Labor market flexibility and investment in human capital*

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Abstract

We consider the effect of labor market rigidities on human capital accumulation and economic growth when some human capital is difficult to observe prior to employment. We distinguish between two types of human capital, those that formal schooling and test scores can measure ("knowledge") and those that can be observed by employers only after a period of employment ("creativity"). We build a simple model to show when employers have limited discretion to set wages or terminate employment they favor the more reliable signals of "knowledge", such as years of schooling and class rank, at the expense "creativity", which stands for non-testable skills. Individuals in rigid labor markets will therefore favor greater acquisition of knowledge at the expense of creativity, which results in distorted accumulation of human capital and lower growth.

An important implication of our model is that for countries with less flexible markets, in which testing of knowledge and formal schooling have thrived at the expense of non-observable skills, increase in education will have a smaller effect on growth than for those with more flexible markets. Employing a simple empirical strategy which accounts for variation in labor market rigidity, we find evidence for this implication. We show that in the sub-sample of countries with more flexible labor markets, where schooling is expected to be correlated with non-testable skills, the effect of schooling on growth is significantly higher than in countries with rigid markets.

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1 Introduction

The recent economic growth literature has emphasized the importance of human capital without carefully delineating its characteristics. In this paper we consider the implications of recognizing that human capital has several dimensions. In particular, we distinguish between *observable* characteristics which we call "knowledge" and *unobservable* characteristics which we denote "creativity." In our terminology knowledge stands for all cognitive skills that can be tested and are therefore observable.[1] By contrast, creativity stands for all non-cognitive human capital that can be only measured at considerable cost and are therefore unobservable, although eventually inferred by employers who observe productivity. This distinction helps us better describe important choices made by individuals that matter for economic growth: not just how much to invest in human capital but in which skills to invest.

Differences in growth rates between nations arise not only from differences in the amount of investment in human capital, but also from from differences in its mix. Societies that promote a balanced portfolio of human capital use their investments in human capital more efficiently and therefore grow faster with a given level of investment. Disparities in growth and income, then, can arise from differences in institutions that influence the amount of investment in people–families, schools, firms–as well as those that influence the mix of skills people acquire. The labor market, where rewards to a variety of skills are determined is the chief institution upon which the efficiency of the portfolio of human capital investments on a nation depend. This study provides a link between labor market institutions and the efficiency of human capital investments.

Although most economists associate human capital with cognitive skills, which are readily measured with formal schooling and test scores and are therefore widely available, there is growing recognition that human capital encompasses much more.[2] Heckman (2000) notes

[1] Mankiw, Phelps, and Romer (1995, 298) likens knowledge to the quality of society's textbooks, and human capital to the amount of time that has been spent reading them. The latter is what we call knowledge. Our distinction is closer to the dichotomy used in Wise (1975), cognitive vs. affective abilities.

[2] The economics literature on the subject uses a variety of terms to describe general abilities such as ambition, leadership, industriousness, entrepreneurship, and social skills, as well as more specific skills such as creativity, self-discipline, time preference, motivation, perseverance, tenacity, and teamwork. See Fonseca et al. 2001; Murnane et al. 2001; Dunifon et al. 2001; Carneiro and Heckman 2003; Carneiro, Cunha, and Heckman 2003; Heckman 2000; Heckman and Rubinstein 2001, Salehi-Isfahani 2000.

the "staggering gap between the list of productivity characteristics available to economic analysts in standard data sources and what is available to personnel departments of firms." Regressions based on the former typically explain 20 to 30 percent of the variation in wages, whereas personnel data can explain 60 to 80 percent in professional labor markets (Heckman 1998, and Abowd and Killingsworth 1983). There is also direct evidence that non-cognitive skills are correlated with labor market success later in life (Wise 1975, Filer 1981, Jencks 1979, Goldsmith 1997, Dunifon and Duncan 1998, Duncan and Dunifon 1998, Murnane et al. 2001).

There is increasing interest on the part of economists to understand the role of non-cognitive skills in productivity, but progress has been slow in part because they are hard to measure (Heckman and Rubinstein 2001), and in part because we tend to equate non-observable skills with innate ability Carneiro, Cunha, and Heckman (2003). The large literature on 'ability bias' (Card 2000), creates the impression of a dichotomy between education which can be taught and measured and ability which is hidden from the econometrician's eye and is presumed innate. But all that cannot be measured is not necessarily innate. Indeed, skills which we call creativity must satisfy three criteria: (a) they matter for production, (b) are difficult to measure and verify, and (c) can be accumulated.[3] We acknowledge that some non-cognitive skills and characteristics which have been identified with a variety of labels may not satisfy all three criteria, especially the last one. One could find more agreement that these personal attributes matter for production and are costly to observe than on the proposition that they can be enhanced by education. Carneiro, Cunha, and Heckman (2003) make a strong case that the human capital literature has underestimated the range of skills that can be enhanced by family and personal investments. Developmental psychologists believe that many non-cognitive skills are indeed accumulable and try to find how to stimulate their growth. For example, a large literature and two specialized journals exist on creativity alone (Guilford 1986, Sternberg and Lubart 1995). The business world is full of optimism about our ability to increase leadership and interpretership through training, judging by the proliferation of such programs, some more inspirational

[3]Thus an important distinction between what we call 'creativity' and 'affective abilities' used by Wise (1975) and Murnane et al. (2001) is the emphasis on accumulability.

than academic. Still, the evidence on whether specific traits such as ambition, self esteem, or creativity are hereditary, like intelligence, or can be enhanced by better parenting and coaching is far from complete. For the purpose of this paper we do not need to take a position on which abilities are indeed accumulable. We use the term creativity generically to describe the subset of individual attributes that satisfy criteria a through c, and believe that this subset includes several important attributes.

The great appeal of focusing on differences in observability of skills is the way they interact with labor market flexibility. Labor markets provide signals to individuals about the relative rewards of investments in different dimensions of human capital. Parents, educators, and ultimately children respond to these rewards by choosing a mix of the two types of human capital. In rigid labor markets, where layoffs are costly and wages may be set administratively according to the level of education, individuals may over-accumulate formal schooling and under-invest in unobservable human capital. Labor market rigidity can thus reduce the efficiency of human capital investments and hinder economic growth.

Rigidity can result from a variety of sources. Government legislation can make it costly for employers to terminate employment at will. For example, in India firms with more than 100 workers need permission to dismiss workers (Basu, Fields, and Debgupta1 2000). In Iran, the labor law authorizes government appointed local councils to review layoff decisions and fine employers for unfair dismissal (Tabatabai and Salehi-Isfahani 2001). Large public sectors with costly layoff also contribute to labor market rigidity (Haltiwanger and Singh 1999, Edwards 1997). Wage scales that tie earnings to diplomas and certificates are prevalent in the public sector (e.g., public school systems in the United States) and sometimes in private sectors of countries with rigid labor markets, such as in the Middle East (Said 2001). Like employment protection, they prevent managers from using their discretion to engage in favoritism. One frequently voiced justification for such an arrangement is that rewards should be based only on objective criteria. In many employment settings, particularly in the public sector, there is a constant tension between the allocation of resources (e.g. wages, procurement contracts) based on objective measures, verifiable by an outside observer, and subjective measures, which are observable by an individual manager or employer, but which may not be verifiable by an outside observer.

We build a simple model to show that when employers lack discretion to terminate employment, they base their hiring decisions on the more reliable signals of knowledge, such as years of schooling, test scores and class rank. Hiring workers with promise of non-testable skills is risky as it is costly to dismiss them if those skills are later found to be lacking. This leads individuals in rigid labor markets to favor greater acquisition of knowledge at the expense of other types of human capital, which results in distorted accumulation of human capital and lower growth. Where employers can terminate employment at low cost, they can learn about workers' non-testable skills and appropriately reward them. Flexible labor markets, therefore, offer more accurate signals of productivity for various types of skills and thereby encourage more efficient human capital accumulation, which is good for economic growth. Our model is closely linked to the signalling literature initiated by Spence (1973), in which employers take schooling as a signal of productivity. Signalling models either assume a rigid employment contract or a long delay before the employer learns about true worker productivity.

We believe that the link that our model establishes between labor market flexibility and the efficiency of human capital formation fills an important gap in the growth literature noted by Topel (1999). There is a large literature on the role of the labor market in allocating people to jobs but, curiously, not in accumulation of human capital and economic growth. There are complex reasons why flexibility should matter for economic performance. The literature on incentives argues that flexibility in paying individuals differentially and the ability to demote or fire them provides incentives for managers and workers to perform better on their jobs (Shapiro and Stiglitz 1984, Esfahani and Salehi-Isfahani 1989). Some studies have shown that labor market flexibility is important for employment and economic growth (Lazear 1990; Heckman and Pages 2000; Fonseca et al. 2001; Botero et al. 2003; Besley and Burgess 2004; Caballero et al. 2004). Although the debate on the reasons for higher European unemployment rates relative to the United States is not conclusive, the relatively less flexible labor markets of Europe have received some of the blame (Nickell 1997, and Nickell and Layard 1999, Karanassou and Snower 1998, Rafael Di Tella 2005). Our model adds efficiency in accumulation of human capital to the list of reasons why labor market flexibility is good for economic growth.

