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THE ECONOMIC RETURNS TO HIGHER EDUCATION IN THE BRIC COUNTRIES AND THEIR IMPLICATIONS FOR HIGHER EDUCATION EXPANSION⁵

This paper focuses on the changing economic value of secondary and higher education in four potential world economic powerhouses—Brazil, Russia, India, and China—known as the BRIC countries. We show that in the past twenty-five years in the BRIC countries, changes in rates of return to higher education have not conformed to the diminishing returns to capital theory, which says that rates decline with level of education and that this pattern holds as countries develop economically and educationally. The rates to university completion have generally risen relative to the rates to investment in lower levels of education, and in all but India are now higher than the payoff to secondary schooling. We argue that this reflects the rapid economic change in all four countries, including their incorporation into the global economy, and, in Russia and China, the transformation from command to increasingly market economies

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This paper is about the changing economic value of secondary and higher education in four potential world economic powerhouses—Brazil, Russia, India, and China—known as the BRIC countries. We were motivated to study the payoff to education in the BRICs for two main reasons. First, we want to make the case that these payoffs are primarily shaped by varied economic and political forces, not by an “iron rule” of diminishing returns to capital. The BRICs are good examples for making this case because they are big, developing economies with rapidly expanding educational systems—including major changes in their higher education—and they represent a variety of educational supply and demand contexts, particularly at the university level. Second, the BRICs produce a high proportion of the world’s university graduates—especially in technical fields—so we want to assess whether the level and observed changes in rates help us understand the expansion and financing of higher education.

Analysts have disagreed about the trends in the pattern of rates of return by level of education over time. Psacharopoulos (1989) argued that rates decline with level of education and that this pattern holds as countries develop economically and educationally. However, his argument ignored some important features of a changing global economy and educational expansion. For example, employers tend to substitute higher for lower educated labor as the proportion of youth completing higher levels of education increases (Carnoy 1972); new technology and new products and services are increasingly human capital intensive (Katz, 1999), and changing government fiscal policies (taxes and spending) and incomes policies (minimum wage and collective bargaining) may impact payoffs to investing in different levels of schooling (Dionardo and Lemieux, 1996; Carnoy, 2011). By the early 1990s, it was evident that as countries industrialized, joined the global economy, and expanded their educational systems toward the universal completion of primary, lower secondary, and upper secondary school, rates of return to higher education increased relative to rates to investing in lower levels of schooling. Further, there was evidence that in many countries this process had left the rates to university education higher than those to secondary education, and those to investment in secondary education higher than those to investment in primary (Carnoy, 1995).

We show in this paper that in the past twenty-five years in the BRIC countries, changes in rates of return to higher education have not conformed to the pattern predicted by Psacharopoulos’ version of the diminishing returns to capital theory. The rates to university completion have generally risen relative to the rates to investment in lower levels of education, and in all but India are now higher than the payoff to secondary schooling. We argue that this reflects the rapid economic change in all four countries, including their incorporation into the global economy, and, in Russia and China, the transformation from command to increasingly market economies. In all four cases,

these economies are also gradually moving toward the production of more technologically sophisticated goods and services, and economic growth rates have been high in the last ten years—highest in China, followed by India, Russia, and then Brazil.

Further, especially in Russia and China, wage and income distribution, tightly controlled and equalized under Communist governments, has become much more unequal with the transition to market economies. University graduates benefited from this transition more than less educated groups, because, as Fleisher and Chen (1997) have argued, the productivity-income gap in the command economies was larger for relatively underpaid higher skilled workers. The higher educated in China and Russia probably also benefited from shifts in demand for products and services, particularly as these economies began to compete in global markets.⁶ This appears to be the case in India as well.

We suggest that where rates of return are highest—Brazil and China—the greatest pressure exists for expanding higher education, as expected, and cost sharing through fees and private higher education is greatest. At the same time, we show that fields of study, such as engineering and business, have higher than average payoffs in several of the countries. In India and Russia, families are more willing to pay high fees for their children to enroll in such high return university programs.

The Models for Estimating Rates of Return

Most readers are by now familiar with how rates of return are estimated. This section is just a brief review of two popular estimation models referred to in the presentation of empirical results below. In the “calculated rate,” the rate of return is found by setting the discounted value of costs and benefits over time equal to zero and solving for the implicit discount rate, r ,

$$0 = \sum C_i / (1+r)^i + \sum B_i / (1+r)^i \quad (1)$$

where what the individual spends for education or other costs, such as income foregone, (C) is negative and the additional income or other benefits the individual gains from the additional education (B) are positive. Costs incurred and benefits gained (net of taxes and subsidies) by the individual are “private.” To estimate the “social” rates of return, we use the sum of public plus private costs (social costs) and the sum of private benefits and benefits (externalities from additional education) not captured by individual (social benefits).

⁶ In some cases, such as the United States in the 1980s/early 1990s, salaries of (male) university graduates did not rise in real terms, but those of secondary graduates fell, which still had the effect of sharply increasing the payoff to university graduates (Camoy, 2000). In Russia, university graduates’ real wages fell drastically in the early 1990s and stayed lower throughout the decade, but they fell less than the wages of workers with lower levels of education. University graduates had greater flexibility in adapting to the new economic conditions. Again, this increased income inequality and the payoff to investing in university.

The Mincer method uses regression analysis to fit a Mincerian human capital earnings function to individual data on earnings (Y), years of schooling (S), and years of labor market experience (E) in a semilogarithmic form (Mincer, 1974). The average private rate of return to schooling is the estimated regression coefficient, b, of schooling:

$$\text{Ln } Y = a + bS + cE + dE^2 \quad (2)$$

Marginal rates of return to particular levels of schooling can be estimated from Mincerian regressions by substituting a string of dummy variables for each level of schooling. The coefficient of the dummy variable yields the marginal private rate of return to that level minus the level omitted from the regression estimate.

One drawback of the Mincerian estimates is that the only costs included are income foregone ($b = \delta \text{Ln}Y/\delta S$), which suggests that Mincer private rates are generally overestimates of the “true” private rates, and that the bias from these omitted costs is larger at lower levels of schooling, where the proportion of direct private costs to total private costs of schooling is higher. However, as Weisbrod (1962) and others (Comay, Melnik, and Pollatschek, 1973; Heckman, Lochner, and Todd, 2006) have suggested, Mincer rates (and calculated rates) to lower levels of schooling may be underestimated because they do not include the “option value” of taking more schooling, an inherent part of the return to investing in lower schooling levels.

A more general problem with estimating rates of return to schooling is selection bias. Individuals are not randomly assigned to different levels of schooling—those from higher social class families and those with greater “ability,” for example, are more likely to take more schooling and earn more income. An unbiased estimate of the rate of return to schooling would need to compare individuals of the same social class and ability with different levels of schooling. As an increasing proportion of the age cohort completes a level of schooling and enters the labor force, the rate of return would decline, everything else equal, because the average socioeconomic background and ability of graduates declines. Economists have grappled with this problem for four decades, including twins studies (Ashenfelter and Krueger, 1994, Ashenfelter and Rouse, 1998; Rouse, 1999), instrumental variables (for example, Angrist and Krueger, 2001), and ability matching (Dale and Krueger, 2002).

Our review of rate of return estimates for the BRICs should be viewed with these limitations in mind. Some the studies we cite do attempt to use instrumental variables to correct Mincerian estimates for selection bias; most do not. Our own calculated rate estimates are definitely subject to selection bias, hence are overestimates. However, since we are interested in rates of return over time to university education, the important issue is whether selection bias is decreasing substantially as a

higher proportion of the population completes university, which may well be the case. Thus, if measured rates of return are rising to university education, this suggests that we may be underestimating the rise. Further, because our focus is on university education and graduate education is limited in the BRICs, omitting the option value of a university education for graduate education is likely to have little impact on our rate of return estimates. On the other hand, with rising rates of return to university, the option value of secondary education increases over time, hence we may be underestimating the rate of return to secondary schooling relative to university.

Rates of Return to Higher Education in China

As mentioned above, China (and Russia) until the 1990s were command economies with tightly regulated labor markets, although China's agricultural sector was partially "marketized" in the late 1970s. Since the Communist government tightly controlled Chinese wages and income, and an important goal of the Party was equality rather than market-driven allocative "efficiency," income distribution was quite equal and the payoff to education as measured by income differences was low. According to Zhang et al (2005), "Although the wage scale permitted wage differentials by level of completed schooling, these differentials were very small. At the same time, the government effectively eliminated most of the direct private costs of education by waiving all tuitions and fees for college students and by providing living stipends to students from poor families" (p. 732). Nevertheless, the government tightly controlled the number of young people attending university. Only about 2-3 percent of the age cohort was in higher education even in the late 1980s.

