Entrepreneurship, Innovation and Growth

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Abstract
The three basic sources of growth in any economy are growth in inputs of production, improvements in the efficiency of allocation of inputs across economic activities, and innovation that creates new products, new uses for existing products and brings about increases in the efficient use of inputs. Solow’s path-breaking analysis of growth in the US economy during the first half of the twentieth century showed that the contribution of growth in inputs of production, namely labour and capital to aggregate growth, was around half, and the remaining half, that is the unexplained Solow residual, is commonly attributed to technical progress or the contribution of innovation in the sense I have used the term. Economic growth is driven significantly by innovation which increases the stock of useful knowledge. The process of innovation is largely endogenous, influenced by incentives, institutions and political economy. The paper exposits the analytics of the contribution to growth of innovation drawing on some recent models of endogenous growth. Increasing openness by reducing trade barriers and by encouraging foreign investment, plays an important role in spurring innovation, particularly as it occurs through learning by doing. In some models of trade between the industrialized North which innovates, and the developing South which imitates Northern innovation, trade accelerates the rate of innovation in the North because of the threat of imitation by the South. Entrepreneurship and factors that are conducive to its existence are explored. An entrepreneur is one with an innovative idea which she herself or others to whom she sells or licenses it implement. The entrepreneur assumes in part or all of the risk of profit or loss of the business venture. Issues of access to capital or finance, intellectual property protection and the chances of the idea of the entrepreneur being stolen or appropriated if she herself does not implement it are explored. The role of venture capital in financing start-up enterprises is found to be important, both because it relieves financial constraints and because the venture capitalist carefully screens the ideas of the entrepreneur and also monitors the enterprise after financing. The strength of intellectual property regimes (IPRs) improves the returns to commercialization of an innovation. Public provision of capital to small start-up enterprises, particularly in the high-tech sector, has been attempted in the US. The paper reports on the empirical analyses of their success. Research on national R&D systems and spending is summarized. The phenomenal success of the Indian software industry, and the contribution of India’s education system and public policies (particularly foreign trade and investment policies) to the success of this industry are discussed. The paper concludes by examining the roles of patent protection and the strength of IPRs on increasing the rate of innovation. The empirical evidence on the significance of monopoly rights through grant of patents on the rate of innovation and cost-effectiveness of patents as compared to alternatives in spurring innovation is found to be inconclusive. Finally the importance of openness to foreign trade and foreign direct investment to developing a positive climate for innovation, entrepreneurship and growth is stressed.

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1. Introduction

The three basic sources of growth in any economy are growth in inputs of production, improvements in the efficiency of allocation of inputs across economic activities, and innovation that creates new products, new uses for existing products and brings about increases in the efficiency of use inputs. Solow’s (1957) path-breaking analysis of growth in the US economy during the first half of the twentieth century showed that the contribution of growth in inputs of production, namely labour and capital to aggregate growth, was around half, and the remaining half, that is the unexplained Solow residual, is commonly attributed to technical progress or the contribution of innovation in the sense I have used the term. Since by definition the residual growth is the difference between aggregate growth and the contributions of growth in factors of production; it is also called Total Factor Productivity growth or TFP growth. Whether or not TFP growth accounts for a similarly large share of output in East Asian economics of Korea, Singapore, and Taiwan has been debated (Young (1992) and Lau and Kim(1994)), in part on methodological grounds (for example, the dependence of estimates on essentially arbitrary assumptions about scale economies and functional forms for the aggregate production function) and in part on grounds of possible errors of measurement and biases in the data (Pack, 2001). I do not propose to enter into the debates on the empirics of estimating TFP growth. I will simply assume, as seems reasonable, that economic growth is driven by ideas or increases in “the stock of useful knowledge” as Lucas (2002) puts it. Again, as he rightly points out, treating growth in technology or knowledge as exogenous for an economy implies that it originates from activities outside that economy. In other words, what is external to one economy must be internal or endogenous in some other economy. One is thus led to modeling the endogenous
process that generates technological change in that economy. Even if one were to assume that for developing economies technical progress comes about through the adoption or imitation of technologies developed elsewhere, still the adoption and imitation processes themselves could be endogenous. It is therefore essential to view processes to innovation and their adoption as endogenous processes that are influenced by incentives, institutions, as well as political economy.

I will first (Section 2) briefly report on the analytics of the generation of ideas and their contribution to growth selectively drawing from the vast recent literature on endogenous growth models. Of course, there was an earlier literature (Kaldor and Mirrlees (1962), Boserup (1965)) on endogenizing the innovation process. A major strand of this literature goes under the rubric of induced innovation (Ruttan 2001, for a recent treatment). I will not report on this body of work primarily because in the models of this genre the market for ideas (more precisely the process of compensation of innovators in contexts that benefits of innovation have spillover effects) and the link between innovation and growth are not transparent. In the model of Arrow (1962), technical progress through “learning by doing” was the unintended effect of production and was external to the firms who did the producing. Nordhaus (1969) and Shell (1973) modeled the incentives to innovate as arising from the prospect of monopoly rents. In models of pure learning sustained growth effects are ruled out if there are diminishing marginal returns to learning in any single activity, unless new activities with learning potentials emerge and are adopted all the time, as in the model of Lucas (2002, Chapter 3). Moreover, as Lucas (2002, p. 84) points out, one has to recognize there is considerable ambiguity about learning processes:

“Is it the individual worker who is doing the learning? The managers? The organization as a whole? Are the skills being learned specific to the production
process on which the learning takes place, or are they more general? Does learning accrue solely to the individual worker, manager, or organization that does the producing, or is some of it readily appropriable by outside observers?”

The dictionary meaning of the word “entrepreneur” is a person “who organizes, operates, and assumes the risk for a business venture” (American Heritage Dictionary of the English Language, Fourth Edition, 2000) and “one who undertakes an enterprise; one who owns and manages a business; a person who takes the risk of profit or loss” (Oxford English Dictionary [database online], April 25, 2003). Neither definition includes what economists usually think of as the essential characteristic of an entrepreneur, namely, as the source of a new idea, which, the entrepreneur herself or others to whom she licenses or sells the idea, implements in a productive enterprise. In this sense, it is not so much the generation of ideas, but its implementation in an enterprise, that is the center of attention from the perspective of growth. In particular, the ease of access to capital or finance, and the chances of the idea of the originator being appropriated or stolen if the enterprise is not entirely controlled by the originator become important issues. Also, a particular form of organization, namely venture capital, has proved to be significant in financing high-tech start-up enterprises in the US. Also, the US government, through its Small Business Innovation Research Awards and Small Business Investment Company, has supported start-ups. I will discuss some recent models of entrepreneurship and also empirical findings on venture capital and other financing in Section 3.

The empirical literature on expenditures on Research Development (R&D) including private and social returns to such expenditures, the interaction of market structure and R&D is vast. Also, even on the narrower issue of the role of monopoly rights through the grant of patents and that of international intellectual property regimes in promoting innovation, there is a
vast literature. I will make a few brief remarks on these issues in Section 4. Section 5 concludes.