There is indirect empirical evidence suggesting that competitiveness of labor markets may enhance the role of education in growth. For example, Levin and Raut (1997) show that the interaction of exports and years of schooling affects growth but schooling by itself does not. Similarly, Borenstein, DeLong, and Lee (1999) show that although the interaction of foreign direct investment and human capital is associated with growth, each variable used separately is not. Openness, foreign direct investment, and labor market flexibility are likely to be related. Evidence presented by Kim and Topel (1995) indicates that labor market flexibility in the fast growing countries of Taiwan and Korea helped growth.

In the empirical section of the paper, we illustrate the importance of labor market flexibility for growth by re-examining the role of education in growth, taking account of differences in labor market institutions between countries. In some cross country studies years of schooling does not appear to foster growth (Benhabib and Spiegel 1994; Berthelemy, Dessus, and Varoudakis 1997; and Pritchett 2001). Our model suggest that schooling is a good proxy for overall human capital only where markets induce an efficient choice of human capital portfolios. Indeed, in our sample of countries with flexible labor markets education and growth are positively associated, but in the sample of countries with rigid labor markets (where, incidentally, schooling has been growing faster) there is no relation between schooling and growth. We argue that many of the existing regressions of growth on years of schooling are misspecified. The proper specification should model the effect of schooling on growth *conditional* on the labor market regime, because it is only in the conditional distribution of growth and years of schooling that the latter is correlated with human capital.

The analysis of the paper has important implications for education and labor market reforms. A well functioning education system in which teachers and school administrators are fully responsive to parents and students may turn into a diploma mill when the signals it receives from the labor market are distorted. To set the incentives right for parents, students and educators, reform of the labor market to increase its flexibility, and thereby better align private and social returns to a wider range of skills, should precede education reform.

The paper is organized as follows: the next section introduces a stylized model of ob-

servable and unobservable human capital. Section 3 examines the implications of the model for the empirical relationship between schooling and growth. We utilize widely available measures of labor market flexibility to show that, controlling for labor market flexibility, the effect of education on growth is positive and significant, as predicted by theory. Section 4 discusses the implications of the model for the reform of education systems and the labor markets in developing countries. Section 5 concludes.

2 Model

We first discuss a simple one period version of the model to provide the basic intuition for our claim that rigid labor markets can induce inefficient tradeoffs between observable and unobservable human capital.[4] Even this simple version illustrates how using schooling as *the* measure of human capital can overstate the productive effects of an economy's investments in education.

Our model is primarily concerned with the incentives for individuals to build efficient portfolios of human capital when one component of those portfolios is unobservable. But, as we consider the basic model, a natural question arises: "What happens when the firm observe the worker's productivity?" One might assume this problem away; perhaps observing the productivity of individual workers is costly, or it takes long enough to observe productivity that a model of the initial negotiation based only on the worker's observable characteristics captures most of the important elements. This is essentially the path chosen by, for instance, Spence (1973) in his celebrated model of signalling. We first consider an economy of this kind, a short run economy. In the short run economy, what matters is observability: can firms observe workers' complete human capital portfolios, or can they only observe one component?

But firms are likely to eventually observe workers' true productivity and respond to the new information (Jovanovic 1979, Farber and Gibbons 1996). In the long run version of our model we assume that this is the case and consider two possibilities: in the first, firms face no restrictions on hiring and firing. They are free to contract and so we consider the incentives

[4]For more sophisticated models of how flexibility affects worker incentives, see Lazear (1990).

individuals have in the face of the firms' anticipated actions to either efficiently allocate their human capital endowments or to allocate their endowments in a distorted fashion. Second, we consider the case in which firms, for legal reasons, are unable to renegotiate initial wage contracts. Here, hiring is conducted knowing that initial wages cannot be later revised in the face of new information about worker productivity.

2.1 Short run

We initially restrict our attention to a world with no tomorrow: one in which all decisions are short run decisions. The simplification highlights some of the important tradeoffs faced by individuals and firms and also allows us to show how this model relates to and differs from signalling models. We begin with the benchmark case of full observability in which, as in the standard human capital model, individual decisions maximize individual earnings and total output. We then consider how decisions and outcomes change when one type of human capital is unobservable.

2.1.1 Full observability

Suppose that productivity is a function of human capital only, but that human capital has two components: knowledge (n) and creativity (r). Individual productivity is described by a standard neo-classical production function $f(n, r)$:

$$f_n, f_r > 0$$

$$f_{nn}, f_{rr} < 0$$

$$f_{nr} > 0$$

Let f be symmetric and choose units such that $f_n = f_r$ and $f_{nn} = f_{rr}$.

Individuals are born with a human capital endowment e which may be allocated to either knowledge (n) or creativity (r). The two are both "produced" from the endowment e. For simplicity we assume that the marginal rate of transformation is -1:

$$n + r = e \tag{1}$$

We assume that endowments are fixed at birth at level e and that individuals have a one-time decision to make regarding their endowment allocation. One might imagine that education increases e, so that both n and r can increase with expenditure of resources. But in our model the role of education is to allocate a fixed endowment to knowledge and creativity. One can think of the role of learning at home and school as the movement along the budget constraint imposed by e. The tradeoff postulated here reflects limited time of the parents and the children in engaging in various activities that promote different skills. For example, in some East Asian and Middle Eastern countries in which entry into universities, and later into desirable jobs, depends critically on grades in schools and on national tests, test preparation competes intensely for parent's and children's time pushing aside other activities such as sports or group projects at school that may enhance self esteem and ability to work in teams. Students in these countries place undue emphasis on memorization of facts and on private tutoring in preparation for tests.[5] Indeed, heated competition for grades and for limited places in public universities may reduce self esteem and ability to work in teams resulting in a negative relation between testable and not-testable skills.

Our formulation of the tradeoff also ignores complex interactions between various attributes. It is more accurate to think of knowledge as input into production of creativity, and of ambition, self control, and time preference helping learning of facts and techniques. Indeed, in a model of early childhood development, Carneiro, Cunha, and Heckman (2003) emphasize complementarity among a variety of skills. However, we believe that this simple construct captures well our idea that, at the margin, individuals who are acquiring human capital face a choice between those aspects of human capital which are observable and those which are not. It helps us focus on our main objective which is to study the impact of labor market behavior on the allocation of resources to different types of human capital.

Firms employ constant returns to scale production technologies in which the only input is labor. Therefore, the marginal product of a worker characterized by the human capital

[5]Ono (1999) describes the so-called "examination hell" in Japan and the vast amount of time students spend preparing for university entrance examinations, known as *ronin*. In Egypt, private tutoring is a bustling industry absorbing 1.6 percent of the GDP (World Bank 2002). In Iran, one observer lamented the pressure put on students by their parents who employ the services of large and small classes for *concour* [the national entrance examination], and highly paid private tutors ... depriving their children of all forms of relaxation, even bathing. Quoted in Salehi-Isfahani (2002).

portfolio (n, r) is:

$$MP_L = f(n, r) \tag{2}$$

In the benchmark, full observability economy, firms can observe workers' complete human capital portfolio. Then, the perfectly competitive firms offer wage contracts:

$$\hat{w}(n, r) = f(n, r) \tag{3}$$

Individuals recognize that firms will offer these contracts and allocate their human capital endowments to knowledge and creativity to maximize their income:

$$\begin{aligned} \underset{(n,r)}{\text{Maximize}} \quad & \hat{w}(n, r) = f(n, r) \\ \text{s.t.} \quad & n + r = e \end{aligned}$$

Assuming an interior solution exists in which both knowledge and creativity are productive (that is, assume $\lim_{n \to 0} f_n = \infty, \lim_{r \to 0} f_r = \infty$), the first order conditions imply that earnings are maximized when

$$\frac{\partial f}{\partial n} = \frac{\partial f}{\partial r} \tag{4}$$

Figure 1 depicts the individual's optimal choice of a human capital portfolio, given his endowment e and the wage contracts $\hat{w}$. Given the assumed symmetry of $f()$ with respect to knowledge and creativity, and the strict concavity in n and r, the optimal allocation of an endowment e splits it evenly across knowledge and creativity:

$$n^* = r^* = \frac{e}{2} \tag{5}$$

Individuals earn $w^* = f(n^*, r^*)$, which maximizes their earnings; these choices in aggregate also maximize total output.

