Rationality of Post-Accession Migration[1]

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Given large-scale Polish migration to the U.K. following EU enlargement in 2004, this study evaluates market efficiency in sorting Polish-born workers to the locations offering the highest returns to their skills. To establish whether Polish workers that emigrated to the U.K. did so on rational premises, wage regressions are run to identify the wage gains individuals may have expected to realize when migrating and when staying; and the Heckman (1979) self-selection model is used to tie up the migration decision with the decision to work and to identify returns to unobservable skills (e.g. motivation). Whereas the results support the rationality of migration from Poland to the U.K. (those who left gained in nominal and real terms), they are less conclusive about the optimality of staying (some of those who stayed might have earned more abroad). The outcomes suggest that the anticipated wage gains do not fully explain the intensity of observed migration and underline the importance of including nonincome factors, i.e. social costs, in exploring post-accession migration.

1 Introduction

Workers from Central and Eastern European countries (CEECs) that joined the EU in 2004 remain temporarily shut out of most "old" EU countries' labor markets, given concerns that the large income disparity might facilitate an unprecedented movement of labor from east to west. Only the U.K., Ireland and Sweden introduced an open-door policy right away, followed after some time by Southern European countries and the Netherlands. Even though Germany and Austria, which had expected to attract the highest share of migrants, retain a closed-door policy, the outflow of workers from the CEECs greatly outpaced earlier estimates (Zaiceva, 2006). Thus, EU enlargement in 2004 constituted a "natural experiment" that encourages testing the hypothesis about the rationality of migration choice, i.e. evaluating to what extent migration movements may have been explained by expected earnings differentials.[3]

While the rationality of internal migration has been verified by a few studies, including Kaun (1970), Tunali (2000) and Dostie and Leger (2006), no study to my knowledge has so far focused specifically on the rationality of EU post-accession cross-border migration. I assess temporary migration from Poland to the U.K. to test whether migration, once barriers to cross-country labor force mobility were removed, improved the welfare of Polish natives by leading to an optimal selection of those staying and those migrating. The underlying data stem from labor force surveys (LFS) conducted in the U.K. and Poland. Although not designed for migration studies, such surveys contain relevant information about skills and wages. Moreover, the survey schedule enables tracking trends and changes over time.[4]

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[3] *Assessing the role of disparities in the expected income differentials in triggering migration might also be restated as examining the validity of the neoclassical view on labor force movements according to which individuals attempt to maximize their anticipated income.*

[4] *A more popular approach used in migration research is to merge population census data, as census data usually include more detailed information about individuals and cover larger subsamples of migrants (see Aydemir, 2002; Mishra, 2007; and Chiquiar and Hanson, 2008). For this study, the census approach was not an option, however, as neither Poland nor the U.K. have as yet conducted a population census since EU enlargement in 2004.*

To evaluate the rationality of migrate-or-stay decisions, this study measures the wage gain individuals may have expected to achieve by either migrating or staying, given the different pricing of workers' observed and unobserved skills on different labor markets. In addition, the study assesses the difference in the valuation of unobserved skills on the two labor markets among observationally identical individuals, building on the presumption that rational workers with identical observed characteristics should have chosen the location allowing them to maximize their income via higher returns to unobserved skills.

Expected wage differences between countries may be easily derived through consistent estimates of wage regressions. To identify the value of unobserved characteristics, I follow the idea of Tunali (2000), who studied internal migration across Turkish regions. He used the popular Heckman (1979) self-selection scheme, first to arrive at consistent estimates of returns to observable characteristics of workers; and second to establish the expected value of returns to unobservables, which allows an ex post assessment of the impact unobserved heterogeneity had on expected income profiles.[5]

The intuition behind the approach is clear-cut. If earnings depend on observed and unobserved human capital characteristics, assuming unbiased wage anticipations and rational decision-making, individuals should have chosen the option allowing them to reap the highest return to their skills. Two conclusions follow. First, migration propensity assessed ex post should be correlated with returns to the full set of workers' skills. Therefore migration propensity might be used as an instrument in the wage regression controlled for observable characteristics, with a view to rendering consistent estimates of returns to observables. Second, sustaining the assumed correlation between observables and unobservables from the first stage of the Heckman procedure, expected differences in returns to unobservables might be approximated effectively by the difference in correction terms of observationally equivalent individuals.

As wage figures are available only for those employed, it was necessary to deal with the additional problem of nonrandom selection into employment, and in particular with the interdependence of self-selection into employment with self-selection into migration. To alleviate bias problems in wage equation parameter estimates resulting from the simultaneous action of the selection mechanisms, I developed a sequential Probit model of joint selection, where the emigrate-or-stay decision is followed by a labor force participation decision[6] dependent on labor

[5] *The alternative would have been to adopt a productivity-based approach following Dostie and Leger (2006), who employ data on Canadian physicians and approximate their unmeasured productivity by calculating how much wages deviated from "the average" wages of observationally equal physicians prior to migration decisions. However, the data used in this article delivered insufficient information on past productivity to implement that approach.*

[6] *The selectivity issue constitutes the core problems that are usually addressed in empirical studies of migration movements, particularly those that refer to wage data. The issue of self-selection into migration goes back to the article of Borjas (1987; for male U.S. immigrants; Cobb-Clark (1993) delivered corresponding results for women), who showed that the selection of unobservables such as migrants' motivation need not be related to the selection of observables. Among recent studies that explicitly addressed the problem, Constant and Massey (2002) estimated wage equations, controlling them for effects of selective outmigration. Their main concern was to check the robustness of earlier estimates of assimilation effects on wages. Rabe (2006) attempted to measure earnings gains of couples following their decision to migrate to Britain. She studied migration decisions and earnings of couples in Britain in a self-selection framework taking account of double selectivity in couples' mobility and labor participation. The main novelty of the approach used here is that I use the self-selection correction method developed by Heckman not only to arrive at unbiased estimates of the wage regressions but also to identify wage effects tied to unobservable characteristics of individuals.*

market-specific factors. Tying up the migration decision with an employment decision seemed a natural extension of Tunali's (2000) approach, as unequal employment probabilities in different destinations may impact the emigration decision.

The contribution of the present study to the existing literature lies in the systematical application of the above rationality tests to (temporary) international migration.[7] Contrary to earlier works on the rationality of migration, the study explicitly deals with double selectivity regarding migration and employment, thus allowing the sample to include the nonworking population. Finally, as the data structure allows to track the evolution of wage differentials and rationality measures over time, some conclusions may be derived from the evolution of migration, and some forecasts may be formulated on the intensity of future migration flows.

In what follows, the article describes the wage and selectivity model (section 2), defines earnings differentials and rationality measures (section 3) and explains model implementation (section 4). Section 5 provides an overview of the data used, and section 6 an outline of the regression estimates. The main results are presented in section 7 and discussed in section 8. Conclusions close the paper.

2 Model

In the model, individuals are allowed to move freely between the two labor markets and may remain employed or not. The decision to migrate is influenced by the distribution of wage offers and employment prospects on the two markets. Observed wages are denoted as w_0 on the source country labor market and as w_1 on the foreign labor market (where wage rates are given in logarithms). To facilitate understanding of the analysis in the empirical section, observed wages w_M for $M \in \{0,1\}$ are decomposed into three components after Vijverberg (1995):

$$w_M(i) = \mu_M(i) + \eta_M(i) + \varepsilon_M(i) \tag{1}$$

where μ_M is interpreted as the "wage norm" or market-determined average productivity that depends on a worker's education or particular labor market-relevant job experience and is assumed to be observed by workers and econometricians. η_M represents person-specific productivity factors summarizing work attitude or skills and is observed imperfectly by workers and employers but is not observable by econometricians. ε_M is a random variation in productivity and $E(\varepsilon_M) = 0$.

Individuals anticipate having the earnings prospects w_0^* and w_1^*. The star indicates their subjective expectations based on information available when choosing to migrate or not and when taking on a job. If the variables describing a person's observed characteristics are summed up in a vector $x(i)$, then:

$$\mu_M(i) = \alpha_M x(i) \tag{2}$$

[7] *The decision to focus on short-term migration in this study reflects the predominance of temporary movements across EU national borders following enlargement in 2004. Establishing drivers of short-term labor force movements therefore seemed a promising avenue for understanding labor market developments following the removal of immigration restrictions between Poland and the U.K. Second and partly tied to the former point, data on short-term migrants to the U.K. of Polish origin were relatively abundant while the sample of longer-term migrants was significantly smaller, which might have hampered the reliability of results derived for long-term migrants.*

where α_M are vectors of wage equation parameters with some set of nonzero elements. Individuals elicit information about η_M on the basis of past realizations of $\eta_M + \varepsilon_M$ under additional assumptions that $\varepsilon_M^* = 0$ and that they know the correlation between the two η_M. The model describes subjective wage expectations of individuals who are aware of the wage distribution in both countries conditional on a given education or work history but have incomplete information about the worth of their nonmeasurable skills. They derive the latter information observing the "smoothing-out" effects that unpredictable events like sickness (contained in ε_M) have had on productivity in the past. An important point is the assumption that individuals who know how much unobservable skills acquired in the past are worth are able to predict the value of their unobservable skills on another labor market. Hence:

$$E(w_M^*(i)) = \alpha_M x(i) + E(\eta_M^*(i)) = \alpha_M x(i) + \eta_M(i) = E(w_M(i)) \tag{3}$$

where E is an expectation operator denoting values expected by econometricians, or:

$$w_M(i) = w_M^*(i) + v_M(i) \tag{4}$$

The prediction error fulfills the condition $E(v_M) = 0$. Unbiasedness of the wage rate predictions, stated in (3), is a strong identifying assumption in the model. Forecast errors of individuals originate in a false assessment of the valuation of unobservable skills.

People who are not employed expect to have a shadow income of b_0^* (on the home labor market) or b_1^* (on the foreign labor market). It is further assumed that the shadow income may be decomposed similarly to (1) and (4), and that individuals know the correlation structure between the valuation of person-specific productivity factors across different labor market states and labor markets.

The probability of being employed depends on individuals' labor supply decision given their wage prospect w_M^* and fallback position b_M^*, worker selection by employers, and the influence of labor market institutions on matching effciency. A worker living in M will decide to work if the difference between w_M^* and b_M^* (denoted by δ_M^*) is above zero, or else withdraw from the labor market. Job creation is observed only if the labor supply condition stated above is fulfilled concurrently with the labor demand condition, which is not explicitly specified. The reduced-form employment equation is of the form:

$$V_M(i) = \begin{cases} 1 \text{ if } V_M^*(i) > 0 \\ 0 \text{ if } V_M^*(i) \leq 0 \end{cases} \tag{5}$$

where V_M^* is a latent variable corresponding with the dichotomous outcome of individuals' V_M actual employment:

$$V_M^*(i) = \beta_M x(i) + \varsigma_M(i) \tag{6}$$

and $E(\varsigma_M(i)) = 0$.

