Appendix to

The Dynamics of Return Migration, Human Capital Accumulation, and Wage Assimilation

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A. Data Description

The estimates of our model parameters are based on sample moments from several data sources, most notably from the German micro-census (GMC) and from the German Socio-Economic Panel (SOEP). We reduce heterogeneity along dimensions not modeled by restricting the sample to males without tertiary education, who were born in Turkey and aged 16 or older at immigration, and who arrived in Germany after 1961. The GMC provides information on employment and earnings,\(^1\) and the representativeness of its samples allows a construction of synthetic cohorts that are informative about the rate of out-migration (see Dustmann and Weiss, 2007). The SOEP provides longitudinal data on accumulated work experience, separately prior and post immigration, as well as savings and integration outcomes (spoken and written language knowledge, the tendency to read German language newspapers, and attachment to the host country). Importantly, the SOEP asks for migration plans, i.e. whether an individual plans to stay or (and when) to return. The exact wording (in respondents’ preferred language) of the question is as follows: “How long do you want to live in Germany? [1] I want to return within the next 12 months _____ [2] I want to stay several more years in Germany _____ number of years _____ [3] I want to remain in Germany permanently _____” (Infratest Sozialforschung, 2011).

We illustrate the positive correlation between wage growth and changes in the planned migration duration in Panel (a) of Figure A1. The figure shows conditional mean log wage changes within bins of expected duration changes, together with the linear fit. To identify latent host country specific human capital in our model, we use the evolution of a number of observed outcomes reported in the SOEP that reflect the level of host country specific human capital an individual has accumulated. These include spoken and written language knowledge, the tendency to read host country newspapers, and respondents’ sense of belonging to the host country. Panel (b) of Figure A1 illustrates how these indicators increase with time spent in the host country.

We augment these individual level data sources with macroeconomic information and data that describe the conditions individuals face in Turkey if they choose to return. In particular, we

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\(^1\) In the GMC, earnings are reported in brackets, and we assign individuals an earnings level equal to the mid-point of their respective bracket. This is not a problem for our estimation, as we categorize simulated earnings into exactly the same brackets and construct the same earnings measure for the simulated moments (see the description of our estimation strategy below). The GMC reports net earnings. To account for this, we apply the tax schedule described in Appendix B.1 to the simulated sample.
use individual level data from a survey conducted by the German Institute for Employment Research (IAB) in Turkey among former migrants to Germany to identify individuals’ earnings function after a return to Turkey (see Hönekopp, 1987). To capture the evolution of earnings in Turkey relative to German earnings levels, we use time series on nominal compensation per employee in the two countries, provided by the European Commission (2015), and gross national income from the World Development Indicators (World Bank, 2014).\(^2\) To obtain a better measure of earnings for the particular group of non-tertiary educated male workers to which we restrict our micro-samples, we scale the macro time series using median gross labor income for male workers without a tertiary education in Turkey, information that is provided by the Turkish statistical office (TurkStat 2006) for 2006.

All monetary variables are adjusted to 2005 euros using consumer price indices from the Bundesbank (2013). The relative price levels individuals face in Turkey and thus the rate at which accumulated assets are converted are taken from the OECD (2013).\(^3\) We allow for different interest rates in Germany and Turkey. Real interest rates are computed using nominal interest and inflation rate series, taken from the OECD (2013) and the World Bank’s (2014) World Development Indicators.\(^4\) Finally, we obtain unemployment rates and unemployment durations in Turkey from Tansel and Taşçı (2010).

\section*{B Model Description}

\subsection*{B.1 Specification Details}

\textit{Labor Market Transitions.} In each period, employed workers are laid off with probability \(\delta^j, j = I, E,\) while individuals who are unemployed receive a job offer with probability \(\lambda^j\) and decide whether to accept the job or remain unemployed. For the host country, the rates at which jobs are lost and new job offers arrive are functions of age \(age_{it}\) and host country specific human capital

\(^2\) The European Commission’s AMECO database provides series of average nominal compensation per employee for both Germany and Turkey back to 1988. To extrapolate to earlier relative earnings levels in Turkey, we use gross national income from the World Bank’s (2014) World Development Indicators.

\(^3\) Relative price levels are based on the ratio of purchasing power parities for actual individual consumption and nominal exchange rates, each taken from the OECD’s statistical database at http://stats.oecd.org/.

\(^4\) We use short-term annual interest rates from the OECD’s statistical data base (http://stats.oecd.org/) for Germany. Since the same measure is not available for Turkey, we use the deposit rate series from the World Bank’s (2014) World Development Indicators.
$H_{it}$, since better knowledge of the host country may improve job finding and job retention:

$$\delta^t = \Phi(\delta_0 + \delta_H H_{it} + f^\delta_{\delta}(age_{it}))$$

and

$$\lambda^t = \Phi(\lambda_0 + \lambda_H H_{it} + f^\lambda_{\lambda}(age_{it})),$$

where $f^\delta_{\delta}(age_{it})$ and $f^\lambda_{\lambda}(age_{it})$ are piecewise linear functions of age, and $\Phi(\cdot)$ denotes the standard normal distribution function. For the home country, we define $\delta^E = f^E_{\delta}(age_{it})$ and $\lambda^E = f^E_{\lambda}(age_{it})$, implying age-specific job loss and job finding probabilities.$^5$

**Earnings conversion factor, interest rates and relative price levels.** To account for the diverging macro trends between Germany and Turkey that affect immigrants’ return decisions, we model behavior of immigrants who arrive at different points in time. To account for this in the estimation, we simulate choices and outcomes of immigrants arriving in 1970 and 1990. These individuals face different macroeconomic conditions that we obtain directly from the data. In the model, all macroeconomic variables (relative earnings in Turkey, relative price levels and interest rates in the two locations) are based on the series described in the previous sub-section, and are predicted using second order polynomials of time, as we detail below.

Earnings in Turkey are based on the IAB’s Return Migrant Survey, and in the model simulation predicted as $\log y_{it} = \rho_t + 7.64 + 1.82 \alpha_t + 0.0279 X^P_{it} - 0.475 \cdot 10^{-3} (X^P)^2_{it}$, where the conversion factor $\rho_t$ accounts for macroeconomic convergence between the origin and destination countries. This factor varies over time as predicted by a second order polynomial of years $t$ since 1970 ($\rho_t = 0.034 + 7.267 \cdot 10^{-3} t - 3.054 \cdot 10^{-5} t^2$).

To account for the higher purchasing power of assets in the country of origin, the budget constraint in period $t$ before a return becomes $A_{it+1} x_{t+1} = (1 + r^f_t)A_{it} + \eta_{it} work net(y_{it}) + (1 - \eta_{it}^{work})b_{it} - c_{it}$. Relative price levels and thus the rate $x_t$ at which assets are converted if an individual returns to Turkey are predicted as $x_t = 0.328 - 3.759 \cdot 10^{-3} t + 2.732 \cdot 10^{-4} t^2$.

