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Local Unemployment and the Earnings-Assimilation of Immigrant Men in Sweden: Evidence from Longitudinal Data, 1990-2000*

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Abstract

The earnings-assimilation of first-generation immigrant men in Sweden was analyzed using eleven waves of panel-data, 1990-2000. Employment-probabilities and earnings were estimated simultaneously in a random-effects model, using a quasi-fixed effects to control for both individual effects and panel-selectivity due to missing earnings-information. Assuming equal-period effects produced bias which could distort the findings. To correct the bias, local unemployment-rates were used to proxy for changing economy-wide conditions. Labour-market outcomes differed considerably across immigrant arrival cohorts, region and country of origin, and educational levels.

Keywords: *Immigrants, earnings-assimilation, unbalanced panel, selection-bias, random-effects, Mundlak's formulation, local unemployment-rates.*

JEL Codes: C33, J15, J61.

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1 Introduction

The economic assimilation of immigrants has become an important topic in highly- immigrated Western countries. Governments generally desire to assimilate immigrants as rapidly and completely as possible, and thus need to know how their country-specific skills and resultant earnings develop after arrival. We estimated immigrant earnings in the context of the Swedish labour-market for the period 1990-2000, improving the existing (conventional) methods in order to control for several potential sources of bias.

Sweden has experienced large migration-waves since World War II, originally from southern Europe in response to high demand for labour. Since the mid-1970s, immigration to Sweden has largely switched from economic to political, partly due to a decline in economic growth and because of resultant immigration-restrictions. At the same time Sweden's liberal rules for political refugees led to a new influx of immigrants from non-European countries (at first from Chile; later from Iraq, Iran, Afghanistan, and many African countries in the 1980s; then from the former republics of Yugoslavia in the 1990s).

Thus the composition of the immigrant-population by country of origin changed substantially, while the employment-possibilities and earnings of immigrants also declined relative to native Swedes.

This occurred despite the boom in the Swedish economy during the 1980s, and then got worse during the slump in the early 1990s. Probably both supply and demand-side factors were responsible for the worsening income-gap between immigrant and native Swedes. A structural shift in the Swedish economy from industrial to service-oriented increased demand for employees with language and interpersonal skills, including the culture-specific ability to deal with authorities and labour-market organizations. Such demand for informal competence made it difficult for immigrants to compete even if they had the same level of formal education.

Beyond the income-inequality itself and stresses that immigrants have placed on public services and income-transfer programs, their economic status is a matter of interest since it relates to the persistence of social problems. Assimilation can be even more difficult for children if their parents were not only immigrants but low-income as well.

Many studies have assessed the economic assimilation of immigrants, for North America: Chiswick, 1978; Borjas, 1985, 1989; LaLonde and Topel, 1991, 1992; Baker and Benjamin, 1994; and Duleep and Regets, 1999; for Europe: Aguilar and Gustafson, 1991; Bauer and Zimmermann, 1997; Bell, 1997; Longva and Raaum, 2003. But because of data limitations these studies were prone to some important potential biases. The synthetic panel methodology which has been standard for assimilation-studies ignores the influence of unobserved factors on immigrants' economic performance; if these factors

are correlated with immigrants' observed characteristics, the results will be biased. The possibility of sample-selection bias has also been neglected. And whether synthetic or not, identification of any model which aims to separate assimilation-, cohort-, and period-effects needs some parameter-restrictions (Mason et al., 1973; Glenn, 1981). Further, the results can be quite sensitive to what restrictions are made (Glenn, 1976). The restriction usually used in assimilation studies is that period-effects (assumed representative of overall macroeconomic conditions) be the same for immigrants and natives (Borjas, 1985, 1995). However, Barth et al. (2002a, 2002b, 2004) show that if the earnings of immigrants and natives have different sensitivities to varying economy-wide conditions, then this assumption leads to bias which can distort the earnings-predictions for immigrants. They found different unemployment elasticities not only between immigrants and natives, but also among immigrant-groups from different world regions. Longva and Raaum (2002) found that the earnings of immigrants and natives were affected differently by regional unemployment rates in Norway; McDonald and Worswick (1997) found a similar result for the immigrants to Canada using aggregate unemployment rates.

