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# Human capital and economic development

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## Abstract

This paper develops a general equilibrium model of fertility and human capital investment with young adult mortality. Because young adult mortality is negatively related to average young adult human capital, human capital accumulation lowers mortality, inducing demographic transition and industrial revolution. Data confirm that young adult mortality is related negatively to schooling, and the rate of return to schooling, and positively to fertility. The data indicate a negative relationship between TFP growth and schooling accumulation. The model fits the data on country populations, per capita incomes, human capital, total fertility rates, infant mortality, life expectancy and conditional life expectancy.

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## 1. Introduction

This paper develops a general equilibrium model of fertility and human capital investment choice under uncertainty. Uncertainty exists because not all young adults survive to old age.<sup>1</sup> Parents maximize utility arising from their own consumption, their

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<sup>1</sup> In the empirical work I consider young adult mortality to be measured as the probability of dying between the ages of 1 and  $X$ , where  $X$  varies from 25 to 55. This specification clearly lumps child deaths with young adult deaths, see Hazan and Zoabi (2004) for the importance of this. However the model assumes all human capital investments are made before survival is known. The data clearly has partial human capital investment. I thank an anonymous referee for making this explicit.

fertility and the discounted utility of consumption of their children. Fertility depends positively on the probability of an early death, or a young adult death. Because human capital investments are made prior to the realization of survival from young adult to old adult, higher young adult mortality, by increasing the number of children born, reduces human capital investment in each child. This is the standard [Becker and Lewis \(1973\)](#) interaction of quality and quantity of children. If young adult mortality depends on the average human capital of young adults, then an endogenous demographic transition occurs. The economy evolves from high mortality, high fertility, slow human capital accumulation, and slow (if any) economic growth to low mortality, low fertility, rapid human capital accumulation and rapid economic growth. Human capital accumulation reduces young adult mortality, which in turn induces lower fertility. Lower fertility reduces the cost of human capital investment, and thus parents increase their human capital investments per child. This leads to a virtuous cycle in which human capital growth leads to lower fertility and more rapid human capital growth.

This paper makes three fundamental contributions: (1) it derives and analyzes a general equilibrium model of fertility and human capital accumulation under uncertainty, (2) it estimates a structural model of young adult mortality and empirically evaluates the model, further it provides evidence on a complementary model developed by [Galor \(in press\)](#) of the rising demand for education arising from technological progress, and (3) it numerically solves the model and provides goodness of fit tests of the solution to historical data on population, income per capita, total fertility rates, age at entry into the labor force, infant mortality, life expectation and conditional life expectation for 28 countries and regions.<sup>2</sup>

Reductions in young adult mortality through increases in the human capital of young adults occurs on many levels. When a mother teaches her child to wash her hands before preparing and eating food, her mortality risk is lowered. Thus higher own human capital lowers an individual's young adult mortality risk. A community that separates drinking water from waste water and collects garbage for disposal lowers young adult mortality risk as well, cf. [Melosi \(2000\)](#). Hence higher average human capital in a community reduces young adult mortality risk. If any society discovers antibiotics and vaccines for immunization against disease, then all societies can benefit from these discoveries, cf. [Haines \(2002\)](#). This body of knowledge, modeled as the maximum human capital in the world, lowers young adult mortality risk.

In the empirical section I estimate the relationship between young adult mortality and young adult human capital. The estimates are consistent with the model specification. The model predicts that young adult mortality affects parental investments in their children's human capital, but infant mortality and middle age mortality do not. The model also predicts that infant mortality and young adult mortality positively effect fertility. Empirically three of the model's predictions are confirmed, only the strong negative relationship between infant mortality and human capital investment rejects the predicted insignificant relationship. I present detailed goodness of fit tests that verify that

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<sup>2</sup> The preferred model fits almost 3500 observations.

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