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ECONOMIC ASSIMILATION AND OUTMIGRATION OF IMMIGRANTS IN WEST-GERMANY

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Economic Assimilation and Outmigration of Immigrants in West-Germany*

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Abstract

By analyzing earnings of observed immigrants workers, the literature on the economic assimilation of immigrants has generally overlooked two potentially important selectivity issues. First, earnings of immigrant workers may differ substantially from those of non-workers. Second, earnings of immigrants who do not return to their native country may differ from earnings of outmigrants. Economic theory has contradictory predictions on the signs of these potential selection biases. This paper uses data drawn from 8 waves of the German Socio-Economic Panel and estimates a three-equation model of income, work and outmigration decisions taking into account time-invariant unobserved heterogeneity across individuals. We find strong evidence in favor of negative outmigration selection in both the earnings and work equations. Simulation results show that the magnitude of the outmigration bias is important.

JEL Codes: J24, J61
Keywords: Economic Assimilation, Return migration.

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1 Introduction

One important policy parameter in the immigration literature concerns the measurement of the convergence rate of earnings between immigrants and natives, formally referred to as the economic assimilation rate. The importance of this measure are numerous. First, the economic benefits of immigration for a host country crucially depends on the earning differentials of natives and immigrants (Borjas, 1999). Second, successful assimilation leads to a reduction in earnings inequality in the host economy as immigrants generally tend to be located at the bottom end of the host country income distribution. Third, successful economic assimilation indicates that the labor market of the host economy can absorb the labor force expansion that results from immigration.[1] Finally, it has recently been argued that economic growth can be positively linked with the social diversity of a nation's inhabitants (Lazear, 1998; Durkin Jr., 1998).

Shultz (1998) recently pointed out that most studies estimating the economic assimilation rate of migrants have two important shortcomings.[2] First, most of these studies focus on earnings or wages of working migrants. This is of concern as there are a variety of reasons to think that the rules governing self-selection into the labor market may differ between natives and immigrants. One may think of returns to education and to labor force experience of immigrants which differ from those of natives. As these differences are likely to generate different tradeoffs between leisure and consumption, selection into work may be very different in both groups. If selectivity into work is correlated with labor market earnings, differential labor selectivity processes will lead to inconsistent estimates of the assimilation rate.

Second, most empirical studies do not take into account of outmigration, whereas some immigrants return to their native country after some time abroad.[3] The theoretical literature generally models outmigration as an optimal decision resting on the savings behavior of the migrants, their investment in human capital accumulation in the host country and the relative wage differentials between host and home country. The motivation for outmigration can be justified on several grounds: higher marginal utility of consumption in the home country (Dustmann and Kirchkamp, 2002; , Stark, Helmstein and Yogorov, 1995), high returns to human capital investments in the host country (Dustmann (1997)) and information dissemination (Stark, 1995;1998). Stark (1998) surveys the recent sociological literature on outmigration and adds to the list of factors shown to be correlated with outmigration whether or not the spouse or children live outside the host coun-

[1] Dustmann (1996) analyzes the social assimilation of immigrants in Germany.

[2] For an historical overview on the measurement of the assimilation rate see Borjas (1999).

[3] Part of the return migration literature focuses on the performance of outmigrants in their home economy upon remigration (e.g. Co, Gang and Yun, 2000 ; Dustmann and Kirchkamp, 2003).

try, health satisfaction and integration perceptions . These results imply that outmigrants may be immigrants with above average earnings, or the less successful immigrants with below average earnings.

Because the econometric techniques to test for selectivity bias are now well established[4], it might seem surprising that few results exists on the presence, direction and magnitude of work and outmigration selectivity and its effect on the measurement of economic assimilation. We believe that two reasons can explain the lack of empirical evidence.

First, most studies have adopted the framework of Borjas (1985) who used repeated cross sections of data to infer the assimilation rate of immigrants in the United States. These repeated cross-sections pose substantial challenges in the presence of work and outmigration selectivity as the composition of cohorts change over the years. More importantly, it does not allow to model work and outmigration based on individual specific time-varying and time invariant characteristics of immigrants. Hu (2000) compares assimilation rates of immigrants living in the United States using two data sources, a series of repeated census based data sets and a longitudinal sample from the Health and Retirement Survey (HRS) not subject to outmigration. Using quantile regression techniques, Hu finds significant negative outmigration selectivity, which indicates that outmigrants are drawn from the bottom end of the host country's income distribution. One drawback of Hu's analysis is that he does not control for individual unobserved heterogeneity, primarily due to the lack of guidance in controlling for unobserved heterogeneity in quantile regressions models. Failing to take into account of unobserved heterogeneity in nonlinear models can lead to biased and inconsistent estimates of the model parameters (see Cameron and Heckman, 1998 for a nice proof of this result). Furthermore, his estimates do not take into account of work selectivity which, as argued above, may lead to biased estimates of the assimilation rate. Closely related to the current paper is Dustmann (1993) who studies economic assimilation of temporary and permanent immigrants living in West-Germany. Using one wave of the immigrant sample of the German Socio-Economic Panel (GSOEP), he finds that outmigrants have less incentives to invest in human capital than permanent immigrants. These lower investments may not be sufficient to these migrants' earnings to catch up with those of native workers and would lead to conclude to a lack of assimilation. Again, the use of a single cross-section of data prevents any test of work and outmigration selectivity.

Second, part of the scarcity of empirical tests of outmigration bias can be attributed to the mere fact that it is reliable indicator of individual outmigration. Borjas and Bratsberg (1996) proxy

[4]Pagan and Ullah (1999) present an overview of parametric and semiparametric methods to control for selectivity.

return migration with observed sample attrition . Since outmigration is embedded in panel attrition, this could lead to biased and inconsistent estimates of the underlying model parameters (See Bound et al. 2001 for a survey of this literature.). In other cases, identification of outmigration rests on comparisons of descriptives of cohorts across censuses. Jasso and Rosenzweig (1990) heuristically document the importance of return migration in the U.S. but do not have direct information on the magnitude or direction of return migration selectivity in terms of earnings.

This paper is a first attempt to test for the presence, direction and magnitude of work and outmigration selectivity and to document its impact on immigrant assimilation. Our methodology can briefly be summarized as followed. First, an econometric model where labor market earnings, labor force participation and outmigration are modelled jointly is estimated, controlling for unobserved heterogeneity at the individual level. In this paper, panel attrition is taken as a proxy for outmigration. Second, we propose a new and simple way to deal with the problem that panel attrition partially reveals outmigration. Specifically, our empirical model nonparametrically identifies and estimates the probability that panel attrition may be confounded with outmigration and provides estimate of the outmigration process and its impact on earnings and work. The implications of this partial observability on model estimates are also discussed. Third, we estimate the model using 8 waves of the German Socio-Economic panel which contains detailed information on labor market and sociological factors believed to be related with outmigration. By allowing outmigration to be related to economic and sociological variables, we contribute to the understanding of the interplay between economic success and social integration of immigrants living abroad.

Our main findings are the following. First, there is a strong negative outmigration bias affecting both work propensities and labor market earnings. simulation results indicate that average log earnings of outmigrants remained roughly 18% lower than those of immigrant stayers, a clear indication that outmigrants are drawn from the bottom of the income distribution. Second, our empirical model estimates the annual outmigration rate to be of roughly 3% per annum, a figure in line with those commonly found in the migration literature.

The rest of this paper is organized as follows. Section 2 sketches the state of immigration in Germany and the historical policies that have been implemented to favor and curb immigration flows. It also presents the data used in the paper. Section 3 presents the econometric model used to model outmigration in conjunction with the work decision and labor market income. Section 4 discusses the empirical results of the model and tests for the presence of outmigration bias. Section 5 presents some simulation results to quantify the impact of outmigration selectivity. Section 6 concludes.

2 Background and Data

The historical inflow of immigrants in Germany has never been stable. The period of post-war adjustment saw a tremendous decolonization of former Soviet economies. For example, 12 million Germans left eastern Europe by 1950, with 8 million coming to West-Germany (Zimmermann, 1995; pp.46). Between 1955 and 1973, the strong economic development across northern Europe paved the way to an increase demand for labor and led to a large inflow of migrants mainly from the southern European countries and Turkey. The percentage of foreign born workers employed in West-Germany increased from 0.6% in 1957 to 11.2% in 1973.

