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 of "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. We explore the implications of our model for empirical issues in the literatures in education and growth, and for education policy. We show that accounting for labor market flexibility in cross country growth regressions provides an explanation for the observed low productivity of schooling in economic growth. A key policy implication of our model is that education reform in countries with rigid labor markets is unlikely to succeed unless it is combined with labor market reform that reduces distortions in the incentives for investments in human capital.

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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." Knowledge stands for all cognitive skills that can be tested and are therefore observable,[1] and creativity stands for non-cognitive human capital that is 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 across countries arise not only from differences in the amount of investment in human capital, but also from differences in its mix. Societies that promote a balanced portfolio of skills use 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 the behavior of families, schools, and firms that determine not only the amount of investment in people but also influence the mix of skills people acquire. The labor market, where rewards to skills are determined, therefore play a critical role in the efficiency of human capital investments.

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

[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.

can explain 60 to 80 percent in professional labor markets (Heckman 1998, Abowd and Killingsworth 1983). There is also direct evidence that non-cognitive skills are correlated with labor market success later in life (Wise 1975, Jencks 1979, Filer 1981, Goldsmith 1997, Dunifon and Duncan 1998, Duncan and Dunifon 1998, Murnane et al. 2001).

Economists have become increasingly interested in the role of non-cognitive skills in determining productivity, but progress has been slow. In part this is because these skills are hard to measure (Heckman and Rubinstein 2001), and in part because we tend to equate unobservable 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 therefore presumed innate. But not all that is not measured is innate. The skills which we call creativity satisfy three criteria:

1. They matter for production
2. They are difficult to measure and verify
3. They can be accumulated.[3]

The line between innate ability and non-cognitive skills is often blurred, and there are non-cognitive skills that do not satisfy all three criteria. However, opinion seems to have shifted over time on the extent to which particular skills can be enhanced through training. 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. There is a large literature and two specialized journals on creativity alone (Guilford 1986, Sternberg and Lubart 1995). The business world is full of optimism about our ability to increase leadership and entrepreneurship through training, judging by the proliferation of such programs. Still, the evidence on whether traits such as ambition, self esteem, or creativity are, like intelligence, determined at birth or can be enhanced by better parenting and coaching is far from complete.

[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.

For the purpose of this paper we do not need to take a position on which specific abilities can be accumulated. We use the term creativity generically to describe the subset of individual attributes that satisfy criteria 1 through 3, and believe that this subset includes several important attributes.

The appeal of focusing on differences in observability of skills is in the way they interact with labor market rules and regulations, especially those that affect its 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 Debgupta 2000). In Iran, the Labor Law authorizes government appointed local councils to review layoff decisions and fine employers for unfair dismissal. Only recently the Law was amended to exempt establishments with fewer than five workers (Salehi-Isfahani 2005). Large public sectors with costly layoff also contribute to labor market rigidity (Edwards 1997, Haltiwanger and Singh 1999). 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). A frequently voiced justification for employment protection and wage scales is that they prevent managers from using their discretion to engage in favoritism and that rewards should be based only on objective criteria. In many employment settings, particularly in the public sector, there is 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 verified by an outside observer.

In section 2 we present 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 who *may* have non-testable skills is risky, as it is costly to dismiss them if those skills are later found to be lacking. Instead, hiring decisions will be made only on what can be observed. 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 after hiring and then and appropriately reward workers as their productivity is observed. 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 related to the signaling and screening literature initiated by Arrow (1973) and Spence (1973), in which employers take schooling as a signal of productivity. Signaling 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 labor markets 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). Numerous 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. 2004; Besley and Burgess 2004; Caballero et al. 2004), though the theoretical debate on the effect of flexibility on employment is not conclusive (Bertola 1992). The relatively less flexible labor markets of Europe have been blamed for higher European unemployment rates relative to the United States (Nickell 1997, and Nickell and Layard 1999, Karanassou and Snower 1998, Di Tella and MacCulloch 2005). Our model adds efficiency in accumulation of human

capital to the list of reasons why labor market flexibility may be good for long run economic growth.