2. Illustrative Models of Innovation, Imitation and Growth

Grossman and Helpman (1994) provide an accessible survey of endogenous innovation in the theory of growth drawing on their classic book (Grossman and Helpman, 1992). Although there have been several contributions since then (some of which are included in Aghion and Howitt (1998)), for my expository purposes it is enough to concentrate on the simplest general equilibrium model of innovation and growth presented in Helpman (1990). He considers a model in which there is a continuum of costlessly differentiated brands of consumer goods produced only by labour. However, to produce each new brand, the producer has to incur expenditure on product development. Product development or R&D, uses only labour. Once he develops a brand, the entrepreneur enjoys indefinite monopoly power over its production and sale. There is free entry into product development. Then, at each time $t$, product development costs $c_n[w(t)]$ must equal the present value of future profits $\pi(\tau)$, where $w(t)$ is the wage rate and $n(t)$ is the number of brands in existence at $t$. Thus,

$$c_n[w(t)] = \int_0^\infty \exp\left[R(t) - R(\tau)\right] \pi(\tau) d\tau \quad (1)$$

where the discount factor $R(\tau) = \int_0^\tau r(u) du$, with $r(u)$ being the instantaneous interest rate. Differentiating both sides of (1) with respect to $t$ and rearranging,

$$\frac{\dot{\pi}(t)}{c_n} + \frac{\dot{c}_n}{c_n} = \dot{R}(t) \quad (2)$$

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1 My exposition follows closely, almost verbatim in parts, Helpman (1990, pp. 29-31).
Consider a symmetric equilibrium in which the same amount \( c_n(t) \) of all \( n(t) \) brands available at \( t \) are consumed and all brands are sold at the same price \( p(t) \). With a constant elasticity \( \sigma \) of substitution among brands in the instantaneous utility function, utility \( u(t) \) of the representative consumer (all consumers are identical) would be given by

\[
u(t) = \frac{1}{\sigma - 1} \left( \log n(t) + \log E(t) - \log p(t) \right)
\]

where \( E(t) \) is expenditure on the \( n(t) \) brands available at time \( t \).

The consumer maximizes the discounted present value of \( u(t) \), i.e.,

\[
\int_0^\infty u(t) e^{-\rho t} dt, \text{ subject to the wealth constraint}
\]

\[
\int_0^\infty E(t) e^{-\rho t} dt = \text{wealth, by choosing } E(t), \text{ taking } n(t), p(t) \text{ as given.}
\]

This maximization can be shown to imply

\[
\frac{\dot{E}(t)}{E(t)} = \dot{R}(t) - \rho
\]

Turning to the supply side, a unit of each brand requires \( a_{Ln} \) units of labour to produce, while each new brand of product \( a_{Ln} / K \) units of labour per unit for its development where \( K \) is knowledge or R&D stock. Thus, the larger this stock, the lower is the labour per unit of R&D output. Suppose the stock \( K(t) \) of R&D reflects learning by doing according to

\[
\dot{K} = n(t).
\]

Then by a proper choice of units we can set \( K(t) = n(t) \).

Now the cost \( c_n \left[ w(t) \right] \) of each new brand is \( a_{Ln} / n(t) \) \( w(t) \). If we choose a new brand as the numéraire, then free entry into R&D sector will ensure zero profits in that sector, so that

\[
1 \equiv c_n \left[ w(t) \right] = \frac{w a_{Ln}}{n}
\]
omitting the time argument \( t \) from \( w \) and \( n \). Under monopolistic competition in the symmetric equilibrium, the price \( p(t) \) of a unit of each brand will equal its marginal cost \( w(t)a_{Lx} \) times the mark-up or

\[
p(t) = \left( \frac{\sigma}{\sigma - 1} \right) w a_{Lx}
\]  

(8)

where \( \sigma \) (the elasticity of substitution in consumption) is the elasticity of demand. Denoting

\[
\frac{\sigma - 1}{\sigma} \quad \text{as} \quad \alpha,
\]

we can rewrite

\[
\alpha p = w a_{Lx}
\]  

(9)

Equations (7) and (8) imply that wage rate \( w(t) \) and price \( p(t) \) grow at the same rate as \( n(t) \).

The factor market clearance condition, given that \( \dot{n}(t) \) units of new brands are being developed, and denoting by \( x(t) \) the aggregate output of all brands together, yields

\[
\left[ \frac{a_{Lx}}{n} \right] \dot{n} + a_{Lx} x(t) = L(t)
\]  

(10)

For simplicity, let us assume that \( L(t) \) is a constant \( L \). Aggregate consumer expenditure \( E(t) \), by definition, equals \( p(t)x(t) \). Substituting for \( x(t) \) and using (7) and (9) in (10) we get

\[
\frac{\dot{n}}{n} = \left[ L / a_{Lx} \right] - \alpha \eta
\]  

(11)

where \( \eta = E / n = \) expenditure per brand.

Profits \( \pi(t) \) per brand equals price \( p(t) \) minus cost \( w a_{Lx} \) times output \( \frac{x}{n} \) or

\[
\pi(t) = (p - a_{Lx}w) \frac{x}{n} = (1 - \alpha) \frac{px}{n} = (1 - \alpha) \eta \quad \text{using (9)}
\]  

(12)

Since \( c_n(t) \equiv 1 \) from (7), it follows from (2) that \( \pi(t) = \dot{R}(t) \). Using (6), it follows that
\[
\dot{R}(t) = \frac{\dot{E}}{E} + \rho = \pi(t) = (1-\alpha)\eta
\] (13)

Since \( \eta \equiv E/n \) it follows from (13) that

\[
\frac{\eta}{\eta} + \frac{\dot{n}}{n} + \rho = (1-\alpha)\eta
\] (14)

Substituting from \( \frac{\dot{n}}{n} \) from (11) in (14) we get

\[
\frac{\eta}{\eta} = \eta - \rho - \left[ L/a_{ln} \right]
\] (15)

It can be shown that the only solution to the differential equation (15) that satisfies the transversality condition for intertemporal consumer welfare maximization is the stationary solution \( \eta = 0 \). This in turn means, using (15) and (11) and setting \( \eta = 0 \), that is the growth rate \( g \) of the stock of brands is given by

\[
g = \frac{\dot{n}}{n} = (1-\alpha)\left[ L/a_{ln} \right] - \alpha \rho
\] (16)

It is clear from (16) that \( g \) is higher the lower is the labour needed per unit of R&D as indexed by \( a_{ln} \), and higher the mark-up over marginal costs (that is, lower the value of \( \alpha \ )) and lower the value of \( \rho \ ), that is, greater the patience of consumers. It also shows that \( g \) is higher the larger the value of \( L \), the size of the labour force. This is not realistic since it implies that large populous countries such as China and India would have faster growth of R&D. However, this unrealistic feature of the model can be and has been remedied (Matsuyama (1992)) without weakening the other results.