Bilateral recruitment agreements between Germany and Italy, Spain, Greece, Turkey, Portugal and Yugoslavia in the 1950s and 1960s reduced the migrants' cost of migration considerably: workers entered Germany with a 1 year working contract, they could not be dismissed during the first year, travel costs we reimbursed, and employers had to provide accommodation. After the oil shock in 1973, recruitment stopped, but families and dependents of the immigrants living in Germany continued to flow in. In 1984, in light of difficult labor market conditions, the government issued a repatriation scheme which gave financial incentives to outmigrate. The scheme consisted of reimbursement of travel costs to any immigrant living in Germany who wished to return to his home country. In 1999, the Nationality Act was amended with the objective to facilitate the naturalization of foreigners entering the country and to adapt immigration flows to the requirements of the German economy (OECD, 2001). One immediate action of the government was to vote the Nationality Code in July 1999. This code attempts to make it easier for foreigners to obtain the German nationality.

The data used in this paper is taken from the public use file of the German Socio-Economic Panel and covers the 1984-1999 period. The data consists of several subsamples which were drawn at different points in time and for different purposes. Until 1990, the GSEOP data was separated into two subsamples, A and B. Sample A consists of households with German heads living in the former West-Germany. Sample B consists of an oversample of immigrants living in West-Germany coming from countries which had signed a bilateral migration agreement with Germany in the 1950s and 1960s namely Greece, Italy, Spain, Turkey and Yugoslavia[5]. Data on speaking fluency, integration feelings of immigrants, intended length of stay and remittances directed to their family

[5]Immigrants of Portuguese nationality were not included in the panel.

living outside Germany where given in consecutive waves from 1984 until 1987. Starting in 1987, this information was gathered every other year. In order to keep constant the time period between observations, we have chosen to keep the 8 waves of the panel coinciding with full information waves, each spanned by one year, starting in 1985 and ending in 1999. Following the literature measuring the economic assimilation rate (e.g. Borjas, 1985,1999; Hu, 2000), we restrict our attention to males between 18-64 between 1984 and 1999. Excluded from the sample are individuals who died during the observation period and individuals who gave incomplete information on any single variable entering the empirical model in any of the 8 waves. This leaves us with a sample of 1987 native Germans and 732 immigrants starting in 1985.

Sample attrition over time is a prominent feature of this data. Table 1 contains information on the number of individuals observed along with the percentage of the original 1985 subsample who remains in a given wave. We can see from table that 41,9% of Germans and 26,7% of immigrants who were present in the panel remained remained in 1999. The wave specific attrition rate is defined as the percentage of individuals not observed in a wave but which were observed in the previous wave. Over our sample period, an average of 11% of the remaining Germans and 17% of immigrants drop out of the panel every two years. In the case of Germans, outmigration is de facto not an issue. For immigrants, distinguishing which amount of drop outs constitute real panel attrition from outmigration is difficult. Assuming immigrants have the same rate of normal attrition than Germans, our data indicates an outmigration rate of roughly 6% every two years, or 3% per annum. This number is in line with those reported by Borjas and Bratsberg (1996) for outmigrants living in the U.S.

Figure 1 shows the sample frequencies of individuals reporting working in the month preceding the interview. We can see that until 1991, labor force participation was very similar for both Germans and immigrants. After 1991, we observe a steady decline in the work frequencies for both sub-groups. During that period, the work frequency of immigrants remained steadily below that of Germans. The severe drop in work frequencies for both subgroups coincides with the general deterioration of the labor market in the regions of former West-Germany. Table 2 gives the unemployment rate per year by state. With the exception of Berlin whose best performance occurred in 1989, all provinces experienced their lowest unemployment rate of the 1985-1999 period in 1991. After 1991, the unemployment rate has progressively risen apart from a slight fall in 1999 for most landers, except Berlin and Bavaria. These figures explain part of the general decrease in work frequencies but they do not account for the divergence in work activity between Germans and immigrants which, as for earnings, seems to widen over the years.

The diverging economic progress of Germans and immigrants after 1991 is also reflected in the monthly income data. Figure 2 shows the average monthly gross income given for working immigrant and natives over the period covered. At the start in 1985, the mean income of Germans was 3357 DM per month compared to 2690 DM per month for immigrants, giving an income ratio of 1,25 favoring Germans. This mean wage differential remaind relatively steady until 1991, after which, the mean income differential widened even more between the two groups to reach a ratio of 1,34 in 1999, with Germans receiving an average monthly wage of 5848 DM while immigrants were receiving 4348 DM per month.

Table 3 gives variable descriptions and summary statistics for both groups for the 1985 and 1999 waves. Germans and immigrants are on average of similar age. For a given mean age, Germans have acquired more years of education at the expense of lower labor market experience relative to immigrants. The table also shows several variables argued above to be correlated with the return migration behavior. We find that on average age at immigration was approximately 24 years and this seems rather consistent through out the observation period. This implies that most of our immigrants were adults when migration occurred and hence, they are likely to have taken themselves the migration decision. Reported integration feeling and reported speaking fluency improve over time while health satisfaction seem to deteriorate. This could be due to an aging effect. Immigration year does not change for a given individual in the panel. We find that between 1985 and 1999, immigrants who have immigrated the earliest tend to have dropped out of the panel. This is consistent with the finding that average outmigration movements occurs 20 years after migration (OECD, 2002), which for the sample at hand, occurred somewhere between 1985 and 1999. Family structure variable show a diverging patten between both waves. While 73% of immigrants reported having a spouse living outside Germany, a mere 1% report this still being the case in 1999. On the one hand, this could reflect the fact that spouses eventually migrated to Germany during the time period or that immigrants whose spouse was living abroad outmigrated. Reported children living outside Germany also shows this pattern as 14% of the immigrants reported having children of that age. This dramatic fall could simply reflect the fact that over this long period, these children became adults. another explanation would be that immigrants with children living abroad were more likely to return and leave Germany.

3 Model and Estimation Method

We have a random sample of N immigrants in the first period of observation, and each individual i remains in the panel for a T_i periods. In each period t, we observe an immigrants labor market status, his monthly earnings if he works, and whether or not he will drop out of the panel at time $t+1$. The data for Germans is simpler as it simply consists of work and monthly earnings given work. In this section, we present in detail the model for any sequences of observed outcomes of immigrants. The likelihood of a particular sequence of outcomes for Germans is a special case and will not be discussed. We then discuss the economic implications of the model. The section ends with a description of the estimation of the log-likelihood function.

An immigrants labor market earnings w_{it} is assumed to be generated by a mincerian earnings equation

$$w_{it} = \exp\left[\mathbf{x}_{it}'\beta + \eta_i^1 + \varepsilon_{it}^1\right] \tag{1}$$

where $\mathbf{x}_{it}$ is a vector of observed characteristics, β are unknown population constants, η_i^1 is a unobserved time invariant individual specific component of income while ε_{it}^1 represents a stochastic shocks. The earnings of immigrants are only observable when the immigrant work in a given period.

An individuals' labor force participation p_{it}, is assumed to be generated by a latent unobserved process

$$p_{it}^* = \mathbf{z}_{it}'\theta + \eta_i^2 + \varepsilon_{it}^2 \tag{2}$$

where $\mathbf{z}_{it}$ is a vector of observed characteristics, θ are unknown population constants, η_i^2 is an unobserved idiosyncratic component of work and ε_{it}^2 represents some stochastic shocks to the labor market. Participation is observed according to the observation rule $p_{it} = 1\left[p_{it}^* > 0\right]$. When $p_{it} = 1$, earnings w_{it} are observed. Both η_i^1 and η_i^2 can be thought of capturing immigrants unobserved ability to generate higher earnings and to find jobs yielding wages above his reservation wage.

Finally, an immigrants unobservable outmigration propensity r_{it}^* is assumed to be generated by the following equation

$$r_{it}^* = \mathbf{s}_{it}'\gamma + \eta_i^3 + \varepsilon_{it}^3 \tag{3}$$

where $\mathbf{s}_{it}$ are observed factors influencing outmigration, γ are unknown population constants, η_i^3 captures the individual's individual specific attachment to his native country and ε_{it}^3 captures random shocks.

In the three equations above, we assume that the triplet $\left\{\eta_i^1, \eta_i^2.\eta_i^3\right\}$ is observed by the immigrants but not by the econometrician.

