio-economic environment. Our attempt to stress how important the state of confidence can be in deciding the equilibrium outcome is not original.[6] Keynes (1939) thought that optimism plays a central role in

[4]This is an unstable equilibrium. In general, there might exist more than one critical value, some corresponding to stable and some to unstable equilibria. In this paper, we restrict our attention to games with only one such critical value.

[5]In Arthur's work, history is decisive. Any unpredictability in the final outcome arises from a lack of knowledge of initial conditions. In contrast, in Krugman's model, because of complex dynamics, if the initial conditions take values within a specific range the final outcome will still be unpredictable and it will depend on expectations.

[6]See de Meza and Southey (1996) for a recent attempt to introduce optimism in an

economic decisions: "*...a large proportion of our positive activities depend on spontaneous optimism rather than on mathematical expectation,*(General Theory, p.161). Later Keynes proceeds with his well quoted notion of "animal spirits": "*Most, probably, of our decisions to do something positive, ... , can only be taken as a result of animal spirits - of a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities."* (General Theory, p.161). While according to Keynes optimism is related to spontaneity, we suggest that it depends on the environment within which people make their economic decisions.

Our model has the same basic structure as MSV. Because of external economies industrialization is successful only if it takes place simultaneously in a lot of sectors in the economy. In our two-period model, industrialization also requires a labor force with basic skills. During the first period workers allocate their time between work in the primary sector (pre-industrialization state) and education which improves their skills.[7] Their investment in education will be worthless should the economy fail to industrialize. However, even if they decide to improve their skills, the industrialization of the economy might not follow because of lack of coordination among investors. The empirical evidence does not support this last possibility, i.e. undeveloped economies with high literacy rates. Our model suggests that when all agents condition their expectations on the same information set,[8] both workers and investors have the same level of confidence. Therefore, the reason that we do not observe undeveloped economies with high literacy rates is because all agents make decisions in the same politico-socio-economic environment.

In the following section, we develop the theoretical framework and find the equilibrium, for a fixed set of parameter values. Next, we examine how a country's politico-socio-economic profile affects these parameters thus deciding the equilibrium outcome. In the final section, we discuss the policy

economic model,

[7]Lewis (1970) observes that during the early stages of industrial development division of labor provides a good substitute for skills. However, the use of unskilled labor which encouragesthe mechanization of the production process demands the predence of *"a greater proportion of supervisors, to co-ordinate what is subdivided. The need for a high ratio of supervisory staff is a mark of all countries where industrialization is new,"* (p.192). The presence of a high proportion of educated labor during the American Industrial Revolution is well documented in North (1963).

[8]This is also one of the requirements of rational expectations; see Sargent (1993).

implications of our model.

2 The Model

Consider a two-period economy with a representative consumer. In each period the consumer derives utility from the consumption of a continuum of goods defined in the unit interval. We assume that the consumer has a unit elastic demand for each good. Therefore, if his income in period t is y_t, he will spend y_t on every good. In each period the consumer is endowed with one unit of labor.

During the first period the consumer can allocate his endowment between work and education (sector-specific training). Let v denote the fraction of his endowment that the consumer devotes to training. Each good is produced in its own sector by a competitive fringe of firms using a constant-returns-to-scale (CRS) technology which converts one unit of labor into one unit of output. Using the wage rate as the numeraire, the consumer's first period income is given by:

$$y_1 = 1 - v \tag{1}$$

In the second period each good can also be produced by a monopolist who has access to an increasing-returns-to-scale (IRS) technology. This technology requires a fixed set-up cost of F units of labor input. The productivity of each additional unit of labor, h, depends on both the level of education, v, and the degree of industrialization; i.e. the fraction of sectors, n, using the IRS technology. Let,

$$h(n, v) = 1 + ng(v),\ g' > 0,\ g'' < 0,\ g(0) = 0 \tag{2}$$

In the absence of either an educated population ($v = 0$) or industrial development ($n = 0$) the productivity of each worker is the same under both technologies. Industrialization needs skilled labor. However, the development of skills requires some technical training, hence, the dependence of productivity on education. The dependence of productivity on the economy's degree of industrialization captures the benefits from knowledge and technological spillovers. As more sectors of the economy use advanced technologies there

are greater opportunities for each one of them to benefit from the innovations that take place in other sectors.[9]

