

ON HUMAN CAPITAL FORMATION WITH EXIT OPTIONS: COMMENT AND NEW RESULTS

PANU POUTVAARA

CESIFO WORKING PAPER NO. 1648

CATEGORY 4: LABOUR MARKETS

JANUARY 2006

An electronic version of the paper may be downloaded

- *from the SSRN website:* www.SSRN.com
- *from the CESifo website:* www.CESifo-group.de

ON HUMAN CAPITAL FORMATION WITH EXIT OPTIONS: COMMENT AND NEW RESULTS

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.

JEL Code: F22, J24, I21.

Keywords: human capital formation, migration, economic volatility.

*Panu Poutvaara
University of Helsinki
Department of Economics
Arkadiankatu 7
P.O. Box 17
00014 University of Helsinki
Finland
panu.poutvaara@helsinki.fi*

December 19, 2005

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

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

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:

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

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

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

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

$$H_N + H_P = 2h(\hat{e}). \quad (4)$$

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

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

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

$$(1 - v)(a - 2bH_N) = (1 + v)(a - 2bH_P). \quad (5)$$

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

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

The rate of return to human capital is then

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

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

$$\frac{\partial}{\partial v} [(1 - v^2)(a - 2bh(\hat{e}))] = -2v(a - 2bh(\hat{e})). \quad (6)$$

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.

References

- [1] Katz, E, Rapoport, H (2005) On Human Capital Formation with Exit Options. *Journal of Population Economics* 18(4):267-274
- [2] Köthenbürger, M, Poutvaara, P (forthcoming) Social Security Reform and Investment in Education: Is there Scope for a Pareto-Improvement? Forthcoming in *Economica*
- [3] Poutvaara, P (2000) Education, Mobility of Labour, and Tax Competition. *International Tax and Public Finance* 7(6):699-719
- [4] Wildasin, DE (1995) Factor Mobility, Risk and Redistribution in the Welfare State. *Scandinavian Journal of Economics* 97(4):527-546

CESifo Working Paper Series

(for full list see www.cesifo-group.de)

- 1585 Christos Kotsogiannis and Robert Schwager, On the Incentives to Experiment in Federations, November 2005
- 1586 Søren Bo Nielsen, Pascalis Raimondos-Møller and Guttorm Schjelderup, Centralized vs. De-centralized Multinationals and Taxes, November 2005
- 1587 Jan-Egbert Sturm and Barry Williams, What Determines Differences in Foreign Bank Efficiency? Australian Evidence, November 2005
- 1588 Steven Brakman and Charles van Marrewijk, Transfers, Non-Traded Goods, and Unemployment: An Analysis of the Keynes – Ohlin Debate, November 2005
- 1589 Kazuo Ogawa, Elmer Sterken and Ichiro Tokutsu, Bank Control and the Number of Bank Relations of Japanese Firms, November 2005
- 1590 Bruno Parigi and Loriana Pelizzon, Diversification and Ownership Concentration, November 2005
- 1591 Claude Crampes, Carole Haritchabalet and Bruno Jullien, Advertising, Competition and Entry in Media Industries, November 2005
- 1592 Johannes Becker and Clemens Fuest, Optimal Tax Policy when Firms are Internationally Mobile, November 2005
- 1593 Jim Malley, Apostolis Philippopoulos and Ulrich Woitek, Electoral Uncertainty, Fiscal Policy and Macroeconomic Fluctuations, November 2005
- 1594 Assar Lindbeck, Sustainable Social Spending, November 2005
- 1595 Hartmut Egger and Udo Kreickemeier, International Fragmentation: Boon or Bane for Domestic Employment?, November 2005
- 1596 Martin Werding, Survivor Benefits and the Gender Tax Gap in Public Pension Schemes: Observations from Germany, November 2005
- 1597 Petra Geraats, Transparency of Monetary Policy: Theory and Practice, November 2005
- 1598 Christian Dustman and Francesca Fabbri, Gender and Ethnicity – Married Immigrants in Britain, November 2005
- 1599 M. Hashem Pesaran and Martin Weale, Survey Expectations, November 2005
- 1600 Ansgar Belke, Frank Baumgaertner, Friedrich Schneider and Ralph Setzer, The Different Extent of Privatisation Proceeds in EU Countries: A Preliminary Explanation Using a Public Choice Approach, November 2005

- 1601 Jan K. Brueckner, Fiscal Federalism and Economic Growth, November 2005
- 1602 Steven Brakman, Harry Garretsen and Charles van Marrewijk, Cross-Border Mergers and Acquisitions: On Revealed Comparative Advantage and Merger Waves, November 2005
- 1603 Erkki Koskela and Rune Stenbacka, Product Market Competition, Profit Sharing and Equilibrium Unemployment, November 2005
- 1604 Lutz Hendricks, How Important is Discount Rate Heterogeneity for Wealth Inequality?, November 2005
- 1605 Kathleen M. Day and Stanley L. Winer, Policy-induced Internal Migration: An Empirical Investigation of the Canadian Case, November 2005
- 1606 Paul De Grauwe and Cláudia Costa Storti, Is Monetary Policy in the Eurozone less Effective than in the US?, November 2005
- 1607 Per Engström and Bertil Holmlund, Worker Absenteeism in Search Equilibrium, November 2005
- 1608 Daniele Checchi and Cecilia García-Peñalosa, Labour Market Institutions and the Personal Distribution of Income in the OECD, November 2005
- 1609 Kai A. Konrad and Wolfgang Leininger, The Generalized Stackelberg Equilibrium of the All-Pay Auction with Complete Information, November 2005
- 1610 Monika Buetler and Federica Teppa, Should you Take a Lump-Sum or Annuitize? Results from Swiss Pension Funds, November 2005
- 1611 Alexander W. Cappelen, Astri D. Hole, Erik Ø. Sørensen and Bertil Tungodden, The Pluralism of Fairness Ideals: An Experimental Approach, December 2005
- 1612 Jack Mintz and Alfons J. Weichenrieder, Taxation and the Financial Structure of German Outbound FDI, December 2005
- 1613 Rosanne Altshuler and Harry Grubert, The Three Parties in the Race to the Bottom: Host Governments, Home Governments and Multinational Companies, December 2005
- 1614 Chi-Yung (Eric) Ng and John Whalley, Visas and Work Permits: Possible Global Negotiating Initiatives, December 2005
- 1615 Jon H. Fiva, New Evidence on Fiscal Decentralization and the Size of Government, December 2005
- 1616 Andzelika Lorentowicz, Dalia Marin and Alexander Raubold, Is Human Capital Losing from Outsourcing? Evidence for Austria and Poland, December 2005
- 1617 Aleksander Berentsen, Gabriele Camera and Christopher Waller, Money, Credit and Banking, December 2005