We used eleven waves (1990-2000) of the register-based Longitudinal Individual Dataset (LINDA) which allowed us to overcome the problems just discussed. We estimated the employment- and earnings-equations simultaneously while also extending the standard approach using panel methodology with a random-effects model augmented by Mundlak's (1978) formulation. Thus we allow for correlation between persistent unobserved and observed individual characteristics while also correcting for sample selection. Following Blanchflower and Oswald (1994), Card (1995) and Barth at al. (2004), we also used wage-curve methodology with local unemployment rates to avoid inappropriate restrictions.

The next section develops the models used and discusses econometric issues, while Section 3 presents the data. Section 4 gives the estimation results. Section 5 summarizes and draws conclusions.

2 Econometric specifications

2.1 The assimilation model

Our econometric strategy was chosen both to exploit the panel-aspect of the data to correct for potential sample-selection bias. Sample-selection bias[1]can arise from self-selection by the individuals under investigation or from sample-selection decisions made

[1] A simple sample-selection test (suggested by Verbeek and Nijman, 1992) was also performed by adding the lagged selection-indicator ($r_{i,t-1}$) to the equation, estimating the model by fixed effects on the unbalanced panel, and doing a t-test for the significance of $r_{i,t-1}$. For all groups, $r_{i,t-1}$ was significant.

by data-analysts. Such sample-selectivity can be a major problem with cross-sectional as well as panel data (Matyas and Sevestre, 1995; Kyriazidou, 1997). It has been common in many economic analyses of panel-data to study only a balanced sub-panel without correcting for selectivity-bias.

Another big concern in empirical work is unobserved individual-effects (heterogeneity), which may be correlated with explanatory variables. It is desirable to consider both sample-selectivity and unobserved heterogeneity simultaneously, which can be done in various ways. We estimated a random-effects model (as suggested by Zabel, 1992) in which income-generation by immigrants (I) is given by

$$\begin{aligned} y_{it}^{*I} &= x_{it}\beta^I + \phi^I AGE_{it} + \delta\, YSM_{it} + \textstyle\sum_j \psi_j C^j + \sum_k \theta_k^I \Pi^k + \eta^I \log UR_{it}^{mI} + u_i^I + \varepsilon_{it}^I \\ r_{it}^I &= 1\left\{ z_{it}\gamma^I + v_i^I + \omega_{it}^I > 0 \right\} \\ y_{it}^I &= y_{it}^{*I} \times r_{it}^I \end{aligned} \tag{1}$$

and income-generation by native Swede is given (N) by

$$\begin{aligned} y_{it}^{*N} &= x_{it}\beta^N + \phi^N AGE_{it} + \textstyle\sum_k \theta_k^N \Pi^k + \eta^N \log UR_{it}^{mN} + u_i^N + \varepsilon_{it}^N \\ r_{it}^N &= 1\left\{ z_{it}\gamma^N + v_i^N + \omega_{it}^N > 0 \right\} \\ y_{it}^N &= y_{it}^{*N} \times r_{it}^N \end{aligned} \tag{2}$$

where y_{it}^* denotes the log of latent earnings; i denotes individuals; t denotes the year; x_{it} and z_{it} are vectors of socio-demographic characteristics such as educational attainment, marital status, and non-labour income; AGE denotes the age of the individual; YSM is years since migration;[2] C denotes arrival-cohort; Π is also an indicator variable indicating income in year t; UR_i^m is the local unemployment rate for municipality m in year t; r_{it} is a selection-indicator measuring the benefit of being employed relative to unemployed; u_i and v_i are unobserved persistent individual-specific effects; ε_{it} and ω_{it} are idiosyncratic error-terms and $\beta, \phi, \delta, \psi, \theta, \eta$ and γ are vectors of unknown parameters of interest.

