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MASS HIGHER EDUCATION, INVESTMENT IN HUMAN CAPITAL AND HERD BEHAVIOR

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1. Introduction

The role of human capital in economic development has always been of critical importance. Davis and Whalley (1989) marshaled evidence to assess that the stock of human capital is about three times larger than the stock of physical capital in a nation. Human capital, as a corollary, has been labeled as "the most important component of national wealth" (Trostel, 1993; p. 327). The work of Lucas (1988) and Rebelo (1991) also established that formation of human capital makes a significant contribution to the economic progress of a nation. The age of globalization has raised serious questions about the formation of human capital and economic progress since the process of globalization is accompanied with an onslaught of privatization and a gradual retreat of governments in the sphere of economic activities. Budgetary termites have forced governments to reduce their expenditure on merit goods. Universities typically respond to such serious budget cuts by offering mass higher education. The concern of this paper is to examine the precise impact of mass higher education on the investment in human capital.

It naturally leads to the important question of what determines the accumulation of human capital by a nation. A tentative answer is given in a micro-theoretical model that involves individual decision of investment in human capital. The principal input of producing human capital is "***time***" (Trostel, 1993) and, hence, the primary cost of producing human capital is the opportunity cost of hourly wage rate and the shadow premium for leisure. The return on investing time in this pursuit is the net wage rate. Therefore, the principal determinant of the accumulation of human capital is the "net wage rate which is then both the return on and the primary cost of human capital investment" (Trostel, 1993; p. 328)[1]. What then possibly drives an individual to invest in human capital? This may be explained by a strong positive (empirical) relationship between labor income (net wage rate) and level of education (see the pioneering work of Mincer, 1958 and 1974). There are two dominant strands of thoughts in explaining such a positive correlation that induces individuals to obtain higher education that, thereby, determines the accumulation of human capital. On the one hand, Schultz (1962, 1971) and Becker (1962, 1975) advanced the "human capital model" in which higher education enhances the productive capacity of an individual in later life. Since employers pay a positive premium on this increase in productivity, the positive correlation between earnings and higher education arises. On the other hand, the work by Arrow (1973) and Spence (1973, 1974) argued that higher education acts as a screening device to identify certain unobservable "valuable traits" of workers. Though higher education, as such, does not augment productivity; yet higher education signals to employers greater worth of potential employees in terms of their unobserved "innate traits". Subsequent finessing by game theorists has further extended this point (Riley, 1975; Mailath, 1987; Cho and Kreps, 1987).

The fundamental premise of these strands of thoughts is the assertion that the equilibration mechanism in the market for heterogeneous labor will determine a *wage schedule* and not a single wage. From the wage schedule there would emerge "earning functions" such that earning of an individual depends on one's educational attainment. An individual acquires higher education up to the point where the marginal benefits given by the earning functions balances the cost of education at the margin. The compelling common logic of these strands of thoughts is that employers pay a premium for higher

1. Trostel (1993) compellingly argued that there are other costs associated with the production of human capital, but for our purpose this makes little difference.

education. The above two strands mainly differ in the reason that explains why employers pay a premium for higher education. Which one has more empirical corroboration? This is, at best, unclear since both these motivations seemingly guide the decision of an individual to acquire higher education (see Taubman and Wales, 1973; Riley, 1979; Wolpin, 1977; Albrecht, 1974; Kroch and Sjoblom, 1993 among others). What are the likely outcomes of mass higher education? It is expected that individuals utilize higher education instrumentally to attain an enhanced economic status. In the human capital model, the increased availability of higher education increases the accumulation of human capital and, hence, contributes to economic progress (Lucas, 1988; Rebelo, 1991; Trostel, 1993). As a result, one would expect the economy to gain from the enhanced productivity of the labor force. In the signaling models, on the contrary, mass higher education does not affect the productivity of the labor force. It is rather argued that more resources are being diverted to rent-seeking with no productivity gain to the economy (Kroch and Sjoblom, 1993; p. 158).