- 1618 Egil Matsen, Tommy Sveen and Ragnar Torvik, Savers, Spenders and Fiscal Policy in a Small Open Economy, December 2005
- 1619 Laszlo Goerke and Markus Pannenberg, Severance Pay and the Shadow of the Law: Evidence for West Germany, December 2005
- 1620 Michael Hoel, Concerns for Equity and the Optimal Co-Payments for Publicly Provided Health Care, December 2005
- 1621 Edward Castronova, On the Research Value of Large Games: Natural Experiments in Norrath and Camelot, December 2005
- 1622 Annette Alstadsæter, Ann-Sofie Kolm and Birthe Larsen, Tax Effects, Search Unemployment, and the Choice of Educational Type, December 2005
- 1623 Vesa Kannianen, Seppo Kari and Jouko Ylä-Liedenpohja, Nordic Dual Income Taxation of Entrepreneurs, December 2005
- 1624 Lars-Erik Borge and Linn Renée Naper, Efficiency Potential and Efficiency Variation in Norwegian Lower Secondary Schools, December 2005
- 1625 Sam Bucovetsky and Andreas Haufler, Tax Competition when Firms Choose their Organizational Form: Should Tax Loopholes for Multinationals be Closed?, December 2005
- 1626 Silke Uebelmesser, To go or not to go: Emigration from Germany, December 2005
- 1627 Geir Haakon Bjertnæs, Income Taxation, Tuition Subsidies, and Choice of Occupation: Implications for Production Efficiency, December 2005
- 1628 Justina A. V. Fischer, Do Institutions of Direct Democracy Tame the Leviathan? Swiss Evidence on the Structure of Expenditure for Public Education, December 2005
- 1629 Torberg Falch and Bjarne Strøm, Wage Bargaining and Political Strength in the Public Sector, December 2005
- 1630 Hartmut Egger, Peter Egger, Josef Falkinger and Volker Grossmann, International Capital Market Integration, Educational Choice and Economic Growth, December 2005
- 1631 Alexander Haupt, The Evolution of Public Spending on Higher Education in a Democracy, December 2005
- 1632 Alessandro Cigno, The Political Economy of Intergenerational Cooperation, December 2005
- 1633 Michiel Evers, Ruud A. de Mooij and Daniel J. van Vuuren, What Explains the Variation in Estimates of Labour Supply Elasticities?, December 2005
- 1634 Matthias Wrede, Health Values, Preference Inconsistency, and Insurance Demand, December 2005

- 1635 Hans Jarle Kind, Marko Koethenbueger and Guttorm Schjelderup, Do Consumers Buy Less of a Taxed Good?, December 2005
- 1636 Michael McBride and Stergios Skaperdas, Explaining Conflict in Low-Income Countries: Incomplete Contracting in the Shadow of the Future, December 2005
- 1637 Alfons J. Weichenrieder and Oliver Busch, Artificial Time Inconsistency as a Remedy for the Race to the Bottom, December 2005
- 1638 Aleksander Berentsen and Christopher Waller, Optimal Stabilization Policy with Flexible Prices, December 2005
- 1639 Panu Poutvaara and Mikael Priks, Violent Groups and Police Tactics: Should Tear Gas Make Crime Preventers Cry?, December 2005
- 1640 Yin-Wong Cheung and Kon S. Lai, A Reappraisal of the Border Effect on Relative Price Volatility, January 2006
- 1641 Stefan Bach, Giacomo Corneo and Viktor Steiner, Top Incomes and Top Taxes in Germany, January 2006
- 1642 Johann K. Brunner and Susanne Pech, Optimum Taxation of Life Annuities, January 2006
- 1643 Naércio Aquino Menezes Filho, Marc-Andreas Muendler and Garey Ramey, The Structure of Worker Compensation in Brazil, with a Comparison to France and the United States, January 2006
- 1644 Konstantinos Angelopoulos, Apostolis Philippopoulos and Vangelis Vassilatos, Rent-Seeking Competition from State Cooffers: A Calibrated DSGE Model of the Euro Area, January 2006
- 1645 Burkhard Heer and Bernd Suessmuth, The Savings-Inflation Puzzle, January 2006
- 1646 J. Stephen Ferris, Soo-Bin Park and Stanley L. Winer, Political Competition and Convergence to Fundamentals: With Application to the Political Business Cycle and the Size of Government, January 2006
- 1647 Yu-Fu Chen, Michael Funke and Kadri Männasoo, Extracting Leading Indicators of Bank Fragility from Market Prices – Estonia Focus, January 2006
- 1648 Panu Poutvaara, On Human Capital Formation with Exit Options: Comment and New Results, January 2006