Individuals will choose to move abroad when the anticipated gain from migration outweighs a plausible gain from staying. Namely:

$$\mathrm{M} = \begin{cases} 1 \text{ if } M^* > 0 \\ 0 \text{ if } M^* \leq 0 \end{cases} \tag{7}$$

and the latent variable M^* measuring the propensity to emigrate is expected to be proportional to the expected gain from moving:

$$M^*(i) = (V_1(i)\delta_1^*(i) + b_1^*(i)) - (V_0(i)\delta_0^*(i) + b_0^*(i)) \tag{8}$$

Here, the propensity to emigrate is described as a combination of anticipated shadow incomes and expected labor market-specific surpluses over shadow wages (δ_M^*). Further, I assume that the reduced form of (8) may be expressed as:

$$M^*(i) = \pi x(i) + e(i) \tag{9}$$

The reduced-form equation ignores the nonlinearity of the model expressed in (8) and assumes that the shadow value of migration may be linearized without loss of generality. The advantage of this specification is that it keeps the selectivity model simple while enabling a relatively detailed treatment of the limited transferability of skills and education between countries, as vector x may contain different variables for education or job experience gained in different countries. In line with the mechanism of the model, it follows that employment decisions are generally taken jointly with the location decision. This in turn implies that (5) and (6) have to be estimated jointly with equations (7) and (8) determining the propensity to migrate or stay.

Wages are observed only for those who have joined the labor market and are employed. Therefore:

$$\begin{aligned} E(w_0(i)) &= \alpha_0 x(i) + E(\eta_0(i) + \varepsilon_0(i) \mid M(i) = 0, V_0(i) = 1) \\ &= \alpha_0 x(i) + E(\eta_0(i) \mid M(i) = 0, V_0(i) = 1) \neq \alpha_0 x(i) \end{aligned} \tag{10}$$

$$\begin{aligned} E(w_1(i)) &= \alpha_1 x(i) + E(\eta_1(i) + \varepsilon_1(i) \mid M(i) = 1, V_1(i) = 1) \\ &= \alpha_1 x(i) + E(\eta_1(i) \mid M(i) = 1, V_1(i) = 1) \neq \alpha_1 x(i) \end{aligned} \tag{11}$$

If the above equalities hold, then it would be possible to derive individuals' potential wages based on the actual distribution of wages in each of the two countries and a set of individual characteristics. In fact, unobservable characteristics of individuals are likely to impact not only measured wages but also the probability that wages are actually observed (propensity of a person to be employed). Therefore, the self-selectivity problem may emerge. Information on wages in each of the labor markets that applies to all individuals can be obtained with a migration selection model, controlling for the self-selection mechanism in order to deliver consistent estimates of wage equation parameters.

3 Earnings Differentials and Rationality Measures

In this section a range of measures are developed that illustrate the expected change in income following workers' migrate-or-stay decision.[8] Importantly, formulas for the anticipated earnings differential or gain are derived for the entire population of workers even though earnings are observed only for those employed.

[8] *In fact, measures of expected income gains from staying developed here, under the salient assumption imposed in the paper that movement costs other than accounted for by wage differentials are insignificant, may also represent income differences in favor of return migrants.*

3.1 Earnings Differentials

The income differential in favor of migrants z_1 is defined as income gains expected abroad over income anticipated in the home labor market. It may be expressed as:

$$\begin{aligned} z_1(i) &= E(w_1(i) \mid M(i) = 1) - E(w_0(i) \mid M(i) = 0) \\ &= (\alpha_1 - \alpha_0)x(i) + E(\eta_1(i) \mid M(i) = 1) - E(\eta_0(i) \mid M(i) = 0) \end{aligned} \tag{12}$$

Similarly, earnings differentials expressing a foregone option for persons that did not migrate z_0 are defined as:

$$\begin{aligned} z_0(i) &= E(w_1(i) \mid M(i) = 0) - E(w_0(i) \mid M(i) = 1) \\ &= (\alpha_1 - \alpha_0)x(i) + E(\eta_1(i) \mid M(i) = 0) - E(\eta_0 \mid M(i) = 1) \end{aligned} \tag{13}$$

Significant differences in α_M across countries are likely to introduce selection in observables (contained in vector x), which should result in different wages for emigrants and stayers. The second component of wage differentials corresponds with the different valuation of individuals' unobserved characteristics. Earnings differentials for employed individuals (for whom wages are observed) closely correspond with a traditional Blinder (1973) and Oaxaca (1973) decomposition of the average wage rate observed in two subpopulations. Here, the Blinder and Oaxaca scheme is useful for distinguishing between the effect of the different distribution of migrants' observed and unobserved characteristics versus different returns to the same characteristics, on different labor markets. Calculating the average wage rates for stayers and migrants (or alternatively, averaging z_1 across individuals) and ignoring nonrandom selection to reporting wages and employment:

$$\begin{aligned} \overline{w}_1 - \overline{w}_0 &= \alpha_1 \overline{x}_1 + E(\eta_1 \mid M = 1) - (\alpha_0 \overline{x} + E(\eta_0 \mid M = 0)) \\ &= (\alpha_1(\overline{x}_1 - \overline{x}_0) + (\alpha_1 - \alpha_0)\overline{x}_0 + E(\eta_1 \mid M = 1) - E(\eta_0 \mid M(i)) \end{aligned} \tag{14}$$

where $\alpha_1(\overline{x}_1 - \overline{x}_0)$ is part of the wage gap between migrants and stayers that may be explained by differences in their average characteristics ($\overline{x}_1$ is the vector of average characteristics of migrants and $\overline{x}_0$ of stayers). $(\alpha_1 - \alpha_0)\overline{x}_0$ is a fraction of the wage gap that may be explained by different returns to characteristics across labor markets, and $E(\eta_1 \mid M(i) = 1) - E(\eta_0 \mid M(i) = 0)$ is the average selection-into-migration effect on wages.

3.2 Rationality Measures

Following Tunali (2000) I refer to a set of measures that allow for evaluation of the rationality of migration where rationality is understood as earnings-enhancing behavior of migrating individuals. Here, the framework used by Tunali is extended to allow for a nonemployment outcome that is partly the result of self-selectivity. Thus the rationality of labor force movements between countries can be evaluated for those in jobs as well as – a novel feature of this study – for those out of jobs.

The first measure of rationality compares ex ante optimal and nonoptimal choices, expressing the income individuals stands to gain abroad over the income they would earn at home, and vice versa. The returns to migration κ_1 for employed individuals may therefore be defined as:

$$\begin{aligned} \kappa_1(i) &= E(w_1(i) \mid M(i) = 1) - E(w_0(i) \mid M(i) = 1) \\ &= (\alpha_1 - \alpha_0)x(i) + v_1(i) \end{aligned} \tag{15}$$

and returns to staying κ_0 as:

$$\begin{aligned}\kappa_0(i) &= E(w_0(i) \mid M(i) = 0) - E(w_1(i) \mid M(i) = 0) \\ &= (\alpha_0 - \alpha_1)x(i) + v_0(i)\end{aligned} \tag{16}$$

Correspondingly, the left-hand expressions in (15) and (16) can be separated as sorting gains from migration and staying (v_1 and v_0):

$$v_1(i) = E(\eta_1(i) \mid M(i) = 1) - E(\eta_0(i) \mid M(i) = 1) \tag{17}$$

$$v_0(i) = E(\eta_0(i) \mid M(i) = 0) - E(\eta_0(i) \mid M(i) = 0) \tag{18}$$

Rationality implies that the average mover anticipated higher earnings abroad than the average stayer, and vice versa. That interpretation of rationality delivers another measure of rationality, namely the selection of migrants h_1:

$$\begin{aligned}h_1(i) &= E(w_1(i) \mid M(i) = 1) - E(w_1(i) \mid M(i) = 0) \\ &= E(\eta_1(i) \mid M(i) = 1) - E(\eta_1(i) \mid M(i) = 0)\end{aligned} \tag{19}$$

and a similarly defined selection of stayers h_0:

$$\begin{aligned}h_0(i) &= E(w_0(i) \mid M(i) = 0) - E(w_0(i) \mid M(i) = 1) \\ &= E(\eta_0(i) \mid M(i) = 0) - E(\eta_0(i) \mid M(i) = 1)\end{aligned} \tag{20}$$

4 Model Implementation

The selectivity model described by equations (5), (6), (7) and (9) could be estimated jointly with (11) and (12). However, using Maximum Likelihood methods could prove tedious. We refer instead to Heckman's (1979) two-step selection procedure, which was extended by Behrman, Wolfe and Tunali (1980) and by Tunali (1986) to double selectivity. Here I adjust the method to the observation of employment outcomes on one of the two labor markets only.

The population in the model is defined as Polish-born residents of Poland and the U.K. The first Probit equation, corresponding with (7) and (9), represents the selection of Polish natives into one of the two labor markets. Further equations represent the process governing employment decisions where factors influencing the propensity to be employed in one of the two countries can be heterogenous:

$$M(i) = \begin{cases} 1 \text{ if } M^* > 0 \\ 0 \text{ if } M^* \leq 0 \end{cases} \tag{21}$$

$$M^*(i) = \pi x(i) + e(i) \tag{22}$$

$$V_M(i) = \begin{cases} 1 \text{ if } V_M^* > 0 \\ 0 \text{ if } V_M^* \leq 0 \end{cases} \tag{23}$$

$$V_M^*(i) = \beta_M x(i) + \varsigma_M(i) \tag{24}$$

V_1 is observed only if $M = 1$, and V_0 only if $M = 0$. The above equations represent the four mutually exclusive options of employment in Poland, nonemployment in Poland, employment in the U.K., and nonemployment in the U.K. Further, it is assumed that random variation in wage rates ς_M and a random variation in the emigration propensity e are jointly normally distributed with the two covariance matrices:

$$\begin{bmatrix} \sigma^2_{\varepsilon_M} & \sigma_{\varepsilon_M e} & \sigma_{\varepsilon_M \varsigma_M} \\ & \sigma^2_e & \sigma_{e\varsigma_M} \\ & & \sigma^2_{\varsigma} \end{bmatrix} \tag{25}$$

for $M \in \{0,1\}$. The assumption of normal distribution of errors, similarly to the assumption of unbiasedness of workers' anticipations, constitutes an identifying assumption for the empirical model. Importantly, the correlation coefficient between ς_0 and ς_1 remains unidentified in the model due to the inability to jointly observe V_0 and V_1. In the estimation process, diagonal matrix elements are normalized to 1. The corresponding correlation coefficients between ς_M and e are denoted by by $\rho_0 = \sigma_{e\varsigma_0} / \sigma^2_e$ and $\rho_1 = \sigma_{e\varsigma_1} / \sigma^2_e$.