In section 3 we examine the implications of labor market flexibility as developed in our model for empirical research on the role of education in economic growth. The main implication of our model, namely, that in flexible and rigid labor markets individuals acquire different portfolios of observable and unobservable human capital, is by its nature very difficult to test. Therefore, in this section we pursue the more modest aim of illustrating the importance of labor market institutions in understanding social and private returns to education. In section 3.1 we take up a key puzzle in the empirical growth literature, the low observed social returns to education. In cross-country regressions the coefficient of growth of years of schooling is often zero or negative, a finding which is at odds with the emphasis growth theory has placed on human capital (Benhabib and Spiegel 1994; Berthelemy, Dessus, and Varoudakis 1997; Pritchett 2001; Pritchett 2006). We argue that this may be because these regressions do not account for variation in labor market flexibility across countries. According to our model, years of schooling is only a good proxy for human capital where labor markets are flexible. In countries with rigid labor markets, where individuals are likely to focus on formal education at the expense of less observable skills, years of schooling can be a poor predictor of human capital. Thus, ignoring the variation in labor market flexibility across countries results in a (downwardly) biased coefficient for schooling. By including this variation (as a binary variable) in a standard growth regression, we show that the effect of schooling on growth in flexible countries is large while in rigid economies it is nil.

The estimated low social return to schooling is a bigger anomaly when viewed in the context of large private rates of returns estimated from Mincer-type regressions on micro data (Krueger and Lindahl 2001, Pritchett 2006). In section 3.2 we consider the relationship between private returns and labor market flexibility. In our model firms in rigid markets reward diplomas instead of skills, a phenomenon known as credentialism. In countries with rigid labor markets private returns to secondary and tertiary degrees tend to be high relative to basic education because basic education is mainly valued as the path to higher degrees. We examine cross country data on returns to primary, secondary, and tertiary schooling

for evidence of a relationship between differences in the secondary and tertiary premiums and labor market flexibility. We find only weak indications that the average premiums are higher in rigid countries. Despite weak results, given the rather compelling case one can make for the divergence of private Mincer returns from individual productivity based on theory alone, there is reason to think that the practice of using estimates of private returns from wage data to calculate schooling capital may overestimate schooling capital in rigid countries (which are predominantly developing countries), and thereby present an overly pessimistic view of their total factor productivity growth.

In section 4 we briefly discuss the implications of our model for human capital policy. The analysis of this paper has important implications for education and labor market reforms. Most education reform ignores the role of labor markets and focuses on efficient incentives for educators but not families. Strikingly, a well functioning education system in which teachers and school administrators are fully responsive to parents and students may become a mere 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. Section 5 offers concluding remarks.

2 Model

A simple one period version of the model provides the basic intuition for how 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 observes the worker's productivity?" One might assume this problem away; perhaps assum-

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

ing that 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 Spence (1973). We first consider a short run economy of this kind where only observability matters: 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, 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 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, face restrictions on contracting. 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: 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 signaling 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 "produced" from the endowment e. For simplicity we assume that the marginal rate of transformation is -1:

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

Endowments are fixed (at birth) at level e and 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 between knowledge and creativity. One can think of the role of learning, at home and at school, as the movement along the budget constraint imposed by e. The tradeoff postulated here reflects the 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 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, for instance, the ability to work in teams. Students in these countries place almost total emphasis on memorization of facts and preparation for tests.[5] Indeed, heated competition for grades and for limited places in public universities may reduce the ability to work in teams, resulting in a negative relation

[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).

between testable and not-testable skills.

Our formulation of the tradeoff ignores complex interactions between various attributes. It is more accurate to think of knowledge as an input into production of creativity. Non-cognitive skills such as ambition, self control, and time preference help in the 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 our 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 that are observable and those that are not. It helps us focus on our main objective which is to study the impact of labor market characteristics 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 portfolio (n, r) is:

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

In the benchmark full observability economy, firms observe workers' complete human capital portfolios. 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

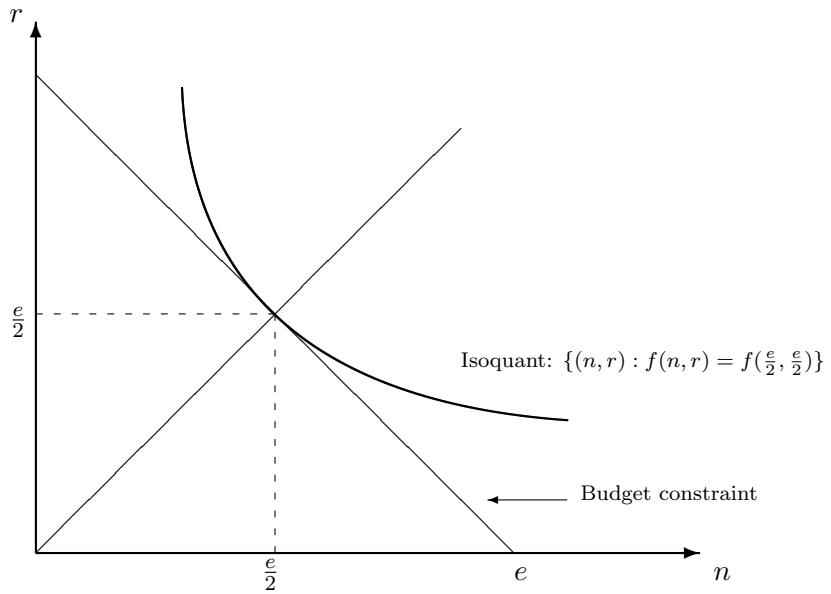

Figure 1: Choice of knowledge and creativity; short run, full observability

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.