The utility \( u(t) \) at any point in time \( t \) of the representative consumer of this economy is given by (3). In the steady state path \( n(t) \) grows at the rate \( g \). Expenditure per worker is the
wage rate \( w \). Substituting in (3) 
\[
\frac{u(t)}{w} = \log \left( n(t)^{1-\alpha} \left( \frac{w}{p} \right) \right) = \log \left[ n(t)^{(1-\alpha)/\alpha} \left( \frac{w}{p} \right) \right].
\]

Since \( w/p \) is constant over time (see (9)) and \( n(t) \) grows at the rate \( g \), the representative consumer’s utility \( u(t) \) rises over time (linearly) at the rate \( (1-\alpha)g/\alpha \). Thus a consumer is better off living in a large economy that starts with the same number of brands of consumer goods as a smaller economy, because her initial utility is the same in both countries but rises faster (i.e., \( g \) is larger) in the larger countries.

Helpman (1990) extends this model of innovation in a closed economy to a world of two countries, North and South. North is developed and it is where innovation takes place. However, a Northern entrepreneur knows that he is not assured of indefinite monopoly as in the above model because of imitation by the less developed South. Suppose at time \( t \) the total number of brands in existence and invented in the North be \( n(t) \) of which \( n_s \) have already been imitated by the South and \( n_N = n - n_s \) are yet to be imitated. Let \( \mu = \frac{n_s}{n_N} \) be the endogenous instantaneous rate of imitation, with every Northern brand yet to be imitated having the same chance of being imitated. Let \( F(t, \tau) \) be the probability that a brand developed at time \( t \) will be imitated by the South before \( \tau \geq t \). It is easy to show that

\[
F(t, \tau) = \left[ 1 - e^{-\mu(t-\tau)} \right] \quad (17)
\]

Northern entrepreneurs maximize the expected present value of their profits, given \( F(t, \tau) \) and that they lose their market to Southern imitators once they are imitated. Free entry into R&D sector in the North leads to the following analogue of (1)

\[
c_n \left[ w_N(t) \right] = \int_{t}^{\infty} \left[ 1 - F(t, \tau) \right] \left[ \int_{t}^{\tau} \exp \left[ R(t) - R(u) \right] \pi(u) du \right] dF(t, \tau) d\tau \quad (18)
\]
where $w_N(t)$ is the Northern wage rate.

Substituting for $F(t, \tau)$ and differentiating we get the analogue of (2)

$$\frac{\pi}{c_n} + \frac{\dot{c_n}}{c_n} = \dot{R} + \mu$$

(19)

Comparing (2) with (19) it is seen that the threat of imitation adds a risk premium $\mu$ to the interest rate $\dot{R}$ to which the sum of the instantaneous rate of profit $(\pi/c_n)$ and capital gains $(\dot{c_n}/c_n)$ has to equal.

We now turn to the Southern process of imitation following Helpman (1990, pp. 31-33) very closely. Suppose it takes resources to imitate a brand. Specifically, a Southern entrepreneur needs $a_{L_L}$ units of labor per brand for imitation. Having imitated a variety, she needs $a_{L_X}$ units of labor per unit of output in manufacturing (just like the North). Imitation takes place only if the present value of profits covers imitation costs. For an imitator, however, the profit calculation is more involved. If she did not face competition from the original Northern innovator, she would mark up price above marginal costs in the usual way. When the resulting price falls short of Northern marginal manufacturing costs, she can still charge this price without being threatened by the Northern producer. This happens when the South’s wage rate is lower than the proportion $\alpha$ of the North’s wage rate and is termed the ‘wide gap’ case (the gap in relative wages is wide). Otherwise, the Southern imitator charges a price that equals the North’s marginal manufacturing costs. Naturally, the imitator would lose money in either case if the wage rate were lower in the North, so that active imitation requires a lower wage rate in the South, and this is assumed hereafter. Free entry into imitation implies a no-arbitrage condition such as equation (2).
In addition, assume that the stock of knowledge capital in imitation equals $n_s$ (this can be extended). Therefore, labor-market clearing in the South implies

$$a_{LJ}n_s / n_s + a_{LJ}x_s = L_s$$

(20)

Now assume the wide-gap case, so that the South’s pricing equations are similar to those of the North. Together with the market-clearing and no-arbitrage conditions and the growth-of-spending equation (in which the subjective discount rate is the same in both countries), the pricing equations imply a steady-state growth equation that is analogous to equation (16)

$$g = (1-\alpha)L_s / a_{LJ} - \alpha \rho$$

(21)

A similar procedure for the North, using equation (19), yields an equilibrium steady-state relationship between the rate of innovation and the rate of imitation:

$$(1-\alpha)(L_s / a_{LN} - g)(g + \mu) / \alpha g = g + \mu + \rho$$

(22)

The left-hand side represents the profit rate, while the right-hand side represents the interest rate plus the risk premium. The right-hand side increases in $g$, while the left-hand side declines in $g$. Therefore, an increase in the rate of innovation reduces profitability relative to the cost of capital. Alternatively, an increase in $\mu$ raises the right-hand side but raises the left-hand side even more. Therefore, an increase in the rate of imitation increases the profitability of innovation relative to the capital cost. This explains the upward slope of curve NN in Figure 1 along which equation (22) holds. As equation (21) holds along SS, the equilibrium levels of innovation and imitation are given by the intersection point 1.
Several implications of this model are worthy of note. First, observe that if innovation in the South requires more resources than imitation, which is reasonable, then trade with the North speeds up long-run growth in the South. This can be seen from equation (21). Without trade, the growth equation is the same [see (16) for a closed economy], except that $a_L$ is replaced by a larger coefficient. Second, trade with the South speeds up long-run growth in the North. This is shown in Figure 1 by the fact that the vertical intercept of NN identifies the autarky growth rate, so that both countries grow faster by trading with each other. Third, it is clear from Figure 1 that a larger South raises both the rate of innovation and the rate of imitation. A larger North, by contrast, does not affect the rate of innovation but reduces the rate of imitation. (The rate of
innovation increases if knowledge capital in imitation also depends on the number of unimitated products.) Lower rate of imitation are associated with longer average time periods during which Northern entrepreneurs command monopoly power. Fourth, it can be shown that the larger a country, the larger is its relative wage rate.

Turning to policy implications, in the single country model it is easy to show that R&D growth (and hence growth of utility of the representative) consumer is undersupplied for the reason that R&D today generates a positive externality for R&D in the future, because it contributes to knowledge capital that reduces future R&D costs. However, this externality is not internalized. For this reason, some degree of growth promotion through R&D subsidies is desirable. But how much?