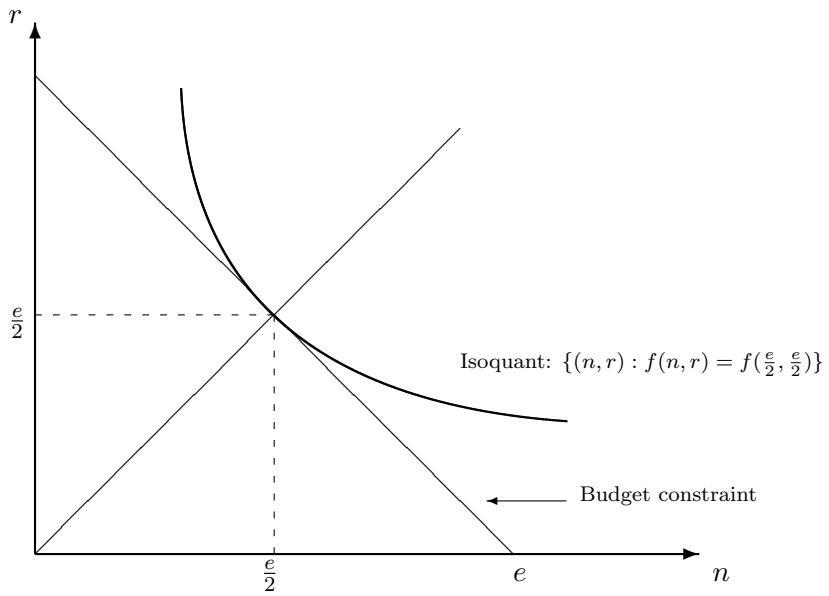

Figure 1: Choice of knowledge and creativity; short run, full observability

2.1.2 Unobservable creativity

The primary alternative we wish to highlight relative to the benchmark full observability economy is an economy in which one component of human capital is unobservable. Here, the economy is still a short run economy in which, in standard neo-classical fashion, the market exists at a point in time. Production is a function of both knowledge and creativity, as in the benchmark economy. However, only the testable component of human capital, knowledge, is observable to employers. Therefore, firms offer prospective employees a wage contract conditional on observed knowledge, $\hat{w}(n)$.

Individuals choose to allocate their endowments between knowledge and creativity to maximize their expected earnings:

$$\begin{aligned} \underset{(n,r)}{\text{Maximize}} \quad & \hat{w}(n) \\ \text{s.t.} \quad & n + r = e \end{aligned}$$

A worker's best response to this wage contract is to ignore the productive aspects of cre-

ativity and allocate his entire endowment to knowledge:

$$(n_u^*, r_u^*) = (e, 0), \tag{6}$$

where (n_u^*, n_r^*) denote a worker's optimal portfolio when creativity is unobservable. Implicitly, one can think about this as individuals pretending to have higher endowments; they show a level of knowledge and hope that firms infer that their levels of creativity are commensurate with their knowledge. Of course, in equilibrium, firms will infer individuals' true level of creativity. But, increasing their own *productivity* by increasing their investment in creativity at the expense of knowledge would not be profitable for individuals.

The choice is illustrated in Figure 2; the most productive allocation of endowment e allows the worker to reach the output level represented by Isoquant $\mathcal{A}$. By signalling knowledge level $n = e$, he purports to be able to produce at the level represented by Isoquant $\mathcal{B}$, but actually (given his choice of $(n, r) = (e, 0)$) can only reach the output level represented by Isoquant $\mathcal{C}$. To be consistent with workers' choices, firms' profit maximizing

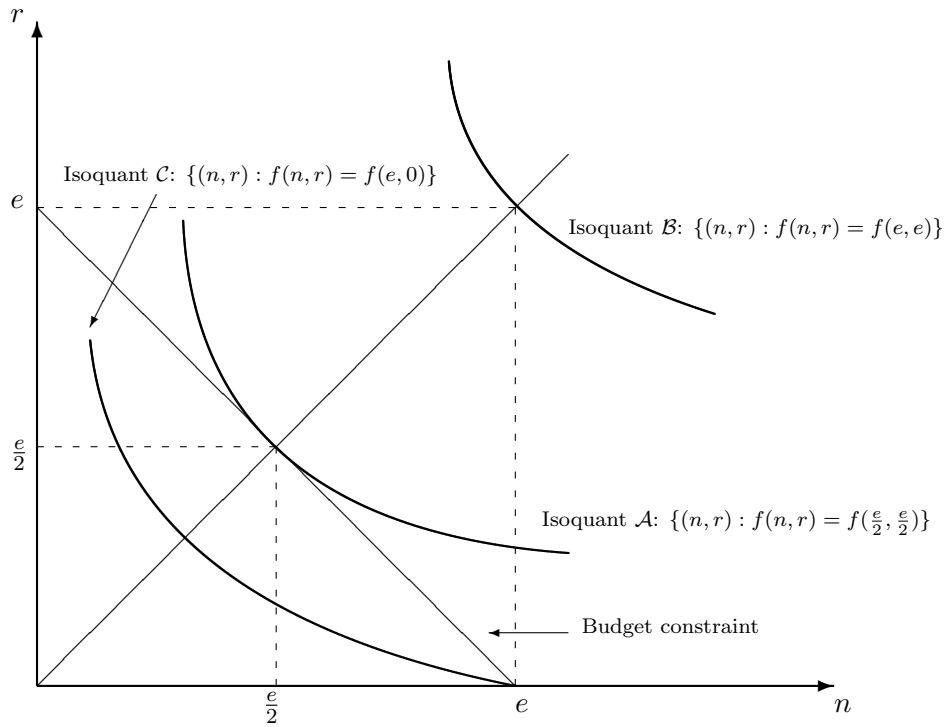

Figure 2: Productivity and human capital portfolio allocations

wage contracts when creativity is unobservable will be:

$$\hat{w}(n_u) = f(n_u, 0) \tag{7}$$

Here, profit maximizing firms again pay workers their marginal products and workers choose human capital allocations to maximize their earnings. But, unlike the benchmark economy, in the economy with unobservable creativity total output is not maximized.

Below, we show that the structure of the labor market, that is the ability of firms to contract freely and to re-negotiate wage contracts in the face of new information about worker productivity, has a critical role to play in influencing the efficiency of human capital allocation. But here, in the short run, labor market rigidity matters not at all. There is no opportunity to re-negotiate since the economy has no dynamic structure.

This timeless structure is a standard component of the basic neo-classical model (prior to the introduction of Arrow-Debreu state contingent claims); it is also the basis for the basic signalling model (Spence 1973). The signalling model of education is akin to what we outline here, but differs in important respects. In the classic signalling economy firms are unable to directly assess workers' productivity. Firms make inferences about workers' productivity conditional on an unproductive observable characteristic: formal schooling. These inferences may be useful because the costs of acquiring education vary with workers' productivity. In our economy, formal schooling *is* productive. Workers vary in their endowments, but the cost of acquiring an additional unit of the observable signal, knowledge, is constant: one unit of creativity. Workers' endowments limit the amount of knowledge (and creativity) which can be acquired, but do not directly affect the cost of acquiring knowledge.

2.2 Long run

Here we extend the basic model to allow for the revelation of information about worker productivity in a simple, natural way. We consider a two-period economy in which period one represents the "short run," the period in which firms' are not able to adjust their initial hiring decisions. Much like the standard definition of short run and long run, we consider the short run to encompass the period in which the firms' initial wage offer governs the

employment relationship. Clearly, this period's chronological measurement depends on the institutional arrangements of the economy in question. In a world in which employment is at will, this period is likely to be relatively short; although here the binding constraint might be the speed at which the firm can update its assessment of the worker's productivity. If information about productivity is revealed only slowly, then the short run would, chronologically, be longer than it would be if information is revealed quickly. Jovanovic (1979) shows how wage dynamics and turnover evolve in an economy featuring job matching. In a sense, our economy features a much simpler version of Jovanovic's matching; our firms are concerned with "matching" wage offers to worker productivity.

2.2.1 Full observability

There are two periods, period one "the short run", and period two "the long run." When workers' human capital portfolios are fully observable, firms know what the marginal product of a worker with portfolio (n, r) will be in each period. Therefore, firms offer wage contracts in period one of:

$$\hat{w}(n, r) = f(n, r) + \beta F(n, r), \tag{8}$$

$F(n, r)$ is period two productivity and period two payments are discounted by a factor $0 < \beta < 1$. Although the two period structure is convenient, period two, which represents the long run, is likely to be "longer" than period one. For instance, period two may represent the on-going future, so let the value of a worker's production in the long run be:

$$\begin{aligned} F(n, r) &= f(n, r) + \beta F(n, r) \\ &= \frac{1}{1 - \beta} f(n, r) \end{aligned} \tag{9}$$

Given wage offers in (8), and full observability of human capital, individuals choose to allocate their human capital endowments just as they did in the short run world with full observability:

$$n^* = r^* = \frac{e}{2} \tag{10}$$

Given these allocations, workers earn $F(n^*, r^*)$ which maximizes their earnings and total

output.