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 creativity 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. Individuals pretending to have higher endowments show their level of knowledge and hope that firms infer that their level of creativity is commensurate with their knowledge. Of course, in equilibrium, firms will infer individuals' true level of creativity. But, it would not be profitable for individuals to increase their *productivity* by increasing their investment in creativity at the expense of knowledge.

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 signaling 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 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

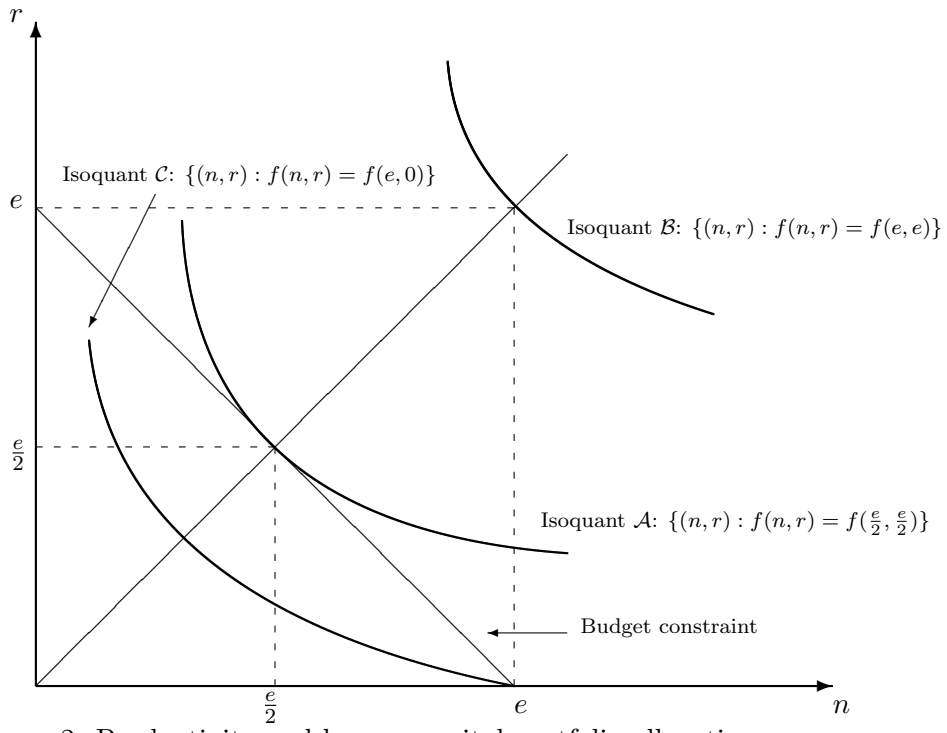

Figure 2: Productivity and human capital portfolio allocations

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 signaling model (Spence 1973). The signaling model of education is akin to what we outline here, but differs in important respects. In the classic signaling 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 with 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:

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

When firms can ultimately deal with workers who misrepresent their true productivity, a

worker's decision of whether 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 period one 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, because of flexibility, time enables the economy to overcome the inefficiencies resulting from the unobservability of creativity.

2.2.3 Unobservable creativity, rigid labor markets

Now assume that creativity is still unobservable, but in addition 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 objective "measures" 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:

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

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 empirical issues in education and growth

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. 2004), yet the large empirical literature on cross-country growth regressions has given little attention to the role of labor markets (Topel 1999). Our model makes a strong case for taking into account cross-country variation in labor market flexibility in understanding the productivity of education. In this section we examine the implications of this proposition for social and private returns to education. In section 3.1 we re-examine the estimation of social (macro) returns from cross country regressions. By including readily available measures of flexibility in the standard cross-country regressions, we show that social returns to education are high in countries with flexible markets and zero in rigid countries. Cross country data on private returns are much less reliable, but we find weak indication that estimated private returns

tend to be higher in rigid countries. As noted earlier, the purpose of our empirical exercises is not to test the implications of our model, but to illustrate the importance of taking labor market institutions for understanding individual and social productivity to education. To the extent that we succeed in doing so, we confirm our general approach to skill formation.