Monopolists will industrialize their sectors, i.e. invest in the IRS technology only if they can earn a profit at the equilibrium price of 1. If they charge a price above 1 they will loose all sales to the competitive fringe and with a unit elastic demand they would never charge a price below 1. Then, when income in period 2 is equal to y_2, their profits are given by:

$$\pi = \left(1 - \frac{w}{h(n,v)}\right) y_2 - wF \tag{3}$$

where w is equal to the wage rate in the industrialized sector and the term inside the parentheses is equal to the mark-up. We assume that the wage rate is determined by Nash-bargaining between workers and firms. The worker will never accept a wage rate less than 1, i.e. the wage rate in the competitive sector, and the monopolist will never pay a wage rate higher than h. Let,

$$w(n,v) = 1 + \beta(h(n,v) - 1) = 1 + \beta n g(v),\ 0 < \beta < 1 \tag{4}$$

where a higher β indicates a stronger worker bargaining power.[10]

The representative consumer owns all profits. When n sectors industrialize his second period income is equal to:

$$y_2(n) = \Pi(n) + (1 - n) + nw \tag{5}$$

where:

$$\Pi(n) = n\pi(n) \tag{6}$$

[9]This type of externality is often considered in the endogenous growth literature; see for example Aghion and Howitt (1998), Lucas (1988) and Romer (1990).

[10]For analytical simplicity, we have assumed that education provides exclusively sector-specific skills, which has allowed us to treat β as a parameter.If, in contrast, some of the skills are transferable across sectors then a case can be made that the bargaining power of the workers should increase with the degree of industrialization. The idea is that when only a fraction of sectors industrialize, workers who do not get jobs in industrialized sectors might be able to bargain down the wages in these sectors (see Stevens (1994) for the effects of transferable training on wage competition). If this effect is strong enough then the economy will never industrialize.

The above framework defines a two-stage game. At the first stage, workers choose their level of education given their beliefs about the chances of industrialization and at the second stage, potential monopolists consider whether to invest in the IRS technology, given a) the level of trainig, and b) their beliefs about the proportion of sectors that will choose to industrialize.

2.1 The Second Stage: The Industrialization Decision

Using (3), (5) and (6) we derive the monopolist's profit conditional on the degree of industrialization and the level of education:

$$\pi(n,v) = \frac{\left[1 - \frac{w(n,v)}{h(n,v)}\right][1 - n + nw(n,v)] - w(n,v)F}{1 - n\left[1 - \frac{w(n,v)}{h(n,v)}\right]} \tag{7}$$

Evaluating (7) at $n = 0$, we get

$$\pi(0,v) = -F < 0 \tag{8}$$

which implies that when all sectors are using the CRS technology it is not profitable for a single monopolist to invest in the IRS technology. This result is not surprising given the specification of the productivity (skills accumulation) function. Labor productivity in the sole sector which attempts to industrialize is equal to 1 (for any level of education) and, thus, the mark-up is equal to 0. It is still possible to get the non-industrialization equilibrium without imposing strong external effects on the productivity function. Even if we assume that productivity is independent of n, we can still get the same result as long as the bargaining power of the workers is strong enough so that the mark-up is not sufficient to cover the fixed cost. In fact, this is similar to one of the multiple equilibria examples in MSV where monopolists have to offer a wage premium to the workers in order to attract them to the factories. In our model, the higher wage captures the return to education.

When all sectors industrialize profits are equal to:

$$\pi(1,v) = \left[\frac{(h(1,v) - 1(1-\beta))}{h(1,v)} - F\right] h(1,v) = \left[\frac{g(v)(1-\beta)}{1+g(v)} - F\right](1+g(v)) \tag{9}$$

Then, a necessary condition for industrialization is that $\pi(1, v) > 0$ or

$$\frac{g(v)}{1+g(v)} > \frac{F}{1-\beta} \tag{10}$$

The left-hand side is increasing in v that has straightforward implications. Industrialization requires that the level of education, and hence the level of labor productivity, must be higher when workers have more bargaining power and when fixed costs are high. We assume that the above inequality is satisfied at $v = 1$[11] and we define as $\hat{v}$ the level of education that equates the two sides of (10).

We can now examine the equilibria of the second-stage game. If $v < \hat{v}$ an industrialization equilibrium does not exist. The level of education is too low and, therefore, the corresponding low productivity is not sufficient to compensate for the investment in the set-up cost. For $v > \hat{v}$ the equilibrium depends on the beliefs each monopolist has about the proportion, n, of sectors that might industrialize. There exist two self-fulfilling stable equilibria. If each potential monopolist believes that the other sectors will keep using the CRS technology then he will not invest in the IRS technology. On the contrary, if he believes that all other sectors will switch to the IRS technology then it is in his own interest to do the same thing. In this case, every monopolist expects a level of income that is sufficiently high to cover the investment in the set-up cost. The high income expectation is based not only on the high worker productivity but also on the expected strong aggregate demand because of the simultaneous industrialization of all sectors.[12] The above discussion suggests that while a high level of education is a precondition for industrial development, it is not sufficient. Industrialization of the economy requires that entrepreneurs are optimistic about the decisions taken in other sectors of the economy; i.e. there is not a coordination failure.