2.2 Identification of the model and quasi-fixed effects approach for the unobserved individual-effects

The models given in (1) and (2) have two identification problems. First of all, a simultaneous focus on employment and earnings immediately implies one has to take a stance

[2] The model also includes the squared-age and squared-years since migration; and interactions of local unemployment-rates with both years since migration and squared-years since migration (but not shown in (1) and (2), for simplicity).

on selection. A credible analysis of selection requires a robust identifying instrument (an exclusion-restriction). The second problem arises because the model (1) aims to separate years since migration, arrival-cohort, and period-effects.

Identification of selection-bias depends on the exclusion restriction or identifying instrument: At least one explanatory variable in the selection equation must be excluded from the earnings equation. The number of variables usable for this purpose in empirical applications is very limited; it is not easy to find a defensible and robust identifying instrument. The restriction adopted here is that *temporary capital (non-labour) income* is assumed to only affect participation, whereas the *permanent* capital (non-labour) income can affect earnings, through human capital investment.

Consider the capital income y_{it}^{nl} of individual i during t, which can be split into two uncorrelated components, $\beta y_{it}^{nl} + \varphi \overline{y}_i^{nl}$, where $\overline{y}_i^{nl} = (1/T_i)\sum_1^{T_i} y_{it}^{nl}$ is the average over time. This can also be written as $\beta(y_{it}^{nl} - \overline{y}_i^{nl}) + (\beta + \varphi)\overline{y}_i^{nl}$. The first part of the expression is the difference from the within individual means, and represents *temporary shocks* on the capital income and the second part is *permanent capital income* or *level effect*. It was assumed that temporary shocks affected only current participation but not the earnings, and it was therefore excluded from the earnings equations and used as identifying restriction.

The period-effect in equations (1) and (2) is a linear combination of the effects of arrival-cohort and years since migration.[3] It is not possible to analyze the effects of age, cohort, and period simultaneously. An additional restriction must be imposed, either period-effect is the same for both immigrants and Swedes, or cohort-effect is the same across arrival cohorts. The changing pattern of immigration over time generated by political conflicts in source-countries and changes in immigration policy in Sweden makes the constant cohort-effects unrealistic. The restriction imposed in this paper is that period-effect in the immigrants' earnings generating process is equal to the one that is in the earnings generating process of natives. If in fact they were not equally affected by the trend in economy-wide conditions, then this restriction could lead to severe bias in estimates of the effects of arrival-cohort and years-since-migration (Barth et al., 2004). This restriction does not mean that labour-market and social conditions were unchanged during the observation period, but that the earnings of immigrants and natives Swedes were equally affected (Borjas, 1985). Our observation period covers the eleven years between 1990 and 2000 in which Sweden experienced an economic downturn. As shown in Figure 1, there is positive trend in the unemployment rates. In this period unemployment

[3] The calendar year of any given cross-section is the sum of years since migration and the year in which the individual immigration occurred.

rates reached its historical maximum at 8.2 % in 1993.

Figure 1 *about here*

To attempt to control for this bias, at least partially, local market unemployment-rates were used by following the *wage-curve model* suggested in Card (1995) and Barth et al., (2004). To include the changes in the sensitivities to changing macroeconomic over time, the model was also augmented by interacting the years-since-migration with local unemployment rates. The augmented wage-curve model was also restricted by equal-period-effects assumption. However, it was assumed that the period-effects could be identified (at least partially) by controlling for local unemployment rates.

In this paper, we will follow a fully parametrized random-effects approach with maximum likelihood estimator. However, the random-effects approach is inconsistent and seriously biased if the probability distribution of the unobserved individual-effects which is conditioned on observed individual characteristics is misspecified ($E\left[u_i|x_{it}\right] \neq 0$). For example, *ability* which can be considered as unobserved factor influencing the employment probabilities and earnings may be correlated with education level while *motivation* can be correlated with immigrant status. In this case, treating the individual effects as i.i.d. errors would also lead to biased and inconsistent estimators.