2.2.2 Unobservable creativity, flexible labor markets

Suppose now that the economy still has both a short run (period one) and a long run (period two), but now creativity is unobservable. Firms, in period one, hire workers with observable (or verifiable) knowledge, but the firms can only guess at the workers' creativity. We assume that the educational system signals each worker's testable human capital, knowledge, accurately, but revelation of creativity is only possible after the individual has worked for an employer.

First, we examine the equilibrium of a flexible labor market. By a flexible labor market we mean one in which firms can freely adjust wages and lay off workers. In a flexible labor market individuals will have more incentives to develop their n and r efficiently because those who misrepresent their overall human capital portfolio (their true level of creativity) can only do so for a limited time. Distortions away from the optimal allocation (represented by Isoquant $\mathcal{A}$ in Figure 2) have long run consequences.

We assume a simple structure for long run beliefs: workers searching for employment in period two are assumed by firms to have masqueraded as more productive workers in period one (i.e. their actual level of productivity corresponds to Isoquant $\mathcal{C}$) and subsequently fired. These beliefs are confirmed in equilibrium. In period two, firms offer wage contracts of:

$$\hat{w}_2(n) = F(n, 0), \tag{11}$$

and in period one contracts of:

$$\begin{aligned} \hat{w}_1(n) &= f(n, n) \\ \hat{w}_2(n) &= \begin{cases} F(n, n) & \text{if } MP_L^1 = \hat{w}_1 \\ 0 & \text{otherwise} \end{cases} \end{aligned} \tag{12}$$

Workers who allocate their endowments to maximize productivity are paid their marginal product in each period; they are employed by the same firm in both the short run and the

long run. Those workers who masquerade as more productive workers are fired in the long run. Long run labor markets clear, however, and so these workers are hired, but at lower wages than they initially earned.

What should an individual do to maximize his lifetime earnings? If a worker with endowment e, for whom $n^* = e/2$, allocates his endowment productively, his payoff will be:

$$F(n^*, n^*) \tag{13}$$

If he chooses to masquerade, his payoff will be:

$$f(2n^*, 2n^*) + \beta F(2n^*, 0) \tag{14}$$

He will choose to allocate his human capital endowment productively if:

$$\begin{gathered} F(n,n) \geq f(2n,2n) + \beta F(2n,0) \\ \text{or} \\ f(n,n) \geq (1-\beta) f(2n,2n) + \beta f(2n,0) \end{gathered} \tag{15}$$

When firms can ultimately deal with workers who misrepresent their true productivity, a worker's decision of whether or not to allocate his endowment efficiently is based on a comparison of his productive output, $f(n,n)$, to a convex combination of the productivity he pretends to have, $f(2n,2n)$, and his true productivity, $f(2n,0)$. As the future becomes more valuable (the larger is β), the more important is the on-going wage, $f(2n,0)$. If the future is discounted heavily, then misrepresentation may be attractive, even if the worker will be fired once his true productivity is revealed. Misrepresentation is also more attractive when the one period gain, $f(2n,2n)$ is large, and when the ultimate penalty, the difference $f(n,n) - f(2n,0)$, is small. The concavity of the productivity function which determines the magnitude of this difference depends, among other things, on the level of technology. As technology becomes more sophisticated, the importance of creativity for production increases and so do losses from having a rigid labor market and a test-based education system.

Suppose that (15) is satisfied; firms, knowing that workers will allocate their endowments efficiently, will be willing to offer the wage contracts (12) and (11). Here, time enables the economy to overcome the inefficiencies resulting from the unobservability of creativity.

2.2.3 Unobservable creativity, rigid labor markets

Suppose now that creativity is still unobservable, but labor markets are rigid. Specifically, suppose that firms are unable to revise initial wage offers after a worker's true productivity is revealed. Our model describes a market with wage scales based on n only.

Now, time does nothing to improve the efficiency of human capital allocation. Just as in the short run economy in which creativity is unobservable, firms can offer wage contracts which are conditional on observable human capital n. However, because the wages of less productive workers (i.e. those whose marginal product is $f(e,0)$ rather than $f(e/2,e/2)$ in period one) cannot be revised downwards (or fired) there is no incentive for workers to choose efficient allocations *ex ante*. Individuals choose:

$$(n_u, r_u) = (e, 0) \tag{16}$$

In equilibrium, firms expect that all workers choose inefficient allocations, so firms offer contracts:

$$\begin{aligned} \hat{w}_1(n) &= f(n,0) \\ \hat{w}_2(n) &= F(n,0) \end{aligned} \tag{17}$$

The firms' beliefs are confirmed and workers all choose to inefficiently allocate their endowments. Because labor markets are rigid, workers never receive the appropriate signals as to how to allocate their human capital endowments. If we wish to equate knowledge with formal schooling, individuals may acquire a great deal of "education" and work diligently to improve their outcomes as best as they can, *given the institutional structure they face.* However, their efforts are largely for naught, since the signals they get give no guidance concerning the long run value of their overall human capital portfolio.

3 Labor market flexibility and the empirics of schooling and growth

The large empirical literature on cross-country regression on growth has given little attention to the role of labor markets (Topel 1999). According to Barro (1998, 3), "long lasting differences in [basic political, legal, and economic institutions] across countries have proven empirically to be among the most important determinants of differences in rates of economic growth." Differences in labor market institutions are perhaps among the most significant of these differences (Botero et al. 2003). Our model suggests that they may help explain the weak empirical support for the role of human capital in growth, which has received strong emphasis in the theoretical literature (Lucas 1988, and Becker, Murphy, and Tamura 1990). In cross country regressions on the rate of growth, the coefficient of increase in years of schooling–the most commonly used measure of human capital–is often not significant and sometimes is even negative (Benhabib and Spiegel 1994, Borenstein et al. 1999, Levin and Raut 1997, and Pritchett 2001).[6] A different formulation of the hypothesis, that the initial *level* of schooling promotes subsequent growth, does find support empirically (Mankiw, Romer, and Weil 1992), but the real question remains as to why *increase* in education fails to show up as an important variable. In his survey of labor markets and growth, Topel (1999, 2964) concludes, "the empirical growth literature does not lend much support to the idea that human capital, at least as represented by measured educational attainment, is a key element of economic growth." Everyone seems to agree that the problem is with the data and not theory. A variety of problems with measuring schooling across nations have been pointed out by Behrman and Rosenzweig (1994).

To resolve the puzzle the emphasis has been on improving the measure of education; for example, by adding measures of quality of schooling to the list of explanatory variables in growth regression (Hanushek and Kimko 2000, Barro 1998), and on employing estimation methods that deal with measurement error in the schooling variable (Krueger and Lindahl 2001). These remedies have by and large been successful in showing a positive effect for

[6] Gemmell (1996), who does find a positive relationship for his carefully constructed overall measure of schooling, still finds that growth of secondary education has a negative (but insignificant) effect on growth.

schooling on growth but they fail to take into account the differences in institutional features of the labor markets of the countries in the sample, which we know are capable of influencing the efficiency of human capital accumulation. Our approach is to correct a misspecification in the regression equation which arises when labor market flexibility is assumed to be homogenous across the countries in the sample. Thus, we argue that a problem with existing cross country regressions is due to an omitted variable, namely, a measure of non-observable human capital. Because labor market flexibility varies across countries, individuals in different countries face different incentives to acquire unobservable human capital. Variation in labor market flexibility affects the mix of testable and not-testable skills in the working population and therefore weakens the correlation between schooling and human capital. Since measures of non-observable skills are not available, we can improve the specification by introducing a measure of labor market flexibility in the growth regression. Barro (1998) and Forteza and Rama (2001) use indices of labor market flexibility to explain growth performance. Forteza and Rama (2001) find that countries with more flexible markets recover faster from recessions, while Barro (1998) did not find any significant relationship between labor market flexibility and growth. Poor quality of data on labor market flexibility makes it difficult to conclude much from either study.[7]

We experiment with several measures of flexibility, but because our aim in this section is to illustrate the main point of the paper rather than obtain precise estimates of the effect of schooling, and so as not to rely heavily on the imprecise measures of flexibility offered by these indices, we focus on a binary measure of flexibility. We show that the marginal effect of schooling on growth is positive and of plausible magnitude for countries with more flexible labor markets, whereas it is nil for those with less flexible labor markets. We interact the binary variable for flexibility with schooling in a standard growth regression to obtain the marginal effects of schooling on growth for the two subgroups of countries. While this

[7]Barro (1998) uses the number of ratifications with the International Labor Organizations (ILO) and concludes that while the results point to a reduction in growth and increase in human capital investment, the ILO variable fails to capture the effect of labor market restrictions. Forteza and Rama (2001) use a mixture of several labor market characteristics to study the effect of structural reform. Their index does not measure those aspects of flexibility highlighted by our model. For example, China is ranked number 3 in flexibility, above the United States (23) and United Kingdom (77), presumably because it does not recognize independent unions or have treaties with the ILO. In our view, the large state sector in China should place it among the rigid countries.

approach is successful in showing that labor market flexibility is an important link in the relationship between education and growth, it falls short of identifying the precise nature of the link. One can imagine other reasons why flexibility may raise productivity of education and economic growth.