Let $r_{it}^u = 1\left[r_{it}^* > 0\right]$ be the true but unobserved outmigration indicator which takes a value of 1 when the immigrant decides to return in the period $t+1$ and 0 otherwise. In most panel data sets, we observe r_{it}^{o}, whether an immigrant drops out of the panel, but not r_{it}^{u}, whether he returns to his native country. To the extent that a significant amount of those immigrants who leave the panel do not leave Germany, the attrition indicator partially reveals the true unobserved outmigration indicator. We address the issue of partial observability by first noting that the probability of attrition can be reexpressed as a weighted average of the probabilities of non outmigration and outmigration

$$\begin{aligned}\Pr\left(r_{it}^{o}=1|\mathbf{s}_{it},\eta_i^3\right) &= \Pr\left(r_{it}^{o}=1|r_{it}^{u}=1\right)\cdot\Pr\left(r_{it}^{u}=1|\mathbf{s}_{it},\eta_i^3\right)\\ &\quad+\Pr\left(r_{it}^{o}=1|d_{it}^{u}=0\right)\cdot\Pr\left(r_{it}^{u}=0|\mathbf{s}_{it},\eta_i^3\right)\end{aligned}$$

$\Pr\left(r_{it}^{o}=1|r_{it}^{u}=1\right)$ is set to 1 since an immigrant who returns must always leave the panel. On the other hand, $\Pr\left(r_{it}^{o}=1|r_{it}^{u}=0\right)=\alpha_{10}$ implies that there is a positive probability that an immigrant drops out of the panel given he stays in Germany. This parameter will be incorporated directly in the likelihood function below and is nonparametrically identified from limit observations who have close to zero probability of returning to their native country as $\lim\limits_{r_{it}^{*}\to-\infty}\Pr\left(r_{it}^{o}=1|\mathbf{s}_{it},\eta_i^3\right)=\alpha_{10}$.[6]

The earnings, work and outmigration outcomes are not likely to be independent of each other. This will be case if, for example, immigrants who finds work very easily and/or who earns a high income are more reluctant to outmigrate. Furthermore, there can be intertemporal dependencies between and across equations. The vector of unobserved heterogeneity terms $\left[\eta_i^1,\eta_i^2,\eta_i^3\right]'$ can be treated either as fixed unknown constants or as random variables. The main advantage of the fixed effect approach does not require that included explanatory variables be strictly exogenous to unobserved heterogeneity. However, estimation of fixed effects in nonlinear models remains today a sizeable complication, with very little guidance in the choice of models (see the recent review of Arrelano and Honore, 2002). A second drawback of fixed effect estimation is that by treating the unobserved heterogeneity components as fixed, cross equation correlations which drive selection bias in our model are not identified. As the present paper is mainly concerned with selection issues, fixed effect estimation would limit our insights in the type of selections present in the data. We therefore introduce these dependencies via the stochastic time-invariant effects, which we assume

[6]The is mathematically equivalent to the class of discrete choice models where the endogenous discrete outcome is either misclassified or misreported. Recent applications of these models include regime switching models (Lee and Porter, 1984), work status (Hausman et al., 1998), reported speaking fluency (Dustman and van Soest, 2001) and work transition data (Abrevaya and Hausman, 2001)

to be independently normally distributed over time with mean 0 and covariance matrix Ω where

$$\mathbf{\Omega} = \begin{bmatrix} \sigma^2_{\eta^1} & \rho^{\eta}_{1,2}\sigma_{\eta^1}\sigma_{\eta^2} & \rho^{\eta}_{1,3}\sigma_{\eta^1}\sigma_{\eta^3} \\ \cdot & \sigma^2_{\eta^2} & \rho^{\eta}_{2,3}\sigma_{\eta^2}\sigma_{\eta^3} \\ \cdot & \cdot & \sigma^2_{\eta^3} \end{bmatrix}$$

where $\sigma^2_{\eta^j}$ denotes the variances of the unobserved heterogeneity components, and $\rho^{\eta}_{i,j}$ denotes their correlations.[7] These correlations are indicative of whether or not work and return migration induce positive or negative selection effects on the observed earnings distribution based on their individual unobserved characteristics. A significant and positive $\rho^{\eta}_{1,2}$ signifies that individuals who are more likely to work are also more likely to have higher earnings. This is the familiar selection effect introduced in labor economics by Heckman (1978). $\rho^{\eta}_{1,3}$ has a similar interpretation and captures return migration bias. We expect a negative estimate if conditional on unobserved individual heterogeneity, immigrants who have a higher probability of returning to their native country have below average monthly income in a given time period and a positive estimate if these individuals have above average monthly earnings. Finally, $\rho^{\eta}_{2,3}$ can be interpreted as measuring outmigration bias for the work decision which would occur with a negative estimate as individuals with a higher probability of returning to their native country are also those more likely not to be working in a given time period.

Finally, we assume that the vector $\varepsilon_i = \left[\varepsilon^1_{it}, \varepsilon^2_{it}, \varepsilon^3_{it}\right]'$ is i.i.d normally distributed with mean 0 and covariance matrix Σ

$$\mathbf{\Sigma} = \begin{bmatrix} \sigma^2_w & \rho^{\varepsilon}_{1,2}\sigma_w & \rho^{\varepsilon}_{1,3}\sigma_w \\ \cdot & 1 & \rho^{\varepsilon}_{2,3} \\ \cdot & \cdot & 1 \end{bmatrix}$$

where σ^2_w is the variance of log earnings, while the variances of the unobserved stochastic shocks entering the work and return migration equations are set to 1 for identification purposes. Contemporary correlation between the three stochastic components are captured by the correlation coefficients $\rho^{\varepsilon}_{1,2}$ $\rho^{\varepsilon}_{1,3}$ and $\rho^{\varepsilon}_{2,3}$.

[7] We have experimented with a flexible nonparametric mixture model which assumes that $\left(\eta^1_i, \eta^2_i, \eta^3_i\right)$ is drawn from a discrete distribution with domain D. We have estimated the model assuming a 8 type population of immigrants assuming a discrete distribution $H\left(\eta^1_{ik}, \eta^2_{ik}, \eta^3_{ik}\right) = \pi_k$ for $k = 1, ..., 8$ where $\sum_{k=1}^{8} \pi_k = 1$. Results were relatively similar to those presented here and are available upon request.

3.1 Economic implications of the model

In this paper, we aim to characterize work and return migration selection bias and it's impact on average conditional wage of immigrants. Heckman's (1978) seminal paper derived an expression for the conditional expected earnings with worker selectivity assuming joint normality of the stochastic shocks. Heckman's results apply directly to evaluate the expected conditional income of German workers

$$\mathbf{E}\left\{\log\left(w_{it}\right)|p_{it}=1\right\} = \mathbf{x}_{it}'\beta + \rho_{12}\left\{\frac{\phi\left(\mathbf{z}_{it}'\theta\right)}{\Phi\left(\mathbf{z}_{it}'\theta\right)}\right\}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are respectively the standard normal density and distribution functions. The conditional log earnings function of immigrants conditions both on work and outmigration status. Generalizations of this results to the case of multiple binary selectivity have since appeared (see e.g. Pudney (1990)) but do not apply here as one of our selectivity indicators is misreported. The following proposition generalizes previous sample selection results to the case where one binary selection indicator has random measurement error and for simplicity, we omit conditioning on the exogenous variables.

Proposition 1

$$\begin{aligned}\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1, r_{it}^{o}=1\right\} &= \sum_{j=\{0,1\}} W_{1j}\left(\mathbf{s}_{it},\alpha_{10}\right)\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1, r_{it}^{u}=j\right\} \\ \mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1, r_{it}^{o}=0\right\} &= \mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1, r_{it}^{u}=0\right\}\end{aligned}$$

where $W_{10}\left(\mathbf{s}_{it},\alpha_{10}\right)\rightarrow 0$ *and* $W_{11}\left(\mathbf{s}_{it},\alpha_{10}\right)\rightarrow 1$ *when* $\alpha_{10}\rightarrow 0$

Proof. See Appendix A. ■

The results of the proposition are non-parametric in the sense that they do not rely on any distributional assumptions apart from α_{10} being independent of background characteristics. It shows that the expected conditional wage of immigrants who will leave in the next period is a weighted average of the expected conditional earnings of return and non return migrants, where the weights are functions of the measurement error probability α_{10}. In general, this conditional expected income of those who drop out of the panel will not coincide with that of return migrants unless the return migration indicator is perfectly measured ($\alpha_{10}=0$). At the opposite, the expected conditional wage of immigrants who do not drop out of the panel coincides with that of immigrants who do not outmigrate. On the one hand, this result seems trivial as individuals who do not drop out of the panel and known to remain in the Germany with probability one, hence they constitute a sample of non-returners. What is more surprising is that they constitute a random sample on non-returners which implies that expected conditional income estimates could in principle be carried out in a given wave using only those immigrants who are observed to be in the panel, ignoring the information of those immigrants who drop out of the panel but who do not return.

The proposition also has implications in terms of estimation. In principle, one could estimate the parameters of the model by using a two step procedure. In the first step, the out-migration and the work decisions could be estimated jointly. In the second step, one can use non-linear least squares methods to solve for the parameters entering the conditional expectations $\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1, r_{it}^{o}=1\right\}$ and $\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1, r_{it}^{o}=0\right\}$ by averaging over $\left\{\eta_i^1, \eta_i^2, \eta_i^3\right\}$. Due to the relative inefficiency of two step estimators and to the complexity in computing the second step covariance matrix, we prefer to estimate the model using Maximum Likelihood.