To deal with this issue, we follow a quasi-fixed effects approach which is allowing correlation between unobserved and observed individual-characteristics. Thus, the correlated random-effects approach of Mundlak (1978) and Chamberlain (1984) is adopted by parameterizing the fixed-effects as linear projection on the *within*individual means of *time-varying* regressors,

$$u_i = \xi \overline{x}_i + \zeta_i$$

and

$$v_i = \vartheta \overline{z}_i + \kappa_i$$

where $\overline{x}_i = (1/T_i)\sum_1^{T_i} x_{it}$ and $\overline{z}_i = (1/T_i)\sum_1^{T_i} z_{it}$; T_i is the number of periods an individual is observed; ζ_i and κ_i are the new unobserved individual-effects which are assumed as not correlated with observed explanatory variables. ξ and ϑ are parameters. Adding these expressions to the earnings and selection equations, the composed error terms become $\widetilde{\varepsilon}_{it} = \varepsilon_{it} + \zeta_i$ and $\widetilde{\omega}_{it} = \omega_{it} + \kappa_i$, with it assumed

$$\widetilde{\varepsilon}_{it} \sim N\left[0, \sigma^2_{\widetilde{\varepsilon}_{it}}\right], \qquad i = 1, ..., N; t = 1, ..., T$$

$$\widetilde{\omega}_{it} \sim N\left[0, 1\right], \qquad i = 1, ..., N; t = 1, ..., T$$

$$\rho_{\widetilde{\varepsilon}\widetilde{\omega}} = Corr(\widetilde{\varepsilon}_{it}, \widetilde{\omega}_{it})$$

The error-terms $\widetilde{\varepsilon}_{it}$ and $\widetilde{\omega}_{it}$ are assumed to be non-autocorrelated and the selectivity is assumed to show-up through the correlation of these composite error terms. The model was estimated by a simulated maximum likelihood estimator with smooth recursive simulator (GHK) using 100 random draws.

2.3 The estimator of assimilation

Just as it would be with cross-sectional data the conditional mean function for the sample selection model here is not changed by the presence of random effects:

$$E\left[y_{it}|x_{it}, z_{it}, r_{it}=1\right] = x_{it}\beta + \rho_{\widetilde{\varepsilon}\widetilde{\omega}}\sigma_{\widetilde{\varepsilon}}\frac{\phi\left(z_{it}\gamma\right)}{\Phi\left(z_{it}\gamma\right)} \tag{3}$$

where ϕ and Φ probability density and distribution function of standard normal random variable, respectively; the variance of the augmented error-term is $\sigma^2_{\widetilde{\omega}} = 1$ due to the normalization. In this paper, the earnings assimilation is measured as a situation where immigrant earnings catch up over time with native earnings by following Borjas (1985, 1999). Then, the expected earnings-difference between immigrant group k and native Swedes at any time t after arrival, evaluated at the mean values is

$$\Delta y_k = E^I - E^N$$

or

$$\begin{aligned}\Delta y_k(t) = {} & E^I\left[y_{it}|AGE(t_0+t), YSM(t), x_{it}, z_{it}, r_{it}=1\right] \\ & - E^N\left[y_{it}|AGE(t_0+t), x_{it}, z_{it}, r_{it}=1\right]|_{x=\overline{x}, z=\overline{z}}\end{aligned} \tag{4}$$

where t_0 is labour-market entry age of the individuals. The *initial earnings-difference* (or *entry-effect*) is calculated by $\Delta y_k(0)$. Then, the estimator of the *marginal rate of assimilation* (MRA) for any time t after arrival is

$$\widehat{MRA_k}(t) = \frac{\partial E^I}{\partial t} - \frac{\partial E^N}{\partial t}$$

or in terms of estimated marginal effects of the variables age $ME(AGE(t))$ and year since migration $ME(YSM(t))$,[4]

$$\widehat{MRA_k}(t) = \left(ME(YSM(t)) + ME^I(AGE(t_0+t))\right) - ME^N(AGE(t_0+t)) \tag{5}$$

[4] Note that the model in (1) and (2) has non-linear conditional expected value, and thus the estimated parameters are no longer equal to the marginal effects.