A social planner of this economy would maximize discounted present value of aggregate welfare subject to the constraint of aggregate labour availability (see (10)) \( a_{\ln g} + a_L = L \) through her choice of \( g \) and \( x \). Aggregate consumption per brand is \( x/n \) and aggregate utility \( U \) is easily seen to be:

\[
U = \frac{1}{\sigma - 1} \log n + \log x = \left( \frac{1 - \alpha}{\alpha} \right) \log n + \log x
\]  

Now \( n = n_0 e^{r_t} \) and \( x = \frac{(L-a_{\ln g})}{a_L} \). Thus discounted sum of utility

\[
W = \int_0^\infty e^{-\rho t} U(t) dt = \frac{1}{\rho} \left[ \log \left( \frac{L-a_{\ln g}}{a_L} \right) + \log n_b \right] + \frac{g(1-\alpha)}{\alpha \rho} \tag{24}
\]

Maximizing \( W \) or equivalently \( \rho W \), leads to maximizing \( \log \left( L-a_{\ln g} \right) + \frac{g(1-\alpha)}{\alpha \rho} \) with respect to \( g \). Thus the socially optimal \( g^* \) is
\[ g^* = \frac{L}{a_{t_0}} - \left( \frac{\alpha}{1 - \alpha} \right) p \]  (25)

Comparing \( g^* \) with the laissez-faire market optimum \( g \) given by (16), it is seen that

\[ g^* = \frac{g}{1 - \alpha} > g \]  (26)

Hence, R&D subsidies that bring market optimum growth closer to the social optimum \( g^* \) are worthwhile, but further increases in subsidy would reduce social welfare.

Helpman points out that:

“commercial policy can also affect long-run growth rates. If, for example, trade policy succeeds in diverting resources toward product innovation, it accelerates growth. But even in cases where the free-trade growth rate falls short of the optimal level and trade policy accelerates growth, trade policy may nevertheless be harmful. Monopolistic competition per se introduces a distortion that can be aggravated by a growth-enhancing trade policy. In addition, in the presence of rent seeking, growth is slower under quotas than under tariffs because quotas divert resources to rent seeking, thereby reducing employment in R&D. This effect is particularly strong when rent seeking uses entrepreneurial skills that are useful in product development. These examples highlight the role of policy in a dynamic context.” (Helpman, 1990, p. 35)

Lucas (2002, Chapter 3) describes a model in which learning occurs in individual product lines. New goods or product lines, which are better in a well-defined sense than other goods in existence, are introduced, and labour reallocated between new and old goods, all the time. The rate at which the new goods are introduced is endogenous through the assumption that the learning accumulated in producing a good reduces the cost of producing each good that is introduced later (thus the spill-over effect is loaded in the direction of improving productivity of better goods introduced later). The spillover decays in the sense that the initial productivity of a good is a weighted average of learning on lower quality goods, with the weights declining exponentially with the difference in qualities. The equilibrium rate of introduction of new goods in inversely proportional to the rate of decay of spill-over experience, an increasing function of
the spill-over parameter, and the learning rate, and increases as employment is more heavily concentrated on more advanced or better goods.

Lucas finds his learning-spillover models attractive for at least two reasons, the main one being that it offers the potential of accounting for the great differences in productivity growth rates that are observed among low and middle income economies, although he admits that little is known empirically about crucial spillover parameters of the model. The second reason is that the model is consistent with a strong connection between rapid productivity growth and trade or openness. For example, in two small economies facing the same world prices and with similar factor endowments, suppose one somehow shifts its workforce onto the production of goods not formerly produced there, and continues to do so, while the other continues to produce its traditional goods. The learning-spillover theory implies the economy which shifts its labour force would grow more rapidly. For the story of such a shift to be plausible, shifting economy has to open up a larger difference between the mix of goods it produced and the mix it consumes (recall that both economies are assumed to have similar in incomes and tastes and to face the same world prices). Thus a large volume of trade is essential to a learning-based growth episode. This reasoning applies also to show why import-substitution policies ultimately fail, although they might initially succeed in stimulating growth. As Lucas rightly argues, an economy which exports agricultural products and imports manufactures, could create prohibitive trade barriers which succeed in closing the economy and in shifting workers to producing formerly imported manufactures, and indeed rapid learning will occur initially. But this is just “a one-time stimulus to productivity, and thereafter the mix of goods produced in this closed system can change only slowly, as the consumption mix changes” (Lucas, 2002, p. 94). Thus there is no room for opening a large gap between what is produced and what is consumed in a closed economy.
3. Entrepreneurial Success, Venture Capital and Public Policy

In the models of Section 2, learning-by-doing and/or R&D expenditures that result in the development of new products. However, those who engaged in R&D were rewarded directly by the growth of monopoly profits permanently or at least until they were competed away by imitators. In this section, I want to focus on financing of entrepreneurs with innovative ideas. Again, the literature on this is large and growing. Venture capital is an important intermediary in this context as they provide:

“capital to firms that might otherwise have difficulty attracting financing. These firms are typically small and young, plagued by high levels of uncertainty and large differences between what entrepreneurs and investors know. Moreover, these firms typically possess few tangible assets and operate in markets that change very rapidly. Venture capital organizations finance these high-risk, potentially high-reward projects, purchasing equity or equity-linked stakes while the firms are still privately held. The venture capital industry has developed a variety of mechanisms to overcome the problems that emerge at each stage of the investment process. At the same time, the venture capital process is also subject to various pathologies from time to time, which can create problems for investors or entrepreneurs. (Gompers and Lerner, 2001, p. 145)

I will be selective in my presentation of this literature.

There are alternative ways of capturing innovation and adoption and the implication of alternative development strategies on innovation. Although it is natural to think of entrepreneurs as having ideas but no capital, one could also think of them as lacking skills. A particularly insightful model that illustrates this is Acemoglu et al (2003). They consider an economy where firms owned by capitalists are run by managers hired by capitalists. Managers are of two types (high and low skill) and perform two tasks: engage in innovation, a task in which skills are important for success, and adoption of technologies from the world frontier, a task in which skills are not as important. Each firm also invests, choosing between levels large and small. Investment costs are financed either through retained earnings or borrowing from competitive
intermediaries. There is a moral hazard problem in that a manager could divert a fraction of the firm’s returns for his own use without ever being prosecuted. Capitalists make contracts with managers and financial intermediaries, the contract specifying the loan amount from intermediaries, payments to managers and intermediaries and the level of investment. In the dynamic equilibrium, an economy starts with an investment-based strategy (high investment) and long-term relationships between firms and managers and as it approaches the world technology frontier. There is a switch to an innovation-based strategy with lower investment, shorter relationships, younger firms and more managerial selection. However, depending on parameter values, there is the possibility that an economy could fall into one of two traps: a stagnation trap, where the economy starts too far below, and progressively falls further and further behind, the world technology frontier, and a non-convergence trap, where the economy grows at the same rate as the world frontier without every converging to it. This occurs when the economy fails to switch out of the investment-based strategy.

The authors show that the switch out of the investment-based strategy may occur too soon because firms do not internalize the greater consumer surplus from higher investment or too late because the presence of retained earnings enables managers not having to compete for investment funds and thus shield themselves from competition. This prolongs the investment-based strategy.