The main issue raised by economists regarding the payoff to education in the 1980s was just how low it was (Johnson and Chow, 1997; DeBrauw and Rozelle, 2006; Meng and Kidd, 1997; Liu, 1998), and whether productivity differences for more educated workers (especially college graduates) were actually much larger than wage differentials (Fleisher et al., 1996; Fleisher and Chen, 1997; Fleisher and Wang, 2004). Economists further considered steadily rising returns to schooling from the early 1990s as an indicator of the degree of China's economic transition away from centralized planning (Yang, 2005). They were also interested in examining the changing returns to schooling between urban and rural areas, different regions of the country, as well as males and females, as these all had implications for growing inequality (Maurer-Fazio, 1999; Knight and Song, 1995).

A number of studies found that the overall rate of return to an additional year of schooling was quite low in China in the late 1980s and early 1990s (Knight and Song, 1991; Liu et al., 1998; Maurer-Fazio, 1999). For example, Liu (1998) used data from 1988 to show that the marginal rate of

return per year of university was somewhat higher than to secondary school—about 4.5 percent per year of university versus about 3 percent per year of secondary school. A meta-analysis of rate of return studies in China concluded that the rates of return to education during this period were close to zero primarily due to the compression of wage differentials by the government (Liu, 2008).

The most interesting aspect of looking at the economic payoff to schooling in China, however, is the change in the rates of return to education in the past 20 years. With the reduction of wage controls, rates of return rose sharply in the 1990s (Zhang et al, 2005, Knight and Song, 2003; Fleisher et al. 2004), and even more rapidly, according to our estimates, in the 2000s, especially to higher education (Table 4-1). This was predictable, given the higher rates of return to younger Chinese in the 1990s than to older Chinese. Older Chinese were more likely to be paid at lower rates in state-owned enterprises when they were younger, and when older they were less able to take advantage of opening opportunities offered by economic reform. We also observe this rising marginal rate of return in Russia, for very much the same reasons.

Table 1. China: Rates of Return to Education, by Level of Education and Gender, 1988-2005 (percent).

Study	Year	Total	Total Male	Total Female	Total Urban	Total Rural	Upper Secondary	Professional	University
Johnson & Chow ^a	1988	3.3			3.3	4.0			
Li ^b	1995		4.3	6.9	5.4		6.2-8.3	6.2	6.8
de Brauw & Rozelle ^c	2000					6.5 ^d			
Heckman and Li ^c	2000								10.8 ^f
Zhang et al ^g	1988		2.8 ^h	5.2 ^h			3.7 ⁱ	1.0 ⁱ	3.1 ⁱ
	1992		3.7	5.8			3.2	3.1	5.0
	1995		5.6	7.9			5.1	4.0	6.1
	1998		6.4	9.2			5.4	5.5	8.0
	2001		7.5	12.5			7.1	5.9	9.3
Loyalka ^j	2005						10.5	10.0	16.0
	Males								
	2005						14.5	22.6	26.1
	Females								

Sources: Johnson, E. and Chow, G. (1997). Rates of Return to Schooling in China. *Pacific Economic Review*, Vol 2, no. 2:101-113.

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de Brauw, A. and Rozelle, S. (2006). Reconciling the Returns to Education in Off-Farm Wage Employment in Rural China. Stanford University (mimeo).

Heckman, J. and Li, X. (2003). Selection Bias, Comparative Advantage, and Heterogeneous Returns to Education: Evidence from China in 2000. *Pacific Economic Review*. Vol. 9, no. 3: 155-171.

Zhang, J., Zhao, Y., Park, A., and Song, X. (2005). Economic returns to schooling in urban China, 1988 to 2001. *Journal of Comparative Economics* 33 (4): 730-752.

Loyalka, P. (2010). Estimates made for this study.

Notes:

Total = Annual return per year of schooling.

a. Based on the 1988 Chinese Household Income Project (CHIP), a national survey of urban and rural households in 10 provinces.

b. Based on the 1995 CHIP, a national survey of 6,928 urban households in 11 provinces. RORs shown here are all based on wages—the estimates using earnings are lower. The RORs for secondary are per year of schooling compared to those with primary education

(lower rate is for academic, and the higher rate is for secondary professional; the RORs for professional and for university are per year of schooling compared to those with primary schooling, so they represent average rates over 9-10 years of schooling beyond primary. Li also shows that those educated later have higher RORs.

c. Based on nationally representative survey of 1199 households in 60 villages in 6 provinces in rural China.

d. They based their estimates on off-farm wages, and includes both local wage earnings and wages of migrants from rural areas. The ROR based on local wages is 4.3 percent per year of education, and of migrants, 7.8 percent. For those under 35 in the sample, the RORs are 8.9 and 11.7 percent for locals and migrants.

e. Based on China Urban Household Income and Expenditure Survey (CUHIES) for the year 2000. Data used in ROR estimates are for six provinces, 4,250 households. They focus on 587 individuals, mostly younger, with senior high school graduation or more.

f. The figure here is the average treatment effect per year of university. Heckman and Li correct for selection bias, showing that the treatment affect varies across groups. The ROR for those who actually attend college is considerably higher than 11 percent.

g. Based in the CHIP survey of urban households, 1988-2001. We only report some of the years here, but the paper includes all years. The authors estimate OLS regressions no corrected for selection bias. They use earnings, not wages.

h. Gender RORs reported here for 1988-2001 are the Heckman-corrected for labor market participation RORs.

i. RORs reported here for 1988-2001 are the marginal rates per year of schooling beyond the previous level (for example, secondary ROR is the annual ROR for individuals with secondary school compared to individuals with middle school).

j. Based on the 1% national population survey data for 2005. The results shown were estimated using a censored least absolute deviations (CLAD) model (Powell, 1984) with dummy indicator variables for level of education completed. These estimates correct for the censoring of wages at zero (i.e. the estimates account for the fact that many persons do not work and earn wages), but do not correct for other types of selection bias.

Especially important to note is that the rising payoff to higher education has occurred despite a massive increase in university graduates as the government rapidly expanded higher education enrollment in the 2000s. Zhang et al point out that between 1988 and 2001, the share of college educated workers in the urban samples they used increased from 12.6 to 28.1 percent (Zhang et al, 2005, p. 745) even as the wage premium for college graduates over high school educated workers increased from 12.2 to 37.3 percent (Zhang et al, 2005, p. 745). This suggests one of several probable explanations:

- The “real” payoff to higher education graduates in the late 1980s and early 1990s was already very high, as reflected in the studies showing a large gap between productivity estimates and wages for the higher educated (Fleisher and Chen, 1997). Tight government constraints on higher education enrollment could have played an important role in driving up this “unmeasured” payoff across age groups. However, this high rate was probably an overestimate of the “true” rate because of the sizable selection bias when only 4 percent of the age cohort attended and completed university.
- Younger workers are likely to have entered the labor market during the period when labor market reforms had already been implemented and with skills more in line with the kind of work required in the new Chinese economy, so their wages are more likely to reflect the “real” payoff to education than the wages of older workers who were tied in to stable positions that offered relatively lower wages. Thus, as older workers retire and younger workers replace them, the payoff to education rises. As Zhang et al (2005) report, the rates of return to education rose for workers of all ages but less for older workers.

- The demand for the higher educated increased rapidly in the 1990s and 2000s with China's very high growth rate and a shift to financial and business services as well as more sophisticated manufacturing production and a sharp increase in private business.
- The skill intensity of work increased within firms increased, possibly because of increased computer use or the introduction of other technologies.

Analysis by Zhang et al (2005) and Fleisher and Chen (1997) provide evidence that the first two of these explanations are highly plausible. Labor market reforms worked their way through the economy gradually, but ultimately did bring wages more into line with productivity differences. The large increase in the pay of to college education in the early 2000s, however, probably is less related to labor market reforms than the second and third possible explanations. We have no evidence that this is the case, but such explanations would conform to what has been happening in the United States, for example (Katz, 1999).

