

HUMAN CAPITAL, INVESTMENT AND MIGRATION IN AN INTEGRATED EUROPE

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ABSTRACT

Human Capital, Investment and Migration in an Integrated Europe*

The short- and longer-term regional consequences of migration for European aggregate supply are examined in a simple model in which human capital enters the production function externally. The planner chooses a reallocation of population across East and West that cannot be replicated by the market without taxes or subsidies. The market solution in this model with free migration is always associated with an efficiency loss and might lead to the 'Mezzogiorno syndrome' in the East.

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NON-TECHNICAL SUMMARY

The large gap between standards of living in Eastern and Western Europe, which was once hidden behind the Iron Curtain, is now very visible. In principle, neoclassical economic theory predicts that living standards could be equated by flow of capital to the East. In principle, however, this task could be accomplished by a flow of labour in the opposite direction. Furthermore, the geographic proximity of the two regions and the limits to capital mobility make migration an important factor in the economic integration of Europe. Estimates that between three and seven million workers – a great many from what used to be the Soviet Union – may migrate to the West in the next decade, are commonplace. Such migration patterns would have important effects on the supply side of both receiving and sending countries.

This paper assesses the effect of migration on the composition and quality of labour forces in the two regions. In order to highlight the implications of migration for European capital formation and aggregate supply as clearly as possible, we suppress a number of issues which are important for the integration of Eastern and Western Europe, but which do not contribute to an understanding of some of the key economic effects of migration. These include private and social costs of migration *per se*, labour market imperfections, unemployment related to the business cycle and externalities in capital formation. Furthermore, consequences for savings and intergenerational welfare are ignored, so that the effect of Europe's investment behaviour on the world rate of interest is ignored. Welfare comparisons of various policies are made solely with respect to productive efficiency.

We consider two regions, East and West, which differ in only two ways: first, the East has an inferior endowment of physical capital; and second, the average level of human capital is lower in the East than in the West. This simply implies a less favourable aggregate level of training for using Western production methods in Western markets. To study the costs and benefits of market-driven migration we need a bench-mark. This is given by the optimal outcome that a benevolent social planner would achieve. The planner would shift population until average human capital levels are equalized. Capital/labour ratios are also equated. This policy reduces the size of the East European economy, but it also maximizes aggregate social product. We then contrast this with the market solution, in which private decisions do not internalize the negative effect of migration on total factor productivity. In some scenarios, unbridled migration can lead to a 'Mezzogiorno' effect, characterized by regional decline. Unless the government implements a tax and subsidy scheme, the market outcome cannot replicate the social optimum.

Another scenario we develop allows for exogenous catch-up of Eastern levels of human capital to those in the West – a much more likely scenario. In this case, there is also a case for taxes and subsidies, but the superiority of the planner's outcome (in terms of present discounted value of national product) to that of the market becomes negligible as time passes. Losses occur only during the transition phase. In the final steady state both regions possess the same human capital and one region is simply a scaled version of the other.

Finally, we discuss the possibility that human capital may be a by-product of existing human and physical capital. The insight given by the planner's solution is that investment now carries an externality which private decisions will not correctly price. The planner will invest more and will employ a lower discount rate in evaluating the investment decision.

1. Introduction

The importance of migration in shaping the economic future of the continent is easily overlooked. Yet, massive population flows have already occurred. By the end of 1991, roughly 5% of the ex-GDR population and 10% of the labor force will have migrated west. In 1990 1.3 million Eastern Europeans have also moved west. A key aspect of migration will be its effect on the composition and quality of labor forces in the two regions. This raises issues concerning dynamic depletion of human capital that was controversial in the development literature many decades ago.¹ This paper highlights some implications of migration for European capital formation and aggregate supply in a full employment model. We do not consider such important factors as private and social costs of migration, labor market imperfections, and externalities in capital formation.² The consequences for savings and intergenerational welfare are ignored, so that the world rate of interest is taken as given and welfare comparisons of various policies are made solely with respect to productive efficiency.

2. A Model with Labor Heterogeneity and Human Capital

East and West begin with a fixed and equal labor endowment normalized at unity for each region. A single good can be produced in either region for either consumption or investment, according

¹ See Myrdal (1957) and Romans (1964).