$^5$ We derive these from unemployment rates and unemployment durations as estimated by Tansel and Taşçı (2010).
where again \( t \) measures the years since 1970 and the coefficients are estimated using the time series described in the previous sub-section. Similarly, using the series of nominal interest and inflation rates from the World Bank’s (2014) World Development Indicators and the OECD previously described, we approximate the real interest rates in Germany and Turkey, respectively, as 
\[
    r_t^I = -9.826 \cdot 10^{-3} + 6.885 \cdot 10^{-6}t - 1.019 \cdot 10^{-7}t^2 \quad \text{and} \quad r_t^E = 1.178 \cdot 10^{-3} - 3.820 \cdot 10^{-5}t + 7.247 \cdot 10^{-6}t^2.
\]

**Benefits and earnings tax schedules.** In the model, unemployment benefits in Germany are defined as a proportion of predicted earnings had the individual been working.\(^6\) The prediction is based on earnings equation (6a) and the individual’s current state variables (excluding the transitory shock \( \varepsilon_{it}^I \)). To account for the non-linearity of benefit schedules, the benefit ratio (denoted \( br \) below) is itself a function of earnings. To calibrate this function, we first compute the ratio of mean benefits and mean earnings for each individual with at least one benefit and one employment spell in the SOEP. We then fit a third order polynomial in log earnings to these benefit ratios, converted by the standard normal cdf (denoted \( \Phi(\cdot) \)). The latter ensures that predicted benefit ratios are bounded between zero and one. This yields the benefit ratio 
\[
    br(y_{it}) = \Phi(1.801 \cdot 10^3 - 0.538 \cdot 10^3 \log y_{it} + 53.659(\log y_{it})^2 - 1.783(\log y_{it})^3). \quad \text{In Turkey, during most of the period of our analysis, no unemployment insurance was in place, so we set } br(y_{it}) = 0. \quad \text{7}
\]

To calibrate the function \( net(\cdot) \) for Germany, we assume that the individual is married.\(^8\) The tax schedule also depends on the number of children, although the differences in taxation with respect to this variable are small. Fitting a third order polynomial in \( \log y_{it} \) to the tax schedule that we bound by the standard normal cdf yields net earnings equal to 
\[
    net(y_{it}) = y_{it}(1 - \Phi(-544.388 + 149.517 \log y_{it} - 13.741(\log y_{it})^2 + 0.422(\log y_{it})^3)). \quad \text{9}
\]

In our model, an individual receives retirement benefits from age 65 until the end of life. These benefits come from pension entitlements accumulated in both the home and the host country. Accordingly, they are a function of the earnings levels in the two locations and vary with the fraction of working life an individual has spent in the host country. Since in the model we keep

\(^6\) Previous earnings, on which unemployment benefits are based in practice, are not a state variable in our model. We thus use earnings predicted by an individual’s current state variables as the closest approximation.  
\(^7\) It was introduced only in 2002, but at a fairly low replacement ratio of 9%.  
\(^8\) In our SOEP sample, 83.2 percent of respondents are married.  
\(^9\) The authors’ own calculations based on the German tax schedule in 1999 (earliest year available on http://www.parmentier.de/steuer/incometax.htm), differences to other years are small.
track only of effective experience (a composite of the years individuals have been working in emigration and immigration country), we need to approximate the shares of experience that have been accumulated in the two locations. To compute pension entitlements from the immigration country, we assume that an individual has worked for a total of 40 years by the time of retirement. Hence, denoting experience accumulated in the emigration and the immigration country by \( X^E \) and \( X^I \), respectively, and dropping subscripts for ease of notation, we have \( X = \xi X^E + X^I \) and \( X^E + X^I = 40 \). Together, these imply that the fraction of experience accumulated in the emigration country amounts to \( \frac{X^E}{40} = 1 - \frac{X^I}{40} \), while that in the immigration country equals \( \frac{X^I}{40} = \frac{X^E}{40} \). We assume a replacement ratio of 0.5 that is applied to the weighted average of an individual’s earnings potential in the two locations at age 64, where the weights are given by the fraction of experience accumulated in either location. This yields retirement benefits in Germany equal to

\[
y_R^I = 0.5 \left[ \left( \frac{X}{40} \right) y_{64}^I + \left( 1 - \left( \frac{X}{40} \right) \right) y_{64}^E \right],
\]

where we denote the earnings potentials in the immigration country and the emigration country at age 64 by \( y_{64}^I \) and \( y_{64}^E \), respectively. Bilateral agreements between Germany and Turkey ensure that returning migrants can repatriate pension entitlements (Holzmann et al., 2005). Retirement benefits individuals receive from the Turkish pension system after a return to Turkey depend on the time spent abroad. Since total duration in the host country is not a state variable in the model that we keep track of once an individual returns, we need a similar approximation to compute retirement benefits in the home country. We do this by computing the average fraction of working life spent in the host country by arrival cohort and age at immigration, both of which are ex-ante determined, constant state variables in our model and observed in the SOEP. We then assign individuals retiring in Turkey a weighted average of benefits in Germany and benefits in Turkey, with the weights given by the fraction of their working life spent in Germany.

### B.2 Dynamic Specification of the Model

\(^{10}\) In our SOEP sample, the average ratio of retirement benefits to earnings at ages 60-64 is 0.51.\(^{11}\) As with unemployment benefits, retirement benefits are based on previous earnings. Since these are not a state variable in our model, we use earnings predicted by an individual’s current state variables as the closest approximation.
We now describe in more detail the dynamic choices of individual immigrants, explained in the main text in Section 3.1 (equation 11) in terms of the generic Bellman equation:

\[ V(\Omega_{it}) = \max_{c_{it}, H_{it}^{it}, \Pi_{it}^{wrk}, \Pi_{it}^{it}} u(c_{it}, H_{it}, \Pi_{it}^{wrk}, \Pi_{it}^{it}, \Omega_{it}) + \beta E_t V(\Omega_{it+1}). \] (A1)

This Bellman equation can be decomposed into a sequence of choices involving conditional value functions conditioned on employment status and the decision of whether or not to return to the home country. We make the distinction between being in work and being unemployed because individuals face different choice sets. Individuals who are unemployed can accept a job if they are offered one. Individuals who are working may be fired but cannot choose to be unemployed. Similarly, the return to the home country is an absorbing state in that we do not allow (nor observe) individuals to come back to Germany. Hence, these conditional value functions explicitly model constraints that are only implicit in (A1).

We begin with the value functions for those who have decided to stay in the immigration country. The value of working is expressed as

\[ V_W^l(\Omega_{it}) = \max_{c_{it}, H_{it}^{it}, \Pi_{it}^{wrk}, \Pi_{it}^{it}} \left[ u(c_{it}, H_{it}, \Pi_{it}^{wrk}, \Pi_{it}^{it}, \Omega_{it}) \right] + \beta E_t \left[ (1 - \delta^l(\Omega_{it+1}))V_W^l(\Omega_{it+1}) + \delta^l(\Omega_{it+1})V_U^l(\Omega_{it+1}) \right], \] (A2)

where \( V_W^l(\Omega_{it}) \) and \( V_U^l(\Omega_{it}) \) denote the value functions of working and unemployment prior to deciding where to locate (defined below). The individual faces a probability \( \delta^l(\Omega_{it+1}) \) of being fired, in which case he starts the next period as unemployed. Individuals who are currently unemployed make choices according to the following Bellman equation:

\[ V_U^l(\Omega_{it}) = \max_{c_{it}, H_{it}^{it}, \Pi_{it}^{wrk}, \Pi_{it}^{it}} \left[ u(c_{it}, H_{it}, \Pi_{it}^{wrk}, \Pi_{it}^{it}, \Omega_{it}) \right] + \beta E_t \left[ \lambda^l(\Omega_{it+1}) \max[V_U^l(\Omega_{it+1}), V_W^l(\Omega_{it+1})] \right], \] (A3)

where \( \lambda^l(\Omega_{it+1}) \) is the probability of a job offer. When offered a job, individuals decide whether or not to accept it, depending in particular on the realization of the income shock \( \epsilon_{it+1} \) (see equation 6a).