Thus, the average rate of return to university education continued to rise (as of 2005) even though the supply of college educated labor increased substantially. As we pointed above, Mincer rates are biased. Heckman and Li (2004), Fleisher et al. (2005), Chen and Hamori (2009) and others attempt to correct for selection bias using instrumental variable (IV) strategies and generally achieve slightly higher estimates than the standard Mincer rates.⁷ Heckman and Li (2004) and Fleisher et al. (2005) also notably allow for the possibility that individuals sort themselves into and out of college based on their own heterogeneous returns to college. The Loyalka (2010) estimates use a large, nationally-representative sample of urban and rural dwellers (as well as migrants) and correct for censoring at zero wages, but do not attempt to correct for selection bias.⁸ These results, despite their significant methodological differences, all suggest a rather high and rising ROR.⁹ In addition, as various authors have shown, the payoff to college is rising over time because the "new" workers entering the labor market are more likely to get wages that reflect their productivity than was the case for older workers leaving the labor market.

Despite the high returns to college education discussed above, media outlets and certain publications in China sometimes declare that college students have difficulty finding jobs after graduation. The media reports do not seem to capture the entire story however. Research confirms that college graduates do take a certain amount of time on average to find jobs and make a relatively

⁷ The meta-analysis of rate of return studies in China by Liu (2008) finds that IV are about four percentage points higher than OLS estimates.

⁸ Correcting for selection bias in ROR studies is extremely difficult without using more rigorous research designs; most of the strategies tried thus far (including instrumental variable strategies) have potential difficulties.

⁹ Liu (2008) finds that 40% of the variability in rate of return to schooling studies in China is due to different model specifications.

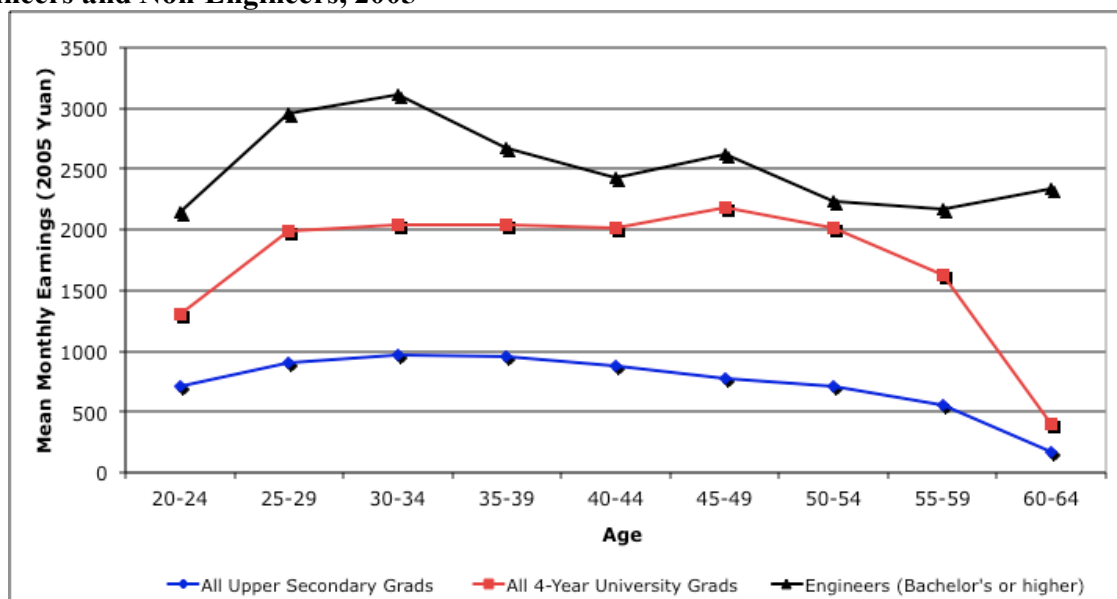
low starting salary (that is on average only a few hundred yuan higher than a migrant worker for instance), but the wages of college graduates generally rise steeply over time thereby creating high returns (Cai, 2010). Furthermore, college graduates may also receive a variety of benefits that are not captured by income measures in surveys.

There may be different returns in China to different university tiers (Shavit et al., 2007). The most compelling evidence of this is the recent study by Fan et al. (2010) which uses a regression discontinuity research design to measure the causal effects of attending four-year (regular) versus three year (vocational) colleges on future wages. Fan and colleagues (2010) find that the marginal return to a four-year college is around 40-60%. Both the high returns to a college education in general and four-year institutions in particular may have continuing repercussions for widening income inequality in China.

The Payoff to Engineering Higher Education. None of the earlier rate of return studies we cite in Table 1 estimated the rates of return to engineering education or to other specializations. However, with the large 2005 national sample, we were able to approximate the returns to engineering education. We do not have data on an individual's degree, but we used their reported occupation as a proxy for their education. The results suggest that the payoff to engineers is even higher on average than for those who went to university and considerably higher than for those who are engaged in other non-engineering occupations. Figure 1 shows the age-earnings profiles for males who are employed as engineers and have BA degrees or higher, for all those who have BA degrees, and for those who have upper secondary degrees.¹⁰

¹⁰ In the interest of saving space, we do not show the age-earnings profiles for females in any of the BRICs, but they are available from the authors.

Figure 1a. China: Male Mean Age-Earnings Profiles by Level of Education, Higher Educated Engineers and Non-Engineers, 2005



These age-income profiles look very different from estimates we make for Brazil and India below, in that they do not rise steadily with age beyond age 32—that is for workers and employees who entered the labor force in the mid 1990s. Nevertheless, both male (and female—not shown) engineers earn more than average university graduates (including engineers) of the same gender, and university graduates earn much more than upper secondary school graduates—in this case, representing the incomes of both vocational and academic upper secondary school graduates.

Because the cross-section estimates measure the earnings of individuals of different ages who entered the Chinese labor market at different points in time, and labor market reforms began to impact wages only in the 1990s, it is likely that these age-earnings profiles for all workers, but especially for higher educated workers, are a fairly accurate estimate of future earnings in the 22-32 age range, but underestimate future earnings at higher ages. Further, if the Chinese economy continues to grow, real earnings should rise at all ages at the same rate as real growth.

The age-earnings profiles are the basis for estimating private “calculated” rates of return to higher education in China. Private calculated rates reflect not only costs in terms of earnings foregone as in the Mincer rates, but also other private costs, such as tuition, housing, and other expenses related to schooling. Zhang et al (2005) approximated the private calculated rate of return to university education in China based on 2001 earnings differences to be 15 percent.¹¹ Taking the

¹¹ They assumed a wage growth of 8.2 percent annually and a 40-year working life, and included tuition costs of 5,000 Yuan per year of university.

2005 earnings profiles shown in Figures 4-1a and 4-1b, we made two estimates by gender of the calculated rates of return for all higher education graduates and for graduates who list their occupation as engineer. The two estimates for each are based on two different assumptions about private costs: one that includes earnings foregone plus tuition costs of 5,500 Yuan, and the other that includes earnings foregone plus tuition and other costs associated with attending university—tuition and other costs were taken as 10,000 Yuan. In addition to potential selection bias, these rates are probably biased downward because of likely increases in earnings at higher ages as younger workers get older.

Table 2. China: Calculated Private Rates of Return to Investment in University Education, by Gender, 2005 (percent annually).

Gender	All University Graduates		Graduates Employed as Engineers	
	<i>Private Costs</i>	<i>Private Costs</i>	<i>Private Costs</i>	<i>Private Costs</i>
	<i>Assumption 1</i>	<i>Assumption 2</i>	<i>Assumption 1</i>	<i>Assumption 2</i>
Males	16.7	13.3	27.4	22.2
Females	17.3	13.8	27.4	21.9

Source: Loyalka et al (2010b)

Notes: Assumption 1: Tuition (5,500 Yuan) plus earnings foregone. Assumption 2: Tuition (5,500 Yuan) plus other private spending (dorm fees, books and supplies, other costs) for higher education (4,500 Yuan) plus earnings foregone.

There are several important implications of these estimated calculated rates:

- Despite the much lower earnings of Chinese women, the payoff to them of investing in higher education is the same as for men.
- The rate of return to taking engineering training (even if one works as an engineer) is much higher than the average payoff to investing in university. This is just as true for women as for men. It may be that much of this additional payoff is to higher ability, although we have not direct evidence that this is the case.
- The rates to investing in university education estimated from the earning curves may be biased upward, but it is likely that they are above 10 percent annually and are much higher for engineering education.