Several policy implications are drawn by the authors. First, when the switch is too soon policies restricting competition or subsidizing investment would slow the switch. However, situations where retained earnings shield insiders too much and economies never switch from the investment-based strategy (and hence do not converge to the world frontier), such policies might lead to non-convergence traps. The authors recognize that while a welfare maximizing policy
sequence consists of a set of policies that at early stages of development would encourage investment and protect insiders, thus being anti-competitive, and at later stages would be pro-competition, such a sequence creates serious problems of political economy. For example, as has happened in economies that have been protected from domestic and import competition through public policy interventions as in India, beneficiaries of such policies would resist reforms. Thus a well-meaning attempt to encourage domestic investment at early stages of development through inward-oriented and anti-competition policies could end up preventing the economy from adopting policies that would speed up growth at later stages.

Lerner (1998) provides a succinct description of the problems faced by start-up firms, particularly those in high technology industries, and the role of venture capital (VC) and outside investors in addressing them. Typically, such firms are characterized by significant uncertainties and information asymmetries that could result in opportunistic behavior by entrepreneurs. Serious incentive problems arise from conflicts between firm managers and investors and these could affect the supply of debt and equity capital to firms. For example, with equity financing the manager has an incentive to engage in disproportionately (to her) beneficial but wasteful expenditures while bearing only part of their costs. Debt financing might induce the undertake excessively risky activities. Because outside investors are aware of these incentives, they would demand a higher rate of return than the cost of funds internally generated by the firm. Even if the manager is driven to maximize shareholder value, if she is better informed about investment opportunities and acts in the interest of current shareholders, she would issue new shares only when the company’s stock is overvalued. The information asymmetries and their consequences in debt markets are well-known since the work of Stiglitz and Weiss (1981).
VC organizations address these information problems and alleviate capital constraints by first intensively scrutinizing the firms before providing capital, and then by monitoring them afterwards. First, the initial scrutiny is intense with only a very small proportion of firms seeking finance being funded. The funding is often syndicated, with more than one syndication partner having to approve funding before it is disbursed. Second, approved funding is disbursed in stages, so that managers have to go back often to their financiers, thus enabling them to ensure that funds are not wasted. Finally, venture capitalists intensively monitor managers through their insistence on representation on the board of directors, preferred stock and restrictive covenants on finance. For all these reasons, VC is the dominant form of financing for privately held technology-intensive firms.

In a preliminary study, Amador and Landier, like Acemoglu et al (2003) put firm managers along with financing constraints at the center of innovation-implementation process. In their model, managers are the ones who generate ideas of projects. They can implement their ideas either inside their firms or be financed outside with VC. Firms, because they own assets complementary to the project, could face a lower cost of implementation. On the other hand, a VC organization could offer a contract to the manager that is contingent on the project’s outcome. The owner of the firm (i.e., capitalist, as in Acemoglu et al), will let the manager implement it within the firm if the cost of compensating the manager to do so does not exceed the cost of the competition it would face if the manager implements the idea outside. The manager would opt for outside implementation if the expected payoff for him from doing so would exceed what the capitalist would be willing to offer to implement it inside the firm. The VC market influences these decisions by affecting both the projects that can be implemented outside and the payoff (to managers) to acquire new ideas. In the presence of asymmetric
information, moral hazard and differences in beliefs about the probable success of projects, they show that the most innovative projects are implemented in new ventures and more focused firms innovate more. Also, if the marginal innovation is implemented under the outside threat, a better VC market increases the innovation rate. If it would have been implemented even without the threat, a better VC market, by reducing the firm’s payoffs would reduce the innovation rate.

In an eminently readable, short but wide-ranging paper, Rajan and Zingales (2001) examine the implications of what they call “financial revolution” consisting of “the ability of financial institutions to price a variety of exotic instruments, and to assess and spread risks . . . [availability of] more [and timely] data on potential borrowers . . . improvements in accounting disclosure [resulting] in greater borrower transparency . . . deregulation [leading to] greater competition and better pricing in financial markets . . . Finally [lowering of] regulatory barriers protecting the turf of different kinds of financial institutions [and] to emergence of new institutional forms” on the way firms are organized (Rajan and Zingales, 2001, p. 206). Starting from the Coasian view of the realm of the firm as the set of transactions that are governed by power or authority, they first ask, “How does anyone in a firm possess power that differs from ordinary marketing?” and note that because contracts are incomplete, the owner of a firm derives power from her ownership of unique alienable assets that are critical to production. They then ask, “Where does power come from when the firm uses no unique alienable assets in production?” In answering it they argue that such power could arise from attributes of the owner such as her unique talent which is critical to the success of the firm or more generally other critical resources such as a set of clients and associates who are rely on working with the unique talent of the owner and who would have been less productive without her. This means that, unlike ownership of unique alienable assets which can be sold, control over other critical
resources has to be built up through other means such as internal organization, work rules, and above all, incentives. The allocation of power within the firm or organization acquires its importance from its impact on incentives and the determination of the range of feasible action each member of the organization has. Moreover, allocation of power at a point in time determines the constellation of power in the future, and thus the future efficiency of the organization.

For the purposes of this paper, their application of the implications of the financial revolution on the framework of power allocation within firms to the exploitation of new project ideas, which may characterize as growth opportunities. In the pre-financial revolution days, the balance of power within a firm affected project choice and implementation as follows:

“A firm’s existing assets generate cash flow and also provide collateral, with which to finance new projects. New projects also need the technical expertise of employees. In the past, the complementarities between inside financial capital and human capital held the firm and its growth together. Owners were happy to let insiders use the funds generated by existing assets to finance new investments because this secured them property rights on growth opportunities. Insiders were happy to exercise these options within the legal framework of the existing firm, because their career and earnings potential were enhanced, and lacking financing, they could not have done it on their own.” (Rajan and Zingales, 2001, p. 207)

In the post-financial revolution days:

“In order to invest, insiders had to make a case to shareholders that the investment would be profitable, and a variety of mechanisms were put in place to compel insiders to repay cash if the case was found wanting. These changes enhanced the efficiency of investments. At the same time, however, they helped sever the link between assets in place and growth opportunities. If insiders could now convince both the corporate bureaucracy and outside shareholders of the merit of new internal projects, they could probably also convince outside financiers to fund the projects as separate ventures.

In other words, the financial revolution has subjected internal decisions to greater scrutiny, while making outside decisions easier. Unless there is a strong complementarities between assets in place and growth opportunities from a technological point of view, there is no reason why new opportunities should be undertaken within the legal shell represented by the existing company. The same developments that led outside owners to gain control over internal cash flows may
have weakened their ability to appropriate many valuable growth opportunities!” (Rajan and Zingales, 2001, 207-08)

Gans et al (2002) note that between 1991 and 1999 there was a rapid increase in VC investments and venture-backed firms accounted for more than 8% of all domestic innovation in the US. They examine whether the returns to innovation are earned through product market competition (the Schumpeterian gale of creative destruction) or through cooperation with established firms through several mechanisms such as alliances and acquisition. These mechanisms differ in their impact on future incentives to innovate but share the common feature of foreclosing product market competition. The strength of the Intellectual Property Regime (IPR) influences the absolute and relative returns to competition and cooperation. There is an ‘expropriation’ threat in either choice: under competition incumbents could attempt to reverse engineer and sell an imitation of the innovation. Under cooperation, negotiating the sale of innovation runs the risk of disclosure, thus eroding the bargaining position of the innovator and reducing the incumbent’s willingness to pay for the innovation. More generally, costs of search and bargaining as well as uncertainty about the value of the innovation could affect the choice between competition and cooperation.