One of the major innovations of our paper is to consider the impact of mass higher education on the allocation of resources/efforts by students. In so doing we dichotomize learning activities: first, a student allocates time for building human capital that enhances labor productivity in his later life. We call this the *core learning*. Secondly, he devotes the rest of the *time* to the formation of educational "*signals*" which increases the probability of finding a job in his earlier life. We call this the *non-core learning*. For the sake of tractability we maintain that total "***time***" as input is given to an individual and that there is no spillover effects between these two types of learning. Both the assumptions can be relaxed. The main results will be through in a more general setting with appropriate restrictions on the values of relevant parameters. The main intuition of this paper is derived from a simple observation that mass higher education and the quality/rigor of training bear an inverse relation. This inverse relation hinges on the interdependence of the quality of students and the academic curriculum (see Brubacher, 1978, p. 56). Mass higher education naturally compels universities to lower the quality of curriculum in order to expand the clientele[2]. As a result, less able students can afford to build the same educational signals as more able students will normally do: This is so since mass higher education, by simplifying curricula, reduces the marginal cost of acquiring education for less able students given their marginal benefits from education. In such a situation, we argue, the inability of higher education to act as a screening device may trigger herd behavior.

We offer a simple game to establish that mass higher education can trigger herd behavior among students in the formation of educational signals. As a result, subjective variations in the belief of a group of students can induce all students to alter the allocation of their efforts/resources that would, in turn, impinge on the accumulation of human capital and drive the economic prosperity of a nation. We, thereby, argue that herd behavior can be a terribly important element in the formation of human capital. To our understanding, this is the first attempt to model the influence of herd behavior on the investment in human capital. The upshot is that investment in human capital may not reflect students' rationally formed expectations and, hence, group psychology will play an important role in determining investment in human capital and the consequent prosperity of a nation. The plan of the paper is the following: Section 2 derives the basic model and Sectin 3 explains a herding equilibrium in this context.We finally conclude in Section 4.

2. Mass Higher Education, "Educational Inflation" and Human Capital

2.a. The Prototype Model:

The purpose of this section is to develop an intuitive model to capture the effects of mass higher education, or "educational inflation" on learning efforts of students. By educational inflation we mean the expansion of higher education along with a marked decline in the quality of curriculum and in the rigor of training (Brubacher, 1978, p. 36). Educational inflation is normally caused by a conscious dilution of the course structure and, hence, we shall interchangeably use mass higher education and educational inflation in the course of the paper. We distinguish between two types of learning: the core learning embodies the efforts of students for building human capital. The non-core learning entails student efforts for building educational signals. In order to simplify the analysis we assume the production function of human capital for a student i to be a Cobb-Douglas function[3]:

$$K_i = Me_i^{\alpha}A_i^{1-\alpha} \quad (1a)$$

$$A_i = \Phi_i A^* \quad (1b)$$

where e_i and K_i represent effort to build human capital and human capital of student i respectively while A_i is the innate ability, or simply ability, of student i. We further assume that the ability A has a prior distribution $\Phi= \Phi_1,\Phi_2,....\Phi_n$ where n is the number of students enrolled in a particular course, and A* is a constant. We impose the following restrictions on the Φ_is: $0<\Phi_i<1$ for all i and if $\Phi_i>\Phi_j$, then student i has higher ability than that of student j. The ability of a student goes up with increased rigor of training. To simplify we further set A*=1. Hence, equation (1a) reduces to the following:

$$K_i = Me_i^{\alpha} \Phi_i^{1-\alpha} \quad (1c)$$

We similarly assume that the formation of educational signals/ results is characterized by the following production function:

$$Q_i = NK_i^{1-\beta}E_i^{\beta} \quad (2a)$$

where Q_i, E_i are educational signals and efforts in signal building respectively by student i, N and ß are parameters.

2. Brubacher (1978) aptly summarized this as,
"At first, there was anxiety, like that as expressed by a Fordham University president (New York Times, 1948), that greatly enlarged enrolments would lead to 'educational inflation'. Paying vast mediocre students into the currency of higher education could lead to its debasement, thus invoking a kind of academic Gresham's law. What was needed, to continue the economic analogy, was a ***gold standard*** for admission." (p. 58).