3.2 Maximum Likelihood estimation

To simplify the presentation of the likelihood function, we divide the observable characteristics of immigrant i into a set $y_i = \{p_{it}, r_{it}^{o}, (w_{it}|p_{it}=1)\}_{t=1}^{T_i}$ of dependent variables and a set $X_i = \{\mathbf{x}_{it}, \mathbf{z}_{it}, \mathbf{s}_{it}\}_{t=1}^{T_i}$ of exogenous variables, the latter assumed to be non-stochastic. Moreover, we use the shorthand notation $\phi_{\mathbf{TVN}} \equiv \phi_{\mathbf{TVN}}\left(p_{it}^{*}, r_{it}^{*}, w_{it}; \mathbf{\Sigma}|\eta_i^1, \eta_i^2, \eta_i^3\right)$ to indicate the trivariate normal density conditional on the random effects.

Numerical approximation of the likelihood function proceeds in two steps. In the first step, the conditional likelihood function $f^C\left(\mathbf{y}_i|\mathbf{X}_i, \eta_i^1, \eta_i^2, \eta_i^3; \beta, \theta, \gamma, \mathbf{\Sigma}, \alpha_{10}\right)$ is computed holding the unobserved heterogeneity components fixed across all three equations. This first step density is given by

$$
\begin{aligned}
& f^C\left(\mathbf{y}_i|\mathbf{X}_i, \eta_i^1, \eta_i^2, \eta_i^3; \beta, \theta, \gamma, \mathbf{\Sigma}, \alpha_{10}\right) \\
= & \prod_{t=1}^{T_i} \int_{\mathbb{W}_{it}} \int_{\mathbb{P}_{it}} \left\{ \left(1-r_{it}^{o}\right)\left(1-\alpha_{10}\right) \int_{-\infty}^{0} \phi_{\mathbf{TVN}}\, \mathrm{d}r_{it}^{*} \right. \\
& \left. + r_{it}^{o}\left[\int_{0}^{\infty} \phi_{\mathbf{TVN}}\, \mathrm{d}r_{it}^{*} + \alpha_{10}\int_{-\infty}^{0} \phi_{\mathbf{TVN}}\, \mathrm{d}r_{it}^{*}\right]\right\} \mathrm{d}p_{it}^{*}\, \mathrm{d}w_{it}
\end{aligned}
$$

This equation collapses to a familiar continuous and discrete choice model when there is no misclassification error in the return migration indicator ($\alpha_{10} = 0$). The sets $\mathbb{W}_{it}$ and $\mathbb{P}_{it}$ define the domain of integration over the wage and work propensity spaces and vary over time as individuals make different choices in each period according to the following table

Integration domains in period t		
	$\mathbb{W}_{it}$	$\mathbb{P}_{it}$
Work	$-$	$[0,\infty)$
Not Work	$(-\infty,\infty)$	$(-\infty,0]$

Income is integrated out in waves where it is not observed. When an individual works, no integration takes place. The integration domain for the work propensity follows from the work decision rule. In the second step of the estimation procedure, the unconditional likelihood function is obtained by integrating out the random individual effects over $\mathbb{R}^3$

$$f\left(\mathbf{y}_i|\mathbf{X}_i;\beta,\theta,\gamma,\mathbf{\Sigma},\mathbf{\Omega},\alpha_{10}\right)=\int_{\mathbb{R}^3} f^C\left(\mathbf{y}_i|\mathbf{X}_i,\eta_i^1,\eta_i^2,\eta_i^3;\beta,\theta,\gamma,\mathbf{\Sigma},\alpha_{10}\right)H\left(\mathrm{d}\eta_i^1,\mathrm{d}\eta_i^2,\mathrm{d}\eta_i^3\right)$$

where H denotes the trivariate normal distribution function with covariance matrix $\mathbf{\Omega}$.

To solve the numerical integration problem, we approximate the integral by a simulated mean: a sequence of $r=1,2,...,R$ i.i.d. draws $\left(\eta_i^{1(r)},\eta_i^{2(r)},\eta_i^{3(r)}\right)$ is taken from the multivariate normal distribution H at a given value of $\mathbf{\Omega}$.[8] For each draw, the conditional likelihood function f^C is evaluated. The partial MSL estimator consists of replacing f by the simulated mean

$$\frac{1}{N}\sum\nolimits_{i=1}^{N}\log\left[\frac{1}{R}\sum\nolimits_{r=1}^{R} f^C\left(\mathbf{y}_i|\mathbf{X}_i,\eta_i^{1(r)},\eta_i^{2(r)},\eta_i^{3(r)};\beta,\theta,\gamma,\mathbf{\Sigma},\alpha_{10}\right)\right]$$

The resulting estimator is inconsistent for fixed R but will be consistent if R tends to infinity with the number of observations N. If $\sqrt{N}/R\rightarrow 0$ and with independent drawings across individuals, the method is asymptotically equivalent to maximum likelihood (see Train (2003) for details).

Finally, we model labor market earnings and work decisions of Germans using similar specifications of equations (**??**) and (2) and estimate the parameters using the simulation techniques described above.

4 Results and simulations

We include in the earnings and work equations education, labor market experience, labor market experience squared, self reported German speaking fluency, and the number of years since immigration to Germany. These are the standard variables that have appeared in this literature (Borjas, 1999). The provincial unemployment rate for the period is added in both equations to capture regional macroeconomic trends in the state of the labor market along with time fixed effects. We

[8] In this paper, we use sequences of Halton draws to reduce simulation noise (see Train (2003)).

use reported health satisfaction as the exclusion restriction in the work equation. Reported health satisfaction serve as a useful exclusion restriction if health problems occur in the second half of an individuals productive life, at a time where immigrants are more likely to have secured a long term jobs whose wages are no longer related to their intrinsic productivity but whose continuation strictly depends on the workers choices.

The outmigration propensity is modelled as being a function of a series of variables which have been identified in the literature as important determinants of outmigration. These can be classified depending on whether they refer to positive or negative selectivity. Theories of negative outmigration selectivity commonly argue that migrants who perform poorly or are dissatisfied with their lives in the host country will remigrate. The variables we included to capture this state are whether or not the immigrants wife lives in Germany, the immigrants self reported integration in the German society, the unemployment rate. More positive theories of outmigration argue that young migrants build up human capital and financial assets in the host country and are the most likely to return. Dustmann and Kirchkamp (2002) show some evidence that some of the Turkish outmigrants were successful in Germany and had enough financial assets to start their own businesses upon their return. Accordingly, we include an immigrants age at arrival in Germany and cumulative amount of money sent back to their native country since 1984. We have also included reported health satisfaction and the migrants self-reported expected length of stay in Germany. Time dummies are added to capture remaining macroeconomic fluctuations.

The main contribution of this paper is to incorporate both work and return migration selectivity in a model of earnings determination. Accordingly, we need some benchmarks to compare the full specification. We have estimated a single equation earnings function with random effects and a two equation random effects model of earnings and work. We have also experimented with an alternative specification of the return migration propensity which added education, labor market experience and its square, speaking fluency and years since immigration as regressors. A log-likelihood ratio test of the null hypothesis that these human capital collectively have no effect on return migration could not be rejected at conventional levels.[9]

4.1 Equation results

4.1.1 Covariance structure

We begin our analysis of the results with a discussion of the estimates characterizing the covariance structure of the unobserved components as these can be very informative of the differences which

[9]Results are available upon request.

we can find in the systematic parts of each equations. Table 4 contains the covariance structure of the unobserved components for a series of models characterized by either no or some control for work and return migration selectivity. Looking at the results of the full model, results of Table 4 indicate that the unobserved components of return migration show strong patterns of negative correlation across transitory shocks. Shocks between income and work and shocks between work and return migration are significantly negatively correlated, the former at -34.2% and the latter at 30.4% while we do not find significant correlation between the transitory shocks of the income and return migration processes. Of greater interest for this paper are the correlations between the time invariant unobserved heterogeneity terms show a different pattern. First, we find a small but significant positive correlation between the income and work equations. If one interprets these unobserved components as reflecting unobserved ability, then this would imply that higher ability individuals who find work and also more likely to have higher incomes. The correlations between the time invariant correlations between the return migration equation and the earnings equation is -56% while that between return migration and and work propensity is -49.8%, both significant at the 1% level. We interpret these results as evidence suggesting that individuals with higher unobserved individual propensity to remigrate are also those individuals more likely to have lower work propensities and lower earnings, which clearly points to a negative economic selection effect of return migration.