To derive our empirical equation, we begin with a standard neoclassical growth model with constant returns to scale and Cobb-Douglas technology:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{18}$$

Recognizing that effective labor inputs are a function of human capital, much of the literature augments (18) with a measure of human capital (Topel 1999). Re-writing (18) in per capita growth rate form, and letting h measure average human capital, we get:

$$\frac{\dot{y}}{y} = \frac{\dot{A}}{A} + \alpha\frac{\dot{k}}{k} + (1-\alpha)\frac{\dot{h}}{h} \tag{19}$$

Since h represents both types of human capital, its growth rate can be related to the growth rate of its components, a convenient formulation of which is:[8]

$$\frac{\dot{h}}{h} = \theta\frac{\dot{n}}{n} + (1-\theta)\frac{\dot{r}}{r}, \tag{20}$$

where θ is between zero and one. Substituting this into (19) yields:

$$\frac{\dot{y}}{y} = \frac{\dot{A}}{A} + \alpha\frac{\dot{k}}{k} + (1-\alpha)\theta\frac{\dot{n}}{n} + (1-\alpha)(1-\theta)\frac{\dot{r}}{r} \tag{21}$$

$$= \beta_0 + \beta_1\frac{\dot{k}}{k} + \beta_2\frac{\dot{n}}{n} + \beta_3\frac{\dot{r}}{r} \tag{22}$$

Since r is not observed and is therefore ignored, instead of estimating (22) researchers usually estimate,

$$\frac{\dot{y}}{y} = b_0 + b_1\frac{\dot{k}}{k} + b_2\frac{\dot{n}}{n} \tag{23}$$

[8]This relaxes the assumption that knowledge and creativity enter production symmetrically; since that assumption simply involved a convenient choice of units for analytical purposes, it would be inappropriate here.

In a sample of competitive market economies, the growth of schooling and creativity would be highly correlated, as in the model of section 2.2.2. The estimate of b_2 from (23) would then *overestimate* the effect of schooling as the schooling variable will pick up the contributions of both schooling and creativity, $\beta_2 + \beta_3$.[9] This might be inconvenient but presents no real problem: individuals and policy makers recognize, implicitly or explicitly, the contributions of schooling and the econometrician measures their joint contribution to productivity.

However, in a sample of countries with different degrees of labor market flexibility, which is the staple of the empirical growth literature, omitting r leads to an omitted variable bias. The bias is likely to affect the estimated coefficient of n more strongly than k (see below) because variation in labor market flexibility is likely to induce a negative correlation between the growth rates of n and r, resulting in a negative bias. All else equal, in less flexible economies individuals would acquire more schooling (and less creativity) than individuals in flexible economies, causing the negative correlation. We argue that this may be a key reason why schooling has failed to figure significantly in cross-country regressions.

In light of the fact that it is very difficult, if not impossible, to obtain measures of the less observable worker attributes, we can only improve the estimation of (20) indirectly by controlling for labor market flexibility. Labor market flexibility is also difficult to pin down empirically (Schultz 2000), but there are a few published measures, such as by the Heritage Foundation (2002), the Economist Intelligence Unit (2004), and the World Bank (2003a), which rank countries on regulation and the degree to which wages and prices are set by the market vs. the government (more on these below). Because our aim in this paper is to illustrate the importance of labor market institutions for human capital accumulation and growth rather than obtain precise estimates of the effect of labor market rigidity on growth, we adopt a simple empirical strategy that does not heavily rely on precise measures of flexibility. We divide the countries in our sample into two types, flexible and rigid, using the scales offered by different indices. We use the dummy variables thus defined to estimate the effect of schooling on growth separately for the two groups of countries. We further

[9]This is consistent with evidence presented by Topel (1999) that growth estimates of the effects of human capital are too large relative to the consensus (and not too controversial) estimates of returns to education from individual level data.

err on the side of parsimony by choosing a very basic equation to relate human capital to growth across countries:

$$\frac{\dot{y}}{y} = \alpha_0 + \alpha_1 \frac{I}{Y} + \alpha_2 \frac{\dot{n}}{n} + \alpha_3 \times \text{dummy} \times \frac{\dot{n}}{n} + \epsilon', \tag{24}$$

Growth of per capita income y is related to the investment-GDP ratio I/Y, a proxy for the rate of physical capital accumulation, and growth of schooling. The contribution of schooling to growth is allowed to vary between flexible and rigid countries. For flexible countries (dummy= 0) the effect of schooling on growth is α_2 while for rigid countries (dummy= 1) it is $\alpha_2 + \alpha_3$.

If our intuition in this paper is correct, $\alpha_3 < 0$ so that $\alpha_2 + \alpha_3$ would be small, indicating little benefit from formal schooling on growth in countries with rigid labor markets. We would also expect α_2 to be positive and larger than the estimates obtained using the misspecified equation (without the interaction dummy), because, as noted earlier, for these economies schooling stands for both observable and unobservable human capital. Although this method uses the existing measures of labor market institutions in a somewhat limited way, it does provide a straightforward method for testing the main hypothesis of this section, that the growth of schooling should be higher for countries with flexible than rigid labor markets.

3.1 Data

We use several measures of labor market flexibility. Three are indices published by the Heritage Foundation (2002), the Economist Intelligence Unit (2004) and the World Bank (2003a), and a fourth is the ratio of public sector wage and salaries to GDP, which indicates the importance of public sector employment in total employment which reflects the degree to which signals provided by public sector employment policies affect incentives for human capital accumulation. Neither of these measures is ideal for our purposes, but they are the best we could find that address regulation of employment and wages. The Heritage and Economist Intelligence Unit (EIU) indices account for wage and price flexibility, while the World Bank index is more focused on employment regulation. The Heritage index

is calculated using several sources, including the EIU (Heritage Foundation 2002, 72).[10] Because it allows for twice as many countries in the analytical sample as the EIU index, we prefer the Heritage index to that of the EIU.

The Heritage index scores rigidity from 1 (lowest) to 5. The distribution of the index (see Table 1) readily suggests the threshold for a binary definition of rigidity: equal to one if the index is less than or equal to three and zero otherwise. Most countries have values of 2 or 3, and very few countries are in the two extremes of 1 and 5. The EIU index of wage regulation also ranges from 1 to 5, but from high to low regulation. Unfortunately, it allows for half the working sample compared to the other indices. In addition, 25 of the 47 countries in the EIU sample are bunched onto the middle category 3 (defined as between "low" and "high" rigidity), with only 4 countries listed as having "low" or "very low" regulation, and 18 with "high" and "very high" regulation. We are thus forced to define a dummy variable a bit far from the median, taking a value of one for scores of 4-5 and zero for 1-3. World Bank (2003a) takes a more comprehensive approach to measuring labor market flexibility by considering the variety of laws and regulations that impinge on employer decisions (Botero et al. 2003). The rankings cover three areas: flexibility of hiring, conditions of employment, and flexibility of firing.[11] We only use the measures of flexibility of hiring and firing in the World Bank data set as they seem more closely related to the notion of rigidity used in this paper. These indices range from 1 to 100, from low to high regulation, suggesting a convenient definition for the dummy variable: equal to one for values of the index greater than the median (rigid labor markets) and zero otherwise (see Table 2). Our fourth and final index of flexibility is the ratio of public sector wage and salaries to GDP, averaged for the period 1960-1999, using data from World Bank (2003b).

[10] The Heritage wages and prices factor is scored by "the extent to which a government allows the market to set wages and prices. Specifically, this factor looks at which products have prices set by the government, and whether the government has a minimum wage policy or otherwise influences wages. The factors scale measures the relative degree of government control over wages and prices. A very low score of 1 represents wages and prices that are set almost completely by the market, whereas a very high score of 5 means that wages and prices are set almost completely by the government (p. 72).