The empirical analysis of the authors is based on a comparison of 55 VC-backed firms, 63 firms backed by funding by the Small Business Innovation Program (SBIR) of the US government: the principal dependent variable is a combination of two distinct measures of cooperation strategy through two dummy variables, one indicating whether the firm earned licensing fees from innovation and the other indicating whether was acquired since the project was funded. Explanatory variables included measures of IPR strength, measures of investment costs in acquiring assets necessary for effective competition, firm level and project level control variables. Briefly stated, the empirical results provide support for a model in which start-up
innovators earn their returns on innovation through cooperation when there is strong IPR protection and costs of acquiring and controlling complimentary assets for effective competition are high. If IPR regime is weak, start-up innovators are more likely to pursue competition. The results suggest a more subtle role for IPR. While earlier literature emphasized the role of IPR in raising the absolute returns to competition and cooperation, the authors find that a stronger IPR raises the relative returns to cooperation.

Kortum and Lerner (2002) examine the influence of VC on patented inventions in the US across twenty industries over roughly three decades (1965-1992) using annual data on US patents issued to US inventors by industry and date of application as the dependent variable and measures of VC funding and industrial R&D expenditures as the main explanatory variables. They find that increases in VC activity in an industry are associated with significantly higher patenting rates. Their uni-variate comparisons of 122 VC-backed and 408 non-VC-backed firms suggest that VC-backed firms are more likely to patent, have previous patents cited and engage in frequent and protracted litigation of both patents and trade secrets. Their results are robust to different measures of VC activity, sub-samples of industries, and representation of the relationship between patenting, R&D and VC. Averaging across their preferred regressions, they find that a dollar of VC resulted in three times as much patenting as a dollar of $&D expenditure.

Gompers and Lerner (2001) point out that to understand the VC industry, one must understand the VC cycle. The cycle starts with the raising of VC funds, which is followed by investing in, monitoring of, and adding value to firms. The final step is the exit of VC from successful deals and the return of capital to investors in the fund. The authors summarize the findings of the empirical literature on each segment of the cycle, namely, fundraising, investing and exiting.
Lerner (1999) notes that the US federal government played an active role in financing new firms, particularly in high technology industries since the Soviet Union launched Sputnik in 1957, a role that other governments in Europe and Asia, as well as those of states in the US, have tried to emulate. For instance, the Small Business Investment Company (SBIC) program provided $3 billion to young firms between 1958 and 1962. In 1995, the Small Business Innovation Research (SBIR) program provided almost $900 million to young technology-intensive firms. Many US states and some foreign countries have adopted similar policies in recent years. According to Lerner these policy interventions are based on two basic assumptions, namely, that the private sector provides insufficient capital to new firms and that the government can pick winners, that is, it can identify firms where investments will ultimately yield high social and/or private returns. There have been very few attempts to test either assumption. Lerner’s empirical analysis of the long-run success of firms participating in the US SBIR program is based on the employment and sales growth of 1,135 firms, approximately half of which received one of more awards of approximately half a million dollars in the first three cycles of SBIR. The other half was matching firms constructed to resemble the SBIR awardees. He finds that a decade later:

“the SBIR awardees have enjoyed substantially greater employment and sales growth than the matching firms. This superior performance, however, was not universal. The differentials in both employment and sales growth were confined to firms in zip codes that were simultaneously the site of substantial venture capital activity. The SBIR awards appear to have had much less impact on the performance of firms in other regions. The awards contributed both to the growth of firms that were or were not backed by venture capital, and that were or were not in industries heavily financed by venture capital. Some evidence suggests that the positive impact was strongest for firms in areas with many venture investments but in industries not frequently financed by venture capitalists.”

(Lerner, 1996, p. 6)
While these results are consistent with the hypothesis of capital constraints, it is also possible that they are also consistent with two other hypotheses: the selection process successfully picked winners, i.e., firms with superior long-run prospects and alternatively, the award of SBIR funding served as a favorable signal to other investors and potential customers of the firm. Lerner tests these alternative hypotheses and finds that they are not supported in the data. Another hypothesis that did not find support was that SBIR awardees grew because they established relationships with federal officials or politicians which led to their receiving government contracts. Lerner’s finding that the role of SBIR program seems to complement VC organizations and other private institutions that fund new firms, in the sense that the impact of SBIR awards in regions without private sector funding is important—it questions the wisdom of programs that provide public financing of and guarantees for VC funds that invest in economically disadvantaged areas.

4. Research and Development Systems and Innovation

In Section 3, I reported on the role of private actors (innovators, entrepreneurs, firms, etc.) on the innovation process. Clearly, public non-profit motivated actors such as universities and research institutes and government agencies play an important role directly by spending on and doing research. Governments play an equally important role through public policies (fiscal policies, trade policies, regulatory policies, and so on) which influence the incentives of private actors. Data from World Bank (2002, Table 5.11) show that expenditures for R&D as a proportion of gross national income during 1989-2000 averaged as high as 3.67% in Israel and in the range of 2% to 3% in industrialized countries. Among developing countries, the average proportions were as high as 2.70% in Korea and 1.93% in Egypt and in the range of 0.5% to 1% in many others such as Argentina, Brazil, Chile, and
India. These expenditures are by no means negligible. India, for example, had publicly funded and run research institutes such as the Council for Scientific and Industrial Research, Indian Agricultural Research Institute, and several national laboratories for decades. Also, defense expenditures in some of the larger developing countries (India) include significant research components.

Although hard-headed cost-effectiveness analysis across countries of R&D systems using a common methodology and using complete and reliable data does not exist, there are several studies that have looked at national R&D systems in several countries. Nelson (ed. 1993) reports on a comparative analysis of seven large and three smaller high income and five lower income countries. An important objective of the project (other than a description and comparison of national innovation systems) derived from the concern of the authors that earlier studies had concluded, on the basis of little evidence or analysis, that particular features were behind country performance differences, a conclusion that was neither grounded on a strong conceptual understanding of what is or is not likely to be a causal factor nor the requirement that asserted causal connections be consistent with a wide range of country observations. The authors hoped to remedy these effects. Some of their findings, as summarized by Nelson, are:

“First, size and the degree of affluence matter a lot. Countries with large affluent populations can provide a protected market for a wide range of manufacturing industries and may engage in other activities that ‘small’ countries cannot pursue, at least with any chance of success, and their innovation systems will reflect this.”