² For a survey of these issues see Burda and Wyplosz (1991).

to the common technology

$$(1) \quad Y = H^\gamma F(K, \tilde{L}) \quad \text{with } 0 < \gamma < 1.$$

where F exhibits constant returns to scale in the capital stock K and resident employment \tilde{L} , and is assumed to obey the Inada conditions. If L^i denotes the residents of region i who actually remain in region i , then $\tilde{L}^W \equiv L^W + i - L^E$ and $\tilde{L}^E \equiv L^E + i - L^W$ represent actual employment in the West and East respectively. Following Lucas (1988, 1990), H measures the region's average human capital and enters the production function as an externality not appropriable by any particular firm or worker but available to all of them.³ We assume here that workers' human capital takes two values: h^E in the East and h^W in the West, with $h^W > h^E$.⁴ Thus for each region $i=W, E$ and $j=E, W$,

$$(2) \quad H^i = (h^i L^i + h^j (1 - L^j)) / \tilde{L}^i$$

At the outset, $H^E < H^W$ and for each migrant from East to West, $-\partial H^E / \partial L^E = 0$, but $-\partial H^W / \partial L^E = (h^E - h^W) / \tilde{L}^W < 0$; since h^E is less than H^W movement of Easterners westward *decreases* human capital in the West but leaves the Eastern level unaffected.

While movement of labor is assumed to be costless, discrete changes in the capital stock is precluded by convex costs of adjustment: the cost of adding I new units per instant to the existing capital stock K is $I[1 + \psi(I/K)]$, with $\psi(0)=0$, $\psi' > 0$, and $\psi'' > 0$. Physical depreciation is ignored, so $\dot{K}_t^W = I_t^W$ and $\dot{K}_t^E = I_t^E$.

³ Imposing $\gamma < 1$ rules out certain obvious types of path dependence in this context. Lucas (1990) estimates γ at .34.

⁴ For a more discussion of this and alternative specifications, see Burda and Wyplosz (1991).

3. The Central Planner's Solution

The social planner is introduced, visceral reactions notwithstanding, to determine the *optimum optimorum*, which may or may not be attainable as a market outcome. Discounting at constant rate r , the planner chooses $I_t^E, I_t^W, L_t^E, L_t^W$ for $t \geq 0$ to maximize the present discounted value of total European output

$$(3) \quad \sum_{i=E,W} \int_0^{\infty} e^{-rt} \left\{ (H^i)^{\gamma} F(K_t^i, \tilde{L}_t^i) - I_t^i \left[1 + \psi \left(\frac{I_t^i}{K_t^i} \right) \right] \right\} dt$$

subject to (2), initial conditions for the capital stocks, K_0^E and K_0^W , and their respective transition equations. Note that the planner may allocate Westerners to the East as well as Easterners to the West. The usual necessary conditions for an optimum for $i=W,E$ can be rewritten in the following intuitive form:

$$(4) \quad (H^W)^{\gamma-1} (F^W / \tilde{L}^W) = (H^E)^{\gamma-1} (F^E / \tilde{L}^E)$$

$$(5) \quad (H^W)^{\gamma} [F_L^W - \gamma(F^W / \tilde{L}^W)] = (H^E)^{\gamma} [F_L^E - \gamma(F^E / \tilde{L}^E)].$$

$$(6) \quad I_t^i = K_t^i \phi(q_t^i - 1), \quad \phi' > 0 \quad \text{where} \quad \phi^{-1} \equiv \psi + \left(\frac{I_t^i}{K_t^i} \right) \psi'$$

$$(7) \quad \dot{q}_t^i = \int_0^{\infty} e^{-rt} \left\{ (H^i)^{\gamma} F_K^i + \left(\frac{I_t^i}{K_t^i} \right)^2 \psi' \right\} dt$$

where the Lagrangian multipliers q^i represent the shadow values of an additional unit of capital in either region.⁵ According to (4)

⁵ Equations (4) and (5) derive from the two first order conditions with respect to L^E and L^W ; (6) derive from the first order conditions with respect to I^E and I^W , and (7) derive from forward integration of the time derivative conditions for q^i in East and

and (5), the planner reallocates Eastern and Western labor so that the respective marginal products of human capital H and employment \tilde{L} are equated in the two regions; (6) and (7) dictate the allocation of physical investment according to its shadow value, which is the present discounted value of present and future net marginal products of capital.

Defining $f \equiv F(K/\tilde{L}, 1)$, (4) and (5) give:

$$(8) \quad r^w \{ (1-\gamma) f^w - k f^{w'} \}^{(1-\gamma)/\gamma} = f^E \{ (1-\gamma) f^E - k f^{E'} \}^{(1-\gamma)/\gamma}$$

which depends only on k^i , the capital-labor ratios in the two regions, and is independent of human capital levels.