3.1 The "missing education" puzzle

It is well known that in cross country regressions of growth the coefficient of increase in years of schooling — the most commonly used measure of human capital — is often insignificant and sometimes even negative (Benhabib and Spiegel 1994, Borenstein et al. 1999, Levin and Raut 1997, Pritchett 2001, and Pritchett 2006).[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 question remains as to why *increase* in education fails to explain growth of output. In his survey of labor markets and growth, Topel (1999, 2964) concludes that, "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."

The insignificance of the schooling coefficient may be attributed to well-known problems with measuring schooling across countries (Behrman and Rosenzweig 1994). Attempts have been made to deal with these problems by introducing measures of quality of schooling (Barro 1998, Hanushek and Kimko 2000) and correcting for measurement error in the schooling variable (Krueger and Lindahl 2001). These attempts have been by and large successful, thereby confirming that more accurate measurement of human capital can lead to a more significant schooling effect on growth. The hypothesis advanced in this paper suggests yet another difficulty with years of schooling as a measure of human capital, namely, that schooling produced in countries with rigid and flexible labor markets are not the same. In flexible markets formal schooling represents an efficient combination of observable and non-observable skills, whereas in rigid markets years of schooling mean just that.

A quick look at the correlation between labor market flexibility and growth of school-

[6]This is by no means a uniform result. See Temple (2001) and Gemmell (1996) who finds a positive relationship for his carefully constructed overall measure of schooling, but still finds that growth of secondary education has a negative (but insignificant) effect on growth.

Table 1: Average performance of countries with flexible and rigid labor markets (Heritage index), 1960-2000 averages

	Flexible	Rigid	All
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.

ing indicates why flexibility might be relevant in understanding the relationship between schooling and growth. In Table 1 we divide a sample of countries into more and less flexible according to their score for the degree of government control of wages and prices as calculated by the Heritage Foundation (see Appendix for a detailed description of this and other indices). Those with scores of 1-3 – about half of the sample – are classified as flexible and the rest as rigid. During 1960-2000, flexible countries on average invested 5.5 percent more of their GDP per year and grew twice as fast, while their growth in schooling was 45% *lower* than rigid countries. According to this table, growth of schooling and output are correlated in the flexible, but not in the rigid group of countries. Thus, a sample composed of both types of countries is unlikely to yield a reliable estimate of the relation between schooling and growth.

If our conjecture regarding the inefficient portfolio of human capital in rigid countries is correct, this table may have an explanation for why in countries with faster growth of schooling, quality of education may have been lower. It also suggests why accounting for quality in the growth regressions may help improve the estimation of the coefficient of education in growth regressions. However, as Pritchett (2001) has noted, in order for the negative coefficient of education on growth to turn positive, a strong negative correlation must exist between quantity and quality of education. We believe our model suggests one reason why this might be the case.

This table also suggests that the puzzle of "missing education" can be usefully viewed as

a problem of omitted variable, caused by the omission from the right hand of a variable to account for labor market institutions. If the link we have established between labor market flexibility and the composition of human capital is valid, the actual omitted variable is a measure of non-observable human capital. This variable is highly correlated with years of schooling in the flexible group of countries but not in the rigid group (as in the model of section 2.2.2). To see this, consider a standard neoclassical growth model with constant returns to scale and Cobb-Douglas technology:

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

in which effective labor inputs are a function of human capital, h. In per capita growth rate form this can be written as:

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

Now, think of h as an aggregate measure of two types of human capital, knowledge and creativity, so that its growth rate can be related to the growth rate of its components:[7]

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

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 commonly ignored, instead of estimating (22) researchers usually estimate:

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

As just noted, in a sample of economies with flexible labor markets, growth of schooling

[7] 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.

and creativity should be highly correlated and the estimate of b_2 from (23) would pick up the contributions of both schooling and creativity, $\beta_2 + \beta_3$.[8] This might be inconvenient but presents no real problem: individuals and policy makers recognize, implicitly or explicitly, the contributions of schooling and creativity 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 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), that rank countries on regulation and the degree to which wages and prices are set by the market vs. the government (for details see Data Appendix). We also use the share of government wage bill in GDP, 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 help us distinguish between groups of countries with more or less regulation of employment and wages. To examine whether the effect of schooling on growth depends on the level of labor market flexibility, we use the same binary measure of flexibility that we used in Table 1 as a dummy variable in this regression:

[8] 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. It is also consistent with more accurate estimates of the education effect for the more homogenous group of OECD 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 way to see if the effect of schooling on output is higher in countries with flexible than rigid labor markets.