Our main thesis in this paper, is that the same cause of optimism that leads entrepreneurs to invest in advanced technologies has also boosted the confidence level among workers when they sought educational opportunities.

[11] If this is not the case then an industrialization equilibrium does not exist.

[12] In his classic account of the stages of economic growth, Rostow (1971) remarks: "*The dual requirement of a 'manufacturing' sector is that its processes set in motion a chain of further modern sector requirements and that its expansion provides the potentiality of external economy effects, industrial in character,*" (p.39).

2.2 Equilibrium Selection

When the level of education is sufficiently high, $v > \hat{v}$, (7), (8) and (9) imply that there exists a third unstable Nash equilibrium. This is defined as the proportion of sectors that need to be industrialized, n^*, so that $\pi(n^*, v) = 0$; i.e. when a fraction n^* of sectors are industrialized, the IRS technology just breaks even. If each potential monopolist believes that a fraction n^* of sectors will use the IRS technology then he will be indifferent about whether or not to industrialize his own sector. This critical value is negatively related to the level of education; formally:

$$n^* = N(v),\ N' < 0,\ \forall v > \hat{v} \tag{11}$$

A high level of trainong implies a high worker productivity and, thus, a high mark-up for monopolists. As a consequence, even a low fraction of industrialized sectors can generate a sufficient strong demand so that the investment in the IRS technology breaks even.

The equilibrium selection process that we propose is founded on the intuition that industrialization must be more likely when n^* is low. If it only takes a small fraction of sectors to invest in the IRS technology before this investment becomes profitable then the problem of coordination must be less severe. In contrast, when n^* is high, the decision of even a small sectors not to industrialize is sufficient to render the investment in the IRS technology unprofitable.

A simple way to capture the above intuition is to specify beliefs as follows:[13]

$$B(n) = \begin{cases} 0\ if\ n^* > \bar{n} \\ 1\ if\ n^* \leq \bar{n} \end{cases} \tag{12}$$

where $B(n)$ denotes the beliefs of potential monopolists about the coordination outcome and $\bar{n}$ is a constant.[14] When n^* is high, potential monopolists

[13]The exact specification of beliefs is not important. The crucial point is that, other things equal, industrialization is more probable as the critical mass of sectors that need to invest in the IRS technology, before this investment becomes profitable, gets lower.

[14]When $\bar{n}$ is equal to $1/2$ the above selection method is similar to the "risk dominance" equilibrium selection criterion proposed by Harsanyi and Selten (1988). Young (1998)

are pessimistic about the prospects of industrial development. The monotonicity of $N(v)$ implies that there exists a unique level of training $\bar{v}$ such that $N(\bar{v}) = \bar{n}$. When the level of training is higher than $\bar{v}$, hence $n^* \leq \bar{n}$, the level of optimism is sufficiently high and all monopolists choose the IRS technology; i.e. no coordination failure.

The level of training is the only endogenously determined variable influencing the value of n^*. However, this critical value also depends on other parameters of the model. Our next step in this section is, moving backwards, to analyze the educational choice of workers and find the equilibrium of our model for a fixed set of parameter values. In the following section, we examine how a country's politico-socio-economic profile, by influencing these parameters, affects the level of optimism in the economy.

2.3 The First Stage: Educational Choice

We specify the lifetime utility of the representative consumer as:

$$V(c_1, c_2; v) = u(c_1) + \rho u(c_2) \tag{13}$$

where c_t denotes consumption in period t, $\rho < 1$ is a discount factor, and $u(\cdot)$ is strictly concave. We assume that the consumer does not have any access to the capital markets and, thus, he cannot finance his education by borrowing.[15] Because the equilibrium price of goods is equal to 1, each period's consumption equals income, i.e. $c_t = y_t$ $(t = 1, 2)$.