Based on the selection mechanism described by (21) to (25), inverse Mills ratios are derived to control wage regressions (and nonwage income regressions) estimated in the next step of the procedure. Assuming that $\rho_0 = \rho_1 = 0$, the inverse Mills ratio would read

$$\lambda_{M=1}(i) = \phi(\pi x(i))/\Phi(\pi x(i)) \tag{26}$$

for the emigration decision, and

$$\lambda_{M=0}(i) = -\phi(\pi x(i))/\Phi(-\pi x(i)) \tag{27}$$

for the staying decision.

ϕ is the univariate standard normal density function and Φ the univariate cumulative standard normal distribution function. Selection terms into employment would in turn take the form

$$\lambda_{V_M=1}(i) = -\phi(\beta_M x(i))/\Phi(\beta_M x(i)) \tag{28}$$

The wage regressions for residents of the U.K. and for residents of Poland thus read:

$$E(w_1(i)) = \alpha_1 x(i) + \varphi_{1,1}\lambda_{M=1}(i) + \varphi_{1,0}\lambda_{V_1=1}(i) \tag{29}$$

$$E(w_0(i)) = \alpha_0 x(i) + \varphi_{0,1}\lambda_{M=0}(i) + \varphi_{0,0}\lambda_{V_0=1}(i) \tag{30}$$

where $\varphi_{1,M} = \sigma_{\varepsilon_1}$ and $\varphi_{0,M} = \sigma_{\varepsilon_0}$ for $M \in \{0,1\}$. For nonzero correlation between the two selection mechanisms into emigration and employment, relations (26) to (28) are replaced by:[9]

$$\lambda_{1,1} = \phi(\beta_1 x(i))\Phi\left(\frac{\pi x(i) - \rho_1 \beta_1 x(i)}{(1-\rho_1^2)^{1/2}}\right) F(\pi x(i), \beta_1 x(i), \rho_1)^{-1} \tag{31}$$

$$\lambda_{1,0} = (\phi(\pi x(i))\Phi\left(\frac{\beta_1 x(i) - \rho_1 \pi x(i)}{(1-\rho_1^2)^{1/2}}\right) F(\pi x(i), \beta_1 x(i), \rho_1)^{-1} \tag{32}$$

$$\lambda_{0,1} = (\phi\beta_0 x(i))\Phi\left(-\frac{\pi x(i) - \rho_0 \beta_0 x(i)}{(1-\rho_0^2)^{1/2}}\right) F(-\pi x(i), \beta_0 x(i), -\rho_0)^{-1} \tag{33}$$

[9] *Derivations can be obtained from the author upon request.*

$$\lambda_{0,0} = -(\phi(\pi x(i))\Phi\left(\frac{\beta_0 x(i) - \rho_0 \pi x(i)}{(1-\rho_0^2)^{1/2}}\right) F(-\pi x(i), \beta_0 x(i), -\rho_0)^{-1} \quad (34)$$

where F is a bivariate cumulative standard normal distribution function. However, selection terms in (31) to (34) do not allow for a straightforward interpretation of effects on wages of self-selection into emigration (corresponding with λ_1) and into employment (corresponding with λ_{V_1}). Let $\chi_{1,1}$, $\chi_{1,0}$, $\chi_{0,1}$ and $\chi_{0,0}$ be parameters of the wage equations defined as below:

$$E(w_1(i)) = \alpha_1 x(i) + \chi_{1,1}\lambda_{1,1}(i) + \chi_{1,0}\lambda_{1,0}(i) \quad (35)$$

$$E(w_0(i)) = \alpha_0 x(i) + \chi_{0,1}\lambda_{0,1}(i) + \chi_{0,0}\lambda_{0,0}(i) \quad (36)$$

Then the estimated regressions (35) and (36) may be rewritten as in (29) and (30) with $\lambda_{M=1}=\lambda_{1,1}+\rho_1\lambda_{1,0}$; $\lambda_{M=0}=\lambda_{0,1}+\rho_0\lambda_{0,0}$; $\lambda_{V_1=1}=\lambda_{1,0}(i)+\rho_1\lambda_{1,1}$ and $\lambda_{V_0=1}=\lambda_{0,0}+\rho_0\lambda_{0,1}$. The parameters φ are functions of correlation coefficients ρ_1 and ρ_0 and selection regressions parameters. They might be derived based on wage regression estimates as:

$$\varphi_{1,1} = \frac{\chi_{1,1} - \rho_1\chi_{1,0}}{1-\rho_1^2} \quad (37)$$

and:

$$\varphi_{1,0} = \frac{\chi_{1,0} - \rho_1\chi_{1,1}}{1-\rho_1^2} \quad (38)$$

$$\varphi_{1,1} = \frac{\chi_{0,1} - \rho_0\chi_{0,0}}{1-\rho_0^2} \quad (39)$$

and:

$$\varphi_{1,0} = \frac{\chi_{0,0} - \rho_0\chi_{0,1}}{1-\rho_0^2} \quad (40)$$

Tests of rationality were conducted based on model parameter estimates as well as derived predictions. See the appendix for a summary of the formula used to derive measures of "wage gaps" needed to test the income-maximizing behavior of Polish-born workers.

Separate Probit regressions were specified to alleviate biases in wage regressions originating in nonreporting of wages by some of individuals. On the assumption that nonreporting is not correlated with employment or migration decisions, we were able to derive separate Mills ratios.

5 Data

The sample used in the empirical section is based on labor force surveys (LFS) conducted between Q1 2004 and Q1 2008. It is restricted to working-age individuals and, in the case of Polish migrants, truncated to those staying abroad for less than three years because the main focus of the paper is on the rationality of short-term migration. Multiple observations – resulting from the fact that households selected for LFS are interviewed five quarters in a row in the U.K.[10]; and

[10] *Unlike the Polish LFS, the U.K. survey covers not only residents living in individual households but also students living in residence halls and people living in National Health Services accommodation.*

twice for two consecutive quarters, with an annual break, in Poland – were dropped from the sample as they would have violated the identical and independent (i.i.d.) assumption. Taking into account that in the U.K. LFS, wages are reported in the first and the fifth wave only, the U.K. sample was restricted to individuals interviewed either in the first wave, or in the fifth wave if the corresponding observation for the first wave was missing. The Polish sample was restricted to observations from the first and third wave, to mimic the annual break between the first and fifth wave in the U.K. scheme. The sample thus covers over 172 000 working-age Polish natives, of which less than 1500 were British residents (constituting under 1% of the total sample).[11]

5.1 Descriptive Analysis of Variables

In the U.K., the employment rate of Polish-born workers was almost twice as high as in Poland (83% versus 55%). U.K. residents tended to be employed in service sectors like trade, hotels and transport, whereas those who stayed in Poland more often had jobs in smaller enterprises, in agriculture and public services (public administration, healthcare, education). Migrants to the U.K. also tended to be younger than stayers (mean age of 28 years versus over 38 years). Migrant men marginally outnumbered migrant women. There were significantly fewer disabled persons among migrants (less than 2%) than among stayers (around 10%). Migrants

Table 1a

Data Description for Selection Model

	Pooled				Polish residents				British residents			
Statistics	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max
U.K. residence	0.009	0.093	0	1								
Employment	0.556	0.497	0	1	0.553	0.497	0	1	0.832	0.374	0	1
Male	0.509	0.5	0	1	0.508	0.5	0	1	0.558	0.497	0	1
Age	38.469	13.384	16	64	38.561	13.389	16	64	28.064	7.454	16	59
Disability	0.101	0.301	0	1	0.101	0.302	0	1	0.0174	0.131	0	1
Married	0.626	0.484	0	1	0.628	0.483	0	1	0.382	0.486	0	1
Number of kids	0.22	0.659	0	11	0.22	0.66	0	11	0.146	0.461	0	3
Number of kids under 5 years	0.053	0.259	0	5	0.053	0.259	0	5	0.076	0.295	0	2
Number of kids over 4 years	0.167	0.547	0	7	0.168	0.548	0	7	0.07	0.323	0	3
Time of residence	0.012	0.153	0	3					1.366	0.908	0	3
Higher education	0.124	0.33	0	1	0.124	0.33	0	1	0.099	0.299	0	1
Postsecondary education	0.25	0.431	0	1	0.249	0.432	0	1	0.297	0.235	0	1
Secondary education	0.097	0.294	0	1	0.095	0.294	0	1	0.23	0.261	0	1
Vocational education	0.31	0.461	0	1	0.311	0.463	0	1	0.183	0.176	0	0.738
Primary education	0.22	0.414	0	1	0.22	0.414	0	1	0.19	0.393	0	1
Years in education	12.082	3.649	1	27	12.077	3.654	1	27	12.624	3.066	3	27
Number of observations	163,728				162,290				1,438			

Source: Author's calculations.

[11] *Information on Polish migrants in the U.K. collected in the LFS may be impaired by plausibly limited coverage of migrant workers in the survey. This may reflect migrants' unsatisfactory English proficiency, interviewers' reluctance to enter marginal neighborhoods or the design of the sampling scheme, which accommodated changes in the population structure following introduction of the open-door policy in 2004 only with a certain lag. Evidence on the representativeness of LFS migrant data in Ireland recently documented by Barrett and Kelly (2008), even though not yet reproduced for the U.K., provided a positive valuation of the LFS data for migration research.*

were also less frequently married, and less frequently reported having dependent children. Migrants were better qualified on average. Among migrants, there were fewer workers with primary or vocational education but also fewer workers with higher education; most migrants had achieved secondary or postsecondary education (including secondary vocational education). For detailed descriptive statistics, see tables 1a and 1b.