4.1.2 Earnings equation

Table 5 presents parameter estimates of the earnings and work equations for the immigrant and German samples for the three equation model and the two benchmark cases. We will first focus of the results from the three equation model and contrasts it to the benchmark models later on.

Part of the income disparity between Germans and immigrants can be accounted for by different returns to human capital investments. We find that returns to education of immigrants are roughly one third that of Germans, with an increase in one year of schooling generating monthly income increases of a little more than 9% for Germans and a little less than 2.9% for immigrants. These discrepancies can also be observed by comparing returns to labor market experience. We find that those returns to increase almost twice as fast for West-Germans than for immigrants. The quadratic term on labor market experience shows that the sharp rise in returns to labor market experience flattens out more quickly for Germans than for immigrants. Immigrants with better speaking fluency have higher earnings.[10] Finally, we find that the unemployment rate has a negative impact

[10]Dustmann and van Soest (2001) have shown that the self-reported speaking fluency indicator of the GSEOP is measured with noise, a feature which biased downward the effect of speaking fluency

of immigrants wages (at the 10% significance level) while it has no statistical effect on the earnings of Germans. One explanation for this is that immigrants take up jobs without job-security and secure income which makes them more prone to accept lower income in periods of downturn.

We find the returns to education of immigrants to be lower when outmigration is incorporated in the model, with returns for one extra year of schooling passing from 3,46% to 2,88%. The coefficient of years since migration increases progressively as selection is added, passing from 0.069 without any selection to 0.073 when controlling for work selection and to 0.079 when both work return migration selectivities are accounted for, but these increases are not statistically significant. We find that the linear term in labor market experience increases slightly when outmigration is included, while the coefficient of the quadratic term in labor market experience decreases, both changes not significant at conventional levels.

The economic assimilation rate of immigrants is generally estimated to be the earnings differential between immigrants and natives attributed to the effect of one extra year of labor market work plus immigrants returns to one extra year of immigration. We evaluated the assimilation rate at the sample average labor market experience of immigrants in 1985. We find an estimate of the assimilation rate of -5% per year when outmigration is not taken into account and a rate of -4.78% when outmigration is accounted for, the difference not statistically significant at the 10% level. Both estimates clearly point that assimilation is not taking place in Germany. Furthermore, estimates of the assimilation rates are robust to outmigration selectivity.

4.1.3 Work equation

The results of the work participation equation are generally in line with those of the earnings equation. For both immigrants and Germans, all parameters are statistically significant. Both education and labor force experience have similar patterns to those found in the earnings equation. State unemployment rate has a negative effect of work participation for both immigrants and natives. Health satisfaction which serves as the inclusion restriction is significant and positive both for Immigrants and Germans. Increased speaking fluency has a positive effect on work participation while years since immigration has a negative and significant impact on work participation. Like in the income equation, we find that parameter estimates of the immigrant work propensity are quite robust to return migration selectivity. The only noticeable difference concerns the negative effect of the state level unemployment rate, whose coefficient passes from -0.054 to -0.076 when return

on earnings. Due to the complexity of their correction, we have not attempted to include it in the present study.

migration is included.

4.1.4 Outmigration

In a recent paper, Dustmann and Kirchkamp (2002) study the performance of Turkish return migrants who previously lived in Germany. Their empirical work is based on a sample of Turkish immigrants who enjoyed relative success in Germany as a substantial portion of them were observed to have invested in entrepreneurial activities upon their return. The interesting feature of that paper is that it points to the existence of positive rather than negative outmigration. Since the current paper is estimated on the basis of a sample of immigrants living in Germany, it is instructive to test whether a dominant form of outmigration selectivity emerges.

Our discussion of the correlations between the unobserved heterogeneity components clearly pointed in favor of negative outmigration selectivity in the sense that individuals whose unobserved characteristics generated for them lower work propensity and lower income given work are most likely to remigrate. Recall that positive and negative theories of return migration selectivity additionally point to the potential role of several observed characteristics which could determine return migration. Table 6 presents the parameter estimates of the earnings and work equations for the immigrant and German samples. We find that immigrants whose wife lives with them in Germany have a significantly lower probability of remigrating which would imply a strict preference for family. Immigrants satisfied with their health are significantly less likely to remigrate. Intended length of stay captures the expectations of immigrants and offer direct information on their remigration intentions. Not surprisingly, the results show that those migrans who expect to remain longer in Germany are also less likely to remigrate. One interpretation of this result would be that immigrants have rational expectations and act accordingly. It does seem that for most re-migrants, the remigration decision is planned and although there can be deviations from this plan, on average they will stick to it. A planned remigration may be evidence of a strict preference for consumption in home country. The coefficient of the state unemployment rate is positive and significant, indicating that deteriorations of labor market conditions and social distress increase the likelihood of remigrating. This parallels our finding that negative labor market shocks are associated with positive remigration shocks and that individuals with lower unobserved propensity to work are more likely to outmigrate. Taken together, these results indicate that integration in the host country's labor market is one of the most important determinants of outmigration behavior. The effect of cumulative savings returned to the home country is not significant, implying that immigrants who have saved and returned more money to their native country are not more likely to return. Since age at immigration is significant, we cannot completely rule out the positive selectivity theory to outmigration. Finally, the insignificant coefficient of immigrants feeling of integration is society indicate that social integration does not explain outmigration, once we have conditioned on all the other factors and controlled for unobserved heterogeneity.

In our data, natives have a 11% attrition rate per two years, while the observed attrition rate of immigrants is 17%. If immigrants have the same normal attrition rate as Germans, than the difference in observed attrition rates between natives and immigrants, here 3% per year, would be an estimate of immigrants outmigration rate. We do not have direct information indicating that immigrants have the same normal attrition rate than natives. However, panel attrition occurs either because individuals decide to stop participating in the survey project, or individuals move within Germany and cannot be tracked by the survey institution. Clark and Drever (2001) have shown that immigrants in the GSEOP subsample are not more likely to move within Germany than natives. Furthermore, Pischke and Velling (1997) have shown that immigrants in the western parts of Germany live is regions with a high concentration of ethnic minorities. Both findings imply that immigrants are not more difficult to track than native Germans, which provides indirect evidence that the normal attrition rates of both groups should be of similar magnitude. Our empirical model in section 2 explicitly incorporated the parameter α_{10} corresponding to the probability of dropping out of the panel, given that an immigrant remains in Germany. Notice that by definition, α_{10} represents the normal attrition rate of immigrants. If the normal attrition rate of immigrants is indeed the same as that of Germans, we would expect α_{10} to to be close to 11%. This conjecture is verified in the data. We find that α_{10} is estimated to be 10.7%, remarkably close to the attrition rate of Germans. These results reinforces our belief that incorporating α_{10} in our model allows us to identify outmigration in our sample of immigrants.

4.2 Simulations

Simulations are used for two purposes. First, they allow to asses the goodness of fit of the model. Secondly, they allow us to quantify the implications of outmigration selectivity on log monthly earnings and work propensities of immigrants.

Simulations performed to evaluate the overall fit of the model are presented in Table 7.Simulated log earnings represent the average over 1000 simulated expected average log earnings. A single simulated expected log earnings is evaluated by taking a draw from the joint distribution of $\left\{\varepsilon_{it}^1, \varepsilon_{it}^2, \varepsilon_{it}^3, \eta_i^1, \eta_i^2, \eta_i^3\right\}_{t=1}^{8}$ for each individual in the sample and averaging fitted log earnings over all individuals who are predicted to work. The fit for the German sample is very good, with both real and simulated paths closely following each other over the entire sample period. Simulated log earnings paths of immigrants are good up till 1991, after which, the model tends to over predict the monthly log earnings. Part of these discrepancies can be attributed to the progressively small immigrant sample sizes in the latter years, a fact reflected in the increasing dispersion of the simulated log earnings estimates over time. Table 7 tabulates the inter-quartile range defined as the difference between the 97.5% and the 2.5% quantile of the simulated expected income distribution for Germans and immigrants. The dispersion increases from 0.164 in 1985 to 0.289 in 1995 while it increases from 0.052 to 0.069 for Germans during the same period. Table 7 also presents real and simulated work propensities of Germans and immigrants. The predicted participation rates over the entire sample period.follows very closely those found in the data for both Germans and immigrants.