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. The poor quality of data on labor market flexibility makes it difficult to conclude much from either study.[9]

We use indices of labor market flexibility from three sources, but believe that index produced by the Heritage Foundation (2002) comes closest to what we are modeling in this paper (see Appendix for description of the indices). The Heritage index scores government control of wage and prices from 1 (least control) to 5 (see Table 2). The distribution of the index (see Table 2) readily suggests the threshold for a binary definition of rigidity: equal

[9]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.

Table 2: 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)

to one if the index is greater 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 is very similar to the Heritage index in terms of construction and method of calculation, but it is only available for half the sample. World Bank (2003a) offers a more comprehensive data on flexibility, and differs from the other two in that it relies more systematically on laws and regulations that impinge on employer decisions (Botero et al. 2004). It is less suitable for our purposes because it refers to later years when several countries have been actively dismantling these laws, and it tends to be less sensitive to actual implementation of employment regulation that the Heritage and EIU indices. Table 3 shows the distribution of scores and the dummy variables that are based on the median scores for each index. We use a fourth index of flexibility based on the share of public sector wages in GDP. In most developing countries public sector employment, in which the educated are usually heavily over represented, has the most rigid rules for compensation and firing, and thus tends to push education aspirations toward credentialism. A larger size of the public sector should thus imply a more rigid labor market and a less efficient portfolio of skills. The entire sample with key regression variables is presented in a data appendix (Table A.1).

Table 4 compares the Heritage classification of flexibility with the other three. There is some correlation between the Heritage and World Bank indices match well at the extremes of the distribution but not in the middle. As noted earlier, this may be because the World Bank

Table 3: World Bank indices of labor market regulations

Variable	N	Mean	SD	Min	Max
Employment laws index	107	49.7	13.8	19	78
Hiring laws	107	45.6	15.7	0	80
Firing laws	107	36.2	18.4	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	49.5			
1 (%)	54	50.5			

Table 4: Comparison of labor market flexibility indices (mean values)

Heritage index	EIU	World Bank		Government wage share
		Hiring	Firing	
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: The Heritage index measures wage and price controls, the World Bank indices are for regulations of employers' hiring and firing practices and range from 0-100, and the government wage share is the ratio (x100) of public sector wages and salaries to GDP.

rankings rely more on laws and regulations while the Heritage index emphasizes perceived enforcement. The EIU and Heritage indices are slightly more closely correlated (negatively, because EIU defines 1 as "high regulation"), in part because because the Heritage index uses EIU data in constructing its own index. The size of the government wage bill as percentage of GDP shows a close correlation between the importance of government employment and rigidity as measured by the Heritage index.

A caveat for these indices (except the one based on government wages and salaries) is that to obtain 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.[10] This should not present a major problem, because only a handful of countries experienced substantial change in labor market institutions, mainly the former socialist

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

countries after 1990, which are excluded from our sample because they lack data on growth of GDP for earlier years. Lack of data on labor market flexibility for earlier years and the long term nature of the relationship between changes in labor market institutions and investment in human capital necessitates looking at growth over a longer period.

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 Barro and Lee (2000). Because labor market institutions affect education over a long period of time, we do not employ the more powerful panel approach, and look for the determinants of average growth over the entire period. To avoid sensitivity to end point values of GDP per capita and schooling, we calculate growth rates using a regression trend line for 1965-2000 (including in the sample only countries with at least 15 years of observation).[11] Summary statistics in Table 1 show that the estimates of growth from both methods are very close, and regression results based on them are nearly identical.

The results are presented in Table 5. In column 1 we reproduce the well-known missing education puzzle: the estimated coefficient of schooling in the misspecified equation (23), which treats schooling in all countries the same, is not different from zero. In column 2-6, where the dummy variable allows for different effects of schooling on growth in rigid and flexible countries, we produces results that are essentially what we saw in Table 1. The most favorable results to our model are in regressions based on the Heritage index and the size of the government wage bill as percentage of GDP (columns 2 and 6, respectively). For countries with flexible labor markets, the coefficient of schooling is positive and significant and much higher (0.545 in column 2 and 0.461 in column 6), while for rigid countries the estimated coefficient (the sum of this schooling coefficient plus the interaction term) is close to zero in column 2 and negative in column 6. The remaining columns show similar but weaker results. The EIU regression in column 3 exaggerates the effect of schooling, and the coefficient of the interaction variable is not significant in the regressions using World Bank data, though they all have the right sign. These results clearly show that the correlation between growth of years of schooling and growth of income is different in the two sets of

[11] We repeated the regressions using growth rates taking average values for 1960-70 and 1990-2000 as end points. The results were the same.

