Indirect estimation of the rate of return to a university degree

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Abstract. When data are too scanty to permit direct estimates of the rate of return to a university degree, one may resort to an indirect estimate based on the enrollment rate. This rate rises when enrollees perceive an increase in the degree's rate of return. Estimates for universities in Almaty suggest that the rate of return may differ substantially across universities in the short run. (JEL I22)

Keywords: Rate of return, education, enrollment, omitted variables, measurement error

Introduction. Direct estimates of the rate of return to a university degree require data on salaries and the opportunity costs of education. Assembling tuition data is straightforward, but it is difficult for one university to randomly survey graduates of rival universities about their salaries and educational costs. Also, respondents may give thoughtless or misleading information.

An indirect approach to estimating such rates of return might work better than a survey. Briefly speaking, we can infer the rates from what people do. Actions speak louder than words.

Analysis. The indirect approach would model the relative rate of growth in enrollments of two universities as an increasing function of the relative expected rate of return. Denote the expected rate of return to a degree at university i at time t as $r_i(t)$, and the enrollment as $E_i(t)$. The rate of growth in enrollment over time is

$$\frac{\partial E_i / \partial t}{E_i(t)} \equiv \frac{\dot{E}_i(t)}{E_i(t)},$$

where the right-hand side provides a convenient notation. We argue that for universities i and j, the relative rate of enrollment relates directly to the relative perceived rate of return. Thus

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$$\frac{\dot{E}_i(t)}{E_i(t)} - \frac{\dot{E}_j(t)}{E_j(t)} = f\left[r_i(t) - r_j(t)\right] = f\left[x_{ij}(t)\right],$$
$$f(0) = 0, \frac{\partial f}{\partial x_{ij}} > 0, \frac{\partial^2 f}{\partial x_{ij}^{\ 2}} = 0,$$

where x_{ij} denotes the difference in the rates of return for the two universities. For simplicity, we assume that the second derivative of *f(x)* is zero. The model to fit is

$$\frac{\dot{E}_i(t)}{E_i(t)} - \frac{\dot{E}_j(t)}{E_j(t)} = a + bx_{ij}(t),$$
$$a = 0, b > 0,$$

Equation 1

where the second line above gives the hypotheses to be tested.

In the long-run equilibrium, all universities have the same expected rate of return, for this reason: When x_{ij} rises in the short run, the relative rate of enrollment growth for university *i* increases. Over time, this will push up relative costs at university *i*, such as tuition. So, x_{ij} will decrease. In equilibrium, the relative rate of enrollment growth is zero, implying that both universities have the same expected rate of return. Testable hypotheses are that over the long run, the differentials in the rate of return and the rate of enrollment tend toward zero.

The differential in the rates of return can be estimated from Equation 1.

Specifying the model. We fitted the model for four universities in Almaty. Our calculation of $r_i(t)$ comes from the work of the department of institutional research at university *i*. The provisional value of *a* is 0. This leaves two unknowns in Equation 1: *b* and $r_j(t)$. We estimated *b* by considering the impact on university *i*'s enrollment of the transition from a boom economy in 2007 to a recession in 2009 – a transition that must have lowered perceived rates of return to education. We may approximate the reduction in these rates with the reduction in the growth rate of real gross domestic product (GDP) for Kazakhstan in 2009, as compared to 2007 (Appendix). While the expected rate of return to education includes non-monetary factors such as enjoyment of learning, we assume that these factors are constant over the business cycle.

With this calculation, the estimated rates of return for university *i* and for higher education institutions in Kazakhstan as a group ("university" *j*) were roughly the same in both 2007-8 and 2008-9. For the two time periods, the differential $r_i - r_j$ is .028% and 1.307% respectively. The differential is also small for bachelor's degrees only: .018% in 2007-8 and 1.447% in 2008-9.[2]

Table 1 estimates the rate of return for a bachelor's degree at university *i*, relative to the return to a degree at three other universities in Almaty, rivals of *i*, for 2011 and 2012.[3] For example, the estimated rate of return at university *i* exceeded the

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2 Government data for master's students are unreliable for some years, so we do not estimate rates of return to graduate degrees.

3 These estimates use 2011 and 2012 data to calculate the parameter *b*.

corresponding rate for university *g* in 2011 by 32.5%. The results illustrate considerable variation in rates of return at universities in the short run, even when all the schools serve a similar purpose and are in the same city. In this case, universities seem to comprise an industry of monopolistic competition.