3. This is a static version of the production function commonly known as Ben-Porath type (1967) widely used in the literature on the accumulation of human capital.

Taking logarithm of both sides of (1c) we get:

$$Ln\ K_i = Ln\ M + \alpha\ Ln\ e_i + (1-\alpha)\ Ln\ \Phi_i \qquad (2b')$$

We write $Ln\ K_i = k_i$, $Ln\ M = m$, $Ln\ e_i = h_i$, $Ln\ \Phi_i = \phi_i$ to express (2b′) as:

$$k_i = m + \alpha\ h_i + (1-\alpha)\phi_i \qquad (2b)$$

We express equation (2a) in logarithmic form as:

$$Ln\ Q_i = Ln\ N + \beta\ Ln\ E_i + (1-\beta)\ Ln\ K_i \qquad (2c')$$

We write $Ln\ Q_i = q_i$, $Ln\ N = n$, $Ln\ E_i = H_i$ to express (2 c′) as :

$$q_i = n + \beta\ H_i + (1-\beta)k_i \qquad (2c)$$

We also know that each student faces an absolute time constraint W such that:

$$H_i + h'_i = W \qquad (2d)$$

We normalize by setting W =0 such that (2d) reduces to:

$$H_i + h_i = 0 \qquad (3a)$$

Postulate 1: After acquiring higher education every student confronts two dates T and T+1. At date T student i gets a new job that gives him an expected salary of X_i. We posit that the expected salary, X_i, obtained in the new job, is a function of the examination results/signals (q_i) that convey some unobservable traits of the students to the employers. However, the earning at date T+1, Y_i, is due to the human capital K_i and, hence, is a function of the human capital accumulated during the student life. Thus, the payoff function, R_i, of student i is expressed as:

$$R_i = X_i + (Ln\ Y_i/(1+r)) \qquad (3b)$$

where r is the interest rate which is the discount rate.

Postulate 2: We assume that students have a common opinion, q^A, about the educational signal/result q_i that is necessary to obtain a job. It is important to note that q^A is some sort of an average result that students think employers use to compare their (students') relative performance in higher education. We hereafter call q^A an average opinion of students.

Postulate 3: We assume that the expected salary X_i is given by:

$$X_i = P_i B \qquad (3c)$$

$$P_i = [q_i + q_i\ (q_i - q^A)] \qquad (3d)$$

where B is the base salary of a new recruit in the job market and P_i is the probability of obtaining the first job which is given by equation (3d) and q^A is the average opinion. Equation (3d) incorporates the rat race model: the probability of getting the first job depends on one's own result q_i and also on the relative performance (q_i- q^A) against the average opinion.

Postulate 4: The earning at date T+1, Y_i, depends solely on K_i where Θ is a constant:

$$Y_i = \Theta K_i = \Theta M \Phi_i^{1-\alpha} e_i^{\alpha} \qquad (4a)$$

$$Ln\ Y_i = Ln\ \Theta M_i + (1-\alpha)\ Ln\ \Phi_i + \alpha\ Ln\ e_i \qquad (4b')$$

Writing $c_i = Ln\ \Theta M_i$, $\varphi_i = Ln\ \Phi_i$, $h_i = Ln\ e_i$ and $y_i = Ln\ Y_i$, equation (4b′) is reduced to:

$$y_i = c_i + (1-\alpha)\ \varphi_i + \alpha hi \qquad (4b)$$

2.b. The Optimisation Exercise of a Representative Student:

Student i maximizes his payoff R_i subject to the production function of human capital, equation (2b), and the production function of educational signals/results, equation (2c). That is,

$$\text{Maximize } R_i = B\ [q_i + q_i\ (q_i - q^A)] + y_i/(1+r)$$
$$\{H_i\}$$

Subject to:

$$q_i = [\ n + (1-\beta)m] + H_i\ (\beta - \alpha(1-\beta) + (1-\beta)\ (1-\alpha)\ \varphi_i \qquad (4c)$$

and $H_i + h_i = 0$ (3a)

We obtain (4c) by substituting (3a) and (2b) into (2c). We substitute (3c), (3c) (4b) into (3b) to yield the above objective function R_i.