Table 5: The effect of labor market flexibility on growth of GDP per capita

Independent variable	No dummy (1)	Heritage (2)	EIU (3)	WB firing (4)	WB hiring (5)	Govt. wage (6)
Investment/GDP	0.145*	0.142*	0.122*	0.147*	0.150*	0.148*
	(0.025)	(0.024)	(0.030)	(0.026)	(0.026)	(0.026)
Schooling	0.096	0.545*	0.907*	0.279**	0.319*	0.461**
	(0.108)	(0.214)	(0.341)	(0.166)	(0.136)	(0.243)
Dummy*schooling	—	-0.548*	-0.670**	-0.085	-0.245	-0.522*
		(0.240)	(0.388)	(0.211)	(0.212)	(0.264)
Dummy (1=rigid)	—	0.008	-0.002	0.000	0.007	.014*
		(0.006)	(0.008)	(0.006)	(0.006)	(0.006)
Constant	-0.011	-0.027	-0.015	-0.015	-0.018	-0.019*
	(0.006)	(0.007)	(0.009)	(0.008)	(0.008)	(0.008)
Adjusted R^2	0.27	0.30	0.35	0.28	0.29	0.27
N	98	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. GDP per capita growth rates are trends calculated for all countries with at least 15 years of observation. Column (6) uses a dummy based on percentage of government wages and salaries in GDP.

countries with flexible and rigid labor markets. The difference in the estimated effect for the two groups of countries, though significant in only about half of the regressions, suggests that education does not mean the same thing across all countries.

These results are suggestive but fall short of identifying causality, in part because of potential endogeneity. Causation may run from growth of income to schooling rather than from schooling to growth because returns to education may be higher in growing economies and therefore induce investment in education (see Bils and Klenow (2000) for a discussion of causality of education and growth). Labor market flexibility may also be endogenous (Howell et al. 2007), for example, if growing economies find it politically easier to relax their labor laws. Eliminating bias due to endogeneity generally requires finding credible instruments for years of schooling and labor market flexibility, which are not easy tasks. The extensive literature on education and growth does not offer many good leads for instruments. Krueger and Lindahl (2001) use as instrument an alternative data set for years of schooling to correct for errors in the schooling variable, but this results in a much smaller (selected?) sample and much higher standard errors. Pritchett (2001) uses two instruments (different schooling data and neighboring country education) but finds that the estimated

IV coefficient for education is not very different from OLS. Instruments for labor market flexibility are equally difficult to find. The literature on the role of institutions in growth provides examples of instruments for institutions (Acemoglu and Johnson 2005, and Acemoglu, Johnson, and Robinson 2005), but not for labor market flexibility. Changes in labor market institutions that follow abrupt political shifts, such as right wing military coups, may provide opportunities for identification of the exogenous effect of labor market insinuations on growth in future work. Since our aim in this section is to illustrate the potential significance of labor market institutions in the education-growth relationship, and we are not aiming at precise measurement of the effect of education on output, searching for valid and credible instruments for either variable is beyond our scope.

Is the potential bias in our regressions in the difference between coefficients of schooling in flexible and rigid countries likely to be large? Predicting the direction of bias of any coefficient in our regression is complicated by the fact that we are dealing with potentially two endogenous variables on the right hand side. In general, when there is more than one endogenous variable, it is difficult to say with any certainty how a specific coefficient is affected, for the bias depends on all the parameters of the model (Mayston 2005). But if we assume that labor market institutions are exogenous to growth, we can say something about the size of the bias on the coefficient of schooling. Such an assumption can be defended on grounds that changes in labor market institutions are slow and historically rooted. This assumption helps reduce our case to the simple case of regressions with only one endogenous variable, in which the direction of bias depends on the correlation of the endogenous variable with the error term.

To utilize this intuition, we run separate regressions on the two sets of countries (this helps us avoid the interaction term which is a second endogenous variable), each defined based on the value of Heritage dummy. The results of separate regressions in Table 6 are, as expected, very similar to those in Table 5. The estimated coefficients of growth of schooling for rigid and flexible countries are, respectively, -0.021 and 0.563, which yield a difference of 0.542. The regression on rigid countries is much less precisely estimated, and the coefficient of schooling is insignificant and close to zero. The same for flexible countries is positive and significant. In both sets of countries causation may go from growth of output to growth

of schooling, so both coefficients are likely to be overestimates. But since the biases in the two estimates cancel each other to some extent, the bias in the estimate of their difference, which is what interests us most here, is likely to be small.