All this suggests that there is good reason why, just in economic terms, Chinese families are willing to invest the 10,000 Yuan (minimum) required annually for their children's higher education. If the CLAD rates reported in Table 4-1 for 2005 are correct, they suggest further that it may even be worth investing in professional (three year post-secondary) education. We were not able to estimate rates of return to higher education in more recent years, but given China's high and continuing growth rates, it is likely that the payoff to higher education will remain high and that the

demand for places in higher education will continue to grow. This is especially true for engineering education.

Thus, charging tuition and allowing for the expansion of private universities in China is acceptable politically partly because the rates of return are high enough that families can view their sacrifices for their (often only) children as sound economic investments.

Rates of Return to Higher Education in Russia

The changes in the Russian labor market were brusquer than in China. Nevertheless, they followed a very similar pattern of shift from State control of wages, manpower formation, and employment toward a market system of wage setting, response by students to labor market opportunities through choice of courses of study, and employment by employers hiring or not hiring graduates based on market conditions. Many university graduates are still employed in the public or quasi-public sector, and the State, as in China, still sets the numbers of students that universities admit in each field. In Russia, however, the State's direct influence is over the number of "free," or fully subsidized, places in universities and university faculties. Universities have much more leeway in the number of "paying" students they can admit. The result, is a tremendous expansion of students paying tuition to attend public universities, and the fields that have expanded through this education "market" are those that are likely to provide students the best access to employment and better paying jobs.

There have only been a few studies estimating the impact of these changes on the payoff to higher education in Russia. These show a rapid increase in the payoff to completing university in the early 1990s, and that the rates probably peaked in the early 2000s. As the number of university graduates expanded in the early 2000s, there is evidence that the payoff began to decline.

Elizabeth Brainerd (1998) used data from a series of monthly cross-section household surveys conducted by the All-Russian Center for Public Opinion Research (or VTsIOM, its Russian acronym) in 1991, 1993, and 1994 to estimate changes in monthly income (adjusted for hours worked) distribution in Russia in the early years of the transition. As part of her study, she estimated Mincer earnings functions for men and women in each of the three years. These yielded Mincer rates of return to years of schooling and to different levels of schooling. She shows a rapid increase in the overall rate of return to schooling in the three years, and, more important, that the rise in the rate of return is driven by nominal wage declines for those with less than secondary education and nominal wage increases for those Russians who attended university (in terms of purchasing power,

wages fell for all groups).¹² Much of this change in returns to education appears to come from the possibilities for university educated workers to get jobs outside the State sector after 1991—in general, their greater flexibility in responding to the drastically new conditions in labor markets. This also helps explain rising relative payoffs to university graduates as they moved out of jobs that paid government regulated wages. A second fallout of the transition was a decline in the premium paid to seniority, as we also observed in China in the 1990s. Thus, earnings shifted up for younger workers relative to older workers, again probably because of the shift out of government wage regulated jobs. We report her results for payoffs to education (unadjusted for private/public sector employment) in Table 4-3.

Yuriy Gorodnichenko and Klara Sabirianova Peter (2004) use the Russian Longitudinal Monitoring Survey (RLMS) for 1994, 1996, 1998, 2000, and 2002 to estimate Mincer monthly earnings functions for those years. In addition the authors use a feature of the RLMS 2000, namely a series of retrospective questions regarding jobs held in 1985 and 1990 (including earnings), to estimate similar earnings functions based on the characteristics of the same workers in 2000, and projecting their age back to 1985 and 1990. These Mincer rate of return results (again, unadjusted for sector of work, but in this case controlling for gender and for the higher wages paid in Moscow) are also shown in Table 3.

Table 3. Russia: Estimated Rates of Return to Years of Schooling and to Different Levels of Schooling and Gender, 1985-2002 (percent).

Study	Year	Total*	Total**		Vocational***		Professional***		University***	
			Male	Female	Male	Female	Male	Female	Male	Female
Brainerd ^a	1991		3.1	5.4	1.7	3.3	5.2	6.4	3.5	6.7
	1993		6.6	7.4	-3.0	10.1	7.5	7.6	6.2	8.1
	1994		6.7	9.6	-1.9	9.0	5.1	11.4	6.4	10.6
Gorodnichenko & Peter ^b	1985	2.8								
	1990	3.9								
	1996	8.1								
	1998	9.1								
	2000	9.3								
Androushchak & Proudnikova ^c	2002	9.2								
	1994-96					-0.6		5.7		5.1
	2000-02					1.3		6.7		6.4
	2006-08					0.2		3.4		5.5
	2005 ^d								8.3 ⁺	15.9 ⁺
									6.1 ⁺⁺	10.0 ⁺⁺

Sources: a. Brainerd, E. (1998). "Winners and Losers in Russia's Transition." *American Economic Review*, Vol. 88, No. 5: 1094-

¹² Real monthly earnings in Russia fell precipitously in the early 1990s from about 18,000 rubles (in 2009 prices) in 1990 to 5,000 rubles in 1992. They rose gradually to 1997 to about 9,000 rubles, dropped back in 1998, then recovered steadily to 22,000 rubles in 2008.

1116, Tables 3A and 3B.

b. Gorodnichenko, Y. and Peter, K.S. (2004). "Returns to Schooling in Russia and Ukraine: A semiparametric Approach of Cross-Country Comparative Analysis." University of Bonn, Institute for the Study of Labor (IZA), Discussion Paper, No. 1325, Table 2.

c. Androushchak, G and Proudnikova, A. (Higher School of Economics). Mincer rate of return estimates using Heckit selection bias correction made especially for this study based on the Russian Longitudinal Monitoring Survey (RLMS)—about 4,000-4,500 households. Earnings are for full time employees and were averaged for three annual rounds of the survey in order to increase the sample size in each age income category and data adjusted for growth of mean wages in each year within the three separate clusters of years to adjust for wage inflation.

d. Androushchak, G and Proudnikova, A. Estimates made for this study using the RLMS based on 4,000 households and collected in the years 2004-2006. Earnings were averaged for three annual rounds of the survey and data adjusted for inflation to 2005 in order to increase the sample size in each age income category.

Notes: * Annual rate of return per year across all years of schooling, controlling for gender and whether works in Moscow or not.

** Annual rate of return per year of schooling across all years of schooling.

*** Annual rate of return per year of education compared to completed secondary schooling. Vocational education refers to post-basic education vocational; professional education refers to post-secondary non-university professional education.

+ Calculated rate from age-earnings profiles (see below) using only income foregone as costs to make these comparable with Mincer rates for earlier years.

++ Calculated rate from age-earnings profiles (see below) using income foregone, tuition, and entrance test preparation expenses as costs.

The estimates in Table 3 suggest that the payoff to education in Russia rose rapidly with the marketization of the labor market in the 1990s, and was similar to China's—even to the extent that women in both Russia and China earned higher rates of return to investment in education while they averaged much lower incomes. The similar payoff to university investment in Russia in the 1990s obtained despite a much greater supply of university graduates in Russia than in China. We can only hypothesize that the influence of government wage setting continued to be more influential in China than in Russia at that time. One indication that this hypothesis is correct is the apparent big leap in payoff to Chinese university graduates in 2005. In Russia, the Soviet system of the 'uniform tariff grid' was used in the public sector until 2008, when it was formally replaced by a decentralized merit-pay scheme, although public administrators accustomed to the former system still tend to use it for determining their employees' pay. Even so, the process of deregulating public sector pay has begun.

Investing in university level economics, management, and law in the early 1990s—"up-to-date" higher education—greatly increased the probability that graduates could get a better paid job. The most appealing and easy business was retail trade, so skills that could help in entering commerce were the most demanded ((Dubin B., Gudkov L., Levinson A., Leonova A., Stuchevskaya O. (2004), 'Access to higher education in Russia: social and institutional aspects,' in Access to higher education in Russia, eds. Shishkin S., Institute for Social Policy, *in Russian*).

