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On Human Capital Formation with Exit Options: Comment and New Results

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Abstract

Katz and Rapoport (2005) conclude that with linear production technology and the possibility of unilateral migration, region-specific shocks may increase the average level of education. Previously, Poutvaara (2000) derived a corresponding result with Cobb-Douglas technology and migration which may go in both directions. This paper shows that the exit option may reduce human capital formation with a quadratic production technology.

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1 Introduction

In their recent contribution, Katz and Rapoport (2005) explore the relationship between economic volatility and human capital formation in a two-country framework. In one country, the rate of return to human capital is certain. In the other country, it is uncertain but of the same expected value. Katz and Rapoport find that increased variability in the unstable country, which they call undeveloped, increases investment in education there. The reason for this is that the exit option provides an insurance for those who have sufficiently low migration costs.

Previously, also Poutvaara (2000) studied the effect of region-specific shocks on human capital formation when the regions have the same expected rate of return to human capital. Poutvaara (2000) assumes that two regions face symmetric and opposite shocks, and both have ex ante an identical chance of a positive and a negative shock. Also Poutvaara (2000) finds that the individual investment in human capital is increasing in the magnitude of shocks when migration is allowed. Unlike Katz and Rapoport (2005), Poutvaara (2000) assumes that migration can go in either direction. Another difference is in production technology: Katz and Rapoport (2005) assume that production is linear in human capital, while Poutvaara (2000) assumes a Cobb-Douglas production technology which combines human capital and a region-specific fixed factor. Katz and Rapoport assume ex ante heterogeneous and risk-neutral individuals, while Poutvaara (2000) assumes that those who became educated are ex ante identical and that they may be risk-averse. The third difference is that Poutvaara (2000) allows everyone to emigrate, while Katz and Rapoport (2005) assume that the costs of adjustment and preferences for living in the home country restrict emigration.

This comment extends the finding by Poutvaara (2000) and Katz and Rapoport (2005) by showing that the results that they derive with linear and Cobb-Douglas production technology may be reversed with other production technologies. The comment follows Katz and Rapoport (2005) by focusing on risk-neutral individuals in the absence of taxation. As Poutvaara (2000), the comment derives the results when individuals are ex ante identical. The results could be easily generalized to the case of ex ante different productivities, in line with the appendix A in Köthenbürger and Poutvaara (forthcoming).

2 The Model

2.1 A Cobb-Douglas Technology

There are two countries, A and B. In both countries, production combines a fixed factor and human capital. Denoting human capital in country i, $i \in \{A, B\}$ by H_i, the total production is H_i^{α}, where $0 < \alpha < 1$. As in Wildasin (1995) and Poutvaara (2000), both regions face uncertainty about the price of the exported goods. This uncertainty may take two values: prices are high when they are $1+v$ and low when they are $1-v$, where the volatility term v satisfies $0 \leq v < 1$. There are no taxes.

In both countries, the total population is normalized to unity. Investments in education are made before region-specific shocks are revealed. However, the educated migrate costlessly. They take into account that migration equalizes the marginal productivity of human capital in the two countries. Denoting the country which faces a positive (negative) shock by P (N), we can write the migration equilibrium condition as

$$(1-v)\alpha H_N^{\alpha-1} = (1+v)\alpha H_P^{\alpha-1}. \tag{1}$$

In both countries, individuals invest in education to maximize their expected income. Investment in education is denoted by e. The resulting individual human capital is denoted by $h(e)$. The marginal productivity of investment in education is positive and non-increasing, so that $h' > 0$ and $h'' \leq 0$. Individuals decide privately on their own investment in education, taking the market rate of return as given. This follows as there is a continuum of individuals. An individual i chooses investment in education to maximize:

$$-e_i + h(e_i)\left[\frac{1}{2}(1-v)\alpha H_N^{\alpha-1} + \frac{1}{2}(1-v)\alpha H_N^{\alpha-1}\right]. \tag{2}$$