Table 6: Estimation results for groups of countries

Variable	**Coefficient**	**(Std. Err.)**
	Flexible	Rigid
Investment/GDP	0.130	0.152
	(0.044)	(0.025)
Schooling	-0.021	0.563
	(0.155)	(0.170)
Constant	-0.007	-0.019
	(0.010)	(0.007)
Adjusted R^2	0.43	0.16

Our data show a fair degree of correlation between flexibility and per capita income. Most rigid countries are developing countries and most flexible countries are developed (the ratio of average per capita GDP of flexible to rigid countries was 2.4 in 1965 and 2.5 in 2000; see also the Appendix for the list of all countries and their rigidity indices). Is per capita income as good a basis for separating countries into high and low productivity of education? We tried replacing the flexibility dummy with dummy variables defined on the basis of various quartiles of income, but we were not able to obtain a positive and significant coefficient for the income dummy as we do with the flexibility dummy. Thus, the question posed by Pritchett (2001), "Where has all the education gone?", seems more apt for countries with rigid labor markets than for developing countries in general. There are potentially other theories that explain the difference between the effect of education on growth besides our model, so we cannot claim these results are a test of the specific hypothesis we have advanced in this paper regarding the channel through which flexibility affects growth.

3.2 Returns to education

The lackluster performance of schooling in growth regressions is even more striking in light of high private returns to education estimated from micro data for developing countries (Psacharopoulos and Patrinos 2004, Pritchett 2006). Our approach suggests that, as with

social returns, private returns are also influenced by labor market flexibility. In this section we briefly examine the data on this relationship. Blundell, Dearden, and Sianesi (2005) distinguish between three notions of returns to education: (1) *private returns*, which Mincer equations estimate; (2) *labor productivity returns*, which is the effect of education on the individual's productivity; and (3) *social returns*, which, in addition to increased individual productivity, includes the effects of education on health, family planning, civic behavior, and so on, as well as external effects. The focus of our model is on the difference in returns according to the first and the second definitions. Our model (along with several others) implies that in distorted labor markets it is the wage structure rather than the structure of productivity that is reflected in Mincer returns. In rigid markets Mincer returns exceed productivity whereas in flexible markets we expect them to be the same. As with social returns, the direct implication of our model about private returns does not easily lend itself to testing. Productivity returns are observable when market are flexible and employers offer wages based on productivity, but not in rigid markets where they pay according to credentials.

There is an observable implication of labor market rigidity for Mincer returns which is worth a look here. If our analysis is valid, market rigidity should increase private returns to secondary and tertiary education relative to basic (primary and lower secondary) education because payoff to the latter is mainly in making reaching secondary and tertiary levels.[12] In flexible labor markets skills are accumulated along the way and rates of return should be more or less the same for different levels of education. If this conjecture is correct, two important implications follow: First, high returns to, say, university education do not justify greater expenditures on higher education. If labor markets are rigid, the relative rates of return to tertiary and primary levels are no indication of the relative benefits of investment in them. Second, in rigid markets, in which micro returns do not reflect productivity, schooling capital based on available micro-Mincer returns, as in Bils and Klenow (2000), overestimate the stock of human capital in these countries. Thus, these estimates do not improve on years of schooling as a measure of the stock of human capital

[12]Using a different model, Gilles (1996, ch. 10) also shows that higher firing costs tend to increase private returns to education.

in growth regressions. By overestimating the stock of human capital, they underestimate growth of total factor productivity.

Textbook human capital theory suggests that the returns to a year of schooling should decline with schooling. Data in developed countries do not contradict this theory but generally reveal a fairly constant rate of return for all years of schooling (about 10 percent in the USA. See Card 2000). Pritchett (2006) finds evidence of a negative relationship from cross country data: average Mincer returns to schooling are lower in countries with more schooling. But the theory refers to flexible labor markets and the empirical relationship is based on Mincer returns that assume a linear relationship between wages and years of schooling. We are interested in rates of return that allow for differences based on level of schooling. In rigid labor markets we expect a *convex* relationship between returns and years of schooling.