For those who decide to return to the home country and who work at home, the consumption decision is
\[ V^E_W(\Omega_{it}) = \max_{c_{it}} u \left( c_{it}, H^H_{it} = 0, I^H_{it} = 0, \omega^w_{it} = 1; \Omega_{it} \right) \] (A4)

\[ + \beta E_t \left[ (1 - \delta^E(\Omega_{it+1})) V^E_W(\Omega_{it+1}) + \delta^E(\Omega_{it+1}) V^E_U(\Omega_{it+1}) \right]. \]

For those who do not work at home, the respective Bellman equation is:

\[ V^E_U(\Omega_{it}) = \max_{c_{it}} u \left( c_{it}, H^H_{it} = 0, I^H_{it} = 0, \omega^w_{it} = 0; \Omega_{it} \right) \] (A5)

\[ + \beta E_t \left[ \lambda^E(\Omega_{it+1}) \max \{ V^E_U(\Omega_{it+1}), V^E_W(\Omega_{it+1}) \} \right. \\
\left. + (1 - \lambda^E(\Omega_{it+1})) V^E_U(\Omega_{it+1}) \right]. \]

Finally, individuals in the immigration country make every period a location decision by comparing the value of staying an additional year abroad, defined in (A2) and (A3), with the value of returning to the home country, defined in (A4) and (A5):

\[ \tilde{V}^I_l(\Omega_{it}) = \max \{ V^I_l(\Omega_{it}), V^E_U(\Omega_{it}) \}, \quad l = U, W. \] (A6)

### B.3 Simulating Planned Migration Durations

The estimation relies on matching moments predicted by the model to moments observed in the data. To use moments involving intended durations, we need to construct the model counterpart of this observed outcome. The basic idea is as follows. In our model, the probability of returning in a given period has a closed form solution, which given the assumed extreme value distribution of preference shocks \( \eta \) takes a logistic form involving the value functions defined in (9). To determine the conditional probabilities of returning in all future periods, we simulate \( S \) future paths for shocks to earnings, employment, and preferences, and determine the optimal consumption, labor supply, and investment in host country specific human capital for each individual and each of the \( S \) paths in the simulated sample. Each of these paths for every individual determines a future probability of returning to the home country, conditional on the current state vector, and allow us to construct the density of future return dates. This density is again conditional on the simulated individual’s current state vector. We then define the *median* of the distribution of return dates as equivalent to the intention stated by an individual at a given time and observed by us in the data. We opt for the median because it produces a more robust measure of intentions than does the mean, which is sensitive to outliers. If individuals’ intended age at return exceeds age 64, we assume they intend to stay forever.
More formally, the intended length of stay $\zeta$ given the state $\Omega_{it}$ at time $t$ is $\zeta(\Omega_{it}) = m_{it}$ such that

$$\sum_{s=1}^{S} \mathbb{1}\left[\sum_{j=0}^{65-\text{age}_{it}} j \ I_S[\text{return at } t + j|\Omega_{it}] \leq m_{it}\right] \in \left[\frac{s}{2}, \frac{s+1}{2}\right],$$

where at time $t$, $I_S[\text{return at } t + j|\Omega_{it}]$ indicates whether simulation $s$ predicts that the migrant will return at time $t + j$ given current state variables, and at the end of working life $I_S[\text{return at 65|}\Omega_{it}] = 1$ regardless whether the individual returns. This formula allows us to have a theoretical counterpart to the stated return intentions that we observe for each individual in our data.\(^{12}\)

**C. Model Simulation, Choice of Moments and Model Fit**

Estimation requires that the outcomes predicted by the model are simulated under rules following as closely as possible the ones under which the samples observed in our datasets are generated. In our context, the following issues need to be accounted for: (1) Immigrants in our samples have arrived at different points in time, thus facing different macroeconomic conditions. (2) Immigrants arrive at different ages.\(^{13}\) (3) Some individuals have accumulated work experience in the origin country prior to migration. (4) A small fraction of immigrants in our sample who migrated between the ages 16 and 18 also have accumulated some work experience in the destination country. (5) Individuals enter the survey populations at different stages of their life-cycle (conditional on being in Germany). (6) Panel data typically exhibit some degree of attrition. While in our context an important source of attrition is return migration, which we model explicitly, we cannot exclude that there is attrition for other reasons.

To deal with these points, we use the joint empirical distribution of individuals’ arrival cohort, age at immigration, home country experience, host country experience accumulated between ages 16 and 18, the age individuals are first surveyed and the age when they are last surveyed in the SOEP. We then draw an initial value for arrival cohort, age at immigration, home and host country experience from this distribution, and use the model to simulate outcomes in later periods. Finally,

\(^{12}\) We simulate $S = 25$ paths of future shocks per individual. Because the simulation of intentions is computationally intensive, we do it only for individuals aged 25 and 35 rather than simulating intentions at every point in time. We choose these relatively young ages because it is at this life stage that most host country specific human capital investment takes place and many immigrants in our sample arrive. Considering intentions at two points in time is sufficient to allow us to construct dynamic moments involving intentions.

\(^{13}\) As explained in Section 2.1, we restrict the empirical samples to immigrants who have arrived at ages 16 or older.
we draw from the above joint distribution the ages at which individuals are observed. We then construct the simulated moments used in the estimation based on simulated observation points corresponding to these ages. This ensures the selection in the simulated sample closely follows that in the data. In Table A1, we provide a complete description of the moments used to estimate the model. As a weighting matrix, we use the inverse of the diagonal matrix of the standard deviations of the moments. This matrix puts more weight on moments that are measured more precisely in the data, such as labor market outcomes.

To analyze the mapping of parameters into the moments used in the estimation, we numerically compute the gradient matrix of the moment vector with respect to the parameter vector. A necessary condition for identification is that for each parameter there are one or more moments with a non-zero gradient, and that there is no collinearity between gradient vectors for different parameters. Figure A2 illustrates this gradient matrix graphically. Darker shades indicate a larger response of a predicted moment to a change in a particular parameter. As there are no rows that are white throughout, there exists at least one identifying moment for each parameter, and in fact all parameters are identified by more than one moment.

Consider for instance the topmost parameter, which is the intercept $\lambda_0$ of the linear index determining the rate at which job offers arrive. This parameter most directly relates to the intercept in the auxiliary regression of transitions into employment on a spline in age. This moment is displayed as the sixth column in the graph, corresponding to the first column of the second set of moments, which contains the coefficients from precisely this auxiliary regression. However, all other moments are indirectly affected by the probability of finding a job too, most strongly moments relating to agents’ outmigration (moment set H) and saving choices (moment set J). Other parameters are identified from only specific subsets of the moment vector. In particular, the parameters of the factor model for observed integration measures (detailed in Section 3.1) only determine how latent host country specific human capital maps into observed integration outcomes, but these parameters do not determine agents’ behavior. Hence, only moments that directly involve integration information are sensitive to those parameters. Figure A2 shows this, as only moment sets D, G and K are affected by changes in parameters from the factor model (second to last set of parameters on the vertical axis). The effort cost of investing in host country specific human capital is parameterized by an intercept (row 29) and a slope coefficient on age (row 30). As the intercept is low relative to the age dependent part of the effort cost (see the
estimates for $e_0$ and $e_1$ in Table 4), moments are more sensitive to the latter. Hence, whereas the slope coefficient has an effect on all moments, the intercept affects only a relative small set of moments related to savings decisions. Note, however, that this is sufficient for identification of both parameters.

