



# Economic growth, comparative advantage, and gender differences in schooling outcomes: Evidence from the birthweight differences of Chinese twins

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## ABSTRACT

Data from two surveys of twins in China are used to contribute to an improved understanding of the role of economic development in affecting gender differences in the trends in, levels of, and returns to schooling observed in China and in many developing countries in recent decades. In particular, we explore the hypothesis that these phenomena reflect differences in comparative advantage with respect to skill and brawn between men and women in the context of changes in incomes, returns to skill, and/or nutritional improvements that are the result of economic development and growth.

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## 1. Introduction

An emerging worldwide phenomenon is the rise in the schooling attainment of women relative to men, resulting in the level of schooling being higher for women than men in many countries of the world. China is a prominent example. Fig. 1, based on data from the 2005 Chinese Mini-census, displays the mean number of years of schooling, by gender and rural–urban categories, across different birth cohorts by the year each reached the age of 22. As can be seen, at least since 1965, women's schooling has risen faster than that of men in both rural and urban areas, and by 2002 in urban areas women's schooling attainment is higher than that of men. In rural areas, men and women's schooling in the most recent cohort is almost at parity by 2002, despite women's schooling being half of that of men in the 1960s.

Another common finding is that the estimated rate of return to schooling for women, conventionally estimated using log-linear wage functions, is higher than that of men. This is true in almost

all developed countries (Trostel et al., 2002), and is true also for a majority of all countries of the world (Psacharopoulos and Patrinos, 2004). Here again, at least in urban areas where there are superior data on earnings, China is not an exception. Zhang et al. (2005) used successive annual urban surveys from six provinces of China from 1988 through 2001 to estimate the rates of return to schooling separately for men and women by year. Fig. 2, produced from the reported annual estimates from their study, shows three phenomena: (i) a higher rate of return for women in every year, (ii) rising rates of return for both men and women, and (iii) a faster rise in the return for women than for men.

In this paper, data from two surveys of twins in China, the 2002 Adult Twins Survey and the 2002 Child Twins Survey, supplemented with data from the 2005 Chinese Mini-census are used to contribute to an improved understanding of the role of economic development in affecting gender differences in the trends in, levels of, and returns to schooling observed in China and in many developing countries in recent decades. In particular, we extend the framework set out in Pitt et al. (2012) to explore the hypothesis that these phenomena reflect differences in comparative advantage with respect to skill and brawn between men and women in the context of changes in incomes, returns to skill, and/or nutritional improvements that are the result of

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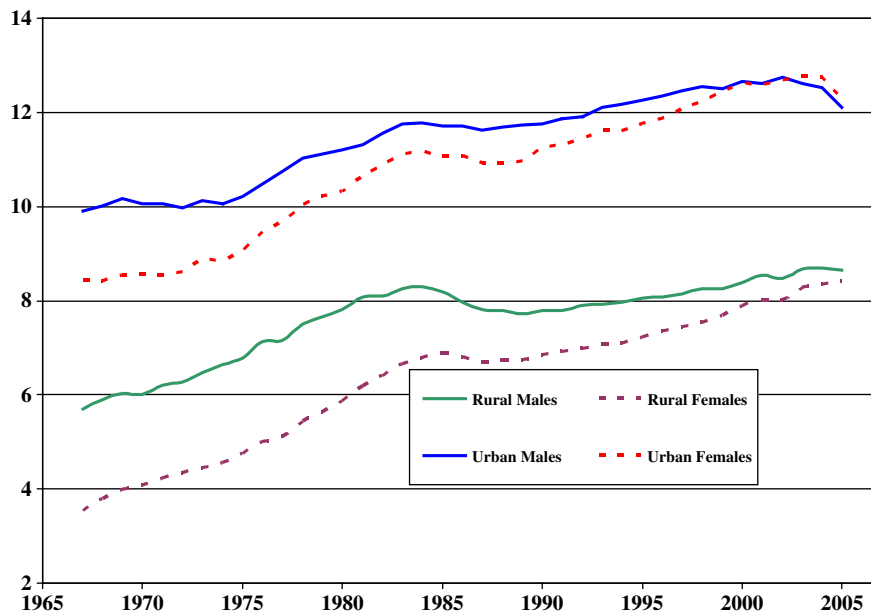


Fig. 1. Mean years of schooling by gender and urban-rural and year attained age 22, 1967–2005. (Source: 2005 Chinese Mini-census.)

economic development and growth.<sup>1</sup> The framework describes optimal human capital investments in an economy in which brawn and skill contribute to production and workers sort among occupations according to their comparative advantage in the two attributes (Roy, 1951). The model incorporates two biological differences between men and women established in the medical literature – that men have substantially more brawn than women (e.g., Günther et al., 2008; Mathiowetz et al., 1985) and that increases in nutritional inputs that augment body mass increase brawn substantially more for males than for females (e.g., Round et al., 1999).