Did the payoff to university education continue to rise in recent years in Russia as well? There is evidence that it may not have. The Mincer rates estimated by Androushchak, and Proudnikova (see Table 3) suggest that the payoff to university corrected for selection bias increased somewhat up to the early 2000s, but with the continued expansion of university enrollment to very

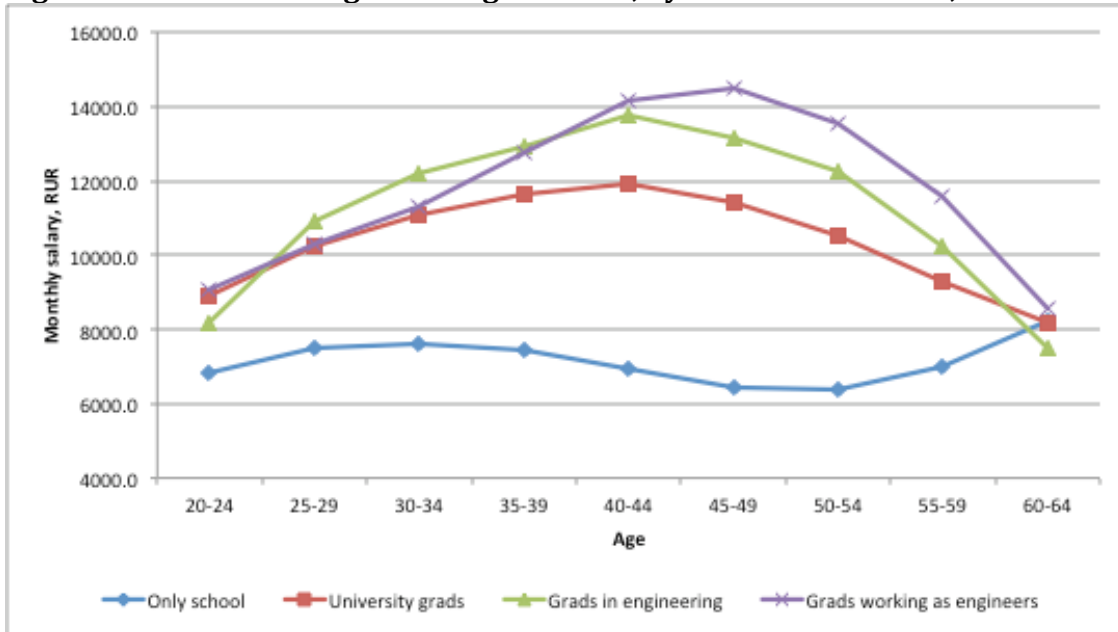
high levels (about 85 percent) among secondary school graduates, they had declined somewhat by 2006-2008. The proportion of university graduates in the labor force in the Soviet Union as a whole was 12-14 percent in the mid-1980s (higher than in China, India, and Brazil in 2010). In the early 2000's, the proportion had increased to 25 percent, and in 2008, about 29 percent. These are very high levels even compared with more developed countries.¹³

Since the percentage of students paying tuition also has also been increasing steadily since the mid-1990s, the rates may have declined even further if we had accounted for tuition and other costs of studying among Russian university students. The proportion of fee-paying students has increased steadily from none in 1994 to about one-half in 2007-08. Androushchak and Proudnikova estimated age earnings profiles for men and women using the RLMS data for 2004-2006 (Figure 2 shows the profiles for men) and used these profiles and average tuition and preparation costs for applying students to estimate “calculated” private rates of return for 2005.¹⁴ Including these additional private costs substantially lowers rates of return compared to the estimate including just income foregone (see the last two rows of Table 3). The calculated rates to five years of university education averaged about 8 percent compared to 12 percent when only earnings foregone are included in costs. These rates are not adjusted for selection bias. Notably, the payoffs to women investing in university are much higher than to men.

¹³ For example, among OECD countries, only 7 had 25 percent or more in the 25-64 year-old labor force in 2006 who had attained Type A (university) or more. See OECD, *Education at a Glance*, 2008, Table A1.1a.

¹⁴ Average spending on entrance test preparation was 9,700 rubles, paid by about 40 percent of all students applying to university, and average tuition spending was 27,000 rubles for university students as a whole and a lower 22,000 for engineering students, since a larger percentage of engineering students are accepted into State-funded slots in universities.

Figure 2. Russia: Male Age-Earnings Profiles, by Level of Education, 2005.



Source: Androushchak, G and Proudnikova, A. (Higher School of Economics). Estimates prepared for this study.

Nevertheless, official data on wage increases in manufacturing and on changes in tuition costs in 2005-2009 suggest that the wage premium for higher education has continued to stay steady (it even may have risen somewhat), whereas tuition costs have risen less rapidly than wages. Therefore, we would not expect that the returns to higher education decreased in 2005-2009. A major factor in maintaining rates in the face of enrollment expansion may have been the large increase in public funding of higher education despite the crisis, which has pushed down the share that families pay for university.

The 2005 cross-section age-earnings profiles are not unlike the profiles in China, except, predictably, they turn down at a higher age (early forties) than in China, reflecting the earlier marketization (1991-92) of the Russian labor market (Figure 2). It is also interesting to note that older workers with only secondary schooling earn as much as younger workers, reflecting the much more equal wage structure of the Soviet period. The question is whether the peak of the age-earnings curve for university educated workers will move to higher ages as those who entered the labor force in the post-Soviet period grow older. We would expect this to happen, and the steady or rising wage premium for higher education mentioned above would support that trend. However, until we have more data, we cannot be sure that the early earnings downturn is not a structural feature of the Russian labor market, particularly because a university degree is gradually becoming almost ubiquitous in Russia. The higher education earnings curve may take on the features of secondary education age-earnings profiles in other countries.

The Returns to Engineering Higher Education. The engineering profession was considerably favored in the Soviet Union. However, with the transformation of the command economy and the corresponding decline of much of Russia's heavy industry after 1991, the demand for engineering places in universities did not increase nearly as rapidly as places in economics and business administration, associated with jobs in financial services and employment in international companies. The demand for engineering education (applications/admissions ratio) was much lower than for studying economics or management.

As the results in Table 4 and 5 suggest, the payoff to technical education in specialist degrees (five years) in Russia was higher at the end of the 1990s and early 2000s than to any other course of study but economics, and in three-year degrees, the returns to engineering education was the highest among the major programs of study. These are Heckman-adjusted Mincer coefficients divided by the number of years of education at each level.

Table 4. Russia: Estimates of Annual Mincer Rates of Return to Higher Education, by Course of Study, by Gender, 1998-2001 (percent/year of study)

Level of Education/Course of Study	1998		2000		2001	
	Male	Female	Male	Female	Male	Female
<i>Professional Degree (3 years)</i>						
Law/economics	a	10.0	a	9.4	a	9.0
Engineering	5.6	10.3	7.5	12.5	6.0	8.0
Humanities	a	a	a	a	a	a
Medical	a	10.2	a	a	(negative)	a
<i>University Degree (5 years)</i>						
Law/economics	5.1	13.0	10.5	14.1	6.5	14.5
Engineering	7.4	12.2	7.7	11.0	7.9	12.0
Humanities	a	10.1	a	9.4	a	9.2
Medical	a	12.0	a	9.7	a	6.7

Source: Denisova I. and Kartseva M. (2005), "Advantages of education in engineering: estimates of returns to educational specialization in Russia", HSE Working paper #WP3/2005/02.

Note: a. This signifies that the estimated Mincer coefficient is not significantly different from zero—i.e., the estimated difference in income between those with those with completed secondary education and the designated level of education and course of study, controlling for age and whether living in the capital city, is not significantly different from zero.

Table 5. Russia: Estimates of Annual Mincer Rates of Return to Higher Education and Higher Engineering Education, 1994/96-2006/08 (percent/year of study)

	1994-96	2000-2002	2006-2008
<i>Total University Education</i>	5.1	6.4	5.5
<i>Higher Engineering Education</i>	3.5	11.2	10.3

Source: Androuschak, G and Proudnikova, A. (Higher School of Economics). Estimates prepared for this study.

Thus, engineering education at the turn of the 21st century and even under “market” conditions (although many university graduates still work for the public sector) was a high payoff

course of study in the early and mid-2000s. As in other countries, this does not necessarily mean that the payoff to working as an engineer is higher than in other professions. Engineers managed (and continue) to find jobs in business—the mathematically and logically structured minds of engineers were more suited to the new realities of the labor market after 1990. Graduates with good mathematics skills and logic (those who could design business models, etc.) were employed by banks, oil companies, and foreign businesses that began investing in Russia (see, for example, Raleigh, 2006, *Russia’s Sputnik Generation*, p. 142-143).