In what follows, we describe the sources of identification for the model’s parameters.

**Earnings.** Information contained in regressions of earnings on a set of explanatory variables contributes to the identification of the parameters in equation (6a). Specifically, we regress earnings observed in the SOEP and earnings simulated by the model on the same sets of observed and simulated variables, including work experiences in the host- and home country (prior to emigration) and integration measures (oral and written skills in German, feeling German, reading of German newspapers). These moments inform on the model parameters in equation (6a) and in $f_y(X_{it})$, the return to experience accumulated in the origin country prior to immigration $\xi$, and the coefficient on host country specific human capital $\alpha_H$.

**Employment Transitions.** We identify parameters governing employment transitions $\delta^l$ and $\lambda^l$ by using as moments coefficients from auxiliary regressions of observed transition in and out of work on a spline in age, actual work experience and the same integration measures as in the earnings equation discussed above. The latter allows the identification of the effect of latent host country specific human capital on employment transitions.

**Utility.** Preference parameters $\phi_c$ and $\phi_H$ are identified from observed choices. In particular, the exponent on consumption $\phi_c$ is identified from the observed level of annual saving by individuals with different earnings and employment status. In our model, host country specific human capital $H_{it}$ complements consumption, so that a higher exponent $\phi_H$ on $H_{it}$ raises the marginal return to consumption in the host relative to the home country and thus lowers the incentive to save. Since accumulation of $H_{it}$ varies across migrants with different return plans, planned migration durations will be more negatively correlated with saving the larger $\phi_H$. Observed variation in savings across different planned migration durations hence identifies $\phi_H$. The age specific effort cost $e(age_{it})$ of investing in $H_{it}$ is identified from the age profiles of integration measures, conditional on age at migration. As previously discussed, persistence in the relative preference for the host country, $\Psi_{it}$, is identified from autocorrelation in individuals’ planned migration
durations. The level of $\Psi_{it}$, on the other hand, is identified from the distribution of migration durations.

Identification of the initial decision. The initial decision depends on the relative sum of discounted flows of utility in each location, the one-time cost of migration and the realization of the transitory preference shocks $\eta$. The discounted flows of utility in the emigration and immigration countries are identified from the observation of wages, assets and labor market choices in either location. The value of moving elsewhere (ROW) is summarized by the value $V^{ROW}$, which we assume is constant and that we identify from the observed number of Turkish emigrants in all OECD countries (except Germany), taken from Docquier et al. (2009). The cost and the variance of preference shocks are identified from the fluctuations in the emigration rate over time, from the early seventies to the nineties. We provide further details in Appendix D.

We list the full set of moments used for identifying the parameters of our model in Table A1. Some parameters have to be normalized because they are only identified up to scale and location. We normalize the initial level of the host country specific human capital to zero for the 1970 arrival cohort and set the effect of $H_{it}$ on oral language knowledge in the factor model to one.

Tables A2–A10 show the goodness of fit with respect to the full set of moments used in the estimation, whereas Figure A3 summarizes this fit graphically. Figures A4-A6 further show the fit for transitions in and out of employment, as well as the model predictions corresponding to the descriptive data patterns shown in Section 2 of the paper.

As an additional test for the model’s validity, we investigate whether the model is able to predict the effect of changes in relative price levels on savings, a moment that is not targeted in our estimation. The effect of relative price levels on savings is relevant in our context: The relative price level in Turkey determines the purchasing power of assets accumulated in Germany but spent in Turkey, and thus is an important determinant of economic migrants’ choices. Table A10 compares the coefficient from a regression of annual savings on relative price levels observed in the data to that predicted by the model. The model’s prediction is well within the confidence intervals of the data moments.14

14 This is similar to the approach by Todd and Wolpin (2006).
D. Simulation of Counterfactual Migration Policies

In considering counterfactual migration policies, the policy environment not only affects selective return migration and other migrant behaviors, but also which migrants immigrate in the first place. We now explain how we take account of selection of who immigrates in the simulation of these policies.

The model in Section 3 predicts – conditional on productivity, location preferences and other state variables – the values individuals attribute to being respectively in the emigration country and the immigration country, \( V^E(\Omega_{it}) \) and \( V^I(\Omega_{it}) \). We subsume the value individuals derive from moving to an alternative destination in the rest of the world by \( V^{ROW} \), and assume that individuals face a utility cost \( C \) of emigrating from \( E \). We first describe identification of a constant cost of migration, before describing how we let this cost vary across emigrant cohorts.

In an initial period \( t = 0 \), an agent’s problem in the emigration country is

\[
\max \{ V^E(\Omega_{i0}) + \eta^E_{i0}; V^I(\Omega_{i0}) + \eta^I_{i0} - C, V^{ROW} + \eta^{ROW}_{i0} - C \}.
\]

The model predicts for each unobserved individual type an emigration rate conditional on \( C \), \( V^{ROW} \) and the variance of the preference shocks \( \eta \), which is governed by a spread parameter \( \tau \). Under the assumption that the preference shocks \( \eta^E_{i0}, \eta^I_{i0} \) and \( \eta^{ROW}_{i0} \) are type I extreme value distributed, this probability takes the logistic form

\[
\Pr(\text{migrate to } I) = \frac{\exp \left( \frac{V^I(\Omega_{i0}) - C}{\tau} \right)}{\exp \left( \frac{V^E(\Omega_{i0})}{\tau} \right) + \exp \left( \frac{V^I(\Omega_{i0}) - C}{\tau} \right) + \exp \left( \frac{V^{ROW} - C}{\tau} \right)}, (A7)
\]

where \( \Omega_{i0} \) includes individual \( i \)'s unobserved type (productivity \( \alpha_i \) and initial location preference \( \Psi_{i0} \)), as well as observed state variables. Focusing on migrants to location \( I \) and of a given type, we can also write this probability as:

\[
\Pr(\text{migrate to } I|C, \text{type}) = \frac{M_{\text{type}}(C)}{T_{\text{type}}}, \quad (A8)
\]

where \( M_{\text{type}} \) denotes the number of migrants to \( I \) of a given type, whereas \( T_{\text{type}} \) is the total number of individuals of that type in the emigration country population.
While the share $\omega^T_{\text{type}} \equiv \frac{T_{\text{type}}}{T}$ of each unobserved type in the emigration country’s population $T \equiv \sum_{\text{type}} T_{\text{type}}$ is not readily observed, data on aggregate migration rates $\frac{M}{T}$ to $I$ allow identification of these shares under the model, as well as identification of the implied migration cost $C$, as we explain below. The distribution of unobserved types in the migrant population is implied by our estimates.$^{15}$ Denote the share for each type by $\omega^M_{\text{type}} \equiv \frac{M_{\text{type}}}{M}$.

Then the total Turkish population can be written as

$$T \equiv \sum_{\text{type}} T_{\text{type}} = \sum_{\text{type}} \frac{M_{\text{type}}}{\text{Prob}(\text{migrate to } I|C, \text{type})} = \sum_{\text{type}} \frac{M \omega^M_{\text{type}}}{\text{Prob}(\text{migrate to } I|C, \text{type})}$$

Since the migration rate in (A7) is a monotonically decreasing function of $C$ for each type, aggregate migration is too. As such, any observed emigration level thus implies a particular value of $C$, with higher migration rates corresponding to lower migration costs. Hence, the observed aggregate migration rate,

$$\frac{M}{T} = \left( \sum_{\text{type}} \frac{\omega^M_{\text{type}}}{\text{Prob}(\text{migrate to } I|C, \text{type})} \right)^{-1},$$

identifies the cost $\hat{C}$ of migrating based on the value function as described above.