When they are young, workers choose their level of education to maximize their life-time utility. Their optimal choice depends on their beliefs about the future of the economy. They anticipate that their investment in education will pay-off only if the economy industrializes which will generate a demand for their skills. Because workers and potential monopolists make decisions in the same environment their beliefs (level of optimism) must be the same. Then workers realize that a necessary condition for the industrialization of the economy is to choose a level of training that is not less than $\bar{v}$. In addition, the

demonstrates that for symmetric 2×2 games risk dominance implies that easch player assigns equal odds to his opponent's playing action 1 or 2. In our model, where there is a continuum of players, when $\bar{n} = 1/2$, each player calculates the expected payoff of each action under the supposition that each action will be chosen by 50% of the players.

[15]This is reasonable because we are interested in economies at their pre-industrial stage of development.

post-industrialization wages must be sufficiently high so that workers can be compensated for their investment in education. The consumer's reservation utility corresponds to the life-time utility he would derive from working in the CRS sector and choosing not to invest in education and is given by:

$$V(c_1, c_2; 0) = (1 + \rho)u(1) \tag{14}$$

The following program solves for the optimal level of training:

$$\begin{array}{l} \underset{v}{Max}\ V(c_1, c_2; v) = u(1 - v) + \rho(1 + \beta g(v) + \Pi) \\ s.t.\ v \geq \bar{v},\ and\ V(c_1, c_2; v) \geq V(c_1, c_2; 0) \end{array} \tag{15}$$

According to (15), the consumer ignores the contribution that his investment in education makes to aggregate profits. The reason is that while the investment has a direct effect on his future income, what matters for his profit share is the aggregate level of education. If the above constraints do not bind then the optimal choice, v^*, must satisfy the following condition:

$$\frac{u'(1 - v^*)}{g'(v^*)u'(1 + g(v^*) + \Pi)} = \beta\rho \tag{16}$$

Given the concavity of $u(\cdot)$ and $g(\cdot)$, v^* is uniquely determined. The following proposition describes the complete solution when the constraints are also taken into account:

Proposition 1 *a) If* $v^* \geq \bar{v}$ *then* $v = v^*$ *and* $n = 1$,
b) if $v^* < \bar{v}$ *and* $V(c_1, c_2; \bar{v}) \geq V(c_1, c_2; 0)$ *then* $v = \bar{v}$ *and* $n = 1$, *and*
c) if $v^* < \bar{v}$ *and* $V(c_1, c_2; \bar{v}) < V(c_1, c_2; 0)$ *then* $v = 0$ *and* $n = 0$.

Conditions (a) and (b) are straightforward. When condition (a) holds, the optimal level of education is above the critical level. The level of optimism is sufficiently high (n^* is low) and, thus, workers improve their skills and monopolists invest in the IRS technology. When condition (c) holds, the level of optimism is too low, workers do not improve their skills and the industrialization of the economy fails. Condition (b) is the most interesting case with significant policy implications. This possibility arises because workers ignore the effects of their education on aggregate profits. The results were

derived within a representative consumer framework but the implications are straightforward when we consider a decentralized economy. From an individual consumer's point of view v^* is the optimal level of training. However, a social planner would take into account the positive external effect that each consumer's training has on aggregate profits. The social optimum level of training $\bar{v}$ is higher than the private optimum v^*. Therefore, when condition (b) holds the government can increase social welfare by providing incentives for workers to seek educational opportunities that will improve their skills. With the level of skills at the social optimum level the industrialization of the economy will follow.

3 The Origins of Optimism

According to our model, the level of optimism in the economy depends on the value of n^*, which denotes the minimum proportion of sectors that must industrialize before the investment in the IRS technology begins to pay-off. This critical value and the level of education are endogenously determined. From (10), (11) and (16), we observe that they depend on the parameters F, β, ρ, and the functional forms of $g(\cdot)$ and $u(\cdot)$. Because we do not expect variations in preferences to account for differences in development trends we concentrate our analysis on F, β, and $g(\cdot)$.

There are high fixed costs associated with industrial development related not only to the construction of factories but also to the distribution of goods and the organization of production. Not surprisingly, our model suggest that the level of optimism is negatively related to these costs captured by F.[16] Any policy that can affect these costs can be crucial for industrial development. Rostow (1971) has argued that 'hard' infrastructure, e.g. transport infrastructure, has played worldwide an important role during industrialization.[17] Equally important is the development of 'soft' infrastructure which includes the quality of public bureaucracies. The establishment of new enterprises depends on the ability of the political system to protect property

[16]This follows from the monotonicity of (10) and (11).