This continued to be the case later in the decade, with increasing numbers of engineering graduates, yet the rates to investment in university and in higher engineering education fell somewhat. This suggests that with Russia’s growth rate in the 2000s, the labor market was able to absorb large increases in higher educated labor. Yet, Table 4a suggests that not all courses of study have positive payoffs.

As discussed above, the estimated Mincer rates do not account for the fact that an increasing percentage of Russian university students paid tuition to attend university in the first decade of the 2000s, and this would work to reduce the private rates of return. The tuition costs for engineering students are estimated to be lower, as mentioned. In Table 3, we presented the calculated rates to investing in university education. In the case of higher engineering education, the estimated calculated private rates of return in 2005 are shown in Table 6.

Table 6. Russia: Estimates of Annual Calculated Rates of Return to Higher Education and Higher Engineering Education, by Gender, 2004-2006 (percent/year of study)

<i>Type of Education</i>	Costs Including Only Income Foregone		Costs including Income Foregone & Tuition/Test Prep	
	<i>Males</i>	<i>Females</i>	<i>Males</i>	<i>Females</i>
Overall university education	8.3	16.0	6.2	10.0
Higher engineering education	9.6	28.2	7.8	19.2
Higher engineering education for those who work as engineers	9.7	18.9	7.9	13.8

Source: Estimates from Figures 2a and 2b.

The data in Table 4 and 6 confirm that women have a much higher payoff to higher education than do men, probably because the jobs available to Russian women with only secondary education pay much lower wages than are available to men with secondary education completed. This is similar to the structure of rates of return in many developed countries (see OECD, 2009) and, as we have reported, similar to RORs in China. Particularly interesting is that because of relatively low pay for Russia’s medical personnel (the health care service is public), the ROR to taking

medical courses of study is negligible for men, but relatively high for women.

The Rates of Return to Higher Education in India

A main reason why students in India are willing to pay fees in public colleges and are willing to pay the much higher fees charged by private institutions is the relatively high rate of return to a degree. There are a number of rates of return studies for India, and these show that since the late 1970s up to the late 1990s, the private rates of return to the investment in higher education were about 11-13 percent per year of higher education (Table 7). This is not as high as in some developing countries, such as Brazil (see below), but it is much higher than it was in China and in the mature, developed economies, such as in Europe and the United States. Thus, even before the economic boom that began in the 1990s with the implementation of freer trade policies and some deregulation, the payoff to higher education was relatively high. This was the case in part because a university degree was a passport to a civil service job and in part because of a relatively low growth in the gross university enrollment rate (it only increased from 6 to 7 percent between 1985 to 1995), and unlike China, the labor market was characterized by unconstrained wage setting (except that a high proportion of university graduates were employed in public sector jobs).

Table 7. India: Rates of Return to Secondary and Higher Education, by Gender, 1965-2006 (percent return per year of schooling at each level).

Year	Secondary			University			Technical/Engineering	
	All	Men	Women	All	Men	Women	Men	Women
1965 ^a	18.8			16.2				
1978 ^a	19.8			13.2				
1983 ^b	13.7	13.2/6.0*	23.8	11.6	12.2/10.0*	9.5	13.9	12.8
1993/94 ^b	13.8	12.6/5.4*	25.5	11.7	12.2/10.9*	10.3	15.6	12.3
1999 ^b		6.1			12.3			
2006 ^b		10.5	15-18.5**		12.0	16/13***	12/24***	16/13***

Source: 1965, 1978: Psacharopoulos, 1985; 1983, 1993/94: Doussami, 2000; 1999: ; 2004: Indian Survey, 2006.

Notes: a: Calculated rates. b: Mincer rates. *: Second figure is recalculation by xxxx. **: First figure is for last two years of secondary school; second figure is for all four years of secondary school. a: First figure is for diploma degree; second figure is for graduate (four year) degree.

Table 7 also suggests that in the past, the rates of return to secondary education were higher for women than for men, but the opposite was true for investment in higher education, and the rates of return to taking a technical diploma (a three-year degree at a technical college) were a better investment than a university education in terms of payoff per dollar of income foregone for men but not for women.

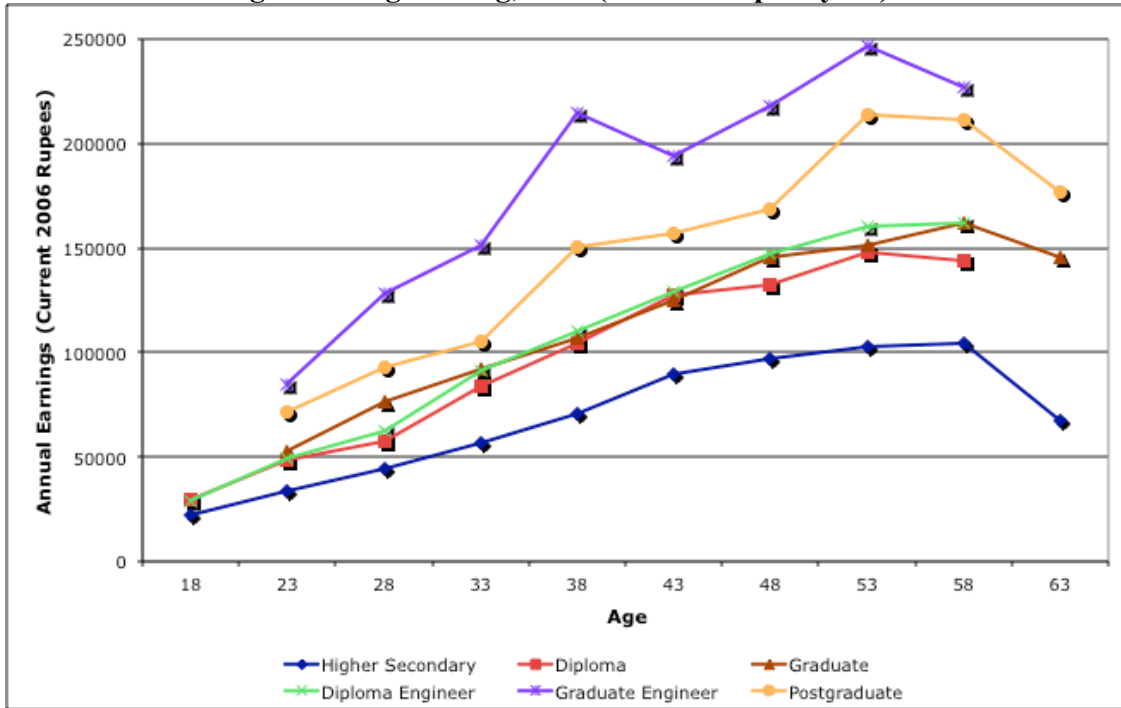
Once the Indian economy began growing rapidly in the late 1990s and into the 2000s, we

would have expected that the payoff to university and to technical or engineering degrees would have risen. But the enrollment in higher education also increased rapidly, and the overall gross enrollment rate increased from 7 percent in 1995 to 11 percent in 2005, the lowest among the BRIC countries by the end of the period.

Mincer rates for 2006 are comparable with previous estimates, so we report them in Table 7. They suggest that the payoffs to secondary schooling and university remained similar to those in the 1990s, except that for women, the payoff to secondary education may have declined somewhat and their payoff to a university degree increased substantially. Indeed, in 2006, it appears that rates of return to both a diploma (3 year) and a graduate (4 year) degree were higher for women than for men. Table 7 also shows that the returns to an engineering graduate degree are much higher for men than to investing in a non-technical college education. It should be stressed that these rates of return are not corrected for labor force participation, and that may bias them, especially for women. Nevertheless, they strongly suggest that the payoff to engineering education is very high.

Figure 3 shows the age-earnings profiles for the various levels of schooling for males. For the sake of illustration, we include the age-earnings profile for post-graduate education. It is lower for males than engineering education at the graduate (first degree) level. As is typical in market economies, the earnings curves peak at age mid-fifties, unlike the curves for China and Russia.

Figure 3. India: Males' Annual Earnings, Secondary Schooling Complete, Bachelors' Degree, and Bachelor's Degree in Engineering, 2006 (current Rupees/year).