This cost implies a fraction of movers $\hat{p}_{\text{type}} = \text{Prob}(\text{migrate to } I|\hat{C}, \text{type})$ to $I$ within each type, which in turn allows us to determine the distribution of types in the emigration country’s population, since $\frac{T_{\text{type}}}{T} = \frac{M \omega^M_{\text{type}}}{T \hat{p}_{\text{type}}}$.

The above argument took as given the value $V_{\text{ROW}}$ of migrating to an alternative destination, as well as the variance of preference shocks $\eta$, and it assumed a constant cost $C$ of migration, for which we show identification through the observed migration rate $\frac{M}{T}$ at one point in time. With repeatedly observed migration rates and given that we distinguish in our model different cohorts of migrants, we can estimate the cost of migration and who is selected into migration at different points in time, and hence for different cohorts of immigrants. Year-to-year fluctuations during the

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$^{15}$ For the immigrant population, we estimate the points of support for unobserved productivity $\alpha_i$ and location preference $\Psi_{it}$ (see Tables 3 and 5).
two decades 1970-1990 furthermore identify the spread parameter $\tau$ of the distribution from which transitory shocks $\eta$ are drawn. We compute annual emigration rates for this period from German National Statistical Office immigration flow data for Turkish males, and the male population in Turkey from Eurostat.

In practice, we allow for different levels of $C_t$ during years in which the guest worker agreement was in place (until 1973) and later years. Besides the sharp drop in emigration after 1973, Turkey has also seen a steep increase in emigration during the political unrest in 1976-1980 that led to the 1980 coup. To match this, we allow for different costs during each of these volatile years. Finally, the value $V^{ROW}$ of migrating elsewhere is identified by matching the observed share for Germany among non-tertiary educated male Turkish emigrants in all OECD countries, with data taken from Docquier et al.(2009). Table A13 lists the calibrated parameters determining the initial immigration decision, with costs denoted in utility. In Figure A7, we show the observed and simulated time series of emigration rates.

Our model also accounts for the effect of changes in macroeconomic conditions on individual migrants’ choices. Specifically, variation in earnings and prices in the country of origin relative to the destination country affect the benefits of migration. Figure A8 shows that we are able to match well the relation between relative earnings and price levels in the country of origin on the one hand, and emigration rates on the other, supporting our model’s validity for the context considered.

\textit{E. General Equilibrium Effects}

Our model does not capture general equilibrium effects. Instead, we focus on idiosyncratic shocks that affect individuals’ perceived horizon within the host country, but are unlikely to change the wage structure either in Germany or in Turkey. One important point to notice is that the policies that we simulate affect a small part of the overall labor market, both in Germany and in Turkey. It hence is plausible that the first order effects derive from those policies directly and their behavior of migrants rather than from an indirect feedback through equilibrium effects in labor markets. The empirical literature on the wage effects of immigration finds, if at all, only small negative effects, so that this channel would likely be of little relevance. Not also that at the end of our sample period in 2011, the annual gross inflow of non-EU migrants, who could be subject to the policies we simulate, amounted to less than 266,000 (Federal Ministry of Immigration and
Refugees, “Migration Monitoring Report 2012”), and thus only about 0.6 percent of the native working age population.

Yet, to investigate the issue of equilibrium effects further, we use wage elasticities estimated in the literature to estimate upper bounds of possible equilibrium effects, which we report in Rows (2) and (3) of Table A14. The probably highest estimates in the literature for a wage elasticity is that by Monras (2020), who reports elasticities in the range of -0.7 to -1.4 for Mexican immigration to the U.S. We use the estimated effects on immigration and return migration of the counterfactual policies we investigate, applied to 0.6 percent of the working age population in Germany (see above), and re-estimate the effects on immigrants’ earnings using Monras’ wage elasticity (Row 2). The most applicable estimate of a wage elasticity for our context is the one by Bonin (2005), who uses German register data for 1975-1997 to estimate labor market effects of immigration and finds a wage elasticity of -0.1, with no effect on employment. We report the implied policy effects if wages respond according to this elasticity in Row 3 of Table A14. The estimates in Rows 2 and 3 are not very different from those we report in the paper (replicated here in Row 1).

F. Behavioral Selection vs Selection on Ability

We now quantify the size of the bias arising when estimating log wage equations, resulting from neglecting behavioral selection. Displaying earnings profiles for four types (i.e., high/low productivity, high/low preference at arrival), Figure A9 illustrates the two separate sources of bias, where the vertical axis shows the log wage, and the horizontal axis time since arrival. Each earnings graph is plotted up to the median time of return within each group. Within the groups of immigrants with a low preference for the host country (the two grey lines), the negative ability selection of those who stay longer is reflected by the difference in length and level of the lines. This difference biases OLS estimates of the returns to experience downward in that those who stay longer have a lower earnings profile. Moreover, within ability groups, the difference in earnings growth between high- and low preference individuals (the difference in length and slope between the grey and black profiles) generates an upward bias. This “behavioral” bias is the result of differential investment into host country specific human capital, where those with high preferences for the host country invest more in host country human capital leading to steeper earnings profiles, and also stay longer. It is present even when there is no heterogeneity in unobserved productivity.
between the two groups of individuals. Thus, whereas the bias arising from selection on productivity can be eliminated using a first-differences estimator, the behavioral bias cannot.

We quantify the two types of bias by simulating a sample of immigrants who differ in both ability and preference from our model and applying different estimators. To isolate the ability selection bias, we control in an OLS estimation for latent host country specific human capital, thus conditioning on behavioral selection. Column 1 in Table A15 shows that return migrants self-selecting on ability induces a downward bias in estimated returns to experience of up to 30 percent. Column 2, in turn, displays the upward bias from behavioral selection, which is isolated by eliminating the ability selection bias through estimation in first differences. Immigrants arrive at different ages, implying different costs and incentives to invest in host country specific human capital, as well as different levels of initial experience. To show that this does not drive the results, columns 3 and 4 restrict the estimation to immigrants all arriving at age 25. We find little impact on the magnitude of estimates, with the behavioral bias still amounting to about 10 percent.

Data Availability Statement

The data and code underlying this research is available on Zenodo at https://doi.org/10.5281/zenodo.5795066.
Appendix Figures and Tables

Figure A1: Additional descriptives
(a) Wages and expected migration durations
(b) Evolution of integration measures

Source: Socio-Economic Panel 1984-2011. The sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Panel (a) shows conditional mean log wage changes within bins of expected duration changes, together with the linear fit. Integration outcomes in Panel (b) are self-reported measured on a scale from 0 to 1.
Figure A2: Mapping of parameters into moments

Note: The figure is a graphical illustration of the gradient matrix of moments used in the estimation with respect to the vector of model parameters. Darker shades indicate a stronger sensitivity of moments with respect to parameters.
Figure A3: Overall model fit

Note: The figure plots moments simulated from the model against their observed empirical counterparts together with the 45 degree line. All moments are measured in their standard deviations.