Clearly, if $\widehat{MRA_j}(t) > 0$ in any time after arrival, then assimilation occurs. Given that the initial earnings difference is negative $\Delta y_k(0) < 0$ and $\widehat{MRA_k}(t) > 0$ is positive, immigrants close the earnings gap with this marginal rate. The estimator of *total years for assimilation* (TYA), that is the time spend needed to catch-up with the earnings of an average native, as a continuous function on the real time axis, is constructed in the following way: TYA is the upper-limit of the integral which accumulates the $\widehat{MRA_k}(t)$ of each time points to initial earnings-difference of the immigrant group (or equivalently, the time needed for the immigrant group in which the age-earnings profiles of the immigrants and natives intersect):

$$\int_0^{\widehat{TYA}_k} \widehat{MRA_k}(t) = \Delta y_k(0) \tag{6}$$

Using a numerical method for finding the roots, equation (6) can be solved for an estimate of $\widehat{TYA}_k$.

In order to create the same estimators for employment assimilation, the above steps are repeated by using the conditional expected value of probit model,

$$E\left[r_{it}|z_{it}, \overline{z}_i\right] = \Phi(z_{it}\gamma) \tag{7}$$

3 The data

The study was based on the 1990-2000 panel of the Swedish register-based Longitudinal Individual Data-set (LINDA), which contains two distinct random samples: a population sample, which includes 3.35% of the entire population each year, and an immigrant sample, which includes almost 20% of immigrants to Sweden.[5] There is no overlap between samples. Apart from being a panel which is representative for the population, the sampling procedure ensures that the data are representative for each year. The sampling frame consists of everyone who lived in Sweden during a particular year, including those who were born or died, and those who immigrated or emigrated. The data is updated with current household information each year with information from the population and housing censuses and the official Income Register, as well as a higher-education register. The Income Register information, based on filed tax returns, is contingent on the tax rules for that year (For more details see Edin and Frederiksson, 2001).

To avoid selection-problems due to retirement at age 65, the 33,504 immigrant men in LINDA aged 18-55 in 1990 were initially selected for the study, as well as an equal-sized

[5] Immigrants to Sweden enter the national register (and thus the sampling-frame) when they receive a residence permit. In general, immigrants may become Swedish citizen after a sufficient number of years.

control group of randomly-selected native Swedish men, matched for age and county (län) of residence.[6] An additional 20% of new immigrants, 2,000-4,000 were included in each year, as well as an equal number of randomly-selected but matched native Swedes. By 2000, these unbalanced panels consisted of 65,800 immigrant men (generating 521,761 annual observations) and slightly more native Swedes.

Edin et al. (2000) point out that the measures of immigrant-assimilation can be distorted if a significant fraction of immigrants return back to their home country. This did not seem to be a problem since less than 5% disappeared from the data during the observation period. In any case it would be difficult to model return migration with this data since it is not possible to distinguish emigrants from those who died.[7]

The immigrants were categorized as being from other Nordic countries, Western Europe (USA, Canada, Australia, and New Zealand), Eastern Europe, the Middle East, Asia, Africa, or Latin America.

The earnings-variable used is gross labour-income, measured in thousands of SEK per year, inflated by the consumer price index (2000-prices). To eliminate those with short employment periods or part-time jobs with low pay, we followed Antelius and Björklund (2000) in considering as employed only those earning at least 36,400 SEK.[8] The employment-indicator (r_{it}) was defined as 1 if the individual was employed and 0 otherwise.