Source: NSS Survey 62nd round

The calculated rates take account of tuition costs as well as earnings foregone. It is key to keep in mind that technical higher education students pay a higher fraction of the costs of their education with fees, so we estimate their private rates of return using higher fees than for diploma and graduate degree students as a whole. Further, we estimate two sets of private rates using a lower and higher estimate of total fees in 2006 for engineering students (25,000 rupees and 40,000 rupees), since tuition fees in technical colleges vary among public and private institutions. The higher average fees are in the more expensive private institutions. We also estimate social rates of return, which include costs per student borne by the public sector in addition to private costs. The results of these estimates are shown in Table 8. They confirm that the private and social (including public spending per student above and beyond tuition and other fees) rates of return to graduate degrees in engineering are extremely high for males, even when tuition and other fees are included. There were too few females with engineering four-year degrees in the India national household survey to compute a reasonably accurate calculated rate of return. Even the social rate of return based on private earnings differences is 16-18 percent per year of technical college.

Table 8. India: Calculated Private and Social Rates of Return to Higher Education, by Gender, 2006 (percent return per year of schooling at each level).

Level of Education	Men			Women		
	<i>Earnings Forgone</i>	<i>Earnings Foregone + Tuition</i>	<i>Private + Public Costs (Social ROR)</i>	<i>Earnings Foregone</i>	<i>Earnings Foregone + Tuition</i>	<i>Private + Public Costs (Social ROR)</i>
<i>Diploma (All)</i>	19.0	13.7	12.0	18.6	12.6	10.7
<i>Graduate (All)</i>	19.5	14.1	12.3	18.0	12.4	10.6
<i>Diploma (Technical)</i>	21.0	11.0-13.2	8.7-10.0	30.0	12.1-16.0	7.8-10.2
<i>Graduate (Engineer)</i>	36.8	20.4-24.1	16.0-18.6	a	a	a

Source: India National Household Survey, 2006

These results suggest that getting students to pay a significant fraction of the costs of a graduate degree in engineering is an effective way to finance increased enrollment, and public investments in engineering education are also a good investment. When tuition is not included, we can observe that the rates of return are extremely high even for non-technical higher education at both the diploma and four-year degree levels. It also makes sense, as the RORs with tuition included show, to charge higher tuition for technical education—even with this higher tuition, the private RORs to technical education remain high.

Rates of Return to Higher Education in Brazil

We have estimates of the payoff to education in Brazil back to 1970, and they show a clear shift, with the value of higher education increasing sharply between 1970 and 1989 and staying high in the 2000s despite rapid increases in enrollment rates. The private payoff to investing in higher education doubled from about 14 percent per additional year of higher education to 28 percent at the end of the 1980s and remained close to this higher level in the 2000s (Table 9).

The shift in payoff is consistent with three important features of the Brazilian economic landscape in this period: (a) a rapid rate of GNP growth in the 1970s (8.5 percent), and low to moderate economic growth since; (b) a very high level of income inequality throughout this period but somewhat rising in the 1970s and 1980s; and (c) a rapid increase in the expansion of secondary schooling, particularly in the 1970s 1980s, and continuing into the 1990s, while university enrollment remained relatively low as a proportion of the age cohort until the 2000s.

Table 9. Brazil: Estimated Annual Rates of Return, by Level of Education, 1970-2008 (percent per additional year of schooling)

Year	Private Rates of Return		Social Rates of Return	
	<i>Secondary School</i>	<i>Higher Education</i>	<i>Secondary School</i>	<i>Higher Education</i>

1970	24.7	13.9	23.5	13.1
1989	5.1	28.2	5.1	21.4
2000 ^a	10.0	24.4		
2001 ^b	5.8	31.4		
2000 ^c	12.7/13.8	23.0/20.5	11.1/11.6	18.4/16.3
2008 ^d	1.6	24.6		

Sources: 1970: Psacharopoulos, 1985; 1989: Psacharopoulos, 1994; 2000: Authors' estimates. Notes: a. Mincer rates from 2000 Census, controlling for gender and race. b. Mincer rates from 2001 household survey, controlling for gender and race. c. Calculated rates from 2000 Census (see Table 8, below, for details). d. Mincer rates from 2008 household survey, controlling for gender and race. Thanks to Ilana Umansky, Stanford University PhD candidate, for these 2001 and 2008 estimates.

Brazil's economic growth in the 1970s, like in other Latin American countries, was rapid, averaging more than 8 percent per year in real terms (corrected for inflation) during the decade, financed by heavy borrowing in international financial markets. The following decade, however, saw a major correction. Real interest rates rose sharply and Brazil was caught with a huge foreign account debt. Gross domestic product only increased 17 percent in the ten years, 1980-1990, so the average real growth rate for 1970-1989 was a reasonable but not stellar 4.8 percent annually. Growth rates in the 1990s and in 2000-2008 were lower, at 2.5 percent and 3.5 percent annually. With these levels of growth, particularly given that Brazil suffered a major recession in the early 1980s, it is conceivable that the demand for secondary educated labor grew only modestly.

A frequently used measure of income distribution—the Gini coefficient¹⁵—increased from 0.57 to 0.62 in 1970-1989, and declined gradually in the 2000s to 0.56 (Deininger, Klaus and Lyn Squire. 1996. "A New Data Set Measuring Income Inequality." *World Bank Economic Review*. 10 (3): 565-91; World Bank, 2009), and in some estimates, somewhat lower. This suggests that at least part of the increase in payoff to higher education may have come from increasing inequality in the 1970s and 1980s.

In addition, the supply of secondary educated labor increased rapidly in the 1970s and continued to grow more slowly in the 1980s and then more rapidly again with the Cardoso reforms of the 1990s. In 1970, the gross enrollment rate in secondary school (post-5th grade) was only 25 percent. By 1980, this had risen to 47 percent, and by 1990, to 54 percent (however, the definition of secondary school had changed to mean post-8th grade). In the 1990s, Brazil reached 99 percent gross

¹⁵ The Gini coefficient is calculated by plotting the cumulative income earned by each successive proportion of the population against the cumulative proportion of the population. An equal distribution of income would be a 45 degree line (each successive decile of the population earns an additional ten percent of the total income in the economy). The Gini is the area between the plot of the actual cumulative percentages of income and the 45 degree line divided by the area of the triangle under the 45 degree line. Thus, the value of the Gini is between 0 and 1. The larger the Gini, the more unequal is the income distribution. If the Gini is close to 1, it means that a very small percentage of the population earns a high fraction of all the income in the economy.. See [http://en.wikipedia.org/wiki/Gini_coefficient] for a more detailed explanation.

enrollment in secondary school and 65 percent net enrollment (net of repeaters). The most recent data show a net rate of about 78 percent of youth in the secondary school age group enrolled.

Meanwhile, gross enrollment rates in tertiary education were 5 percent in 1970, 11 percent in 1985, and 13 percent as late as 1998. It was only in the 2000s that tertiary education began its major expansion. Brazil reports about 25-30 percent gross enrollment in higher education in 2006-2007, but probably only 15-18 percent of the age group is in university degree granting institutions. Since “repetition” rates are relatively high in higher education (people remain enrolled without progressing), graduation rates are much lower than gross enrollment rates.¹⁶

It makes sense that with a rapid expansion of secondary education but only a small increase in tertiary enrollment in the 1970s, a sharp decline in growth rates in the 1980s, and a corresponding increase in inequality between 1970 and 1989, the rate or return to investment in secondary education fell and the rate to investment in higher education increased greatly.

In the 1990s and 2000s, we observe a somewhat different pattern, which also conforms to demand and supply of secondary and higher educated labor and the government moves toward decreasing income inequality. Secondary education continued to expand and, as we have seen, beginning about 1995, higher education enrollment exploded, mainly through increased enrollment in private institutions. In the period 1995-2008, enrollment in Brazilian universities increased from 1.1 to 2.6 million. Of this increase of 1.5 million students, 1 million (two-thirds) was in private universities. Public Federal and State universities, with about the same number of students as private universities in 1995, only increased their enrollment by 500 thousand, and almost all of that was after 2000.

Thus, Brazil waited many years before expanding its higher education system, and this among other factors has kept the payoffs to those who managed to complete university education very high even with the recent expansion. With private rates of return to completing university (and other kinds of higher education) as high as they are, the strategy of letting private, full fee charging institutions absorb the pressure for access to higher education has a certain logic. However, in the Brazilian case, the logic also has its perverse side, since those who attend public institutions pay

¹⁶ The number of students graduating from all higher education institutions increased from 274 thousand in 1997 to 800 thousand in 2008, almost tripling. But the increase in university graduates was much lower, from 176 thousand in 1997 to 431 thousand. Given that about 800 thousand students entered universities and 1.6 million entered higher education institutions as a whole in the 2003 and 2004 academic years, this suggests that about one-half the students who enter university and all higher education in Brazil complete in the “normal” four to five years.

virtually no fees, and a high percentage of the students in public universities (like those attending private institutions) come from the high-income quintile families. This means that the private rate of returns for those who get into public universities are necessarily higher than for those who do not get access to such subsidized education.