Table 1b

Data Description for Wage Regressions

	Pooled				Polish residents				British residents			
Statistics	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max
U.K. residence	0.01	0.102	0	1								
Employment	0.428	0.495	0	1	0.424	0.494	0	1	0.819	0.385	0	1
Reporting wages	0.781	0.4132	0	1	0.782	0.412	0	1	0.733	0.443	0	1
ln(Nominal wage rate)					6.968	0.513	3.689	9.616	6.762	0.416	3.075	8.365
Male	0.496	0.5	0	1	0.496	0.5	0	1	0.55	0.498	0	1
Age	38.127	14.016	16	64	38.234	14.03	16	64	28.061	7.554	16	59
Disability	0.1	0.301	0	1	0.101	0.302	0	1	0.017	0.131	0	1
Married	0.626	0.484	0	1	0.628	0.483	0	1	0.382	0.486	0	1
Number of kids	0.22	0.659	0	11	0.22	0.66	0	11	0.146	0.461	0	3
Number of kids below 5 years	0.053	0.259	0	5	0.053	0.259	0	5	0.076	0.295	0	2
Number of kids over 4 years	0.167	0.547	0	7	0.168	0.548	0	7	0.07	0.323	0	3
Time of residence in the U.K.	0.012	0.153	0	3					1.366	0.908	0	3
Higher education	0.124	0.33	0	1	0.124	0.33	0	1	0.099	0.299	0	1
Postsecondary education	0.25	0.431	0	1	0.249	0.436	0	1	0.297	0.235	0	1
Secondary education	0.097	0.294	0	1	0.095	0.294	0	1	0.23	0.261	0	1
Vocational education	0.31	0.461	0	1	0.311	0.463	0	1	0.183	0.176	0	0.738
Primary education	0.253	0.435	0	1	0.254	0.435	0	1	0.196	0.397	0	1
Years in education	12.114	4.481	1	57	12.103	4.494	1	57	13.128	2.949	3	40
Total job experience in years	19.539	14.005	0	52	19.656	14.007	0	52	8.472	8.154	0	42
U.K. job experience in years									1.242	0.925	0	3
Duration of current employment relation in years	10.304	10.063	0	50.167	10.496	10.073	0	50.167	0.881	0.826	0	7
Number of observations	163,728				162,290				1,438			

Source: Author's calculations.

5.2 Comparability of Information on Education Levels

More than 60% of Polish residents in the U.K. reported education levels other than the categories used in the Polish survey (higher education or more, post-secondary education or secondary vocational education, secondary education, vocational education, primary education or less[12]). For persons who reported "other" education, an imputation procedure was run, using data on Polish migrants to the U.K. from the Polish household survey, which is conducted concurrently with the LFS survey and also covers former residents now living abroad but still affiliated with the household. This survey provides a crude set of emigrants' characteristics, such as age and education level. A key advantage of using the sample is its lack of redundancy with the data used in the further analysis.

[12] *Qualifications earned in the U.K. based on ISCED 97 categorization were aligned with the above categories.*

On the assumption that those reporting "other" education were in one of the three "middle" education groups, i.e postsecondary or secondary vocational education, secondary education and vocational education, the data from the Polish household survey were used to run multivariate Probit regressions where the dependent variable took different values for persons in the three different education groups. Regressions were run on respondents' age and gender as well as on the year of the survey variables, accounting for interaction between them. The estimated regression was next used to predict the odds with which those reporting "other" education were in one of the three educational groups that replaces values for individuals' dummy variables representing different levels of education.

The imputation procedure may have introduced a bias into the final results. Moreover, it does not deal with a plausible misclassification of the education level of workers for whom an ISCED 97 education level was reported. To check the robustness of the results (on regression estimates as well as on the evaluation of rationality of migration) alternative specifications of regressions were therefore introduced with an education level approximated by years in education.

6 Model Estimates

6.1 Independent Selection into Emigration and Employment

When the three selection equations – selection into emigration; selection into employment for Polish residents; selection into employment for Poles resident in the U.K. (see table 2, columns 1 to 3) – are estimated separately, men are not found to have a significantly higher propensity to emigrate than women. The propensity to emigrate was highest for those around 30 to 35 years and falling for older workers. The propensity to emigrate increased with the level of education. Emigrants were more often single than married and less probable to report the presence of dependent children in their household.

Regarding the propensity to work, most of the variables in the U.K. Probit proved to be insignificant, which may reflect the significantly narrower sample of migrants that hinders statistical inference about model parameters. This notwithstanding, most of the characteristics tested were found to have similar effects on labor market participation in Poland and in the U.K. The propensity to work was highest for individuals aged 40 to 45. Disability and the presence of dependent children in a household reduced the probability of staying in employment. Interestingly, the presence of dependent children had a stronger negative effect on the working propensity of Poles living in the U.K. than of Polish residents, possibly reflecting the lower availability of childcare of any kind for migrants. Males were characterized by a higher propensity to work than females, even more so if they were married. A higher education level had a positive impact on working activity in Poland, but it proved to be insignificant for Poles staying abroad. In fact, the results correspond with a loss of a relative edge that better educated workers had over less skilled workers on the home labor market when migrating. Consistent with expectations, a longer stay in the U.K. increases the probability of being employed.

Table 2

Selection into Emigration and Employment

Variable	U.K. residence	Employment: Polish residents	Employment: U.K. residents	U.K. residence	Employment: Polish residents	Employment: U.K. residents
	Separate estimates			Joint estimates		
Male	0.124*** (0.029)	0.172*** (0.027)	0.459*** (0.133)	0.119*** (0.029)	0.183*** (0.029)	0.32*** (0.158)
Married	−0.156*** (0.036)			−0.151*** (0.036)		
Male*married		0.505*** (0.031)	0.185 (0.167)		0.468*** (0.031)	0.217 (0.140)
Disability	−0.402*** (0.088)	−1.092*** (0.033)	−0.579** (0.285)	−0.427*** (0.088)	−1.131*** (0.035)	−0.253 (0.319)
Number of kids	−0.129*** (0.026)			−0.122*** (0.026)		
Number of kids under 5 years		−0.130*** (0.036)	−1.333*** (0.141)		−0.148*** (0.036)	−0.992*** (0.321)
Number of kids over 4 years		−0.052*** (0.018)	−0.512*** (0.120)		−0.045** (0.018)	−0.339** (0.167)
Age	0.172*** (0.012)	0.283*** (0.006)	0.262*** (0.049)	0.170*** (0.012)	0.281*** (0.007)	0.117 (0.094)
Age^2	−0.002*** (0.000)	−0.003*** (0.000)	−0.004*** (0.001)	−0.002*** (0.000)	−0.003*** (0.000)	−0.002 (0.001)
Higher education	1.133*** (0.233)	1.427*** (0.119)	0.829 (0.656)	1.063*** (0.238)	1.430*** (0.133)	0.137 (0.707)
Postsecondary education	1.672*** (0.146)	1.343*** (0.085)	1.194 (1.108)	1.563*** (0.147)	1.057*** (0.109)	−0.169 (1.071)
Secondary education	1.006*** (0.145)	0.280*** (0.097)	1.758** (0.711)	0.875*** (0.143)	0.357*** (0.106)	0.991 (0.792)
Vocational education	0.482*** (0.159)	1.169*** (0.086)	−1.268 (1.306)	0.492*** (0.164)	1.241*** (0.088)	−1.316 (1.086)
Age*higher education	−0.044*** (0.007)	−0.008*** (0.003)	−0.023 (0.021)	−0.042*** (0.007)	−0.010 (0.003)	0.003 (0.023)
Age*postsecondary education	−0.055*** (0.005)	−0.020*** (0.002)	−0.063 (0.044)	−0.051*** (0.005)	−0.013*** (0.002)	−0.008 (0.042)
Age*secondary education	−0.024*** (0.005)	−0.000*** (0.002)	−0.035 (0.024)	−0.019*** (0.005)	−0.003 (0.003)	−0.019 (0.023)
Age*vocational education	−0.026*** (0.005)	−0.021*** (0.002)	0.050 (0.037)	−0.026*** (0.005)	−0.024*** (0.002)	0.049 (0.031)
Time of residence in the U.K.			0.409*** (0.143)			0.345** (0.138)
Time of residence in the U.K.^2			−0.071 (0.049)			−0.060 (0.043)
Constant	−3.994*** (0.186)	−5.576*** (0.107)	−3.652*** (0.783)	−3.940*** (0.186)	−5.620*** (0.117)	−0.375 (1.875)
Correlation coefficient		0	0		−0.388** (0.175)	−0.625** (0.300)
Number of observations	25,666	24,228	1,438	25,663		
LR χ^2	1711.18	9,015.79	288			
AIC	9,401.088	24,309.39	1,051.3	34,903.78		
BIC	9,523.382	24,438.92	1,146.178	35,319.57		
Pseudo R^2	0.1544	0.2708	0.221			

Source: Author's calculations.

*Note: *** = statistically significant at the 1% level and ** = statistically significant at the 5% level. Key to abbreviations: LR = likelihood ratio; AIC = Akaike's information criterion; BIC = Bayesian information criterion.*

6.2 How Results Change when Emigration Decisions are Interrelated with Employment Decisions

To account for interdependence between emigration and employment decisions, trivariate Probit regressions with partial observability were estimated using the Simulated Maximum Likelihood method (see table 2, colums 4 to 6). I referred to the Geweke-Hajivassiliou-Keane (GHK) simulator of multivariate normal probabilities along the lines proposed by Cappellari and Jenkins (2006). Identification of multivariate Probit is assured by a set of exclusion restrictions imposed already while running Probit equations separately. The emigration decision is assumed to depend on individuals' civil status, with marital status in the equation approximating the costs of separation or joint migration (which are assumed to be symmetrical for men and women). The employment propensity equations exclude the marital status variable and include a dummy for married men only. Female labor market participation is assumed to be influenced by the presence of children in a household but not by marital status. Still, married males can be expected to have a higher propensity to work than single men. Finally, the duration-of-stay variable is present only in the U.K. employment propensity equation. To save on calculation time, only a randomly drawn 15% subsample of stayers (but the complete subsample of migrants) was used in the process estimation.

The correlation between factors influencing the employment and migration decision but not included in the regressions was significant. Those who were more likely to stay were also more likely to become employed on the home labor market as indicated by the negative estimate of ρ_0 (–0.38). In turn, individuals with a high propensity to emigrate, after controlling for observable characteristics, had a significantly lower propensity to become employed in the U.K. (negative estimate of ρ_1 of –0.63). The significant correlation of residuals across equations justifies the use of joint estimation methods.

The estimates of emigration and of employment-in-Poland equations do not differ significantly between single Probit and trivariate Probit specifications. Some differences can be pinpointed only for the estimated employment-in-the-U.K. regression parameters. The basic difference lies in a loss of explanatory power by age variables. If anything, the estimates indicate that those who are most probable to work in the U.K. are somewhat younger than those who would be most probable to work in Poland. The standard errors of estimates of variables tied to education also increase, lending stronger support to the hypothesis that they do not provide significant information about the propensity to work in the U.K. (given the decision to migrate). The effect the presence of children in a household has on women's labor market activity is slightly lower than the results from independently run Probit regressions for U.K. employment participation.