By inserting (1), this yields the first-order condition

$$-1 + h'(e_i)(1-v)\alpha H_N^{\alpha-1} = 0. \tag{3}$$

As all individuals face the identical optimization problem, they all choose an identical education in both countries. From now on, denote this by $\widehat{e}$. The condition that pre-migration and post-migration stocks of human capital are equal is

$$H_N + H_P = 2h(\widehat{e}). \tag{4}$$

Note that the total value of production in the two regions is $(1+v)H_P^\alpha + (1-v)H_N^\alpha$. Solving H_N and H_P from (4) and (1), we obtain as the total value of production in the two countries

$$Y^W = \left[(1+v)^{\frac{1}{1-\alpha}} + (1-v)^{\frac{1}{1-\alpha}}\right]^{1-\alpha} (2h(\widehat{e}))^\alpha.$$

Note that

$$\begin{aligned} & \frac{\partial}{\partial v}\left[(1+v)^{\frac{1}{1-\alpha}} + (1-v)^{\frac{1}{1-\alpha}}\right]^{1-\alpha} \\ = & \left[(1+v)^{\frac{1}{1-\alpha}} + (1-v)^{\frac{1}{1-\alpha}}\right]^{-\alpha}\left[(1+v)^{\frac{\alpha}{1-\alpha}} - (1-v)^{\frac{\alpha}{1-\alpha}}\right] > 0. \end{aligned}$$

Therefore, an increased volatility increases the total value of production in the two countries with any given investment in education. As a constant fraction α of this production accrues to the educated, this implies that the rate of return to any given stock of human capital increases. As investment in education equalizes the marginal cost and the return, this implies an increase in the investment in education. We can summarize the result as

Proposition 1 *With a Cobb-Douglas production technology, the investment in education is increasing in the magnitude of symmetric and opposite region-specific shocks.*

Note that as α approaches unity, the production technology approaches the linear case. In the linear case, the marginal productivity of all human capital would equal that of the country experiencing a positive shock. Therefore, an increase in the positive shock would increase investment in human capital, in line with the findings by Katz and Rapoport (2005).

2.2 A Quadratic Production Function

Assume next that the production technology is quadratic. The total production in country i is $aH_i - bH_i^2$. The region-specific shocks are the same as in the case of a Cobb-Douglas technology. Denoting again the country which faces a positive (negative) shock by P (N), we can write the migration equilibrium condition as

$$(1-v)(a-2bH_N) = (1+v)(a-2bH_P). \tag{5}$$

An individual i chooses investment in education to maximize:

$$-e_i + h(e_i)\left[\frac{1}{2}(1-v)(a-2bH_N) + \frac{1}{2}(1+v)(a-2bH_P)\right].$$

By inserting (5), this yields the first-order condition

$$-1 + h'(e_i)(1-v)(a-2bH_N) = 0.$$

As the maximization problem is the same in both ex ante identical countries, the solutions are identical. Solving H_P from (4) and inserting it into (5) yields

$$H_N = h(\widehat{e}) - \frac{v}{2b}(a - 2bh(\widehat{e})).$$

The rate of return to human capital is then

$$(1-v)(a-2bH_N) = (1-v^2)(a-2bh(\widehat{e})).$$

Note that this is both the expected and the realized rate of return: as the two countries face opposite shocks, there is no uncertainty about the post-migration productivity of human capital. Differentiation yields

$$\frac{\partial}{\partial v}\left[(1-v^2)(a-2bh(\widehat{e}))\right] = -2v(a-2bh(\widehat{e})). \tag{6}$$

Note that $a - 2bh(e_i)$ has to be positive, as otherwise the marginal productivity of human capital would be negative. The right-hand side of (6) is thus negative. This implies that with any given investment in education, an increase in the region-specific shocks reduces the expected rate of return to human capital investment. Thus, it would reduce investment in human capital. We can summarize the result as

Proposition 2 *With a quadratic production technology, the investment in education is decreasing in the magnitude of symmetric and opposite region-specific shocks.*

Contrary to the finding with linear and Cobb-Douglas production technologies, region-specific shocks would reduce investment in human capital with a quadratic production technology.

3 Conclusion

Previous literature has concluded that the possibility of migration boosts human capital formation with region-specific shocks (see Poutvaara (2000) and Katz and Rapoport (2005) for analysis of countries with same expected returns to education, and references therein on contributions where the expected rates of return differ). This paper shows that this result is sensitive to the assumptions about the production technology. The results that Poutvaara (2000) derives with a Cobb-Douglas technology and Katz and Rapoport (2005) with a linear production technology may be reversed with quadratic production technology.

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