[11] Flexibility of hiring covers the availability of part-time, fixed-term, and family members contracts. Conditions of employment cover working time requirements, including mandatory minimum daily rest, maximum number of hours in a normal workweek, premium for overtime work, and restrictions on weekly holidays; mandatory payment for non-working days, which includes days of annual leave with pay and paid time off for holidays; and minimum wage legislation. Flexibility of firing covers workers legal protections against dismissal, including the grounds for dismissal, procedures for dismissal (individual and collective), notice period, and severance payment.

Table 1: The Heritage index for wages and prices control

Score	Rigidity	Determination of wages and prices	Number
1	Very low	Market determines wages and prices, no effective minimum wage	3
2	Low	Market determines most prices, minimum wage may or may not be effective	63
3	Moderate	Mixture of market and government determines wages and prices minimum wage applied effectively	66
4	High	Market determines few wages and prices, government sets most wages.	15
5	Very high	Wages and prices almost completely controlled by the government	4

Note: Number of countries in the sample reported by Heritage Foundation.
Source: Heritage Foundation (2002)

Table 2: World Bank indices of labor market regulations

Variable	N	Mean	SD	Min	Max
Employment laws index	107	49.72	13.75	19	78
Hiring laws	107	45.6	15.69	0	80
Firing laws	107	36.21	18.43	0	73
Dummy variable for hiring laws	96	0.5	0.5	0	1
0 (%)	48	50			
1 (%)	48	50			
Dummy variable for firing laws	107	0.5	0.5	0	1
0 (%)	53	49.53			
1 (%)	54	50.47			

The shares range from less than one percent to 17 percent, with a median of 6 percent. We define a rigidity dummy equal to one for greater than the median and zero otherwise. The entire sample with key regression variables is presented in a data appendix (Table A.1).

A caveat for all these indices (except that based on government wages and salaries) is that, to obatain a larger sample, we have to use more recent values, which may not reflect accurately the average conditions of labor market flexibility for the entire period, 1960-2000.[12] This should not present a major problem, because only a handful of countries experienced substantial change in labor market institutions, mainly the former socialist countries after 1990, which are excluded from our sample because they lack data on growth of GDP for earlier years.

The score for measures of flexibility for regulation calculated by the World Bank and

[12]In the case of EIU, we were able to use data from 1995, striking a balance between an early date and sample size.

Table 3: Comparison of labor market flexibility indices

Heritage index	Mean value of World Bank index for flexibility in			
Wage and price controls	EIU	Hiring	Firing	Government
1	3.50	45.5	28.0	3.87
2	3.50	45.2	33.6	5.88
3	3.25	47.3	39.5	7.25
4	2.67	40.9	35.5	7.79
5	–	68.0	73.0	–

Note: World Bank indices are regulations of employers' hiring and firing practices and range from 0-100; government is the ratio (in percentages) of public sector wages and salaries to GDP.

for wage and price controls calculated by the Heritage Foundation and EIU do not match well (see Table 3), indicating that perhaps they are not measuring the same thing. There is little correlation between the Heritage and World Bank indices except when going from the Heritage category 4 to 5 (only four countries are in the most rigid category). The lack of correlation may be due to the fact noted earlier that the World Bank rankings rely more on laws and regulations while the Heritage index also tries to measure their enforcement, which can vary from one country to another (MacIssac and Rama 1997). The EIU and Heritage indices are only slightly more correlated (negatively, because EIU defines 1 as "high regulation"), perhaps because the Heritage index uses EIU data in its construction.

Data on growth of GDP per capita and the ratio of investment to GDP are taken from the Penn World Tables Mark 6.1, and growth of years of schooling are from the latest version of Barro-Lee (2000). Our approach requires the use of growth rates which reflect performance over a long period during which labor market institutions can affect the mix of human capital. This consideration precludes using the more powerful panel approach. To avoid sensitivity to end point values of GDP per capita and schooling, we calculate growth rates in two ways, one using a regression trend line for 1965-2000 (including in the sample only countries with at least 15 years of observation), and another the average values for 1960-70 and 1990-2000 for the base and end points. Summary statistics in Table 4 show that the estimates of growth from both methods are very close, and regression results based on them are nearly identical (Table 5).

Table 4: Average performance of countries with flexible and rigid labor markets (Heritage index), 1960-2000 averages

	Flexible	Rigid	Total
Investment/GDP ratio	19.10	14.33	16.72
Growth of GDP per capita (trend)	2.01	1.12	1.56
Growth of GDP per capita (average)	2.35	1.12	1.82
Growth of schooling 25+ (trend)	1.74	3.01	2.37
Growth of schooling 25+ (average)	1.77	3.22	2.40
Number of observations (trend)	47	42	89
Number of observations (average)	47	37	84

Notes: Average growth rates of GDP per capita and years of schooling measure the annual percentage increase from the mean value for 1960-70 to the mean value for 1990-2000; trend growth rates are calculated from regressions of log of the variable on year for all countries with at least 15 years of observation.

3.2 Estimation results

The differences in the means for the investment-GDP ratio, growth rate of GDP per capita, and years of education between rigid and flexible countries (defined according to the Heritage index) are revealing (Table 4). During 1960-2000, flexible labor markets on average invested 5.5 percent more of their GDP per year, grew about twice as fast but exhibited a growth rate in average years of schooling which was 45% *lower* than countries with rigid labor markets. World Bank and EIU indices show the same pattern but the differences are less pronounced. That the growth rate of schooling has little correlation with growth of output in countries with less flexible labor markets is already apparent from these comparisons.

The results of estimation for equation (24) are reported in Table 5. First, consider the baseline case (column 1), which is basically the misspecified model (23) applied to the pooled sample of countries in which countries with rigid and flexible labor markets are treated the same. Note that, as expected, in this regression the growth of years of schooling appears to have no effect on growth of output. This (non)result, which echoes earlier findings in the literature, lies at the root of the search for the missing human capital effect on growth. Introducing the interaction term with the Heritage dummy (columns 2 for average and 3 for trend growth rates) allows for different effects on growth in rigid and flexible countries and changes the results for schooling completely. As predicted by our model, the coefficient of schooling is positive and significant and much higher for countries with flexible labor markets, 0.545 (column 3) compared to virtually zero for rigid countries (the algebraic sum

of the coefficients of schooling and the interaction term). The same is true for column 2 which uses period average growth rates.

Regression with the interaction terms thus estimate the elasticity of output with respect to human capital in countries with flexible labor markets at around 0.5, which is a much more than (the insignificant) estimate of 0.1 from the misspecified equation (column 1). The result that in countries with rigid labor markets the effect of schooling on growth is almost nil may seem too strong but it would not surprise Pritchett (2001), whose article bears in the telling title, "Where has all the education gone?" In column 4, for which we use the smaller sample with the EIU dummy, the coefficient of the interaction term is only significant at 10 percent level, but the indication is still of a much lower effect of schooling in less flexible economies. The results from the World Bank indices (columns 5-6) have the right sign but are not significant. The divergence between the Heritage and EIU results on the one hand and the World Bank results on the other could arise from their different emphasis on the legal environment vs. the degree to which restrictive laws are actually enforced.

The coefficient of the dummy variable is not significant in any of the regressions and its point estimates are very small, indicating little direct effect from labor market rigidity on growth. If these estimates are taken seriously, one might conclude that the negative effect of labor market rigidity on growth is mainly through distortion of human capital accumulation.

4 Implications for policy

The intuitive idea that unobservable human capital is less rewarded in rigid labor markets, for which the preceding section presented some indirect evidence, has important implications for comparison of returns to schooling across countries and for education policy in developing countries with less developed labor markets.