Results showing age and education variables to be insignificant in the U.K. employment regression are supported by an alternative specification of the model approximating education levels by years spent in education. That specification saves on degrees of freedom, which is helpful as the sample of Polish migrants is relatively small. These results (not included in the article) broadly confirm the pattern found in the baseline model. Although not only age but also the education (and interaction) variables enter significantly the independently run regression for propensity to work in the U.K., they loose their explanatory power once the three model equations are estimated simultaneously. The outcomes suggest that above

all those with higher employment chances in the destination country opted for migration.

6.3 Accounting for the Propensity to Report Wages

High income earners and individuals more likely to earn at least part of their income in the shadow economy were presumed to be more reluctant to report their earnings. Therefore the propensity to report wages was regressed on a range of variables like gender, education and labor market experience that could have a significant impact on wages; and moreover on variables referring to the unit in which an interviewed person was employed.[13] As expected, the personal characteristics which were most likely to positively affect wages were negatively correlated with the propensity to report wages for Polish residents. Firm size and industry mattered also with those employed in small enterprises and/or services, which had a lower probability to report wages. In fact, the Probit regression for Poland described the probability to report wages well with a pseudo R^2 of almost 64%. The results are less clear for the propensity to report wages in the U.K. Most variables included in the regression proved statistically insignificant. The propensity to report wages could be systematically linked mostly to firm and sector characteristics. In line with expectations, those employed in small enterprises indicated a lower probability to report wages than those in larger units. Employment in the trade sector could also lower the propensity to emigrate. Although all independent variables are jointly significant (as indicated by likelihood tests), the fit of the regression as described by R^2 statistics is rather poor (with only 4% of variation in the dependent variable explained by the regressors).

6.4 Wage Equations

The estimated wage regressions, based on variables relating to education and labor market experience other than those used in the selection equations, were run on nominal monthly wage rates expressed in national currency. To account for a plausible trend in the dependent variable, time dummies were added. To control for the effect of firm-specific experience on earnings, the duration of stay with the present employer was included. To control for different working hours, the number of hours worked (in the reference week) enters the wage regressions in both linear and squared form. The specification of the wage regressions was kept as simple as possible to ensure close correspondence across countries and facilitate counterfactual predictions. Therefore, wage equations contain (almost) no region- or employer-specific variables, which would be difficult to impute in counterfactual routes. In fact, the absence of variables describing regional or employer choices by Polish-born workers would imply that additional emigrating or staying workers are expected to display "the average" behavior of emigrants or stayers observed in the period.

The specifications for education and labor market experience are more detailed in the case of the U.K. (see table 3). I distinguish between total labor market experience (approximated by years since finishing education) and country labor market experience (approximated either by years since finishing education if a

[13] *Estimates may be obtained from the author upon request.*

Table 3

Wage Regressions

	ln(Nominal wage rate): Polish residents	ln(Nominal wage rate): U.K. residents	ln(Nominal wage rate): Polish residents	ln(Nominal wage rate): U.K. residents	ln(Nominal wage rate): Polish residents	ln(Nominal wage rate): U.K. residents
Male	0.254***	0.173***	0.177***	0.148***	0.130***	0.134***
	(0.004)	(0.032)	(0.006)	(0.038)	(0.005)	(0.033)
Disability	−0.234***	−0.252**	0.015	−0.325***	0.042**	−0.229*
	(0.012)	(0.112)	(0.018)	(0.122)	(0.017)	(0.117)
Total job experience in years	0.034***	0.002	−0.001	0.018*	−0.028***	−0.013
	(0.001)	(0.009)	(0.002)	(0.011)	(0.002)	(0.014)
U.K. job experience in years		0.035		−0.052		−0.051
		(0.050)		(0.052)		(0.052)
Total job experience in years^2	−0.001***	−0.000	0.001**	−0.001***	0.000***	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
U.K. job experience in years^2		−0.011		0.007		0.011
		(0.016)		(0.017)		(0.017)
Higher education	1.011***	0.031	0.484***	0.114		
	(0.018)	(0.086)	(0.034)	(0.100)		
Postsecondary education	0.545***	0.057	0.188***	0.347*		
	(0.017)	(0.137)	(0.026)	(0.159)		
Secondary education	0.567***	−0.001	0.347***	0.185		
	(0.020)	(0.091)	(0.023)	(0.117)		
Vocational education	0.405***	0.145	0.103***	0.166		
	(0.017)	(0.186)	(0.024)	(0.183)		
Years in education					0.026***	0.020**
					(0.002)	(0.010)
Total job experience in years*higher education	−0.006***	0.028***	0.010***	0.007		
	(0.001)	(0.008)	(0.001)	(0.011)		
Total job experience in years*postsecondary education	−0.007***	0.000	0.003***	−0.010		
	(0.001)	(0.015)	(0.001)	(0.015)		
Total job experience in years*secondary education	−0.009***	−0.005	−0.002**	−0.014*		
	(0.001)	(0.007)	(0.000)	(0.008)		
Total job experience in years*vocational education	−0.010***	−0.006	−0.001	−0.035***		
	(0.001)	(0.011)	(0.001)	(0.012)		
Total job experience in years*years in education					0.001***	0.001***
					(0.000)	(0.001)
Duration of current employment relation in years	0.020***	0.116***	0.019***	0.105**	0.021***	0.117***
	(0.001)	(0.043)	(0.001)	(0.043)	(0.001)	(0.042)
Duration of current employment relation in years^2	−0.000***	−0.029**	−0.000***	−0.025	−0.000***	−0.032**
	(0.000)	(0.016)	(0.000)	(0.016)	(0.000)	(0.016)
λ_M			−0.358***	−0.503***	−0.308***	−0.491***
			(0.048)	(0.116)	(0.052)	(0.143)
λ_{VM}			−0.015	0.328**	0.166***	−0.069
			(0.075)	(0.140)	(0.073)	(0.132)
λ_{REP}			−0.181***	0.284**	−0.193***	0.277**
			(0.006)	(0.125)	(0.007)	(0.127)
Constant	4.884***	6.346***	5.679***	5.225***	5.833***	5.687***
	(0.022)	(0.108)	(0.049)	(0.315)	(0.052)	(0.298)
Number of observations	41,760	801	41,760	801	41,760	801
F	1,674.26	19.299	1,545.03	31.352	1,725.44	39.553
AIC	38,171.33	6,821.121	37,052.91	6,547.717	40,537.92	6,499.453
BIC	38,352.76	7,945.727	37,260.26	7,781.29	40,693.43	7,483.483
Adj-R^2	0.4449	0.2322	0.4596	0.2607	0.4125	0.2597

Source: Author's calculations.

*Note: *** = statistically significant at the 1% level; ** = statistically significant at the 5% level; and * = statistically significant at the 10% level. Key to abbreviations: LR = likelihood ratio; AIC = Akaike's information criterion; BIC = Bayesian information criterion.*

person attended school in the U.K. or years since arrival if not). Moreover, a dummy variable is added for the presence of U.K. education if information on the duration of stay and year of graduation of a Polish immigrant in the U.K. indicates that an individual attended school or university in the U.K. The separate treatment of foreign labor market experience and education was inspired by previous results on the limited transferability of human capital capital between countries. Friedberg (2000) found significant differences to returns to source and host country education among Russian immigrants in Israel. Chiswick and Miller (2005, 2007) showed that those with foreign education and experience are at a disadvantage of those with human capital endowment acquired on the host labor market. Sanroma et al. (2008) provided similar evidence for immigrants in Spain.

Estimates of the wage regression parameters are generally similar for regressions non-accounting and accounting for selection effects (columns 1 and 3 of table 3) and with selection effects accounted for (column 3). In Poland, men earned more than women. Wages increased both with years of total and firm-specific experience. Once the wage regression is controlled for unobserved characteristics of workers, the effect of education on earnings appears slightly lower, even though increasing (and not decreasing) with years of experience for those in upper education groups. The selection term to staying is significantly different from zero, which implies a selection bias due to endogenous selection into staying. Interestingly, selection into employment does not enter the regression significantly, reflecting the strong correlations between two controlling variables. It follows that skills which increased employment probability should have remained in close relation with skills which outweighed the location decision of workers in favor of staying in their native country. Signs of the coefficient on the Mills ratio controlling regression for selective nonreporting of wages indicate that the higher income workers tended not to report wages.

In regressions on U.K. wages, without and with controlling for selection effects respectively (see columns 2 and 4 of table 3), country-specific variables on education and experience are statistically insignificant. However, at the same time the estimates indicate that the wage rate of Polish immigrants was a strongly increasing function of time spent in current employment, and the effect of firm-experience on wages was much more pronounced in the U.K. than in Poland. These results might be driven by strong correlation between country-specific and firm-specific experience of short-term migrants. The sample covers Polish born immigrants who arrived in the U.K. not earlier than three years before the reference week (most of the respondents had been staying in the U.K. for much longer at the time the interview was conducted). The time in current employment could simply overtake the joint effect of firm- and country specific-experience.

Similarly to the results on Polish wages, being a male had a positive impact on the wage earned by an employed. A positive impact of total experience on wages could be identified only in the specification where the endogeneity of the staying and working choice was explicitly taken into account. Returns to education for Polish immigrants seemed to be lower than returns to education at the source labor market. Still, immigrants with lower education earned less than the better educated, mostly due to age-related depreciation of their skills.

Interestingly there were meaningful differences in the pattern of dependency of wages on the number of hours worked on the two labor markets. Earnings increased monotonously with the number of hours worked in the U.K. but started to decrease after crossing a threshold of around 60 hours in Poland. On the one hand, this may reflect national differences in income taxation (and different degrees of tax avoidance for migrants and stayers). On the other hand, this suggests a stronger incentive to work more in the U.K. than in Poland. Finally, wages of Polish immigrants to the U.K. were roughly stable throughout 2004 to 2008 while continuing to trend upward in Poland.

6.5 Counterfactual Routes

Comparing earnings of migrants and stayers with measures that exploit counterfactual routes required a number of assumptions. In all predictions the number of hours worked is set to 40. Predictions are run on a selection term to reporting wages, with employment set to zero. Hence, for those reporting income and employment, predictions are systematically biased, even though they remain unbiased for the whole population of workers. These assumptions might be classified as normalization of predictions run on the estimated wage regressions.