It follows immediately that one solution is $k^E = k^W$, $H^E = H^W$, and $q_t^E = q_t^W$ for all t . The planner equates human capital levels in both regions by pairing Westerners and Easterners in each region; this determines a set of admissible combinations (L^E, L^W) given by $L^E = 1 - L^W$. The actual extent of population movement chosen is determined by the initial gap in physical capital, $K_0^W - K_0^E$. With k equated in both regions, $K_0^W > K_0^E$ implies $\tilde{L}^W = K_0^W / k^E > \tilde{L}^E$, and $L^W = (K_0^W - K_0^E) / (K_0^W + K_0^E) + L^E = [(K_0^W - K_0^E) / (K_0^W + K_0^E) + 1] / 2$. The greater the gap, the larger is optimal migration. A significant degree of migration is desirable but as long as $K^E > 0$, it is never optimal in this solution to fully depopulate the East since $(K_0^W - K_0^E) / (K_0^W + K_0^E)$ is bounded from above by 1.⁶ After the first instant, no more reallocation of labor takes place. Both q 's jump to equal levels

West, imposing the respective transversality conditions.

⁶In a more general setting with congestion costs or costs to moving individuals, this "national park" result will not hold. The planner will prefer to restrain migration and possibly accelerate investment in Eastern Europe.

and decline at the same rate over time, enforcing equal investment rates in the two regions for all t . The two regions converge to S_W^P and S_E^P in Figure 1. The new common steady state capital labor ratio is lower than in the West at the outset, since the common value of H and the optimal capital-labor ratio is lower in both regions.

Although $k^E = k^W$ is always a solution, it may not be unique, and others may result in a higher value of (3). If the production function is Cobb-Douglas, the $k^E = k^W$ solution is unique as long as the wage share exceeds γ . If production is CES with elasticity of substitution σ less than unity, a sufficient condition ruling out multiple solutions is that the initial aggregate capital stock of Europe be sufficiently large.⁷ Other solutions will imply $k^W > k^E$ and $H^W > H^E$ throughout. Under this scenario, the central planner might actually hinder migration initially, and under some conditions may choose a "Mezzogiorno solution" which condemns the East to low levels of human capital and physical capital forever.

4. The Decentralized (Market) Solution

The market solution does not deliver the optimal outcome. We assume here that workers are paid their marginal product and that migration is costless.⁸ Since $H^W > H^E$ at the opening of the borders and westward migration by Easterners does not influence H^E , no

⁷ We require the function $\phi(k) \equiv f((1-\gamma)f - f'k)^{(1-\gamma)/\gamma}$, the left or right hand side of (8) to be strictly monotone in k , or that $(1-\gamma)f - f'k$ not change signs. For CES with $\sigma < 1$ there will be exactly one solution when $(k_0^W + k_0^E)/2 > 2k^*$, where $\phi(k^*) = 0$.

⁸ The assumption that migration continues until wages are equal can be modified to account for moving costs. See Burda and Wyplosz (1991).

Westerner will migrate eastward.⁹ In contrast, Easterners will migrate until the wage is equal in both regions, or

$$(9) \quad (h^E)^{\gamma} F_L^E = (H^W)^{\gamma} F_L^W$$

Since $h^E = H^E < H^W$, it must be the case that $k^E > k^W$. The marginal product of capital and q will be higher in the West, implying a lower investment rate in the East. As capital accumulates more rapidly in the West, migration will continue to enforce the arbitrage condition (9). Relative to the planner's problem, there is too much migration from East to West and none at all in the other direction; in the steady state, everyone "goes west" and Eastern Europe is depopulated. This "private Mezzogiorno solution" is depicted as the paths to S^M in Figure 1.

5. Exogenous Human Capital Formation

It is probably unreasonable to assume that East Europeans will possess a lower level of human capital indefinitely. If the regional transfer of human capital evolves exogenously according to $\dot{h}_t^E = \alpha(h_t^W - h_t^E) + gh_t^W$ while $\dot{h}_t^W = gh_t^W$, the planner's solution is identical to that of Section 3. Subject to the feasibility and uniqueness conditions discussed above, human capital is equated initially in both regions, after which it approaches a common steady state value h^W from below and grows at rate g .

The *laissez-faire* solution results in a suboptimal path only in a dynamic sense. The adjustment path is characterized by low

⁹ Under more realistic assumptions, migration from East to West would reduce H_t^E , since those with the highest level of human capital would have the greatest incentive to leave.

investment in the East and continued migration to the West. There is a quantifiable dynamic output loss that the central planner would have avoided. Regardless of the adjustment path, the steady state is characterized by $H^W = H^E$ so $k^W = k^E$. Europe recovers the diagonal of its original Edgeworth box, with a common capital labor ratio depending on the world rate of interest, the common h , and the total European population level. The market solution results in a lower Eastern steady state population than the planner's optimum.

6. Policy Implications

In order for the market to attain the optimal solution, incentives will be necessary, not only to prevent East Europeans from migrating, but also to allow the East to profit from the West's superior initial human capital endowment. There is clear justification for some form of labor subsidy in the East driven by a divergence of private and social costs of migration. The optimum cannot be achieved by a single subsidy alone, but will require a one-off lump sum subsidy to Westerners for migrating to the East (or a tax on staying), combined with a one-shot tax on Easterners for migrating (or subsidy for staying). As soon as the workers have migrated, the resulting equalization of human capital levels will preclude any desire to reverse migrate and the social optimum is attained as a market outcome.