Proposition 1: The *optimal* educational signal, q_i, is the examination result that maximizes the payoff R_i of student i and is given by:

$$q_i = q^A/2 + V \qquad (5a)$$

where $V = (\alpha/[2(1+r)B(\beta - \alpha\ (1-\beta)])$ (5a´)

Proof: We derive the above from the first order condition of the constrained optimization exercise.

2.c. *Interdependency in Allocation of Efforts and the Cournot-Nash Characterization:*

The representative student i spends an effort H_i to obtain the optimal result/signal q_i. We call H_i the examination-oriented efforts. These efforts form the second type of learning. What is important is that the optimal result/signal of student i depends on the average opinion q^A. Thus there is interdependency in the allocation of efforts: if all other students j increase their H_j, then q^A goes up that will in turn increase the optimal of effort of student i, H_i, in the formation of results/signals. Hence, as in the rat race, student i is driven by the knowledge that for lower q_i he must share a lower probability, P_i, of finding a job with less able students. Similarly, he is aware that for higher q_i he will enjoy a higher probability of finding job that he will share with students of higher ability. Why does not the student raise the q_i to the maximum feasible level? In our model the formation of signals is costly since such formation reduces the human capital. Different students have different costs wherefrom the optimal result/signal arises. If all students behave in this fashion then the equilibrium efforts of a student depend on his expectations about the efforts in signal formation by other students. We summarize these expectations as q^A. In the Cournot-Nash characterization we assume that each student assumes that as he changes his effort the efforts of others will remain unchanged. Therefore equation (5a) is the function of student i for optimally allocating his effort H_i given the "average opinion" q^A. We will express q^A as a function of q_is to derive the reaction functions of these students. Based on the reaction functions, we will derive the

Cournot-Nash equilibrium in the allocation of efforts between human capital and educational results/signals. The Cournot-Nash equilibrium effort is such that once reached no student has any incentive to unilaterally deviate from the equilibrium allocation.

3. The Cournot-Nash Equilibrium and Herding

For the sake of tractability we present the equilibrium allocation in the context of two groups of students which can be generalized for n students. Hence we lose no analytical bite in the special case when there are two, or two groups of, students. We call them Student 1 and Student 2. In order to derive the Cournot-Nash equilibrium allocation we follow two steps. In Step 1 we derive the reaction functions of these students. In Step 2 we derive their optimum allocation of efforts from the equilibrium. In order to proceed further we express the beliefs of students about the average opinion in the following postulate:

Postulate 5: We define $E_i(q^A)$ as the subjective belief/estimate of Student i about the average opinion q^A. We express this as:

$$E_i\,(q^A) = 2\psi_i q_j + \eta q_i \qquad (6a)$$

We set $\eta=0$ for simplifying calculations, hence, for i =1, 2

$$E_i\,(q^A) = 2\eta_i q_j \qquad (6b)$$

Note that ψ_i is a purely subjective belief/estimate of student i.■

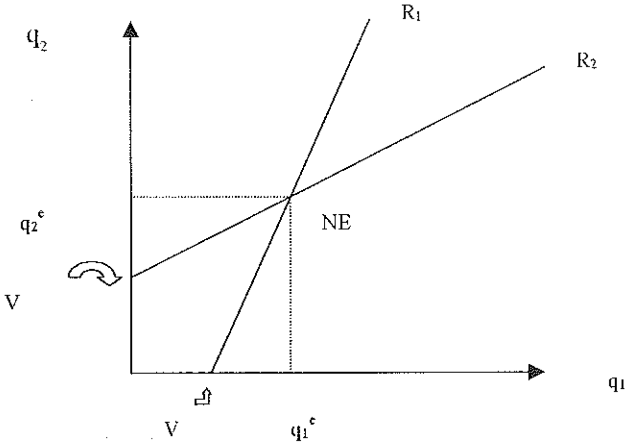
Step 1: From equation (6b) (5a) we know that the reaction function of student i is

$$q_i = \psi_i q_j + V \qquad (6c)$$

Step 2: The Cournot-Nash equilibrium is given by the consistency condition and, hence, the solution to the simultaneous equation system of (6c). This will give us the equilibrium educational signals q_1^e and q_2^e:

Diagram 1

THE COURNOT-NASH EQUILIBRIUM WITH TWO GROUPS OF STUDENTS



R_1 and R_2 are respectively the reaction functions of Students 1 and 2 while NE represents the Nash equilibrium where R_1 and R_2 intersect. These equilibrium values, q_1^e and q_2^e, are given by

$$q_1^e = V(1+\psi_2)/[1-\psi_1\psi_2] \quad (6d)$$

$$q_1^e = V(1+\psi_1)/[1-\psi_1\psi_2] \quad (6e)$$

Note that the existence of an equilibrium is guaranteed if $(1-\psi_1\psi_2)>0$. Substituting (6d) and (6e) into (2c) and from (3a) we get optimal efforts corresponding to the Nash equilibrium as:

$$H_i^e=[q_i^e-n-(1-\beta)k_i]/\beta \quad (7a)$$

$$h_i^e=[-q_i^e+n+(1-\beta)k_i]/\beta \quad (7b)$$

The herd behavior can be traced by differentiating (6d) through (7b) with respect to ψ_1 and ψ_2:

$$\delta q_i^e/\delta\psi_i = V(1+\psi_j)/(1-\psi_i\psi_j)^2>0 \quad (7c)$$

$$\delta q_i^e/\delta\psi_j = [V(1+\psi_j)\psi_i+(1-\psi_i\psi_j)V]/(1-\psi_i\psi_j)^2>0 \quad (7d)$$

$$\delta H_i^e/\delta\psi_i = V(1+\psi_j)/[\beta(1-\psi_i\psi_j)^2]>0 \quad (7e)$$

$$\delta H_i^e/\delta\psi_j = [V(1+\psi_j)\psi_i+(1-\psi_i\psi_j)V]/[\beta(1-\psi_i\psi_j)^2]>0 \quad (7f)$$

$$\delta h_i^e/\delta\psi_i = -V(1+\psi_j)/[\beta(1-\psi_i\psi_j)^2]<0 \quad (7g)$$

$$\delta h_i^e/\delta\psi_j = -[V(1+\psi_j)\psi_i+(1-\psi_i\psi_j)V]/[\beta(1-\psi_i\psi_j)^2]<0 \quad (7h)$$

First, from the reaction functions we know that q_i and q_j are strategic complements, hence a decision by one group of students to increase (reduce) their effort to build human capital (educational signals) would prompt the other group to increase (decrease) their efforts to build human capital (educational signals). The reason is that an initial shift in efforts in resources into educational signals by one group of students opens the other group under/over-performance for building educational signals. This induces the other group to respond by moving in the same direction. Secondly, decisions concerning human capital are significantly influenced by herd instincts: Subjective variations in the beliefs/estimates of a group of students, that is, changes in ψ_i, ψ_j, induce all these students to shift the allocation of their efforts towards H_I, or h_i. These changes are not driven by changes in the objective world as they take place in the subjective evaluation of a group of students. The other group – though has unchanged subjective beliefs, yet they change their efforts and decide to flow with the herd in their allocation of efforts in forming human capital (see Palley, 1995 for details).

4. Concluding Comments

We consider education as an instrument in advancing human interests: it partially augments the productivity of the student in the later life as a worker. Education partially acts as a signaling device to secure an early job. In such a mixed model there are two types of learning associated with mass higher education. First, there is core learning that augments human capital by increasing productivity of labor in the later life of a student. Secondly, there is non-core learning that merely allows the students to signal the innate ability that does not augment human capital. We establish "educational inflation" can engender a herding equilibrium in the formation of educational signals. Herd behavior can seriously warp higher education as a screening device. It can adversely impinge on the accumulation and distribution of human capital. It is important to note that changes in the accumulation and distribution of human capital can thus be driven by subjective variations without an anchorage to the objective world. Such fluctuations in the accumulation of human capital are bound to have a profound impact on the economic fortune of a nation in the modern era of globalization, retreat of governments, budgetary termites and educational inflation.

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