Figure A4: Model fit - Working transition profiles

Note: Simulated profiles are based on a simulation of 40,000 immigrants. Data profiles based on SOEP 1984-2011. Job finding and job loss rate refer to transitions in and out of employment.
Figure A5: Model fit - Outmigration

Note: Simulated profiles are based on a simulation of 40,000 immigrants. Data profiles based on synthetic cohorts constructed exploiting the representativeness of the micro-census samples and information on the year of arrival.

Figure A6: Earnings and consumption profiles

Note: The figure shows earnings and consumption profiles by productivity type and intention to stay permanently, based on a simulation of 40,000 immigrants. Earnings are indicated by solid, consumption by dashed lines. Plans to stay (black lines) and plans to return (gray lines) correspond to high and low preference types at arrival.
Figure A7: Model fit - Emigration rates

Note: Simulated profiles are based on a simulation of 40,000 individuals. Data points show annual migration rates of Turks to Germany, computed from German National Statistical Offices immigration flow data for Turkish males, and the male population in Turkey from Eurostat.

Figure A8: Model fit - Macroeconomic determinants of emigration

(a) Emigration rate by relative earnings level

(b) Emigration rate by relative price level

Note: Simulated profiles are based on a simulation of 40,000 individuals. Data points show annual migration rates of Turks to Germany, computed from German National Statistical Offices immigration flow data for Turkish males, and the male population in Turkey from Eurostat. Emigration rates plotted against predicted relative country of origin (a) earnings and (b) price levels as explained in Appendix B.
Figure A9: Log wage profiles by unobserved type

Note: Simulation of 40,000 immigrants who all arrive at age 25 in 1990. The figure shows the log annual earnings profiles by years since arrival for each of the unobserved types in the model. To capture differences in migration durations, we plot profiles until the median time of return within each type. "Low preference" and "high preference" refers to relative preference for the receiving country. "Low productivity" and "high productivity" refers to the time constant unobserved level in
### Table A1: Moments

#### Moments related to earnings

| Description                                                                 | Dataset | # moments |
|----------------------------------------------------------------------------|---------|-----------|
| Log earnings by age (rounded to 20, 30, 40, 50, 60 years)                    | GMC     | 5         |
| Log earnings differences between cohorts                                     | GMC     | 1         |
| Log earnings on a spline* of host country experience and on home country experience (M1) | SOEP    | 7         |
| Log earnings on oral language knowledge                                      | SOEP    | 2         |
| Log earnings on written language knowledge                                   | SOEP    | 2         |
| Log earnings on reading host country newspaper                               | SOEP    | 2         |
| Log earnings on feeling German                                               | SOEP    | 2         |
| Log earnings fixed effects (net of home and host country experience) on oral language knowledge | SOEP    | 2         |
| Log earnings fixed effects (net of home and host country experience) on written language knowledge | SOEP    | 2         |
| Log earnings fixed effects (net of home and host country experience) on reading host country newspaper | SOEP    | 2         |
| Log earnings fixed effects (net of home and host country experience) on feeling German | SOEP    | 2         |
| Residual standard deviations of earnings regression (M1)                     | SOEP    | 1         |
| Standard deviation of within individual mean residual of earnings regression (M1) | SOEP    | 1         |

#### Moments related to employment

| Description                                                                 | Dataset | # moments |
|----------------------------------------------------------------------------|---------|-----------|
| Employment by age (rounded to 20, 30, 40, 50, 60 years)                      | GMC     | 5         |
| Not working to working transitions on a spline** in age                      | SOEP    | 4         |
| Working to not working transitions on a spline** in age                      | SOEP    | 4         |
| Not working to working transitions on oral language knowledge               | SOEP    | 1         |
| Working to not working transitions on oral language knowledge               | SOEP    | 1         |
| Not working to working transitions on written language knowledge            | SOEP    | 1         |
| Working to not working transitions on written language knowledge            | SOEP    | 1         |
| Not working to working transitions on reading host country newspaper        | SOEP    | 1         |
| Working to not working transitions on reading host country newspaper        | SOEP    | 1         |
| Not working to working transitions on feeling German                        | SOEP    | 1         |
| Working to not working transitions on feeling German                        | SOEP    | 1         |

Note: Table continued on next page. All auxiliary regression contain a constant and control for year of observation.

* with nodes at 2, 5, 10 and 20 years

** with nodes at 30 and 50 years

*** Intentions are simulated at ages 25 and 35. Observed moments are based on intentions at five years around the simulated ages, with auxiliary regression including age indicators.
Table A1 continued:

| Moments related to savings | Dataset | # moments |
|---------------------------|---------|-----------|
| Annual saving on intention to stay permanently***, working and annual earnings (zero if not working) | SOEP | 4 |

| Moments related to location preferences | Dataset | # moments |
|-----------------------------------------|---------|-----------|
| Log fraction staying on interaction of immigrant cohort and years since arrival | GMC | 4 |
| Mean intended time until return*** conditional on age | SOEP | 1 |
| Intended time until return*** at age 35 on intended time until return at age 25 | SOEP | 2 |
| Residual standard deviations of intentions conditional on age | SOEP | 1 |
| Standard deviation of within individual mean residual of intentions conditional on age | SOEP | 1 |

| Moments related to host country human capital | Dataset | # moments |
|---------------------------------------------|---------|-----------|
| Oral language knowledge on intention to stay permanently***, arrival cohort and years since immigration | SOEP | 4 |
| Written language knowledge on intention to stay permanently***, arrival cohort and years since immigration | SOEP | 4 |
| Reading host country newspaper on intention to stay permanently***, arrival cohort and years since immigration | SOEP | 4 |
| Feeling German on intention to stay permanently***, arrival cohort and years since immigration | SOEP | 4 |
| Residual standard deviation of social integration regressions | SOEP | 4 |
| Oral language knowledge on age and age squared | SOEP | 2 |
| Written language knowledge on age and age squared | SOEP | 2 |
| Reading host country newspaper on age and age squared | SOEP | 2 |
| Feeling German on intention to age and age squared | SOEP | 2 |

**Total number of moments:** 93

Note: All auxiliary regression contain a constant and control for year of observation.

* with nodes at 2, 5, 10 and 20 years
** with nodes at 30 and 50 years
*** Intentions are simulated at ages 25 and 35. Observed moments are based on intentions at five years around the simulated ages, with auxiliary regression including age indicators.
|                          | Data   | Std. err. | Model |
|--------------------------|--------|-----------|-------|
| Intercept                | 9.529  | (0.078)   | 9.451 |
| Host country experience 0-2 years | 0.200  | (0.050)   | 0.205 |
| Host country experience 3-5 years | 0.060  | (0.020)   | 0.083 |
| Host country experience 6-10 years | 0.017  | (0.008)   | 0.019 |
| Host country experience 11-20 years | 0.013  | (0.003)   | 0.006 |
| Host country experience 21+ years | 0.001  | (0.003)   | 0.005 |
| Origin country experience | -0.008 | (0.001)   | -0.002 |
| Residual standard deviation | 0.396  | (0.012)   | 0.270 |
| Within-individual mean residual standard deviation | 0.327  | (0.036)   | 0.228 |