As it stands, the model does not justify a subsidy to physical investment in the East. The distortion arises in the labor market, because the private migration decision fails to incorporate its external social costs. On the other hand, several

modifications could change this property. One interesting example arises if external human capital were to evolve endogenously after the opening of the border as a constant returns function of physical and human capital according to

$$(10) \quad H_t^1 = G(K_t^1, H_t^1) = H_t^1 g(\kappa_t)$$

where $\kappa \equiv K/H$ and the condition $r > g - \kappa g'$ is imposed for all κ . The social planner maximizes (3) subject to the same conditions as before plus (10). In addition to (4), (5), and (6) the first order conditions for an optimum now include for $t \geq 0$

$$(H_t^1)^\gamma F_K^1 + \left(\frac{I_t^1}{K_t^1}\right)^2 \psi' + \nu_t^1 g' + \dot{q}_t = q_t r$$

$$\gamma (H_t^1)^{\gamma-1} f_t^1 + \nu_t^1 (g - \kappa_t^1 g') + \dot{\nu}_t = \nu_t^1 r$$

$$q_0^1 = \int_0^\infty e^{-rt} (H_t^1)^\gamma F_K^1 + \left(\frac{I_t^1}{K_t^1}\right)^2 \psi' + \nu_t^1 g' dt$$

$$\nu_0^1 = \int_0^\infty e^{-[r - (g - \kappa_t^1 g')]t} \gamma (H_t^1)^{\gamma-1} f_t^1 dt$$

where $h \equiv K/H$, and ν is the shadow value of an additional unit of human capital. To the extent that physical investment has an external benefit in human capital formation and ν is positive, the central planner will subsidize capital in both regions, but more so in the East, since $H^E < H^W$ initially.¹⁰

¹⁰ Although beyond the purview of this paper, this model has interesting implications for investment and education subsidies in general.

7. Conclusion

It seems to be an established fact in the context of East-West European migration that the most likely migrants are young, educated, and mobile.¹¹ This paper has analyzed some of the theoretical ramifications of migration for aggregate supply when human capital has an external effect on production. The optimal solution sets migration to spread human capital across both regions, and is not achieved by the market. These results would be strengthened, of course, if migration involves other external costs such as congestion.

The external effect discussed in this paper has ramifications for endogenous growth as well. Allowing for human capital formation along the lines of Lucas (1988) or the model sketched in Section 6 might magnify the gap in East-West living standards, especially if the productivity of, and the private returns from this activity depend only on local conditions. These predictions, especially those involving multiple equilibria, will no doubt be sensitive to the specification of the production function and the external effect of human capital. In any case, the impact of several million future migrants on the economic development of Eastern Europe should bring new evidence to bear on the role of external human capital in the production function.

¹¹ This is consistent with Sjaastad's (1962) predictions. For summary of the earlier literature see Greenwood (1975), and for review of the evidence on migration's effects on US factor markets see Greenwood and McDowell (1986).

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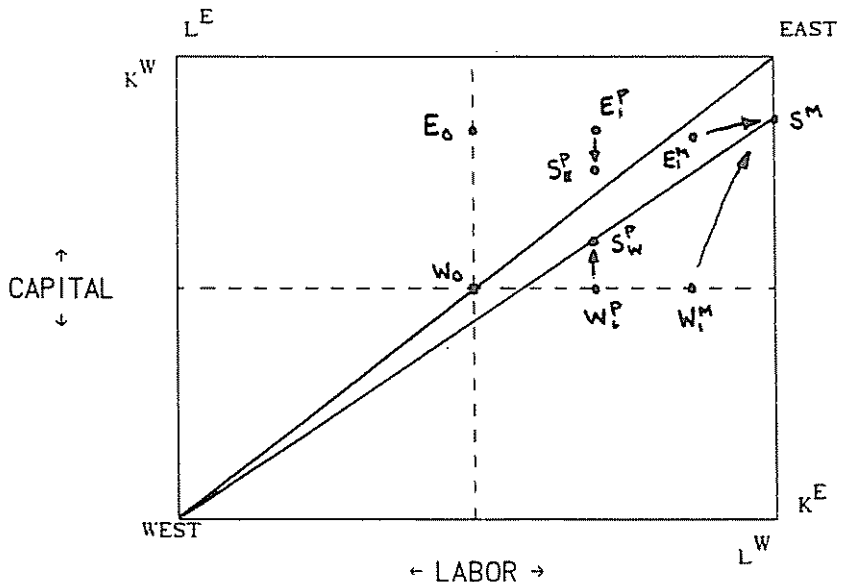


Figure 1. The Edgeworth Box Diagram