The key explanatory variables were age and age-squared; years since migration and squared; marital status (cohabiting was considered married); number of children at home; highest education level; residence in Stockholm or elsewhere; other income; arrival-cohort; and local unemployment rates. Local unemployment rates were calculated by dividing the number of unemployed by the population in the municipality of residence, which was assumed to be exogenous to employment and income though conditional on individuals' observed and unobserved characteristics.[9]

No data on work-experience was available. In most U.S. studies this is handled by

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[6] The self-employed were excluded from the analysis since their employment- and earnings-conditions are considerably different from wage-earners.

[7] Klinthäll (2003) found that 40% of immigrants arriving from Germany, Greece, Italy and the U.S., 40 percent left Sweden within five years. The main hypothesis which is borrowed from the U.S. Emigration Studies is that the least successful immigrants leave. However, as pointed out by Arai (2000), even low-earning immigrants may have strong incentive to stay due to a relatively high level of living standard in the lower range of the earnings distribution as compared to other countries. The difference in mean earnings between who disappeared (2,934 individuals) and those in the final sample was minimal.

[8] This criterion, also adopted in LINDA is the "basic amount" that qualifies one for the earnings-related part of the public pension-system.

[9] Because of the immigrant-placement policies implemented in 1985, immigrants' country of origin and their municipality of residence can be correlated (Edin et al, 2002 and 2003; Åslund and Rooth, 2003).

calculating "potential work experience" as age minus years of schooling minus six. But Swedish education-data is given in terms of highest level, not years, so such a calculation would introduce severe measurement-error.

Table 1 shows the mean values for these variables, for both native Swedes and immigrants.

Table 1 *about here*

Both the earnings and employment rate (82% vs. 37-68%) and were considerably higher for native Swedes. On the other hand, more immigrants were married or cohabiting (40% vs. 38-59 %). Native Swedes were generally better educated: About 77% had at least upper-secondary education, compared to 61-76% for immigrants. The earlier immigrant arrival-cohorts each had 9-12% of the total, whereas 1985-89 had 18% and 1990-94 had almost 25%. The Iran-Iraq war and various conflicts in former Yugoslavia occurred during the latter periods. The Nordic area accounted for 25% of all immigrants followed by the Middle East (23%), Eastern Europe (21%) and Western Europe (14%). Asia, Africa, Latin America each had 5-6%.

The immigrant population was clearly not homogenous: Employment rates and earnings were much higher for those from Nordic or Western countries. Middle-Eastern and African immigrants were far less likely to be employed, and had lower earnings if they were. Immigrants from non-Nordic Western countries had more education than all other groups (nearly 32% had a university degree), followed by Eastern Europeans. Despite the fact that Nordic immigrants, most of them from Finland, had less education, they had a higher employment-rate and earned more than the other groups. All this is generally in accord with previous studies on immigrants in Sweden.

4 Empirical analysis

Since immigrants to Sweden were heterogeneous across regions of origin, we estimated the model given in (1) and (2) for each group separately. Our primary interest is to determine whether they enter Sweden with an earnings differential relative to natives and whether their earnings converge to those of the natives as years since migration increases.

First let's consider evidence whether such period-effects on both employment-probabilities and earnings can be identified with local unemployment rates. Then, we will look at estimation results on employment and earnings assimilation. We will consider whether the quality of immigrants is declined by across-immigrant cohorts and finally we will address the effect of educational levels on employment probabilities and earnings.

4.1 Local unemployment-rates and the identification of economy-wide conditions on employment probabilities and earnings

Since, as we noted earlier, simultaneous identification of the effects of age, arrival cohort and economy-wide conditions is not possible, the last effect is generally assumed equal for both immigrants and natives. If this is not true, then the earnings-difference and marginal assimilation rates calculated using the classical assimilation model, which does not include local unemployment-rates, will be biased downward (or upward) depending on the positive (or negative) trend in the local unemployment rates. The hypothesis can be tested by using the local unemployment-elasticities obtained from jointly estimated earnings and employment equations.