Our model and empirical results speak directly to a key issue in the literature on returns to education, the attempt at reconciling the divergence between micro and macro returns to education (Krueger and Lindahl 2001). From our viewpoint, in developing countries,

Table 5: Regression of GDP per capita growth, with and without accounting for labor market flexibility

Independent variable	No dummy (1)	Heritage (2)	Heritage (3)	EIU (4)	WB firing (5)	WB hiring (6)	Govt. (7)
Investment/GDP	0.145*	0.133*	0.142*	0.122*	0.147*	0.150*	0.148*
	(0.025)	(0.019)	(0.024)	(0.030)	(0.026)	(0.026)	(0.026)
Schooling	0.096	0.426*	0.545*	0.907*	0.279**	0.319*	0.461**
	(0.108)	(0.166)	(0.214)	(0.341)	(0.166)	(0.136)	(0.243)
Dummy*schooling	—	-0.475*	-0.548*	-0.670**	-0.085	-0.245	-0.522*
		(0.193)	(0.240)	(0.388)	(0.211)	(0.212)	(0.264)
Dummy (1=rigid)	—	0.004	0.008	-0.002	0.000	0.007	.014*
		(0.004)	(0.006)	(0.008)	(0.006)	(0.006)	(0.006)
Constant	-0.011	-0.010	-0.027	-0.015	-0.015	-0.018	-0.019*
	(0.006)	(0.006)	(0.007)	(0.009)	(0.008)	(0.008)	(0.008)
Adjusted R^2	0.27	0.44	0.30	0.35	0.28	0.29	0.27
N	98	84	98	47	80	80	96

Notes: 1. Standard errors are in parenthesis; * means significant at 5 percent level and ** at 10 percent. 2. Investment/GDP ratios are averages for for the 1960-2000 period; and schooling is growth of average years of schooling for population 25 and older. 3. Column (2) is based on period growth rates for GDP per capita and years of schooling using their average values of for 1960-70 and 1990-2000; all other columns are based on trend growth rates calculated from regressions of log of the variable on year for all countries with at least 15 years of observation. Column (7) uses a dummy based on percentage of government wages and salaries in GDP.

many of which lack flexible labor markets either by design or lack of design, and where employers therefore reward formal schooling above all other skills, it is no surprise to find that returns to education estimated from micro level survey data are as high as those reported in Psacharopoulos and Patrinos (2002). Because individuals in these countries by and large have chosen an inefficient mix of observable and non-observable skills, social returns estimated from cross country regressions is low. Our analysis would therefore suggest that estimated high micro returns are not a good basis for increasing investment in formal schooling.

In evaluating education policies our model suggests paying close attention to labor market institutions that inhibit flexibility. If the problem that reform intends to redress is caused by distorted signals of productivity, the reform's effectiveness depends on first removing those distortions. Consider the recommendation to increase public investment in technical and vocational education and training (TVET), for which returns are presumed high but investment is low, especially by more able students.[13] Able students prefer to

[13]For an articulate statement of TVET benefits which does not refer to labor market conditions, see Internationsl Labour Organization (2002).

take the formal high school track because it gives them a shot at more formal schooling at the tertiary level, even in subject less in demand, such as the humanities. In a rigid labor market, one with a "no-return policy", employers may rationally prefer a graduate of the humanities who has at least demonstrated certain competencies by passing various tests to a technical and vocational training graduate whose skills are not fully reflected in the certificate he holds. How good a welder welds is not as easily measured as his or her knowledge of the properties of metals. If the argument of this paper is correct, in a rigid labor market the difference in testability translates into differences in rates of return, implying that public investment in better workshops with more advanced equipment will not attract the right level of investment from the right type of student until the labor market becomes more flexible and is able to send the right signals of reward for unobservable skills. This point that the effect of education reform is sensitive to the level of labor market flexibility can be generalized to other types of school improvements, such as lower class size and better teachers, whose main impact is no so much to raise test scores as raise student motivation, curiosity, self-esteem, and the like. The literature shows school quality and increased resources for education can raise returns to schooling (Glewwe 2002) and economic growth (Hanushek and Kimko 2000), but we do not know to what extent obtaining these results depends on having the right kind of labor market institutions.

By making investment in education endogenous to labor market institutions, our model offers strong implications for the importance of combining labor market reform with education reform. Education systems take their cues from the labor market, so when signals are distorted, even good education systems produce bad outcomes. The poor match between what students learn in schools and what they need to be successful in their jobs, or the emphasis on rote memorization and diplomas (credentialism) rather than acquisition of productive skills, are not necessarily signs of badly run schools. Where labor markets reward diplomas and test scores rather than productive skills, it is natural to expect students and schools to focus on memorization of facts over acquisition of skills. So, effective education reform presupposes labor market reform. Yet, most discussions of education reform fail to take this basic point into account.

The debates on privatization of schools and giving testing a more prominent role in

student evaluation often ignore labor market conditions.[14] But if the labor market sends the wrong signals of productivity to families and individuals who decide on what to learn at school, privatization may not only fail to improve productivity of education, it may exacerbate the problem. In the spirit of the second best theorem, one could argue that public schools, precisely because they suffer from incentive problems and are less attuned to labor market signals, may actually perform better where the labor markets are rigid.

Nowhere are the tensions inherent in these debates more evident than in the Middle East and North Africa (MENA), where rigid public employment policies send the strongest signals for what to learn and national tests dominate the education systems. Pritchett (1999), who finds that education in MENA has yielded particularly low social returns and argues that the region's education systems produce the wrong kind of education, blames the low productivity of the educated on public education. But in Iran, where private schools have flourished in the last decade, the opposite seems to be taking place. Private schools provide a less varied educational menu for children, are more focused on test taking than public schools, and typically lack even a yard for children to play in. Private incentives for test preparation are so strong that they sometimes defy the good intentions of public schools in offering a more balanced curriculum. Education ministry officials in Iran complain that parents defy their policies for minimum participation in arts and sports in public schools by taking their children out of school for private tutoring during the hours for arts and sports (Salehi-Isfahani 2002 and 2005). In other countries of the Middle East, too, private tutoring is popular because public schools do not offer enough test preparation skills.[15] The celebrated *Arab Human Development Report* (United Nation 2002) which is eloquent on the failing of the Arab education systems, and notes in particular that, "Arab education systems should be restructured to give precedence to creativity and the dignity of productive work," and "Education should aim at promoting ... students physical, emotional and societal well-being as well as their acquisition of knowledge, fails to mention labor market reform in the chapter on education reform.

[14] For a surveys of private education around the world see Tooley (2001) and Toma (2005). For references to the literature on testing in the US context, see Hanushek and Raymond (2004).

[15] For Turkey see (Tansel and Bircan 2004). In Egypt the willingness of parents to pay for private tutors has created an industry which accounts for about 2% of the GDP (World Bank 1998, 24).

Education reform in East Asia has targeted nationwide multiple choice testing regimes which many consider responsible for rote memorization and learning of a narrow set of skills. In Japan, where labor market rigidity is blamed for slow growth (Ono and Rebick 2003), concern over lack of creativity in education has brought pressure to reform the university entrance examinations but not on labor market rigidity (Schoppa 1991).[16] International emigration of skilled labor from China, which has in effect brought the incentives generated by the more flexible US labor market to bear on the Chinese education system, is also a case in point. It appears that local incentives on what to learn are sensitive to even distant possibilities, as evidenced by the immense popularity of a how-to book on child rearing which emphasizes character development.[17]

In sum, success in education reform depends on first getting the incentives arising from the labor market right. Heckman (2000) has used the more comprehensive term human capital policy to refer to all policies that affect investment in productive skills at home, in schools, and at the workplace. Good human capital policy in countries that lack well developed and transparent labor markets should then aim to reduce the distortion in signals of productivity that families and schools receive from employers before spending resources on skill training or increasing the responsiveness of teachers and school administrators to those signals. Fortunately, many policies that increase the transparency of the labor market can be already found on the agenda of the leading development institutions. Privatization to reduce the share of public sector in total employment, where signals of productivity travel the worst, and strengthening social protection programs to reduce the burden of provision of income protection on the labor market are now actively supported by institutions such as the World Bank. Labor market reform that increases flexibility is politically very difficult to implement because it redistributes income from the currently employed to new entrants and the unemployed. Linking flexibility to learning more useful skills will help strengthen

[16] A 1996 "Action Agenda" by the Japanese Business Federation (Nippon Keidanren), entitled *Developing Japan's Creative Human Resources*, calls for and end to "Japan's 'examination war' ...which distorts education," and suggests that the "current university entrance examination format, which evaluates the volume of knowledge by means of points, must be replaced by an examination which includes evaluation of a student's scholarship, cognitive ability, interests and basic potential," and calls for essay writing and an interview as part of the examinations. http://www.keidanren.or.jp/english/policy/pol043.html.

[17] According to the Harvard Magazine, July-August 2002, the book, entitled *Harvard Girl*, has sold 1.6 million copies in China.

the case for such reform.

5 Conclusion

In this paper we have used a simple model of human capital accumulation to show how labor market rigidities distort the signals that help individuals choose the optimal mix of human capital components. In the model we posit two types of human capital: knowledge which is testable and therefore observable prior to employment, and creativity which is only observed by employers after a period of employment. To the extent that employers are free to set wages and decide on termination of employment, that is, labor markets are flexible, individuals will have the incentive to invest in the right mix of skills. If, on the other hand, labor market regulation prevents employers from rewarding all skills, then individuals will invest in observable and testable skills, and educational systems, public or private, will specialize in the delivery of knowledge at the expense of creativity.