This pattern has been observed in studies of returns to education in individual countries with rigid labor markets, such as in Egypt, Iran, and Syria (Assaad 1997, Salehi-Isfahani 2005, Huitfeldt and Kabbani 2007). It is also weakly observable in cross country data on rates of return to primary, secondary and tertiary education from Psacharopoulos and Patrinos (2004), the same source used by Pritchett (2006). These data are taken from a variety of empirical studies published mostly in the 1980s and 1990s. There are valid criticisms of such comparisons across countries because of differences in quality of data and estimation methodology (Bennell 1996, Pritchett 2006). A further problem is that once we match these data to our data on flexibility, the sample drops to only 30 countries, which makes inference very problematic. But, for what it is worth, a preliminary examination of this sample reveals interesting differences in the pattern of returns to schooling based on labor market flexibility. Table 7 shows the average rates of return for two groups of countries divided according to the Heritage index. Flexible countries have higher returns at the primary level but slightly lower at the tertiary level. Returns are on average lower at the secondary and tertiary levels compared to primary (last two columns). The pattern is somewhat different for rigid countries: average returns to secondary are actually significantly higher than primary for this group of countries, though the same for tertiary level is not significant, and the difference in differences for secondary versus primary is only significant

Table 7: Mean private returns to education by labor market flexibility

		Average rate of return			Difference in returns	
Labor market	Sample	Primary	Secondary	Tertiary	Sec-prim	Ter-prim
Flexible	17	22.87	16.36	20.49	-6.51	-2.38
		(5.20)	(3.90)	(2.39)	(3.01)	(4.60)
Rigid	13	17.59	18.72	20.46	1.13	2.87
		(2.80)	(2.82)	(3.25)	(3.86)	(4.64)

Source: Psacharopoulos and Patrinos (2004).

at 12 percent.

These difference in differences become more significant in a regression of the gap in returns on the labor market flexibility dummy, controlling for the level of economic development and schooling. Although the data is too ad hoc and the sample too small for good inference, there are two intriguing observations to make based on this regression. The coefficient of the flexibility dummy indicates greater tertiary premium in rigid countries, and income is *negatively* correlated with the tertiary premium so, contrary to expectation, poorer countries have lower tertiary premiums. A similar (but weaker) result holds for the difference between secondary and primary returns.

$$\begin{array}{lccccc} \text{Tertiary-primary} = -12.15 & -0.003\ \text{rgdpl} & +37.77\ \text{dummy} & +5.30\ \text{schooling} & -10.10\ \text{dummy x schooling} \\ & (11.02) \quad (0.001) & (17.07) & (2.84) & (4.18) \end{array}$$

$N = 30, \bar{R}^2 = 0.16$, and standard errors are in parenthesis. Income and schooling data refer to 1980 to avoid endogeneity with respect to rates of return which are estimated for later years.

4 Implications for policy

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, its 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 take the formal high school track because it gives them a shot at more formal schooling at the tertiary level, even in subjects 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 different 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 not 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

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

reform presupposes labor market reform. Yet, most discussions of education reform fail to take this basic point into account.[14]

The debates on privatization of schools and giving testing a more prominent role in student evaluation often ignore labor market conditions.[15] 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 of welfare economics, 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.[16] The celebrated *Arab Human Development Report* (United Nation 2002) which is eloquent on the

[14]The most recent World Bank flagship report on MENA education focuses entirely on reforms internal to the education sector, ignoring the role of incentives that originate in the labor market. See (World Bank 2006).

[15]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).

[16]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).

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.

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).[17] 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.[18]

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

[17] 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.

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

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 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 examine data to show how the insights generated by our model can throw light on two empirical issues in the literature on education and growth. The first is an anomaly in the literature on cross country regressions in which the usual measure of human capital, years of schooling, does not appear to account for growth. We conjecture that this may be because schooling fails to accurately reflect the level of creativity in countries with rigid labor markets, and growth regressions do not control for labor market rigidity. When we use a dummy variable to separate countries with rigid and flexible labor markets, we observe that for the latter education is positively associated with growth, while the effect of education on growth is insignificant for the former group. We also investigate the effect of labor market flexibility on private returns to education, about which our model has an indirect implication, namely that in rigid countries, where credentialism prevails, Mincer

returns to university and secondary education may be higher than primary, whereas in flexible countries returns to difference levels of education should be more uniform, or even declining.

We hasten to emphasize that while these empirical findings are consistent with our model, they are also consistent other theories. As such, we do not view them as proof of our model's validity, rather as evidence that taking account of labor market institutions is important in understanding the role of education in economic growth. Hopefully, our empirical results are persuasive enough to warrant a more ambitious search for the effects of labor market flexibility on human capital accumulation.

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.

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Data Appendix

We use the following measures of labor market flexibility: three indices published by the Heritage Foundation (2002), the Economist Intelligence Unit (2004) and the World Bank (2003a), and a fourth we construct as the ratio of public sector wage and salaries to GDP. 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).[19] 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 rankings cover three areas: flexibility of hiring, conditions of employment, and flexibility of firing. 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. 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. 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). 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.

[19] 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).

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.