“Whether a country had rich natural resources or ample farming land clearly is another important variable influencing the shape of its innovation system.”

“Countries that lack them must import resources and farm products, which forces their economies toward export-oriented manufacturing, and an innovation system that supports this.”

“...a nation’s innovation system is shaped by factors such as size and resource endowments that affect comparative advantage at a basic level. But it also is true
that a nation’s innovation system tends to reflect conscious decisions to develop and sustain economic strength in certain areas, that is, it builds and shapes comparative advantage.”

“... in many countries national security concerns had been important in shaping innovations systems.”

“... several basic features that are common to effective innovative performance, and that are lacking or attenuated in countries where innovation arguably has been weak. First, the firms in the industry were highly competent in what mattered to be competitive in their lines of business. Generally this involved competence in product design and production, but usually also effective overall management, ability to assess consumer needs, links into upstream and downstream markets, and so on.”

“One important feature distinguishing countries that were sustaining competitive and innovative firms was education and training systems that provide these firms with a flow of people with the requisite knowledge and skills.”

“Another factor that seems to differentiate countries in which firms were effectively innovative from those in which they were not, is the package of fiscal, monetary, and trade policies. Where these combined to make exporting attractive for firms, firms have been drawn to innovate and compete. Where they have made exporting difficult or unattractive, firms have hunkered down in their home markets, and when in trouble called for protection.”

“All the countries that are strong and innovative in fine chemicals and pharmaceuticals have strong university research in chemistry and the biomedical sciences. A strong agriculture, and a strong farm product processing industry, is associated in all of our cases with significant research going on relevant to these fields in national universities, or other types of public research institutions dedicated to these industries.”

“... the record of national policies expressly aimed to help high-tech industries through support of industrial R&D is very uneven.” (Nelson, 1993, pp. 507-17.)

Eaton and Kortum (1997) examine productivity growth since the Second World War in five leading research economies: France, West Germany, Japan, the UK, and the US. They estimate a multi-country model of technological innovation and diffusion to address several controversies:

“One is whether countries that start out poor grow faster than initially rich countries, so that income levels are ‘converging.’ A second is whether sources of
growth are primarily domestic or foreign in origin. A third, and perhaps most
fundamental, is what causes growth rates in output per worker to differ among
countries: differences in capital per worker or differences in available
technology.” (Eaton and Kortum, 1995, p. 1)

They conclude:

“As for the issue of foreign vs. domestic sources . . . growth is primarily the result
of research performed abroad. We find that even the United States obtains over
40 per cent of its growth from foreign innovations. These findings seem to be
consistent with historical accounts.” (Eaton and Kortum, 1995, p. 30)

The study of Eaton and Kortum was confined to just five leading R&D countries. Coe
and Helpman (1995) and Coe, Helpman, and Hoffmaister (1997) test the impact of openness on
the transmission of technical knowledge across countries and hence on TFP growth. Both
estimate variants of the following basic regression:

\[ \ln F_i = \alpha_0 + \alpha_1 \ln S_{i}^d + \alpha_2 \ln S_{i}^f + u_i, \]

where \( F_i \) = level of total factor productivity in country \( i \)

\( S_{i}^d \) = domestic knowledge stock of country \( i \)

\( S_{i}^f \) = foreign knowledge stock relevant for country \( i \)
defined as the sum of import-share weighted domestic knowledge stock of countries from which \( i \) imports

\( u_i \) = random disturbance.

The sample of Coe and Helpman (1995) include 21 OECD countries and Israel for the years
1971-90. Their results suggest a statistically significant and similar quantitative impact of
domestic and foreign knowledge stocks on TFP growth.

Coe, Helpman, and Hoffmaister (1997) analyze data from 77 developing countries for the
period 1971-90. Since few developing countries undertake R&D, the variable \( S_{i}^d \) of equation
(27) is not relevant. In addition to \( \ln S_{i}^f \), they include the secondary school enrollment rate \( E \),
the share of imports from industrial countries $M$, dummies for time periods 1971-75, 1975-80, 1980-85, and 1985-90, and the interaction (i.e., product) of $S^f$ with each of $M$ and $E$. For various reasons of primarily econometric nature, they settle on the specification:

$$\Delta \text{Log}F = -\frac{9.853}{(3.043)} \Delta M + \frac{0.837}{(0.252)} \Delta (M \text{Log}S^f)$$

$$+ \frac{0.247}{(0.096)} \Delta \text{Log}E, \text{ Adjusted } R^2 = 0.208.$$

Using this equation, they estimate R&D spillovers from the industrial countries to the developing countries. These estimates suggest that such spillovers from North to South are substantial and in 1990 “may have boosted output in the developing countries by about 22 billion US dollars” (Coe, Helpman, and Hoffmaister, 1997, p. 148, emphasis added). To put this figure in perspective, total official development aid from multilateral and bilateral sources in 1990 amounted to about 50 billion US dollars. Like all cross-country regressions, the two studies are subject to criticism on data, econometric and analytical grounds [see Srinivasan and Bhagwati (2001) for a critique]. What is more, Keller (1998) shows that replacing actual import share weighted foreign knowledge stocks by random share weighted ones reduces the impact of domestic stock and increases that of foreign stock in explaining TFP! Since the rationale for using actual import weights is that through trading more with a country having a large knowledge stock, a country can augment its productivity by importing a variety of intermediate and capital goods embodying that knowledge, Keller’s results based on random, rather than actual, import weights could be interpreted either as raising doubts about trade as a mechanism through which knowledge spillovers occur or alternatively that the growth of knowledge stocks of different industrial countries was very high correlated so that alternative weighing schemes yield highly correlated values for $S^f$. 

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Since the conference at which this paper is to be presented is taking place at Bangalore, India’s software capital, I will conclude this section report some research findings on that industry. The success of Indian Information Technology (IT) industry, widely viewed to be high-tech and knowledge intensive, is well known. Software exports increased from $0.3 billion in 1993-94 to $7.2 billion in 2001-02 (Reserve Bank of India, 2003, p. VII-18). Indeed, it is no exaggeration to say that the success of the industry, particularly recognition abroad (especially in the Silicon Valley) of the professionalism and competence of software engineers, has brought a certain visibility and media attention that India rarely received in the past. Within India, the success of IT has transformed the mindset of the young to one of confidence in their ability to compete with the world’s best from one of resignation and despair. According to Murthy and Raju (2002), the revenues of IT industry grew in excess of 50% a year after 1991, reaching $7 billion in 2000. They cite a report by the consultants McKinsey which projected in 1999 that the revenues would grow to $87 billion by 2008, of which $50 billion would be from exports. The growth since their paper was written in 2000 has exceeded their expectations. What is more, even during the slowdown in growth in the US and Europe after 2000, Indian IT exports continued to grow. For the purposes of this paper, what is of interest is the extent to which India’s educational and R&D systems, public policies and ease of access to finance contributed to parrot the success of IT industry and possibly constrain its future growth. From this perspective, the paper of Saxenian (2002) and comments on it by Murthy and Raju and also Desai are illuminating.