We used the insights generated by our model to throw light on an apparent empirical anomaly in the growth literature that fails to reveal the kind of affirmative role for education in growth that theory has predicted for human capital. We argue that the usual measure of human capital, years of schooling, fails to accurately reflect the level of creativity in countries with rigid labor markets. We therefore use dummy variables to separate countries with rigid and flexible labor markets and show that for the latter group education is positively associated with growth, while the effect of education on growth is insignificant for the former group.

Our analysis has important implications for education policy. Curricular reform and improved incentives for teachers and school administrators are effective only when the signals that parents and schools receive from the labor market regarding rewards for various types of skills do not conflict with the reform's objectives. For example, getting parents and schools to teach skills that increase production when employers reward diplomas is an uphill battle. Labor market reform to increase flexibility should therefore precede education reform.

Data Appendix

Table A1. Sample for regression analysis

	Country	GDP pc growth	Schooling growth	Investment GDP ratio	Heritage index	EIU index	WB hiring	WB firing	Gov. share
1	Algeria	0.01	0.06	0.18	3	3	58	19	7.75
2	Argentina	0.00	0.01	0.17	1	3	58	44	2.51
3	Australia	0.02	0.00	0.24	2	3	33	14	0.51
4	Austria	0.03	0.01	0.26	2	3	33	19	3.90
5	Bangladesh	0.01	0.03	0.1	4	.	33	38	.
6	Barbados	0.04	0.01	0.16	2	.	.	.	9.90
7	Belgium	0.02	0.00	0.24	2	3	58	22	7.24
8	Benin	0.00	0.07	0.07	3	.	46	21	5.92
9	Bolivia	0.00	0.01	0.1	2	.	58	57	5.95
10	Botswana	0.06	0.05	0.18	2	.	33	19	8.15
11	Brazil	0.02	0.01	0.21	2	3	77	69	2.27
12	Bulgaria	-0.03	0.01	0.05	2	3	32	31	2.17
13	Cameroon	0.01	0.03	0.07	3	.	46	45	6.21
14	Canada	0.02	0.01	0.22	2	3	33	17	2.50
15	Cen. Afr. R.	-0.03	0.06	0.05	3	.	.	.	11.79
16	Chile	0.02	0.01	0.15	2	3	55	31	6.13
17	China	0.05	0.02	0.17	3	.	33	42	.
18	Colombia	0.02	0.02	0.12	2	3	33	62	2.61
19	Congo	0.03	0.04	0.19	3	.	.	.	11.33
20	Costa Rica	0.01	0.01	0.15	2	.	58	47	7.6
21	Croatia	0.04	0.01	0.16	3	.	74	42	9.54
22	Cuba	-0.04	0.02	0.03	5	.	.	.	.
23	Cyprus	0.04	0.02	0.26	2	.	.	.	9.74
24	Czech R.	0.01	0.00	0.22	2	3	0	35	3.01
25	Denmark	0.02	0.00	0.23	1	4	33	12	5.24
26	Dominican R.	0.04	0.01	0.13	3	.	.	.	16.53
27	Ecuador	0.02	0.02	0.2	3	3	35	67	5.28
28	Egypt	0.03	0.05	0.07	3	3	33	46	7.94
29	El Salvador	0.00	0.02	0.07	2	.	.	.	7.03
30	Fiji	0.02	0.02	0.16	3	.	.	.	10.32
31	Finland	0.02	0.02	0.26	2	2	68	57	3.04
32	France	0.02	0.01	0.25	3	3	60	31	7.01
33	The Gambia	0.00	0.05	0.06	3	.	.	.	6.54
34	Ghana	0.00	0.04	0.08	2	.	33	16	4.68
35	Greece	0.02	0.02	0.26	3	4	74	29	9.31
36	Guatemala	0.01	0.02	0.08	3	.	58	53	4.27
37	Guyana	0.01	0.01	0.19	2	.	.	.	13.35
38	Haiti	0.01	0.04	0.05	3	.	.	.	5.61
39	Honduras	0.00	0.03	0.13	3	.	33	49	5.57
40	Hong Kong	0.05	0.02	0.25	2	4	33	1	.
41	Hungary	0.02	0.01	0.19	2	4	43	22	3.93
42	Iceland	0.02	0.01	0.27	2	.	.	.	7.45
43	India	0.03	0.03	0.12	4	4	22	19	1.79
44	Indonesia	0.04	0.03	0.13	2	4	74	43	2.76
45	Iran	0.00	0.05	0.19	4	1	33	48	11.17
46	Ireland	0.04	0.01	0.19	2	4	33	12	5.37
47	Israel	0.02	0.01	0.27	2	4	33	16	7.61
48	Italy	0.03	0.01	0.24	2	3	64	24	5.66
49	Jamaica	0.00	0.02	0.19	2	.	33	13	8.64
50	Japan	0.03	0.01	0.32	2	4	39	19	.

Table A1. (continued)

	Country	GDP pc growth	Schooling growth	Investment GDP ratio	Heritage index	EIU index	WB hiring	WB firing	% public wage
51	Jordan	0.02	0.04	0.14	2	.	58	55	15.35
52	Kenya	0.01	0.04	0.11	2	.	33	17	8.04
53	Lesotho	0.02	0.01	0.17	3	.	.	.	12.23
54	Malawi	0.01	0.01	0.14	3	.	33	44	5.02
55	Malaysia	0.04	0.03	0.21	3	5	33	9	7.77
56	Mali	0.00	0.05	0.08	3	.	52	21	6.89
57	Malta	0.06	0.01	0.18	3	.	.	.	12.64
58	Mauritius	0.04	0.02	0.12	4	.	.	.	8.05
59	Mexico	0.01	0.03	0.18	2	3	80	71	3.84
60	Mozambique	-0.03	0.04	0.03	3	.	58	71	.
61	Nepal	0.02	0.11	0.12	3	.	33	49	.
62	New Zealand	0.01	0.01	0.21	2	4	33	4	6.50
63	Nicaragua	-0.03	0.02	0.11	3	.	33	59	6.92
64	Niger	-0.02	0.05	0.07	3	.	52	38	2.89
65	Norway	0.03	0.02	0.32	3	3	42	30	3.38
66	Pakistan	0.03	0.02	0.12	3	3	48	18	.
67	Panama	0.02	0.02	0.21	2	.	80	67	10.73
68	Paraguay	0.02	0.02	0.11	3	.	.	.	3.92
69	Peru	0.00	0.02	0.18	2	4	34	70	3.75
70	Philipines	0.01	0.02	0.15	3	.	58	57	4.47
71	Poland	0.01	0.01	0.24	3	3	33	46	4.77
72	Portugal	0.03	0.02	0.21	2	4	74	70	9.47
73	Romania	0.03	0.02	0.28	3	3	47	30	3.28
74	Russia	-0.02	0.01	0.17	3	3	68	68	3.10
75	Rwanda	0.00	0.03	0.04	3	.	.	.	5.07
76	Senegal	0.00	0.01	0.07	4	.	46	29	9.57
77	Singapore	0.06	0.03	0.44	2	5	33	11	5.96
78	Slovak R.	-0.01	0.00	0.24	3	.	32	61	5.09
79	Slovenia	0.03	0.01	0.22	3	.	52	45	8.20
80	South Africa	0.00	0.02	0.12	2	2	33	16	6.26
81	Spain	0.02	0.02	0.25	2	3	74	50	5.76
82	Sri Lanka	0.03	0.01	0.11	2	5	33	42	4.99
83	Swaziland	0.00	0.04	0.18	3	.	.	.	9.99
84	Sweden	0.02	0.01	0.22	2	2	55	39	2.77
85	Switzerland	0.01	0.01	0.27	2	5	33	26	1.26
86	Syria	0.03	0.04	0.13	4	.	33	24	8.79
87	Thailand	0.05	0.02	0.31	2	3	60	43	4.87
88	Togo	-0.01	0.06	0.07	3	.	.	.	8.56
89	Trinidad	0.02	0.02	0.1	2	.	.	.	9.04
90	Tunisia	0.03	0.05	0.17	2	.	71	38	9.73
91	Turkey	0.02	0.03	0.16	3	3	58	20	6.09
92	Uganda	0.01	0.03	0.02	2	.	17	50	2.06
93	United Kingdom	0.02	0.01	0.18	2	5	33	20	4.59
94	United States	0.02	0.01	0.19	2	4	33	8	2.41
95	Uruguay	0.02	0.01	0.12	2	.	58	3	5.99
96	Venezuela	-0.01	0.02	0.16	4	3	.	.	6.00
97	Zambia	-0.02	0.04	0.19	3	.	33	0	9.84
98	Zimbabwe	0.01	0.03	0.22	4	.	33	20	9.14

Notes: Growth rates of GDP per capita and years of schooling are based on estimated trends. Government share is the percentage of public sector wage and salaries in GDP.

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