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the Socio-Economic Panel 1984-2011. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Host and origin country experience refer to years of actual work experience accumulated after and prior to immigration, respectively. The regression controls for the year of observation.
Table A3: Goodness of fit: Integration age profiles

|                                 | Data  | Std. err. | Model |
|---------------------------------|-------|-----------|-------|
| **Spoken German language knowledge:** |       |           |       |
| age                             | 0.018 | (0.003)   | 0.018 |
| age squared*1000                | -0.151| (0.035)   | -0.232|
| **Written German language knowledge:** |       |           |       |
| age                             | 0.012 | (0.004)   | 0.028 |
| age squared*1000                | -0.101| (0.042)   | -0.334|
| **Reading German newspaper:**   |       |           |       |
| age                             | 0.021 | (0.005)   | 0.028 |
| age squared*1000                | -0.211| (0.054)   | -0.33 |
| **Feels German:**               |       |           |       |
| age                             | 0.007 | (0.004)   | 0.021 |
| age squared*1000                | -0.051| (0.046)   | -0.233|

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the Socio-Economic Panel 1984-2011. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Integration outcomes are self-reported measured on a scale from 0 to 1. All regressions control for the age at immigration and the year of observation.
Table A4: Goodness of fit: Integration regressions

|                          | Data   | Std. err. | Model |
|--------------------------|--------|-----------|-------|
| **Feels German:**        |        |           |       |
| Intends to stay permanently | 0.144  | (0.030)   | 0.131 |
| Arrived after 1973       | 0.057  | (0.048)   | 0.098 |
| Years since immigration  | 0.013  | (0.004)   | 0.061 |
| Constant                 | -0.004 | (0.082)   | -0.444|
| Residual standard deviation | 0.214  | (0.004)   | 0.228 |
| **Reading German newspaper:** |          |           |       |
| Intends to stay permanently | 0.067  | (0.033)   | 0.171 |
| Arrived after 1973       | 0.195  | (0.068)   | 0.111 |
| Years since immigration  | 0.032  | (0.005)   | 0.076 |
| Constant                 | -0.222 | (0.130)   | -0.438|
| Residual standard deviation | 0.308  | (0.006)   | 0.289 |
| **Spoken German language knowledge:** |          |           |       |
| Intends to stay permanently | 0.016  | (0.024)   | 0.124 |
| Arrived after 1973       | 0.139  | (0.038)   | 0.135 |
| Years since immigration  | 0.034  | (0.004)   | 0.046 |
| Constant                 | 0.080  | (0.052)   | -0.065|
| Residual standard deviation | 0.283  | (0.004)   | 0.207 |
| **Written German language knowledge:** |         |           |       |
| Intends to stay permanently | 0.054  | (0.030)   | 0.174 |
| Arrived after 1973       | 0.221  | (0.047)   | 0.123 |
| Years since immigration  | 0.039  | (0.004)   | 0.076 |
| Constant                 | -0.221 | (0.064)   | -0.437|
| Residual standard deviation | 0.331  | (0.005)   | 0.298 |

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the Socio-Economic Panel 1984-2011. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Integration outcomes are self-reported measured on a scale from 0 to 1. Intention to stay permanently takes value 0 if an intention to return prior to age 65 is reported, and value 1 if either an intention to stay permanently or to return after the age of 65 is stated. All regressions control for the year of observation.
Table A5: Goodness of fit: Log earnings regressions on integration outcomes

| Regression on spoken German language knowledge: | Data  | Std. err. | Model |
|-----------------------------------------------|-------|-----------|-------|
| Spoken language                              | 0.123 | (0.043)   | 0.230 |
| Constant                                     | 10.066| (0.026)   | 10.038|

| Regression on written German language knowledge: | Data  | Std. err. | Model |
|-------------------------------------------------|-------|-----------|-------|
| Written language                               | 0.049 | (0.034)   | 0.231 |
| Constant                                       | 10.115| (0.017)   | 10.092|

| Regression on reading German language newspaper: | Data  | Std. err. | Model |
|--------------------------------------------------|-------|-----------|-------|
| Newspaper                                       | 0.215 | (0.053)   | 0.237 |
| Constant                                        | 10.057| (0.066)   | 10.092|

| Regression on feeling German:                   | Data  | Std. err. | Model |
|-------------------------------------------------|-------|-----------|-------|
| Feeling German                                  | 0.049 | (0.037)   | 0.322 |
| Constant                                       | 10.113| (0.016)   | 10.113|

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the Socio-Economic Panel 1984-2011. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Integration outcomes are self-reported measured on a scale from 0 to 1. All regressions control for year of observation.
| Regression on spoken German language knowledge: | Data | Std. err. | Model |
|-----------------------------------------------|------|-----------|-------|
| Spoken language                              | 0.189 | (0.128)   | 0.042 |
| Constant                                     | -0.157 | (0.071)   | -0.082 |

| Regression on written German language knowledge: | Data | Std. err. | Model |
|-------------------------------------------------|------|-----------|-------|
| Written language                               | 0.329 | (0.099)   | 0.089 |
| Constant                                       | -0.164 | (0.039)   | -0.084 |

| Regression on reading German language newspaper: | Data | Std. err. | Model |
|-------------------------------------------------|------|-----------|-------|
| Newspaper                                       | 0.400 | (0.124)   | 0.090 |
| Constant                                       | -0.147 | (0.045)   | -0.084 |

| Regression on feeling German:                  | Data | Std. err. | Model |
|------------------------------------------------|------|-----------|-------|
| Feeling German                                | 0.306 | (0.128)   | 0.131 |
| Constant                                     | -0.120 | (0.035)   | -0.078 |

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the Socio-Economic Panel 1984-2011. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Log earnings fixed effects are obtained from a regression on home and host country experience (as in Table A2). Integration outcomes are self-reported measured on a scale from 0 to 1. All regressions control for year of observation.
Table A7: Goodness of fit: Intended and actual length of stay

| Intended length of stay regression on age: | Data   | Std. err. | Model |
|-------------------------------------------|--------|-----------|-------|
| Mean intended length of stay              | 23.552 | (0.573)   | 26.018 |
| Residual standard deviation net of age and year | 12.500 | (0.164)   | 13.123 |
| Within-individual mean residual standard deviation | 10.778 | (0.464)   | 13.030 |

| Intended length of stay auto-regression: |        |           |       |
|-----------------------------------------|--------|-----------|-------|
| Intended length of stay (t-10)          | 0.145  | (0.060)   | 0.260 |
| Constant                                | 24.424 | (5.194)   | 17.045 |

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the Socio-Economic Panel 1984-2011. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Intended length of stay refers to the number of years until age 65 if either an intention to stay permanently or to return after the age of 65 is stated. Regressions control for age and the year of observation.
| Table A8: Goodness of fit: Regressions of employment transitions on age |
|---------------------------------------------------------------|
| **Data** | **Std. err.** | **Model** |
| **Not working-to-working transitions:** | | |
| Age 18-30 years       | 0.028 (0.008) | -0.001 |
| Age 31-50 years       | -0.019 (0.002) | -0.009 |
| Age 50+ years         | -0.012 (0.003) | -0.017 |
| Constant              | -0.338 (0.203) | 0.360 |
| **Working-to-not working transitions:** | | |
| Age 18-30 years       | -0.002 (0.004) | 0.000 |
| Age 31-50 years       | 0.002 (0.001) | 0.002 |
| Age 50+ years         | 0.013 (0.002) | 0.016 |
| Constant              | 0.105 (0.099) | 0.021 |