Saxenian points out that prior to 1984, India’s then dominant import-substitution-led (ISI) development strategy “stifled entrepreneurs and isolated India from the global economy. As a result, exports to promote software exports during the period never took off” (Saxenian 2002, p.
Export performance requirements (such as a guarantee to export a certain amount of software) in return for a license to import state-of-the-art computers after paying high customs duties and obtaining foreign exchange allocations prevented the takeoff. Only after the rejection of ISI and the idea of self-reliance in software, allowing import of any form of software under liberal rules, attempts to attract foreign investment and to provide venture capital by the Rajiv Gandhi government, the industry had a chance to develop. Yet, Saxenian quotes Sen to the effect that “until 1991-92, there was virtually no policy support at all for the software sector. Even the term ‘benign neglect’ would be too positive a phrase to use in this connection” (Sen, 1994, p. 55). Of course, the systemic reforms of 1991 following a balance of payments crisis abandoned ISI and opened the economy to foreign trade and investment. The creation of Software Technology Parks (STPs) in the early 1990s, which are in effect an export processing zone for software, provided infrastructure and administrative support, two concessions guaranteed access to high-speed satellite links and reliable electricity.

The contribution of the Indian educational system, particularly the elite Indian Institute of Technology and other engineering colleges, to the growth of the IT industry in India and to the supply of IT professionals to the Silicon Valley cannot be underestimated. Of course, emigration of highly trained (with substantial subsidies from the government) has been viewed as brain-drain and Cassandra’s like the UNDP have been estimated that the net loss (costs of training minus emigrant’s remittances to India) at $2 billion or more. This is not the occasion to critique UNDP. Suffices it to say that the real question is not brain-drain per se but one of whether subsidizing higher education is socially justified. It can be argued that subsidizing primary and secondary education rather than higher education would be socially worthwhile. Be that as it may, as Saxenian documents, the Indian educational system generated trained programmers and
systems analysts whose wages (in 1994) were less than 10% of the wages of similar personnel in the US. Indeed, Murthy and Raju (2002) identify having a pool of well-educated, high quality, English-speaking professionals as the greatest advantage of India’s IT industry. Among the several disadvantages, the two cite the absence of a vibrant VC market in Bangalore and argue that developing a successful product requires heavy up-front investments in development and branding, which are only feasible if there are VCs. Interestingly, echoing some of the findings of research on VC reviewed earlier, the two authors stress the quality of VC and not merely the quantity. An Indian IT consultancy and software firm, Patni Computer Systems emerged as the biggest beneficiary of VC funding in the region. In their words:

“Though Bangalore has attracted several high-quality, technology-focused venture capitalists, it has a long way to go before matching the hands-on approach, commitment, relationships, and risk appetites of some of the leading VC funds in the [Silicon] Valley . . . Efficient commercialization of cutting-edge output from research labs, entrepreneurship forums at universities, highly efficient alumni networks, close links between leaders in academia and business, risk appetites of venture capitalists, synergies between science/engineering schools and business schools, collaborative research among universities, keiretsus bringing together business and venture capitalists, angels with willingness to nurture talent, the abundance of forums where youngsters may put forth their ideas and interact with industry leaders, opportunities for collective learning—all these are differentiators that put the Valley several notches above other high-tech habitats. In sum, Silicon Valley operates in a vibrant market economy that reveres innovation” (Murthy and Raju, 2002, pp. 200-01).

Interestingly, The Indus Entrepreneurs (TiE), an organization of Silicon Valley IT professionals from the Indian subcontinent, has greatly contributed to this outcome. TiE has a network of chapters in the subcontinent and elsewhere and plays a mentoring role for aspiring entrepreneurs. Its publication (TiE, 2003) on its mentoring experiences is a practical guide to entrepreneurship.

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2 According to the Thomson Corporation of Hong Kong, a total of $1.9 billion VC investments was disbursed to Asia Pacific companies in 2002, with 232 VC firms participating in 381 rounds of financing that supported 362 companies. However, the total amount disbursed sharply declined from over $5.0 billion disbursed a year earlier (www.thomsonfinancial.com, News Release, January 20, 2003).
Desai (2002) argues that “the domestic software industry—as distinct from body-shopping [i.e., sending technicians abroad to service foreign enterprises in situ]—could not have become internationally competitive if India’s computers had continued to cost 50 to 100% more than its competitors’” (Desai, 2002, p. 204). The abolition of quantitative restrictions on computers and peripherals in 1992 and the suspension of restrictions on foreign direct investment (FDI) in the software industry, not only contributed significantly to the success of India’s IT but are also testaments, according to Desai, to the damage that high tariffs and restrictions on FDI have done in the past and continue to do (though to a lesser extent now) on other sectors of the Indian economy.

5. Conclusions

I will be very brief in my conclusions. The theory as well as empirical evidence reviewed here point to the vital role openness to foreign trade, investment and technology plays in spurring entrepreneurship, innovation and growth. Access to finance for entrepreneurs, particularly in the form of venture capital, is important. But it is not just the quantity of capital but the quality aspects unique to VC, such as initial scrutiny of applications for finance and later continued monitoring, that are important as well in encouraging entrepreneurship. The financial revolution that Rajan and Zingales (2001) describe is yet to happen in many developing countries, and indeed their financial sector is rudimentary. As such, traditional balance of power probably continue to prevail. Also, the creation of a vibrant VC market is problematic, although Desai (2002) suggests, citing the examples of Japan and Europe, that their importance in financing start-ups might be exaggerated.

It is clear that there is room for developing countries to open their economies to a greater extent to trade and FDI, that is participate in globalization more. But whether they will or be
deterred from doing so by gloom and doom about globalization being propagated by assertions unsupported by rigorous analysis by luminaries such as Stiglitz (2002) is an open question. The empirical literature on VC financing reviewed in Section 3 emphasized the importance of strong IPR. However, this finding has to be put in perspective: they show that given that ideas of entrepreneurs are protected by patents, the stronger the IPR, the lower would be the chance of expropriation of their ideas. But this by itself does not mean that patents and their strong protection necessarily increase the rate of innovation and that patent protection is the most cost-effective means of encouraging innovation. The study by Lerner (2002) on the nearly 150 years of patent protection in 60 countries including the United States, the paper of Boldrin and Levine (2002), and of Sakakibara and Branstetter (2001) on Japanese Patent Law Reforms throw doubt on the first hypothesis. On the second hypothesis also the evidence is not conclusive. Indeed, whether profit-driven research has the inherent tendency to focus on those areas in which market rewards with patent protection would be highest and neglect other areas (e.g., curative and preventive medicines for diseases widely prevalent in poor countries) has been debated. Unfortunately, without any serious analysis of its global social value, IPR regimes have been strengthened through the agreement in Trade Related Aspects of Intellectual Property Services and enshrined in the WTO.
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