The comparative advantage explanation for the phenomena exhibited in Figs. 1 and 2 is that a rise in the skill-intensity of production (a decline in the value of brawn) leads to an increase in schooling investment overall, higher levels of schooling for workers with a comparative advantage in skill (women), and higher measured returns to schooling overall. Occupational sorting by comparative advantage means that women will be disproportionately represented in skill-intensive occupations so that the average productivity of schooling for women will be higher than that of men, and increasingly so as the occupational division of labor by gender increases.<sup>2</sup> It is difficult to test directly this explanation given that all of these characteristics of an economy are endogenous equilibrium outcomes. Instead, we test the predictions of the model for how exogenous variation in body mass differentially affects schooling investment and wages for males and females, as these reflect both the operation of comparative advantage in occupational choice and the differential effects by gender of nutrition on brawn. We do so by obtaining gender-specific estimates of the effects of differences in birthweight within same-sex twin pairs on schooling, performance in school, and wages. These estimates by themselves are also useful in

assessing directly how nutritional improvements in a population will affect schooling levels and returns by gender.<sup>3</sup>

Birthweight is known to reflect nutritional intake in the womb and to have substantial effects on child and adult health. Differences in birthweight across individuals, however, may reflect parental preferences for investments in human capital and thus any correlation between birthweight and subsequent (post-birth) investments in human capital in the general population is not informative with respect to how an exogenous early increase in nutrition affects post-birth human capital. In contrast, within-twin-pair differences in birthweight cannot reflect parental preferences. A number of studies have estimated the effects of birthweight on longer-term human capital and health outcomes using within-twin-pair birthweight variation, exploiting the fact that this variation is orthogonal to parental preferences and constraints (Behrman and Rosenzweig, 2004; Black et al., 2007; Currie and Moretti, 2007; Oreopoulos et al., 2008; Royer, 2009). There are two limitations to these studies, however. First, none compares birthweight effects by gender.<sup>4</sup> Yet, recent studies of the effects of randomized interventions improving the nutrition of children have found that such interventions increase schooling investment significantly more for girls (Bobonis et al., 2006; Maluccio et al., 2009; Miguel and Kremer, 2004) and wage rates significantly more for boys (Hoddinott et al., 2008), results consistent with the framework we employ here. Second, none of these studies provides a theoretical framework linking early nutritional advantages to human capital investments.<sup>5</sup>

<sup>3</sup> Pitt et al. (2012) document the rise in BMI between 1982 and 2002 in Bangladesh resulting from nutritional improvements associated with public health interventions. In urban, but not rural China, BMI has also increased, for both males and females. Figures A and B in the Appendix show mean BMI by gender and rural-urban for individuals aged 17–19 in 1992 and 2002 in China.

<sup>4</sup> Behrman and Rosenzweig (2004), Currie and Moretti (2007) and Royer (2009) use data on female twin pairs only. Black et al. (2007) combine same-sex twin pairs when they have common information for both; Oreopoulos et al. (2008) combine twins of both sexes for all outcomes.

<sup>5</sup> Glewwe and Miguel (2007) provide such a framework in their review article, but because the model they describe does not incorporate gender differences in brawn or link brawn to labor market outcomes, the model does not provide any mechanisms by which nutrition affects school investments differently by gender.

<sup>1</sup> The idea that the relative rise in female schooling reflects comparative advantage in a dynamic setting was explored by Deolalikar (1993) in his study of gender-specific schooling levels in Indonesia, but due to lack of information on occupations it was not possible to rule out other explanations. Thomas and Strauss (1997) also suggested comparative advantage as an explanation for their findings on the gender-specific effects of body mass on urban wages and the higher returns to schooling for women in their study of the Brazilian labor market.

<sup>2</sup> Zhang et al. (2005) show that the selectivity of labor-force participation cannot account for the gender-specific differences in levels or trends in Fig. 2.

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