Our empirical results indicated that outmigrants were selected from the bottom of the earnings and work propensity distributions of the immigrant population. To gain an insight in the magnitude of these biases, we report in Figure 3 simulations of log earnings and work propensities for the full sample of immigrants, immigrants predicted to be present in Germany and predicted outmigrants for all sample waves. Simulations of log earnings are presented in the top panel while simulated work propensities are presented in the lower panel. The log earnings of outmigrants where 17.2% lower than those of stayers in 1985. This gap widened to 20.1% in 1991 before dropping back to a gap of 17.7% in 1997. The gap in work propensities between stayers and outmigrants also confirms the strong negative outmigration selectivity. Outmigrants are predicted to be have a work propensity 25% lower than that of immigrant stayers in 1985 and reaches a high of 44% in 1995. These simulation results clearly indicate that outmigration, apart from being statistically significant, has a substantial quantitative economic impact, namely that the economic performance of outmigrants in the wave preceding their departure was dramatically worse than that of immigrants stayers.

Finally, Proposition 1 showed that the average earnings of immigrants who drop out of the panel will be a weighted average of the average earnings of immigrant stayers and outmigrants. In terms of the results of figure 3, this implies that the average earnings of immigrants who drop out lies in between the average earnings schedule of immigrant stayers and outmigrants. The average earnings of drop outs will be further from those of outmigrants the higher is the probability of confounding attrition for outmigration. Hence, taking panel attrition as the outmigration indicator leads to overestimate the level of earnings of outmigrants in our data.

5 Conclusions

International evidence suggests that outmigration is an economic phenomenon of sizable importance. It has traditionally been put forward that there are economic gains to skills complementary, which would favor an immigration policy open to attracting low skilled workers. Simulation evidence has revealed that gains from complementarity of skills of immigrants may well be too low to overcome the costs immigrants impose on the welfare system (Borjas, 1999b). As a result, it is now more and more believed that a nation will gain from immigration if 1) migrants who assimilate quickly and perform well in the host labor market remain in the host country and 2) unsuccessful migrants leave. Because the hosts countries economic benefits of immigration depend on the earnings differential between natives and immigrants, testing whether or not outmigrants are drawn from the bottom of top part of the income distribution of immigrants in the host country is of primary interest for policy makers.

Up to know, the empirical evidence on outmigration selectivity is scant, primarily because of the difficulty in measuring outmigration without error. This paper is a first attempt to test for the presence, direction and magnitude of outmigration selectivity. We propose a new econometric methodology to address the problem of partial observability of the outmigration indicator. The approach consists of explicitly introducing a probability that sample attrition is confounded for outmigration. This probability is shown to be nonparametrically identified and can be incorporated in a straightforward way in a model jointly determining earnings, work and outmigration. We estimate the model controlling for unobserved heterogeneity using data on immigrants living in Germany between 1985-1999.

Our empirical results indicate that outmigrants are negatively selected in labor market earnings and work propensities. Simulation results show that the magnitude of outmigration effects are sizable. Through out the sample period, we find that outmigrants have roughly 18% lower labor market earnings and a 30% lower work propensity than immigrants who remain in Germany. Parameter estimates of the earnings and work equations are found to be robust to outmigration selectivity, implying outmigration mostly shifts vertically the earnings function and work propensities. Furthermore, we have shown that not controlling for the partial observability of outmigration would impute higher earnings to outmigrants than actually occurred. We have estimated the outmigration rate to be roughly 3% per year, a figure in line with those previously reported in the literature.

A Proof of Proposition 1

In this section, we derive the expression of the conditional expectation of income of workers used in the simulations of section. Heckman (1978) derived the result for the case of normal errors and one binary selection equation which served as the basis of the now famous two-step estimator. Since, extensions of the Heckman derivation have been made along three lines, a more general treatment of the selection indicator, multiple selectivity, panel data and semiparametric methods.

To prove the result, we will need the following two lemmas

Lemma 2 *Define* $W_{\ell j}(\mathbf{s}_{it}) \equiv \Pr(d_{it}^u = j | d_{it}^o = \ell, \mathbf{s}_{it})$ *for* $\{j, \ell\} \in \{0,1\} \times \{0,1\}$*. Then,*
a)

$$
\begin{aligned}
W_{00}(\mathbf{s}_{it}) &= \frac{(1-\alpha_{10}) + (\alpha_{10}-1)\Pr(d_{it}^u = 1|\mathbf{s}_{it})}{(1-\alpha_{10}) + (\alpha_{10}+\alpha_{01}-1)\Pr(d_{it}^u = 1|\mathbf{s}_{it})} \\
W_{01}(\mathbf{s}_{it}) &= \frac{\alpha_{01}\Pr(d_{it}^u = 1|\mathbf{s}_{it})}{(1-\alpha_{10}) + (\alpha_{10}+\alpha_{01}-1)\Pr(d_{it}^u = 1|\mathbf{s}_{it})} \\
W_{10}(\mathbf{s}_{it}) &= \frac{\alpha_{10} - \alpha_{10}\Pr(d_{it}^u = 1|\mathbf{s}_{it})}{\alpha_{10} + (1-\alpha_{10}-\alpha_{01})\Pr(d_{it}^u = 1|\mathbf{s}_{it})} \\
W_{11}(\mathbf{s}_{it}) &= \frac{(1-\alpha_{01})\Pr(d_{it}^u = 1|\mathbf{s}_{it})}{\alpha_{10} + (1-\alpha_{10}-\alpha_{01})\Pr(d_{it}^u = 1|\mathbf{s}_{it})}
\end{aligned}
$$

with $W_{00}(\mathbf{s}_{it}) + W_{01}(\mathbf{s}_{it}) = 1$ *and* $W_{10}(\mathbf{s}_{it}) + W_{11}(\mathbf{s}_{it}) = 1$.
b) In the special case where d_{it}^o *suffers from 1 sided misclassification (say* $\alpha_{01} = 0$*), then* $W_{00}(\mathbf{s}_{it}) = 1$ *and* $W_{01}(\mathbf{s}_{it}) = 0$ *while* $W_{10}(\mathbf{s}_{it})$ *and* $W_{11}(\mathbf{s}_{it})$ *have values in* $(0,1)$.

Proof. By Bayes rule, these weights have simple close form solutions

$$
\begin{aligned}
W_{00}(\mathbf{s}_{it}) &= \Pr(d_{it}^u = 0|d_{it}^o = 0, \mathbf{s}_{it}) \\
&= \frac{\Pr(d_{it}^o = 0|d_{it}^u = 0)\Pr(d_{it}^u = 0|\mathbf{s}_{it})}{\Pr(d_{it}^o = 0|\mathbf{s}_{it})} \\
&= \frac{(1-\alpha_{10}) + (\alpha_{10}-1)\Pr(d_{it}^u = 1|\mathbf{s}_{it})}{(1-\alpha_{10}) + (\alpha_{10}+\alpha_{01}-1)\Pr(d_{it}^u = 1|\mathbf{s}_{it})}
\end{aligned}
$$

where the last equality follows from assumption of random misclassification. In a similar fashion we can derive the closed form expression of the second weight

$$
\begin{aligned}
W_{01}(\mathbf{s}_{it}) &= \Pr(d_{it}^u = 1|d_{it}^o = 0, \mathbf{s}_{it}) \\
&= \frac{\Pr(d_{it}^o = 0|d_{it}^u = 1)\Pr(d_{it}^u = 1|\mathbf{s}_{it})}{\Pr(d_{it}^o = 0|\mathbf{s}_{it})} \\
&= \frac{\alpha_{01}\Pr(d_{it}^u = 1|\mathbf{s}_{it})}{(1-\alpha_{10}) + (\alpha_{10}+\alpha_{01}-1)\Pr(d_{it}^u = 1|\mathbf{s}_{it})}
\end{aligned}
$$

It follows immediately that $W_{00}(\mathbf{s}_{it}) + W_{01}(\mathbf{s}_{it}) = 1$. Because $W_{01}(\mathbf{s}_{it}) = 0$ in the special case of a one sided misclassification probability ($\alpha_{01} = 0$), it immediately follows that $W_{10}(\mathbf{s}_{it}) = 1$. Similar derivations follow when the noisy indicator takes a value of 1. ■

Lemma 3 $E\left\{\log\left(w_{it}^{I}\right)|d_{it}^{o}=\ell,d_{it}^{u}=j,p_{it}=1,\mathbf{X}_{it}\right\}=E\left\{\log\left(w_{it}^{I}\right)|d_{it}^{u}=j,p_{it}=1,\mathbf{X}_{it}\right\}$ *for* $\{j,\ell\}\in\{0,1\}\times\{0,1\}$

Proof. Define $y_{it}=\log\left(w_{it}^{I}\right)$ and we omit the conditioning on X_{it} until the end.