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the Socio-Economic Panel 1984-2011. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Employment transitions are year-to-year transitions into and out of working. Regressions control for the year of observation.
### Table A9: Goodness of fit: Wages and Employment Profiles

|                     | Data  | Std. err. | Model |
|---------------------|-------|-----------|-------|
| **Log annual earnings** |       |           |       |
| age 20              | 9.734 | (0.103)   | 9.810 |
| age 30              | 9.840 | (0.068)   | 9.910 |
| age 40              | 9.849 | (0.057)   | 9.999 |
| age 50              | 9.768 | (0.061)   | 9.972 |
| age 60              | 9.662 | (0.082)   | 9.972 |

| **Fraction working** |       |           |       |
| age 20              | 0.659 | (0.103)   | 0.810 |
| age 30              | 0.804 | (0.071)   | 0.845 |
| age 40              | 0.823 | (0.060)   | 0.874 |
| age 50              | 0.733 | (0.063)   | 0.798 |
| age 60              | 0.399 | (0.076)   | 0.338 |

| **Wage gap by arrival cohort** |       |           |       |
| Arrived after 1973 (conditional on age an years since arrival) | 0.090 | (0.006) | 0.051 |

| **Log fraction staying:** |       |           |       |
| years since arrival      | -0.014| (0.001)   | -0.015|
| post 1973 arrival        | 0.071 | (0.025)   | 0.003 |
| post 1973 arrival*years since arrival | 0.004 | (0.001) | 0.001 |
| intercept                | -0.283| (0.022)   | -0.077|

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the German Microcensus 1976-2007. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Earnings and savings are denoted in Euros, deflated to 2005. The fraction staying is calculated based on synthetic cohorts.
Table A10: External validity: Savings and relative price levels

|                           | Data   | Std. err. | Model  |
|---------------------------|--------|-----------|--------|
| **Savings ratio:**        |        |           |        |
| Relative price level in Turkey | -5,979.2 | (837.52) | -5,570.4 |
| **t-ratio for relative price level:** | -7.14  |           |        |

Note: Model moments are based on 40,000 simulations. Empirical moments are obtained from the Socio-Economic Panel 1984-2011, merged to exchange rates and price indices from the OECD. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. Annual savings and earnings are denoted in Euros, deflated to 2005. The regression controls for a full set of age indicators.
| Parameter                                                                 | Estimate | Std. err. |
|--------------------------------------------------------------------------|----------|-----------|
| **Job offer function** $\lambda(\Omega)$                                |          |           |
| host country human capital (x100)                                        | 4.058    | (1.446)   |
| *marginal effect of age:*                                                |          |           |
| at age 20 (x100)                                                         | 0.364    | (0.006)   |
| at age 40 (x100)                                                         | -0.571   | (1.658)   |
| at age 60 (x100)                                                         | -0.088   | (2.951)   |
| annual job offer rate at mean values of state variables (x100)           | 30.011   | (27.966)  |
| **Job loss function** $\delta(\Omega)$                                  |          |           |
| host country human captial capital (x100)                                | -1.297   | (0.083)   |
| *marginal effect of age:*                                                |          |           |
| at age 20 (x100)                                                         | 0.061    | (0.007)   |
| at age 40 (x100)                                                         | 0.087    | (0.013)   |
| at age 60 (x100)                                                         | 1.940    | (0.454)   |
| annual job loss rate at mean values of state variables (x100)            | 4.054    | (0.324)   |

Note: The table shows marginal effects. Estimates are obtained by indirect inference, based on 40,000 simulations and empirical moments from the Socio-Economic Panel 1984-2011 and the German Microcensus 1976-2007. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. We weight moment differences by their standard deviation. Marginal effects are computed at mean values of all variables. Host country human capital is measured in standard deviations.
Table A12: Estimates - Integration measures

| Parameter                                  | Estimate | Std. err. |
|--------------------------------------------|----------|-----------|
| Spoken German, intercept                   | \(-2.078\) | (0.194)   |
| Spoken German, effect of social capital    | 1        | (normalization) |
| Spoken German, error stdev.                | 0.088    | (0.017)   |
| Written German, intercept                  | \(-4.852\) | (1.684)   |
| Written German, effect of social capital   | 1.656    | (0.412)   |
| Written German, error stdev.               | 0.172    | (0.758)   |
| Reads German Newspaper, intercept          | \(-4.525\) | (1.741)   |
| Reads German Newspaper, effect of social capital | 1.500    | (0.326)   |
| Reads German Newspaper, error stdev.       | 0.175    | (0.015)   |
| Feel German, intercept                     | \(-4.236\) | (0.298)   |
| Feel German, effect of social capital      | 1.036    | (0.081)   |
| Feel German, error stdev.                  | 0.040    | (0.066)   |

Note: Estimates are obtained by indirect inference, based on 40,000 simulations and empirical moments from the Socio-Economic Panel 1984-2011 and the German Microcensus 1976-2007. The data sample is restricted to non-tertiary educated male immigrants from Turkey who arrive to Germany after 1961 at the age of at least 16 years. We weight moment differences by their standard deviation.
Table A13: Calibrated parameters for initial immigration choice

| Parameter                                                                 | Value  |
|---------------------------------------------------------------------------|--------|
| Utility cost of migration ($C_t$) during guest-worker program (until 1973) | 291.05 |
| Utility cost of migration ($C_t$) post guest-worker program               | 370.32 |
| Utility cost of migration ($C_t$) during years of unrest in Turkey        |        |
| 1976                                                                      | 342.88 |
| 1977                                                                      | 338.17 |
| 1978                                                                      | 329.17 |
| 1979                                                                      | 310.32 |
| 1980                                                                      | 297.69 |
| Value of migrating to rest of the world ($V^{ROW}$)                       | 61.16  |
| Spread parameter of extreme value distribution ($\tau$)                   | 50.30  |

Note: Calibration based on 40,000 simulations; identification through annual emigration rates based on immigration flow data from the German National Statistical Office for Turkish males, and the male population in Turkey from Eurostat. The value of migrating to rest of the world is identified through the observed number of Turkish emigrants in all OECD countries (except Germany), taken from Docquier, Lowell and Marfouk (2009).
| Outcome | Policy |
|---------|--------|
|         | Scheme I | Scheme II | Scheme III |
| Baseline | Permit if in work and earning above €20,000 | Permit if above 30th percentile of host country human capital | Permission declined at random with 30% probability |
| Effects of policies on annual earnings | 2,201.24 | 2,072.20 | -1,940.95 |

(1) Baseline

(2) Large wage elasticity (-1.418, highest estimate by Monras, 2020)

(3) Small wage elasticity (-0.102, main estimate by Bonin, 2005)
**Table A15: Illustration of estimation bias**

|                                             | OLS | FD | OLS | FD |
|---------------------------------------------|-----|----|-----|----|
| Bias in average returns to experience       | -10.2% | +14.2% | -16.1% | +10.1% |
| during first 10 years                       |     |    |     |    |
| Bias in average returns to experience       | -30.2% | +14.2% | -29.9% | +10.0% |
| during first 20 years                       |     |    |     |    |
| host country human capital                  | X   |    | X   |    |
| individual fixed effects                    | X   |    | X   |    |
| restriction to same age (25) at arrival     | X   |    | X   |    |

Note: Estimates based on a sample of 200,000 individuals simulated from the model. We compare regression coefficients to the predicted returns to experience in a model that accounts both for log wage fixed effects and host country specific human capital. The first and third columns show the downward bias from selection on productivity. The second and fourth columns show the upward bias from behavioral selection. The simulated sample is restricted to continuously employed individuals. OLS regressions condition on year of immigration. Standard errors can be made arbitrarily small for large simulation sizes and are thus not reported.