Running counterfactual predictions also required taking assumptions about variables that are observed neither for migrants nor for stayers. These assumptions might have had a nonnegligible impact on final results, therefore we evaluate their robustness in the next section. It is assumed that migration or return migration is coupled with a depreciation of firm-specific human capital. Polish residents are assumed to have no firm-specific experience when entering the U.K. labor market, and no U.K.-specific experience, where the U.K. experience is fully portable.

Given my focus on short-term migration, assumptions taken in counterfactual routes were aimed at delivering "average" gains or losses from migrating or staying when the decision is made sequentially and independently in each period. Still, the measurement of wages expected at the point of entering the labor market in counterfactual predictions might be judged as unsatisfactory. I further discuss that issue in the next section and check the robustness of results to different assumptions about the time horizon taken into consideration by Polish workers when choosing a place of residence.

Measures of relative income and measures of rationality are expressed in nominal and real terms. Wage differences expressed in nominal terms might be thought to better correspond with the problem of rationality of temporary migration. However some share of migrants' income is supposed to cover the cost of living that depends on the host economy price level. Measures expressed in nominal and real terms might therefore be thought of as the "brackets" for the actual gains from migration (or staying). To calculate nominal measures, income on both labor markets is recalculated to euro. Measures in real terms are derived with reference to purchasing power parity (PPP) data and ratios of GDP deflator to private consumption deflator for the U.K. and Poland from the AMRO database.

Table 4

Wage Differentials Measured in Nominal Terms

Year	Earnings differences in observables	Earnings differential in favor of migrants (ex ante optimal)	Earnings differential in favor of migrants (ex ante nonoptimal)	Returns to migration	Sorting gains into migration	Selection into migration	Number of observations
Migrants							
2004	1.782	2.521	1.036	1.910	0.128	0.874	66
	(0.253)	(0.293)	(0.321)	(0.249)	(0.044)	(0.210)	
2005	1.626	2.331	0.923	1.752	0.125	0.829	182
	(0.235)	(0.283)	(0.259)	(0.225)	(0.036)	(0.186)	
2006	1.548	2.270	0.832	1.678	0.130	0.846	359
	(0.253)	(0.292)	(0.281)	(0.236)	(0.040)	(0.197)	
2007	1.458	2.190	0.725	1.587	0.129	0.862	570
	(0.281)	(0.330)	(0.293)	(0.260)	(0.042)	(0.212)	
2008	1.079	1.818	0.339	1.209	0.131	0.870	154
	(0.239)	(0.272)	(0.275)	(0.219)	(0.042)	(0.196)	
Pooled	1.477	2.204	0.752	1.606	0.129	0.854	1,331
	(0.309)	(0.345)	(0.333)	(0.294)	(0.041)	(0.203)	
Stayers							
2004	1.990	2.793	1.169	−1.837	0.153	−0.668	28,198
	(0.625)	(0.604)	(0.731)	(0.608)	(0.099)	(0.257)	
2005	1.884	2.673	1.074	−1.732	0.152	−0.658	30,759
	(0.650)	(0.611)	(0.778)	(0.638)	(0.098)	(0.269)	
2006	1.733	2.518	0.961	−1.602	0.131	−0.641	32,361
	(0.674)	(0.621)	(0.794)	(0.662)	(0.089)	(0.253)	
2007	1.643	2.436	0.861	−1.509	0.134	−0.648	27,433
	(0.698)	(0.642)	(0.823)	(0.686)	(0.091)	(0.261)	
2008	1.333	2.131	0.531	−1.190	0.143	−0.658	7,108
	(0.709)	(0.648)	(0.852)	(0.699)	(0.096)	(0.279)	
Pooled	1.785	2.578	0.989	−1.643	0.142	−0.654	125,859
	(0.686)	(0.644)	(0.802)	(0.672)	(0.095)	(0.261)	

Source: Author's calculations.

7 Results

7.1 Wage Differentials Explained by Observables

The earnings differentials in observables (see tables 4 and 5, column 1) would be a valid measure of rationality if migrants and stayers were randomly drawn from the native Polish population. Hence, this "wage gap" measure cannot be directly used as a basis for rationality testing but might imply the character of selection of emigrants and stayers in observables.

The market value of observable skills and characteristics of the average migrant was 140% higher in nominal terms and around 80% higher in real terms in the U.K. than in Poland. Returns from migration to observable characteristics of those who stayed in Poland would be even higher (160% in nominal terms and 90% in real terms respectively). The income of a randomly drawn Polish born worker might have been expected to roughly double after moving from Poland to the U.K.

Chart 1 plots the wage differentials in favor of migrants for employed Polish and U.K. residents, and chart 2 illustrates the corresponding returns to staying (see page 77). Returns to observables in nominal terms were significantly higher for all Polish workers abroad than at home. Only less than 2% of those who stayed

Table 5

Wage Differentials Measured in Real Terms

Migrants

Year	Earnings differences in observables	Earnings differential in favor of migrants (ex ante optimal)	Earnings differential in favor of migrants (ex ante nonoptimal)	Returns to migration	Sorting gains into migration	Selection into migration	Number of observations
2004	0.977	1.717	0.232	1.106	−0.676	0.759	66
	(0.250)	(0.281)	(0.330)	(0.246)	(0.071)	(0.209)	
2005	0.920	1.625	0.216	1.045	−0.581	0.710	182
	(0.234)	(0.281)	(0.260)	(0.224)	(0.041)	(0.187)	
2006	0.842	1.564	0.126	0.972	−0.576	0.693	359
	(0.252)	(0.292)	(0.281)	(0.236)	(0.042)	(0.198)	
2007	0.781	1.512	0.048	0.910	−0.548	0.699	570
	(0.276)	(0.324)	(0.291)	(0.255)	(0.056)	(0.211)	
2008	0.575	1.314	−0.165	0.705	−0.374	0.807	154
	(0.239)	(0.272)	(0.275)	(0.219)	(0.042)	(0.196)	
Pooled	0.802	1.529	0.077	0.931	−0.546	0.714	1,331
	(0.277)	(0.316)	(0.304)	(0.260)	(0.085)	(0.206)	
Stayers							
2004	1.146	1.949	0.325	−0.994	0.996	0.0529	28,198
	(0.621)	(0.601)	(0.728)	(0.605)	(0.115)	(0.261)	
2005	1.177	1.966	0.367	−1.025	0.860	−0.067	30,759
	(0.651)	(0.611)	(0.778)	(0.638)	(0.100)	(0.268)	
2006	1.030	1.815	0.258	−0.899	0.834	−0.088	32,361
	(0.674)	(0.621)	(0.794)	(0.662)	(0.090)	(0.254)	
2007	0.966	1.759	0.184	−0.832	0.811	−0.134	27,433
	(0.696)	(0.640)	(0.823)	(0.685)	(0.102)	(0.261)	
2008	0.828	1.627	0.027	−0.689	0.647	−0.217	7,108
	(0.709)	(0.648)	(0.852)	(0.699)	(0.096)	(0.279)	
Pooled	1.067	1.859	0.270	−0.924	0.861	−0.069	125,859
	(0.671)	(0.628)	(0.791)	(0.658)	(0.133)	(0.273)	

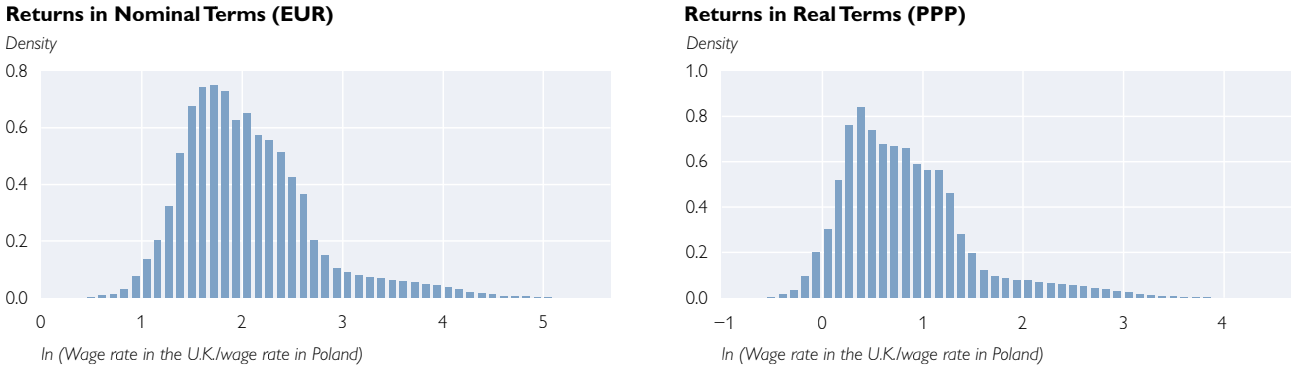
Source: Author's calculations.

had higher returns to their observable characteristics in Poland than they might have expected to get abroad. Interestingly, the predicted wage differences were weakly correlated with the expected return to observables on the home labor market (and strongly positively correlated with the predicted return to observable traits on the host labor market). The expected returns to observables did not systematically differ for those with different valuation of their skills and experience on the source labor market.

The average time differential in observables was shrinking throughout the period under consideration. The first factor that contributed to the falling nominal gains from emigration was the significant appreciation of the Polish currency toward the British pound (by almost 33% from Q1 2004 to Q1 2008). The second factor, which is reflected in the reduction of both nominal and real wage differentials, was the apparent divergence in the national wage growth trends. The average wage rate kept increasing in Poland while it was almost stable (for Polish immigrants) in the U.K.

Chart 1

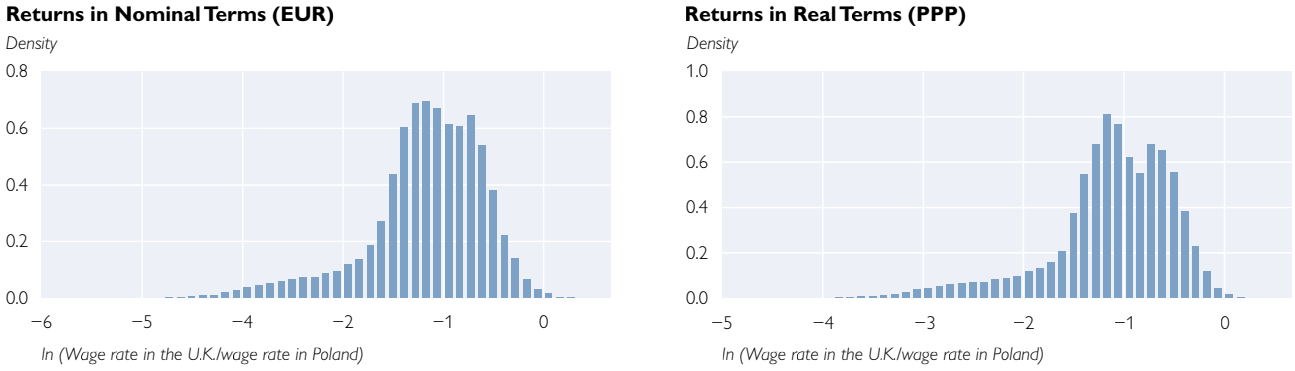
Returns to Migration



Source: Author's calculations.