Table 1. Differential in rates of return for bachelor's degree

University	2011	2012
g	.325	.221
l	.226	.151
m	.400	.245

Omitted variables and measurement errors. One advantage of the indirect approach to estimating rates of return is that it may eliminate some variables that are hard to control for. In the Mincer (1974) model, the rate of return to education is estimated from the coefficient a_1 in

$$\ln(Salary_i) = a_0 + a_1 Education_i + e_i$$

where $Education_i$ may measure the number of years of schooling completed by person *i*.

Mincer's model does not control for ability, which is hard to measure (Griliches 1977). Instead, ability shows up in the error term e_i. Since ability correlates positively with education, OLS attributes the rate of return that is really due to the former to that of the latter, leading to an overestimate of a_1. The estimate is inconsistent as well as biased; that is, increasing the sample need not correct the bias.

In contrast, the indirect approach of Equation 1 may eliminate the rate of return to ability and thus obviate the need to control for it. We assume that the same students may attend either university *i* or university *j*. Consequently, the average rate of return to ability, *k*, is a constant in the rates of return unadjusted for ability, $r_{0i}(t)$ and $r_{0j}(t)$. Their differential is

$$r_{0i}(t) - r_{0j}(t) = r_i(t) + k - \left[r_j(t) + k \right] = r_i(t) - r_j(t).$$

Similarly, the indirect approach may eliminate measurement errors, such as in the level of parental schooling, that may bias the rate of return to education (Griliches 1977; Ranasinghe and Hertz, 2008).[4]

Conclusions and discussion. When we lack data for estimating a rate of return, we may profit by turning the question around: What rate of return can we infer from behavior that we *can* observe? For example, we may infer the return to an education at college A, relative to the return to College B, from the rate of increase in enrollment in A, relative to that in B.

True, the student's decision of whether to enroll depends on her *perceived* relative rate of return, which may not equal the actual rate. But one would expect this equality to emerge in a long-run equilibrium, since a student wouldn't persist in a mistake once she

[4] Since parental education correlates positively with the child's education, an overstatement of the former will bias downward the coefficient on the latter.

has discovered it. In any event, if the perceived rate affects enrollment, an estimate of it may have value even if it incorporates errors.

Appendix

Estimating b

We assume that the perceived rate of return to a diploma at university *i* in 2007 equals the average annual rate of growth of real GDP per capita in Kazakhstan from 2000 through 2007 (denote this as q_0) plus the perceived premium p_0 for this diploma.[5] The assumption stems from the tenet that all assets earn the same return in the long run; one such asset is the stock of national capital per capita, the return to which is the increase in output per capita. Thus $z(2007) = q_0 + p_0$, where $z(t)$ denotes the perceived rate of return to the diploma at time *t*. In 2009, the perceived rate of return was $z(2009) = .8q_0 + .2q_1 + .8p_0 + .2p_1$, where q_1 and p_1 are the counterparts of q_0 and p_0, respectively, for the recessionary years 2008 and 2009. The rate of return for 2009, with respect to the rate for 2007, is

$$z(2009) - z(2007) = .2(q_1 - q_0) + .2(p_1 - p_0).$$

If $a = 0$ and $p_0 = p_1$, then

Equation 2

$$\hat{b} = \frac{y_i(2009) - y_i(2007)}{z(2009) - z(2007)} = \frac{y_i(2009) - y_i(2007)}{.2(q_1 - q_0)},$$

where $y_i(t)$ is the enrollment rate at university *i* at time *t* and the carat indicates an estimate of the *b* in Equation 1. The parameter *b* is the ratio of the change in enrollment to the change in the rate of return, for university *i*. The modeling assumes that the enrollment response to a change in the relative rate of return, both for two universities, will equal the enrollment response over time to a change in the return over time for one university. If *b* equals 2, then an increase of 1% in the difference between the rates of return of universities *i* and *j* (that is, $r_i - r_j$) will be associated with a 2% increase in the difference between the enrollment rates of *i* and *j*.

The average annual rate of growth in real GDP per capita in Kazakhstan was .097 in 2000-7 and .003 in 2008-9, according to the national statistical agency (now a committee). The enrollment rate at university *i* (expressed as a share of all students) was .311 in the academic year 2007-8 and .251 in 2008-9, according to the university's data. Estimating Equation 2 with these data gives us an estimate for *b* of 3.19.

To calculate the returns differential $r_i - r_j$, we estimated enrollment rates for rival universities as the average enrollment rate for higher-education institutions in

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[5] The year 2000 is a convenient starting point, since the economy of Kazakhstan began recovering steadily that year from the Russian ruble crash of 1998. The period of the early transition to a market economy, 1992 to 1998, is uncharacteristic of today's economy and so should be excluded from the calculation of the current perceived rate of return.

Kazakhstan, using data from the Ministry of Education and Science. The rates were .312 in 2007-8 and .293 in 2008-9.

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