$$\begin{aligned}
\mathbf{E}\left\{y_{it}|d_{it}^{o}=\ell,d_{it}^{u}=j,p_{it}=1,\mathbf{X}_{it}\right\} &= \int y_{it}\ f\left(y_{it}|d_{it}^{o}=\ell,d_{it}^{u}=j,p_{it}=1\right)dy_{it} \\
&= \int y_{it}\ \frac{f\left(y_{it},d_{it}^{o}=\ell,d_{it}^{u}=j|p_{it}=1\right)}{\Pr\left(d_{it}^{o}=\ell,d_{it}^{u}=j|p_{it}=1\right)}dy_{it} \\
&= \int y_{it}\ \frac{\Pr\left(d_{it}^{o}=\ell|y_{it},d_{it}^{u}=j,p_{it}=1\right)\Pr\left(d_{it}^{u}=j|p_{it}=1\right)f\left(y|d_{it}^{u}=j,p_{it}\right.}{\Pr\left(d_{it}^{o}=\ell|d_{it}^{u}=j,p_{it}=1\right)\Pr\left(d_{it}^{u}=j|p_{it}=1\right)} \\
&= \mathbf{E}\left\{y_{it}|d_{it}^{u}=j,p_{it}=1,\mathbf{X}_{it}\right\}
\end{aligned}$$

where the last equality follows by the fact that the misclassification probabilities $\Pr\left(d_{it}^{o}=\ell|y,d_{it}^{u}=j,p_{it}=1\right)$ are independent of y_{it} (and also p_{it}), hence they cancel out in the numerator and denominator. ■

Proof of main proposition. Using Lemma 1 and 2, we can derive an expression for $E\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{o}=\ell\right\}$ where d_{it}^{o} is a misclassified binary selectivity indicator of the true but unobserved indicator d_{it}^{u}. By iterated expectations,

$$\begin{aligned}
\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{o}=\ell,\mathbf{X}_{it}\right\} &= \int \mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{o}=\ell,d_{it}^{u},\mathbf{X}_{it}\right\}\mathrm{d}\Pr\left(d_{it}^{u}|d_{it}^{o}=\ell,\mathbf{s}_{it}\right) \\
&= \sum_{j\in\{0,1\}}\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{o}=\ell,d_{it}^{u}=j,\mathbf{X}_{it}\right\}\Pr\left(d_{it}^{u}=j|d_{it}^{o}=\ell,\mathbf{s}_{it}\right)
\end{aligned}$$

where the second equality follows from Lemma 2 and intuitively means that the noisy indicator does not reveal more on the mean conditional income function once knowledge of the true indicator is known. Using Lemma 2, this expression can be expressed as a weighted average of the expected workers earnings when they remain in West-Germany and expected earnings when they return to their native country in the following period

$$\begin{aligned}
\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{o}=\ell\right\} &= W_{0}^{\ell}\left(\mathbf{s}_{it}\right)\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{u}=0\right\} \\
&\quad +W_{1}^{\ell}\left(\mathbf{s}_{it}\right)\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{u}=1\right\}
\end{aligned}$$

where the weights $W_{0}^{\ell}\left(\mathbf{s}_{it}\right)$ and $W_{1}^{\ell}\left(\mathbf{s}_{it}\right)$ are given in Lemma 1. When one of the misclassification probabilities is zero (say $\alpha_{01}=0$), we can use the results of Lemma 1 and Lemma 2 to solve for the two following cases

Case $d_{it}^{o}=0$:

When $\alpha_{01}=0$, $W_{0}^{0}\left(\mathbf{s}_{it}\right)=1$ and $W_{1}^{0}\left(\mathbf{s}_{it}\right)=0$. and

$$\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{o}=0\right\}=\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{u}=0\right\}$$

which is independent of α_{10}.

Case $d_{it}^{o}=1$:

When $\alpha_{01}=0$, $W_0^1(\mathbf{s}_{it})=1$ and $W_1^1(\mathbf{s}_{it})=0$. and

$$\begin{aligned}\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{o}=0\right\} &= \frac{\alpha_{10}-\alpha_{10}\Pr\left(d_{it}^{u}=1|\mathbf{s}_{it}\right)}{\alpha_{10}+(1-\alpha_{10})\Pr\left(d_{it}^{u}=1|\mathbf{s}_{it}\right)}\cdot\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{u}=0\right\}\\ &\quad+\frac{\Pr\left(d_{it}^{u}=1|\mathbf{s}_{it}\right)}{\alpha_{10}+(1-\alpha_{10})\Pr\left(d_{it}^{u}=1|\mathbf{s}_{it}\right)}\cdot\mathbf{E}\left\{\log\left(w_{it}^{I}\right)|p_{it}=1,d_{it}^{u}=1\right\}\end{aligned}$$

which identifies the misclassification probability α_{10}. ■

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	West-Germans			Immigrants		
	N	% 1985	Attrition rate	N	% 1985	Attrition rate
1985	1987	100	-	732	100	-
1987	1648	82,9	17,1	583	79,6	20,4
1989	1408	70,8	14,6	473	64,6	18,9
1991	1253	63,1	11,0	416	56,8	12,1
1993	1122	56,4	10,5	355	48,4	14,7
1995	1002	50,4	10,7	291	39,7	18,0
1997	919	46,3	8,28	242	33,1	16,8
1999	834	41,9	9,25	195	26,7	19,4
Mean 1985-1999			11,6			17,2

Table 1: Panel attrition for West-German and Immigrant subsamples 1985-1999. This excludes refreshment sample observations occuring in 1991 for Germans and in 1995 for Immigrasnts.

	West-Germans		Immigrants		Variable Description
	1985	1999	1985	1999	
Age	38,33	45,85	39,78	44,53	
Experience	257,11	329,76	301,77	333,34	Number of months
Education	11,51	12,10	9,34	10,04	Number of years
Health satisfaction	7,26	6,81	7,21	6,77	0= unsatisfied,...,10 totally satisfied
Wife in Germany			0,73	0,01	1 if yes, 0 otherwise
Integration feeling			3,94	2,93	Do you feel German ?, 1=Totally, ..,5=Not at all
German speaking fluency			2,65	2,30	1=excellent, 5=bad
Intended lenght of stay			2,18	0,59	1 = Within 1 year,2 = After a few years,3 = Never
Age at immigration			24,03	24,90	
Years since immigration			15,75	19,63	
Immigration year			1969	1979	
Number Obs.	1987	1264	732	393	

Table 2: Comparative descriptive statistics for West-German and Immigrant subsamples, 1985 and 1999

State	1985	1987	1989	1991	1993	1995	1997	1999
Berlin	10.3	10.5	9.8	10.6	12.3	13.6	17.3	17.7
Schleswig-Holstein	10.8	10.3	9.6	7.3	8.3	9.1	11.2	10.6
Hamburg	12.0	13.6	11.7	8.7	8.6	10.7	13.0	11.7
Lower-Saxony	11.7	11.4	10.0	8.1	9.7	10.9	12.9	11.8
Bremen	14.5	15.6	14.6	10.7	12.4	14.0	16.8	16.8
North Rhine-Westphalia	10.7	11.0	10.0	7.9	9.6	10.6	12.2	11.2
Hess	7.0	6.7	6.1	5.1	7.0	8.4	10.1	9.4
Rhinel-Palatinate-Saarl.	9.4	9.1	7.8	6.1	8.3	9.2	11.0	9.7
Baden-Wuerttemberg	5.2	5.1	4.5	3.7	6.3	7.4	8.7	7.3
Bavaria	7.7	6.6	5.7	4.1	6.4	7.0	6.7	7.1

Table 3: Unemployment Rate per Wave and Land 1985-1999 Source: Statistiches Bundesamt Deutschland

	Immigrants			**West-Germans**
Work	No	Yes	Yes	
Outmigration	No	No	Yes	
$\rho^{\varepsilon}_{1,2}$		-0.416	-0.342	-0.153
		(0.103)	0.119	(0.069)
$\rho^{\varepsilon}_{1,3}$			-0.106	
			(0.107)	
$\rho^{\varepsilon}_{2,3}$			-0.304	
			(0.151)	
$\rho^{\eta}_{1,2}$		0.044	0.045	0.057
		(0.009)	(0.011)	(0.007)
$\rho^{\eta}_{1,3}$			-0.560	
			(0.143)	
$\rho^{\eta}_{2,3}$			-0.498	
			(0.173)	
$\sigma^2_{\eta^1}$	0.068	0.061	0.042	0.118
	(0.006)	(0.003)	0.002	(0.003)
$\sigma^2_{\eta^2}$		2.739	2.829	2.405
		(0.313)	(0.354)	(0.164)
$\sigma^2_{\eta^3}$			2.937	
			(0.373)	
σ^2_w	0.033	0.037	0.037	0.074
	(0.0005)	(0.0008)	(0.0008)	(0.0005)
Log-likelihood	-7137.81	-333.54	-701.76	-1372.04

Table 4: Covariance structure of the time variant and time invariant components. Asymptotic standard errors in parentheses.