The elasticities given in Table 2 (below) are the marginal effects from the log local unemployment rates of jointly estimated employment and earnings equations. Immigrants' employment probabilities and earnings were more responsive to the changes in local unemployment-rates than were the native Swedes. The employment-probabilities and earnings of Africans, Asians, Middle Easterners, Latin Americans and Eastern Europeans were especially negatively affected (Many Eastern Europeans immigrated in the mid- to late-1990s, which were high-unemployment years, so the high unemployment elasticities for this group are perhaps not surprising). The effect of labour-market conditions on the employment probabilities and earnings of natives was small.

Table 2 about here

Figure 2 (below) profiles the *age unemployment-rate employment probability* and *earnings* of African immigrants and native Swedes in three dimensions.[10] The both panels project employment probabilities and earnings age-profiles along the unemployment axis. The striking observation is that the employment probabilities and earnings of native Swedes were not responsive to changes in local unemployment rates, whereas the employment-probabilities and earnings of Africans declined substantially with local unemployment.

Figure 2 about here

Figure 3 (below) shows the effect of local unemployment on employment-probabilities and earnings for Africans and (dashed lines) for native Swedes under good and bad employment conditions, 1% and 5% unemployment. The employment-probabilities of African Immigrants were much higher with low unemployment, though not as high as those of

[10] We did the same simulation for all immigrant groups by region and country of origin classifications. As expected the results followed the sign and size of the unemployment-elasticity of each group.

native Swedes even with high unemployment. With low unemployment the earnings of those working were also much higher, as they improve their labour-market specific skills and wage-bargaining powers (Barth at al, 2004). It implies that *low* unemployment rate causes *fast* employment probability and earnings assimilation. The classical model with the equal-period-effect assumption ignores these facts and produces biased outcomes. Controlling for local unemployment rates adds back to the assimilation model what the identification restriction ignores in some extent depending on the impact of the labour-market conditions.

Figure 3 *about here*

4.2 Earnings and employment assimilation with local unemployment rates

Table 3 show changes in the earnings-differences of immigrants compared to native Swedes by region or country and by year since migration. The differences were calculated by setting the year since migration variable is equal to zero and evaluating all other right hand side variables at their average values (except for local unemployment rate, set to its median value). The initial age set to 20 and years since migration is increased by five years apart until the end of individuals working life (see Section 2.2). The total years for assimilation (TYA) are denoted FA (full assimilation) or PA (partial assimilation). Partial assimilation is the years it took to reach the minimum earnings-difference, if it never turned positive.

There are initially two main groups of immigrants to Sweden with respect to earnings assimilation: Nordics and Westerners with very small initial earnings-differences; and all the rest. The initial difference was quite negative for Middle Easterners, Africans and Asians as well as Eastern Europeans and (to lesser extent Latin Americans). However, Eastern Europeans and Latin Americans eventually reached full assimilation, whereas after 20-25 years since arrival, the earnings convergence of the others had stopped or gotten worse. These immigrants were never able to attain the earnings-parity with otherwise comparable native Swedes. For instance, Asians did best, but were only able to reduce the initial earnings-difference to 0.213 log points, in 26-30 years after arrival.

Table 3 *about here*

Nordics had smallest initial earnings-difference (-0.136), but it took 22.5 years to full assimilation, much longer than Western Europeans, and even longer than Eastern Europeans. It has been theorized that low initial earnings-differences would correlate with low earnings-growth and low marginal rates of assimilation like the Nordics experienced

(Duleep and Regets, 1997). But, Borjas (1998) points out that the relationship depends on the technology of skill-acquisition, including cultural, social, and institutional similarities between the immigrants and natives. Nordics countries and Western Europeans are closest in this regard.

Table 3 also shows earnings-differences by country of origin, which are very similar to those we just looked at. The Norwegians did best in Sweden, even earnings slightly more than the average matched Swede upon arrival but their marginal assimilation rates turned to negative in 2-3 years. Iranian and Turkish immigrants reached full assimilation while Iraqis (the other large Middle Eastern group) did much worse.