Returns to Engineering Education. The rates of return to engineering education in Brazil are higher than the average rates of return to completing university. We only have data for one year, 2000. However, we speculate that given the similar rate of increase in engineering graduates in 1999-2008 as for the total number of graduates in all fields, rates of return to engineering education probably fell along with the overall rates of return to university graduates in the first decade of the 2000s. Even so, the payoff to engineering and technical education would continue to be very high.

Figure 4 presents the age-earnings profiles for males in the year 2000. As in India, earnings for university completers rise well into the fifties age group and possibly the sixties. Again, these earnings profiles look very different from those in China and Russia, but we have no way of knowing one year's cross section, whether patterns of earnings are changing over time in Brazil. It is clear that, as in all the BRICs, engineering graduates earn much more than the average university graduate.

Figure 4. Brazil: Males' Annual Earnings, Secondary Schooling Complete, Bachelors' Degree, and Bachelor's Degree in Engineering, 2000 (current Reais/year).

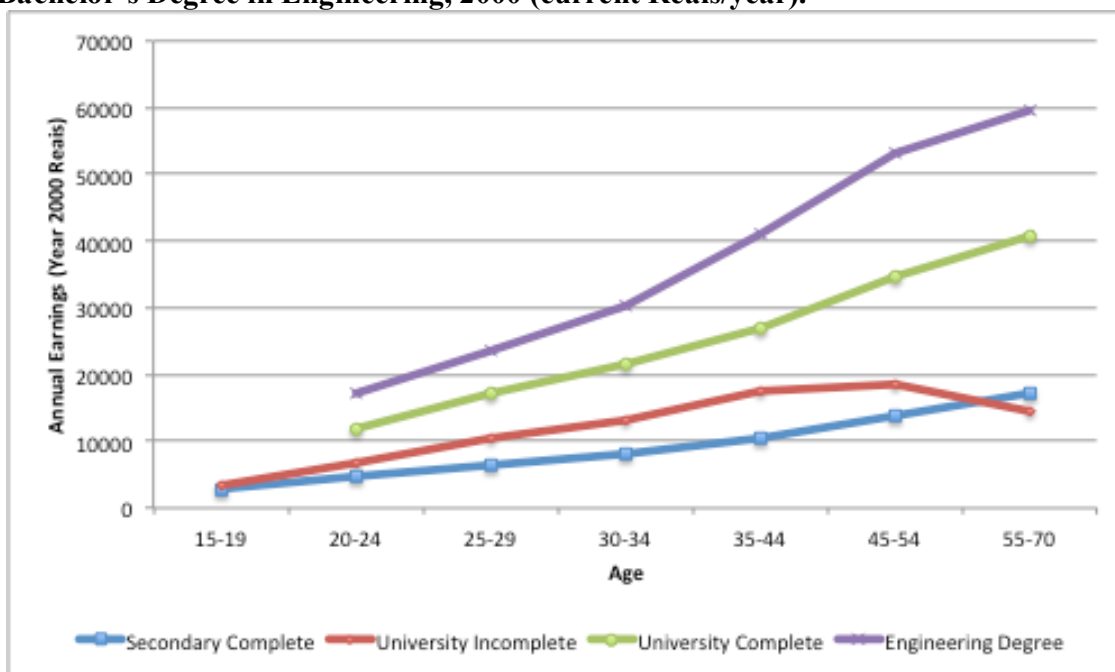


Table 10 shows the calculated private and social rates for complete university education by gender and for those who complete different fields of study in higher education—computer science (five years), engineering (five years), medicine (six years), and economic sciences (five years). Engineers have the highest private rates of return, but the rates are high to completing university overall and in all these subfields. Since these rates are for each year of university, it implies that a graduate engineer earns more than double annually the earnings of a secondary graduate. Other estimates using these same census data suggest that those engineering graduates who work as engineers earn considerably less, on average, than those who work in other occupations (Nunes et al, 2009). As we discussed in the Russian case, getting an engineering degree is an acquired signal that provides access to a wide range of jobs where mathematics and problem solving skills are considered important.

Table 10. Brazil: Calculated Annual Rates of Return to Completing University, Including Tuition Costs, by Field of Study, 2000

Level Compared to Secondary Complete	Private Rates of Return		Social Rates of Return	
	<i>Men</i>	<i>Women</i>	<i>Men</i>	<i>Women</i>
University Complete	23.0	20.5	18.4	16.3
Computer Science	21.5	19.9	18.5	16.9
Engineering	26.5	24.3	20.0	17.7
Medicine	18.7	17.8	13.6	12.7
Economic Sciences	23.3	20.4	18.0	15.2
Non-Engineering/ Non- Computer Science	21.1	20.3	16.8	15.9

Source: Authors' estimates based on earnings from the Brazilian Census data, 2000. Tuition costs based on a sample of private universities' posted monthly tuition costs, tuition trend data from SEMESP, Sao Paulo, and from Hoper Educational Consultants, Sao Paulo. Public spending per student used to estimate public costs for social rates of return estimated from INEP published data. Tuition costs and public spending costs proportioned by the percentage of students in private and public universities in each field of study. Thanks to Mauricio Farias, Stanford University PhD candidate, for these estimates.

With such high payoffs, the demand for higher education in Brazil should be great, and it is, as suggested by the rapid growth in number and enrollment of private, for profit universities. The high rates of return, however, also suggest that the number of students enrolling and graduating from universities is constrained by financial and other barriers. Even if the rates declined between 2000 and 2008, and there is some evidence that they may have, they remain very high, much higher than in Russia, China, and India (where the estimated rate of return to engineering education is comparable, but is does not include tuition costs, hence is overestimated).

Summing Up

The rates of return we estimate for these four large developing mid-income economies tell us a lot about how the value of higher education is changing over time under the varying conditions in

each country. By understanding the nature of these changes and the structure of the age-income profiles behind our rate of return estimates, we were able to draw inferences about three important policy themes:

- The payoff to higher education over the past 25 years appears to have risen rapidly (China), risen (Russia), or remained fairly constant at a high level (India, Brazil), all in the face of rapid increases in the absolute and relative number of university graduates. In all but India, the payoff to completing university rose relative to the payoff to higher secondary school (in the Russian case, post-secondary vocational education), and now exceeds the rate to secondary schooling. This despite the rapid expansion of higher education. Of course, not all the rates we cited were corrected for selection bias, but selection bias should probably be declining as a higher fraction of the age cohort attends and graduates from university. The high and sometimes rising rates to higher education have important implications for government educational investment policies; namely that investment for growth and greater equity definitely have to include a detailed analysis of what is taking place in higher education, particularly who is getting access to these high payoffs.
- The relatively high and, in some cases, rising private rates of return to investing in higher education suggest that the demand for places in higher education should continue to rise in the BRICs, and we should see continued rapid expansion in the percent of the age cohort that seeks and completes university. The pressure to maintain or increase university places for engineering (and business) study should also remain high. The only exception to the general trend is Russia, which already incorporates one of the world's highest proportions (over 70 percent) of the college age group into university studies and is characterized by a declining college age population. Further, in Russia, there seems to be declining demand for engineers, although probably not for the mathematical skills of those who study engineering.
- A number of analysts have discussed the important trend in higher education of governments charging fees in public universities (China, Russia, India) and promoting the expansion of private institutions (Brazil, China, and India). Usually, such "privatization" is characterized as an ideological shift, with governments moving from considering university education as a "public" good to viewing it increasingly as a "private" good (Altbach et al, 2008). However, our results suggest that it is possible for governments to charge for public education (China, India, Russia) because the private rate of return even including tuition cost is relatively high

(China, India), or, as in Russia, the rate of return is high to particular fields of study (business/economics), so that public universities can charge tuition to students in those fields. The promotion of private university education, furthermore, is successful in Brazil because of very high average private rates of return, in India in engineering and business education for the same reason, and in China on a more limited basis because of rising private rates. Rather than an ideological shift, we would argue that this represents government “financial opportunism,” and is quite rational in terms of getting those who stand to make large private gains to share a higher fraction of the cost of that investment.

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