	Immigrants					West-Germans		
Equation	Earnings			Work		Earnings		Work
Work	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Return migration	No	No	Yes	No	Yes		-	
Constant	7.121	7.0198	7.063	-0.596	-0.532	5.971	6.030	-2.652
	(0.066)	(0.055)	(0.051)	(0.489)	(0.499)	(0.051)	(0.038)	(0.238)
Education / 10	0.257	0.346	0.288	1.007	1.060	1.002	0.915	1.489
	(0.045)	(0.029)	(0.029)	(0.326)	(0.327)	(0.031)	(0.016)	(0.130)
Experience / 10^3	3.112	3.150	3.239	21.934	22.002	5.999	6.087	31.613
	(0.201)	(0.174)	(0.175)	(1.484)	(1.612)	(0.147)	(0.157)	(0.966)
Experience squared / 10^4	-0.439	-0.431	-0.451	-3.439	-3.536	-0.786	-0.799	-5.509
	(0.029)	(0.028)	(0.028)	(0.217)	(0.239)	(0.024)	(0.027)	(0.158)
Years since immigration /10	0.069	0.073	0.079	-0.438	-0.416			
	(0.015)	(0.012)	(0.013)	(0.091)	(0.096)			
German speaking fluency	-0.017	-0.015	-0.020	-0.256	-0.232			
	(0.006)	(0.007)	(0.007)	(0.063)	(0.065)			
Unemployment rate	-0.005	-0.007	-0.005	-0.054	-0.076	-0.0041	-0.0004	-0.068
	(0.004)	(0.003)	(0.003)	(0.022)	(0.026)	(0.0029)	(0.002)	(0.015)
Health satisfaction				0.129	0.132			0.069
				(0.016)	(0.017)			(0.011)

Table 5: Estimation results for income and work equations. Asymptotic standard errors in parentheses. Wave dummies were included for 1987-1999 but are not reported in the table.

Constant	-0.538
	(0.504)
Health satisfaction	-0.057
	(0.027)
Wife in Germany	-0.692
	(0.174)
Expected lenght of stay	-0.528
	(0.108)
Integration feeling	0.041
	(0.059)
Unemployment rate	0.069
	(0.029)
Age at immigration $/10^2$	1.618
	(0.755)
Cumulative remitances $/10^3$	-0.011
	(0.016)
α_{10}	0.107
	(0.013)

Table 6: Estimation results for return migration. Asymptotic standard errors in parentheses. Wave dummies were included for 1987-1997 but are not reported in the table.

	Immigrants			Germans		
	Sample	Predictions	IQR Earnings	Sample	Predictions	IQR Earnings
1985	7,85 (0,84)	7,85 (0,84)	0,164	7,98	7,98	0,052
1987	7,93 (0,85)	7,94 (0,86)	0,183	8,10	8,09	0,052
1989	8,06 (0,85)	8,09 (0,84)	0,213	8,22	8,22	0,057
1991	8,16 (0,82)	8,20 (0,82)	0,229	8,31	8,31	0,057
1993	8,23 (0,78)	8,29 (0,77)	0.243	8,46	8,44	0,063
1995	8,29 (0,73)	8,38 (0,71)	0,289	8,50	8,49	0,069
1997	8,30 (0,70)	8,37 (0,70)	0,229	8,58	8,57	0,071

Table 7: Real and predicted log earnings of workers and work propensities for Germans and immigrants. Note: IQR: Difference between the 97.5 and 2.5 percentile of the predicted distribution.

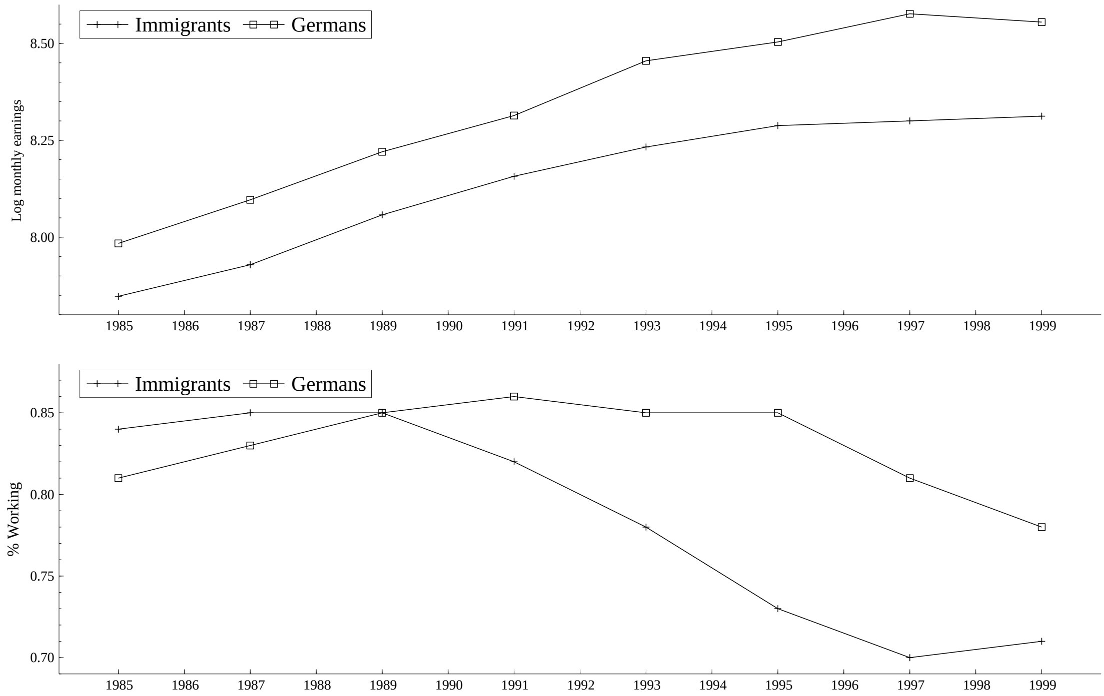

Figure 1: Log monthly earnings and work propensities - Germans and immigrants

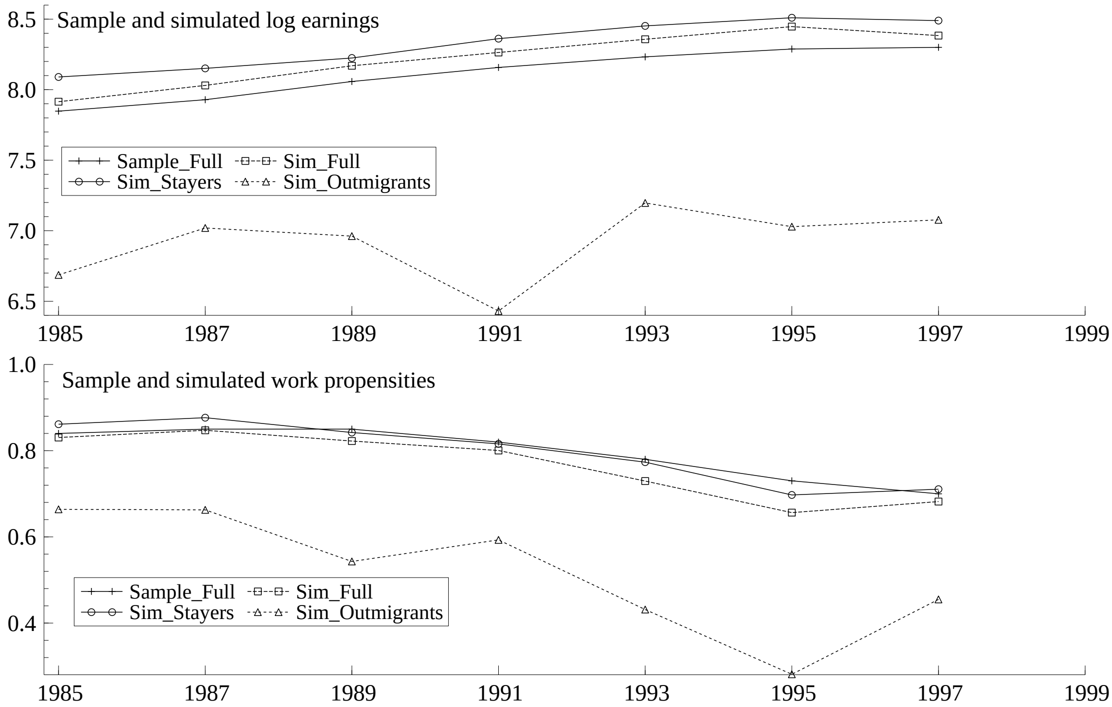

Figure 2: Real and simulated results for log earnings and work propensities