Chart 2

Returns to Staying



Source: Author's calculations.

7.2 Wage Differentials with Endogenous Selection

The gap between average wages predicted for Polish migrants to the U.K. and for Polish residents by accounting for returns to unobservables is significantly higher than the wage gap we would find for migrants randomly drawn from the population. A measure comparing the experience of average migrants and average nonmigrants indicates a wage gap between the U.K. and Poland in a range of 180% to 250% (nominal terms) or 130% to 170% (real terms). The pronounced gap between wage differentials in favor of migrants and differences in the "wage norm" reflect the importance of unobserved heterogeneity as a determinant of wages.

When the skills of those whose observable and unobservable traits paid off better in Poland are priced according to U.K. standards, and vice versa – assuming adverse (nonoptimal) selection of migrants (see tables 4 and 5, column 3) in order to compare foregone earnings – I find a strong income advantage for migrants over stayers in nominal terms and less so in real terms. Time trends in the measures of ex ante optimal and ex ante nonoptimal income differentials resemble trends observed in the wage differences. The earnings differential in favor of migrants was positive but strongly declining.

7.3 Effects of Migration on Wage Income

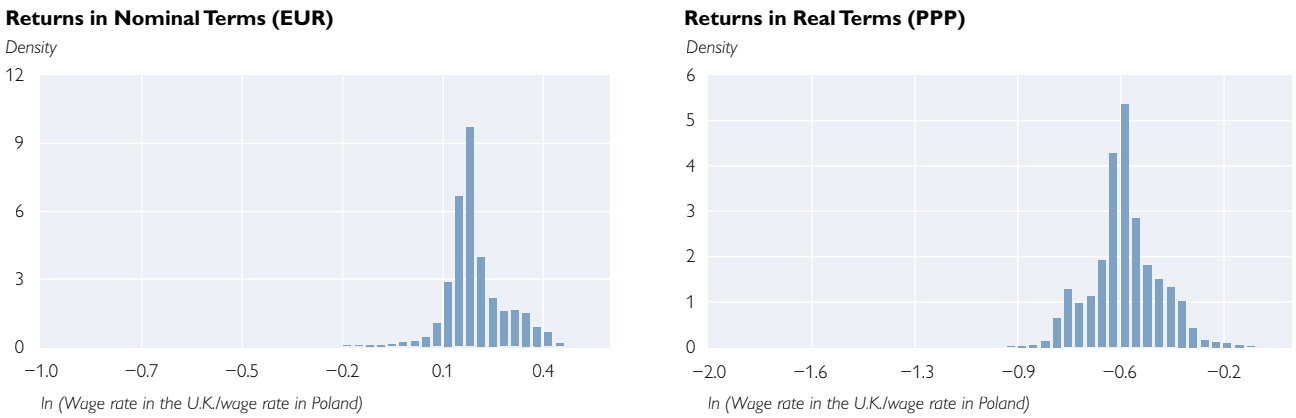
As is evident from chart 1, the distribution of the returns to migration, reflecting the market value of migrants' unobservable traits abroad, is clearly skewed to the right, namely above zero both for nominal and real values. The result is hardly surprising as the dominant share of the returns to migration is tied to the returns to the observable characteristics, which were strongly positive for migrants. The difference in the valuation of migrants' unobservable characteristics was significantly positive for most migrants in nominal terms (yet negative in real terms; see chart 3).

While the returns to staying (see chart 2) were overwhelmingly negative, the difference in the valuation of nonobservable skills between home and destination labor markets was positive for the entire subpopulation of nonmigrants (see chart 4). Hence, the returns to staying turned negative mostly due to the lower value their observable skills would have abroad.

The second measure of rationality proposed in this paper refers directly to nonobservable skills and is more restrictive. It is based on the presumption that

Chart 3

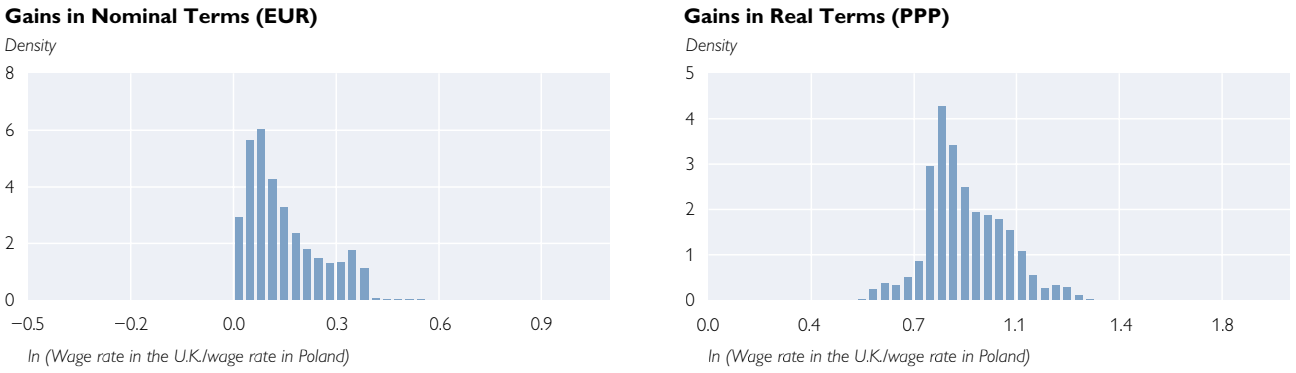
Sorting Gains into Migration



Source: Author's calculations.

Chart 4

Sorting Gains into Staying

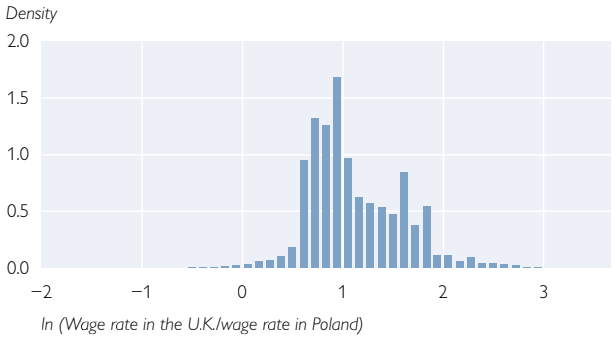


Source: Author's calculations.

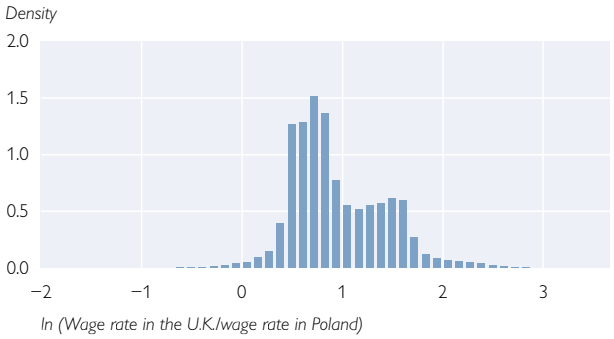
Chart 5

Selection into Migration

Selection in Nominal Terms (EUR)



Selection in Real Terms (PPP)

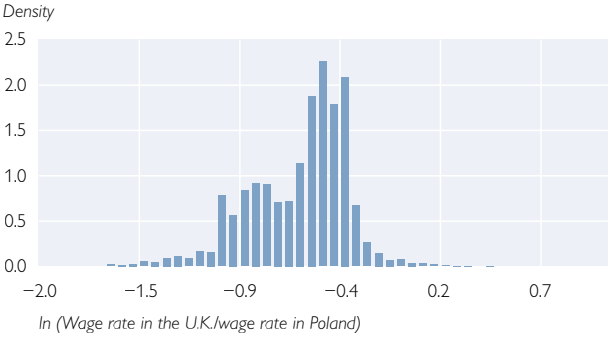


Source: Author's calculations.

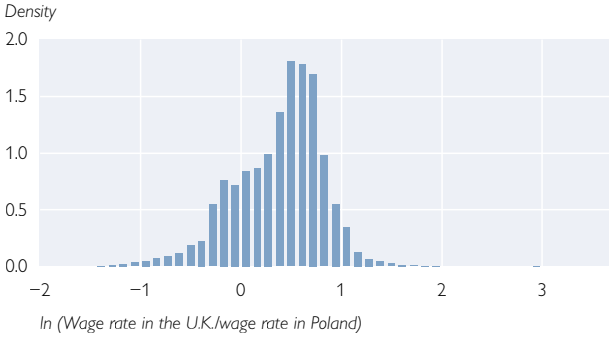
Chart 6

Selection into Staying

Selection in Nominal Terms (EUR)



Selection in Real Terms (PPP)



Source: Author's calculations.

out of two observationally equivalent workers, the one who actually migrates might expect higher gains than the other. Analogously, the worker who stays on the home labor market stands to earn more at home than the migrant would have earned at home. Therefore, observationally identical workers are optimally selected between labor markets. In this respect, the results are strongly supportive for the rationality of migration decisions. Chart 5 illustrates the selection into migration in nominal and real terms, which was significantly higher than zero for all migrants. The rationality test is less conclusive about the rationality of stayers (see chart 6). Only a negligible fraction of stayers recorded a positive selection into staying in nominal terms. Still, selection to staying proved to be positive for around 50% of stayers in real terms.

8 Discussion of Results

The robustness of earlier results was checked in respect of the underlying data and assumptions about the time horizon relevant for cross-country income comparison. Given the limited comparability of the respective education systems, the education level of Polish immigrants in the U.K. was imputed based on Polish

household survey data. Conclusions from the estimated selection models and the wage regressions run on the education level approximated by years in education remain in parallel with results with dummy education variables. Similarly, the rationality of migration and staying measures closely resemble outcomes reported earlier.