[17]More recently, Holtz-Eakin and Lovely (1996) have studied the scale effects of public infrastructure and their consequences for economic growth, while Bougheas and Demetriades (1997) have examined the role of telecommunications infrastructure. Both studies have found that improvements in infrastructure have a positive impact on economic development.

rights, enforce contractual agreements and on the premise that government institutions do not constitute an obstacle but facilitate the development of the private sector.[18] The efficiency of the public sector depends on attitudes and ethics that have deep historical roots and take considerable amount of time not only to develop but even more significantly to change. Interestingly, one of Kuznetz's (1963) criticisms of Rostow's (1963) analysis of 'take-off' was that it *"neglects the effect of historical heritage, time of entry into the process of modern economic growth, (and) degree of backwardness,"* (p.40).

Another important parameter in our model is β which can be interpreted as the labor's share of benefits from industrialization. Condition (16) implies that, other things equal, the optimal level of education is positively related to the bargaining power of workers. This is not surprising, because the willingness of workers to improve their skills depends on the benefits they expect from higher future wages. However, (10) suggests that β cannot be to high, otherwise, potential monopolists, expecting low profits, will not invest in the IRS technology. Thus, our model predicts that industrialization takes place at intermediate values of β when both workers and entrepreneurs expect to benefit from industrial development. Furthermore, the wages received from employment in the industrialized sectors must be higher that the pre-industrialization wages, reflecting the improvement in skills, though the rise in aggregate income means that the overall effect on factor shares is ambiguous. The above predictions are in agreement with Hartwell's (1975) evaluation of the impact of Industrial Revolution on the English standard of living: "*Not the least problem was to change craft and agricultural labourers into factory workers, ... This necessary transformation was certainly painful, but it was gradually achieved without political revolution, and with labor simultaneously increasing its opportunities, its industrial skill and its bargaining power,"* (pp.99-100). In our model, the initial painfulness of industrialization is captured by the loss of income during the first period and optimism is a substitute for political revolution.

A further prediction of our model concerns the mechanism by which education improves productivity which is captured by the function $g(\cdot)$. Education attainment, and hence industrial development, depends on the quality of this mechanism which reflects the ability of training to improve a worker's adaptation to the use of new technologies. It is only recently that the quality

[18]See Knack and Keefer (1995) and Mauro (1995) for empirical studies that support these predictions.

of education and its effects on economic performance have attracted attention in the economic literature.[19] Preliminary results suggest that education quality is positively correlated to future earnings which is in accord with our model.

4 Policy Implications

The literacy rates of LDCs lag far behind those of industrialized nations.[20] There are enough similarities among countries which are at a similar stage of economic development, that raise some scepticism about attempts to explain the coexistence of low literacy rates and poor economic performance as a coordination failure. It is doubtful that building schools and libraries can provide the 'Big Push' for industrial development. The model we have presented in this paper, attributes the correlation between literacy rates and economic development to the environment within which people make their economic choices. When conditions are 'right' the level of optimism is sufficiently high and young workers leave the farms and go to urban areas where they have the opportunity to improve their skills. Entrepreneurs are confident that economic prosperity will generate a high demand for their products and invest in advanced technologies. In the previous section, we have identified some of the factors that can influence the level of optimism. In this section, we consider the role of government.

In their empirical study, Benhabib and Spiegel (1994) have found that education attainment does not have a significant impact on economic development unless it is linked to technological advances. Education fosters economic development by improving the ability to innovate and adapt to new technologies. According to our model, education attainment depends on the ability of education to transform knowledge into productivity. In the last two decades, a promising literature is developing that attempts to evaluate alternative education and training policies.[21] The results can be very valuable to policymakers in both industrialized nations and LDCs.

Our model also predicts that workers and entrepreneurs are more optimistic when they expect a fair share of the benefits from industrial develop-

[19] Reviewed in Aghion and Howitt (1998, ch.10). See also Barro and Lee (1997).

[20] For example, see Kuznetz (1966) who pioneered the method of collecting and comparing data for countries at different stages of economic development.

[21] For an early literature review, see Hanushek (1986).

ment. In his analysis of the relation between knowledge and profits, Lewis (1970) offers the following thoughts: "*If new knowledge is to be accepted and applied to production, it must be profitable as well as new. It takes effort to acquire knowledge, and to apply it may require both extra resources and also extra willingness to bear risks. The application of knowledge therefore demands an institutional pattern which associates differential effort with differential reward,*" (p.180). Thus, government policies that promote the efficiency of labor market institutions and, consequently, protect the economy's reward system, can have a significant contribution to economic progress.

Finally, the establishment of new firms requires the development of 'hard' and 'soft' infrastructure. The former includes, among other things, transport and telecommunications projects that facilitate the distribution and exchange of goods and services. The latter, in addition to education, includes an efficient public sector and a legal system that can protect property rights.

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