Throughout the analysis I maintained the simplifying assumption that the migrate-or-stay decision reflects anticipated earnings differences on the two labor markets for the reference period. This route is a useful working device for analyzing temporary migration. However, it is possible that some migrants (and stayers) in the sample were, at the point of forming anticipations, in fact considering to stay abroad for a longer period. Moreover, returns particularly to human capital accumulated abroad increase sharply within the first years of stay. To check the robustness of the results to changes in assumptions about the time horizon I calculated the expected discounted streams of income over two years and three years on the two labor markets.[14] Based on income differentials and rationality measures thus recalculated, the conclusions about the rationality of migrating or staying remained broadly unchanged, however. The statistics strongly support the rationality of migration to the U.K. while leaving the rationality of staying unsettled. The selection into staying indicated that a significant share of the stayers indeed took an optimal decision, whereas evidence on the returns to staying contradicted such a conclusion.[15] Still, in the exercise no account was taken of the fact that the optimal strategy may consist of repeat migration, where country-specific human capital is accumulated during consecutive stays abroad.

Negative returns to staying for a high share of Polish-born (and strongly positive returns to migration) may be tied to biased anticipations due to information frictions. Individuals that were misinformed about wages and job opportunities in the U.K. may have undercounted possible gains from moving, as suggested by Tunali (2000). Another restriction likely to bias gains of migrants upward and gains of stayers downward is the fact that, while accounting for costs tied to a loss of value of accumulated human capital and education, I largely ignored the fixed costs of relocating to a new place. These were assumed to be a negligible fraction of the total earnings, which seemed plausible given low cost flights and bus tickets, job agencies as well as evolving migrant networks in the U.K. Violation of either of these assumptions can lead to a rejection of the rationality hypothesis even though Polish workers were indeed income maximizers. When the impact of biased anticipations on the results may be generally ambiguous, the absence of fixed migration costs could render misleadingly favorable results for the rationality of migration and against the rationality of staying.

[14] *The discount rate of 5% was assumed. Individuals were supposed to stay with the same employer for the relevant time horizon.*

[15] *The other possibility to check robustness of the results and render some additional insight into the dynamic aspect of migrate-or-stay decisions would be to use available data to calculate the expected wage rate in the reference period as well as the expected growth rate of wages within a year and use both values to establish the expected gain of a migrant or a stayer one year ahead. This approach would correspond with the one which was actually implemented to calculate the expected income streams over a year to the degree to which cross-section data on workers appropriately reflect the dynamic dimension of wage gains on source and host labor markets. However, a dataset of longitudal observations on wages (foremost for Polish migrants in the U.K.) was too narrow to be used in the exercise.*

If neither of the assumptions is strongly violated, the rationality-of-staying choice may be questioned. Factors other than economic considerations may prevent a stronger outflow of labor force from Poland. The new theory of migration underlines the importance of family and community effects. Polish workers may be faced with high noneconomic costs of migration, a need to leave family and friends and the need to adapt, at least temporarily, to a new environment. Further, workers may care not only about earnings but also about job status, and migration often involves a downgrading of the latter. These factors may outweigh economic gains attached to migration.

9 Summary and Conclusions

In this paper I establish the importance of expected earnings gains in driving cross-border migration and in the process of selecting those who stay. The rationality of international migration was verified using data on Polish-born workers resident in Poland or the U.K. following Poland's accession to the EU in 2004. Anticipated earnings gains were approximated by national differences in predicted wages. Wages were derived using a switching regression model with double selectivity regarding emigration and employment. Direct treatment of the simultaneity of employment and location choices constitutes a novel feature of the study. This allowed us to extend the rationality test to workers who were unemployed either before or after migration. Following a method proposed by Tunali (2000) to identify the actual and counterfactual returns to nonobservable skills based on the correlation of emigration probability with differences in valuation of the complete set of skills of individuals, the measures used to scrutinize the rationality hypothesis encompass the expected income gains from nonobservables.

The results robustly validate the hypothesis of rationality of migration. Even though the returns to education are flat across education groups for Poles resident in the U.K. and steeply increasing with both education levels and experience in Poland, the lion's share of those who temporarily emigrated from Poland between 2004 and early 2008 benefited from the move in nominal and real terms. Testing the rationality-of-staying decision did not deliver unambiguous answers. Stayers could on average expect to reap higher returns abroad than at home. However, among observationally identical workers, a great share of those who stayed would possibly have earned more at home than those who emigrated. Moreover, even though not in themselves constituting an argument for the rationality of staying, returns to the unobserved characteristics were clearly higher on the home labor market than on the foreign labor market for stayers.

The preferred interpretation of unequivocal results on the sorting efficiency of labor market mechanisms refers to noneconomic costs of migration. Workers are not only income maximizers but may also attach high values to family and friendship networks and factors such as job status they are likely to loose when migrating. These noneconomic costs have to be taken into consideration when modeling migration movements. Establishing their importance and proposing policies that address these barriers for labor force movement might prove a fruitful avenue for further research on intra-EU migration.

References

Aydemir, A. 2002. Effects of Selection Criteria and Economic Opportunities on Characteristics of Immigrants. Statistics Canada Research Paper 182.

Barrett, A. and E. Kelly. 2008. Using Census to Assess the Reliability of a National Household Survey for Migration Research: the Case of Ireland. IZA Discussion Paper 3689.

Behrman, J.R., B.L. Wolfe and F.I. Tunali. 1980. Determinants of Women's Earnings in a Developing Country: A Double Selectivity Extended Human Capital Approach. Institute for Research on Poverty Discussion Paper. 596–80.

Blinder, A.S. 1973. Wage Discrimination: Reduced Form and Structural Estimates. In: The Journal of Human Resources 4(8). 436–455.

Borjas, G.J. 1987. Self-Selection and the Earnings of Immigrants. In: American Economic Review 77. 531–553.

Cappellari, L. and S.P. Jenkins. 2006. Calculation of Multivariate Normal Probabilities by Simulation, with Application to maximum Simulated Likelihood Estimation. IZA Discussion Paper 2112.

Chiquiar, D. and G.H. Hanson. 2002. International Migration, Self-Selection, and the Distribution of wages: Evidence from Mexico and the United States. Mimeo.

Chiswick, B.R. and P.W. Miller. 2005. Why Is the Payoff to Schooling Smaller for Immigrants? IZA Discussion Paper 1731.

Chiswick, B.R. and P.W. Miller. 2007. The International Transferability of Immigrants' Human Capital Skills. IZA Discussion Paper 2670.

Cobb-Clark, D.A. 1993. Immigrant Selectivity and Wages: The Evidence for Women. In: The American Economic Review 83(4). 986–993.

Constant, A. and D. Massey. 2003. Self-Selection, Earnings, and Out-Migration: a Longitudal Study of Immigrants to Germany. In: Journal of Population Economics 16. 631–653.

Dostie, B. and P.T. Leger. 2006. Self-Selection in Migration and Returns to Unobservable Skills. Cahier de Recherche IEA–06–01.

Friedberg, R.M. 2000. You Can't Take It with You? Immigrant Assimilation and Portability of Human Capital. In: Journal of Labour Economics 18(2). 221–251.

Heckman, J.J. 1979. Sample Selection Bias as a Specification Error. In: Econometrica 47(1). 153–161.

Kaun, D.E. 1970. Negro Migration and Unemployment. In: The Journal of Human Resources 5(2). 191–207.

Mishra, P. 2007. Emigration and Wages in Source Countries: Evidence from Mexico. In: Journal of Development Economics 82.

Oaxaca, R. 1973. Male-Female Wage Differentials in Urban Labor Markets. In: International Economic Review 14. 693–709.

Rabe, B. 2006. Dual-Earner Migration in Britain: Earnings Gains, Employment, and Self-Selection. ISER Working paper 2006–01.

Sanroma, E., R. Ramos and H. Simon. 2008. The Portability of Human Capital and Immigrant Assimilation: Evidence for Spain. IZA Discussion Paper 3649.

Tunali, I. 1986. A General Structure of Models with Double-Selection and an Application to Joint Migration/Earnings Process with Remigration. In: Research in Labour Economics 8B. 235–283.

Tunali, I. 2000. Rationality of Migration. In: International Economic Review 41(4).

Vijverberg, W.P.M. 1995. Dual Selection Criteria with Multiple Alternatives: Migration, Work Status, and Wages. In: International Economics Review 36(1).

Zaiceva, A. 2006. Reconciling the Estimates of Potential Migration into the Enlarged European Union. IZA Discussion Paper 251.

Appendix

Measure	Expression	Relevant subpopulation
Wage differences in observables	$(\hat{\alpha}_1 - \hat{\alpha}_0)\, x(i)$	All
Wage differentials in favor of migrants (ex ante optimal)	$(\hat{\alpha}_1 - \hat{\alpha}_0)\, x(i) + \hat{\varphi}_{1,1} \hat{\lambda}_{M=1}(i) - \hat{\varphi}_{0,1} \hat{\lambda}_{M=0}(i)$	All
Wage differentials in favor of migrants (ex ante nonoptimal)	$(\hat{\alpha}_1 - \hat{\alpha}_0)\, x(i) + \hat{\varphi}_{0,1} \hat{\lambda}_{M=1}(i) - \hat{\varphi}_{0,0} \hat{\lambda}_{M=0}(i)$	All
Returns to migration	$(\hat{\alpha}_1 - \hat{\alpha}_0)\, x(i) + (\hat{\varphi}_{1,1} - \hat{\varphi}_{0,1}) \hat{\lambda}_{M=1}(i)$	Migrants
Returns to staying	$(\hat{\alpha}_0 - \hat{\alpha}_1)\, x(i) + (\hat{\varphi}_{0,1} - \hat{\varphi}_{1,1}) \hat{\lambda}_{M=0}(i)$	Stayers
Sorting gains into migration	$(\hat{\varphi}_{1,1} - \hat{\varphi}_{0,1}) \hat{\lambda}_{M=1}(i)$	Migrants
Sorting gains into staying	$(\hat{\varphi}_{0,1} - \hat{\varphi}_{1,1}) \hat{\lambda}_{M=0}(i) + (\hat{\varphi}_{0,0} - \hat{\varphi}_{1,0}) \hat{\lambda}_{V_0=1}(i)$	Stayers
Selection into migration	$\hat{\varphi}_{1,1} (\hat{\lambda}_{M=1}(i) - \hat{\lambda}_{M=0}(i))$	Migrants
Selection into staying	$\hat{\varphi}_{0,1} (\hat{\lambda}_{M=0}(i) - \hat{\lambda}_{M=1}(i))$	Stayers

Let $\hat{\alpha}_M$, $\hat{\varphi}_{M,M'}$ with $M,M' \in \{0,1\}$ be the estimated coefficients of (22) and (23). Further let $\hat{\lambda}_{M=0}$, $\hat{\lambda}_{M=1}$, $\hat{\lambda}_{V_0=1}$ and $\hat{\lambda}_{V_1=1}$ be variables measuring selection effects to unobservables derived based on x and estimated parameter of wage equations.