Table 4 reports the relative employment probabilities of immigrants by region and country of origin, obtained by jointly estimated probit equation. Only Nordics and Western Europeans were able to reach the employment probabilities of average Swedes. Assimilation in employment-probabilities occurred generally faster than in earnings, but rates turned negative after 10-15 years.

Table 4 *about here*

Figure 4 compares the predicted employment-probabilities and earnings of average immigrants and average native (dashed curves).

Figure 4 *about here*

Employment-probabilities and earning of Middle Eastern, Asian and African immigrants did not converge to those of native Swedes, nor did the employment probabilities of Eastern Europeans or Latin Americans, although their earnings did at least for a time.

We also estimated (1) and (2) without local unemployment rates (not reported here) in order to examine the extent of the bias produced by classical model. This model produced lower initial earnings-difference (almost 0.10 log points less) and weaker assimilation rates (TYAs up to 5 years longer).

4.3 Cohort effects

An important question in the immigration literature is whether there are unobserved differences in the productivity of immigrants across cohorts. Although we have found assimilation, it could be due to the immigrants getting work easier in times of low unemployment, or because earlier arrival-cohorts were more productive or both. Since our model and data allow identification of cohort effects, we tested these possibilities (Table 5 and 6 below).

Relative to the employment-probabilities of the pre-1970 cohort (Table 5) later cohort-

effects were all negative for all regions of origin, and increasingly so over time in almost every case. That decline did not show up in the earnings of all immigrant groups, however (Table 6): The cohort-effects on earnings for Nordics were positive from the start, and for Western and Eastern Europeans as well as Latin Americans they turned positive after 1984. All other things equal, the final Nordic, Western and Eastern European, and Latin American cohorts did better than the first earning 0.12-0.53 log-points more, whereas the last arrival-cohorts of Middle Easterners, Asians and Africans earned 0.3-0.43 log-points less than the pre-1970 cohort. Somewhat Longva and Raaum (2003) found increasingly positive cohort-effects on earnings for OECD immigrants to Norway, increasingly negative for non-OECD immigrants. Possibly the changing country-composition of the Nordic and Western groups over time caused their cohort-effect to chance, as highly educated Danes and Norwegians increasingly took the place of Finns in Nordic immigration, while British and Germans took the place of Greeks, Portuguese, and Spanish among the Westerners.

Table 5 *about here*

Table 6 *about here*

We also calculated the relative earnings differences of immigrants by arrival cohorts.[11] Recent cohorts of Latin Americans and Eastern Europeans had higher initial earnings than pre- 1970 arrivals, and assimilated faster. Our model predicts that an average Latin American who arrived after 1995 would be fully assimilated in 13-14 years, and Eastern Europeans in 7-8 years. No cohort of Middle Easterners, Asians or Africans would be able to reach earnings-parity with an average native Swede.

Barth at al (2004) found that if unemployment was rising, the classical model overestimated the labour-market success of early cohorts and underestimated the success of recent arrivals because of the mechanical correlation between cohorts and calendar time in the data. Thus the classical model can understate earnings-growth across cohorts. We tried both models and found this only for the Middle Eastern, Asian, African and Latin American immigrants. For the others the classical model overstated the assimilation of earlier cohorts but did not understate the assimilation of later ones. For Nordics and Western Europeans we also found no statistically significant differences in the cohort-effect.

4.4 Effects of the educational attainments on assimilation

Table 7 and 8 show the marginal effects of education on employment-probabilities and earnings obtained from the jointly estimated earnings and employment equations. Com-

[11] The relative employment probabilities and earnings, and total years for assimilation (TYA) by arrival cohort can be provided by the authors.

pleting high school or a university degree was positive for all groups of immigrants, as expected. But having a university degree improved employment probabilities much less for Middle Eastern and African immigrants than for the others. Western Europeans, Nordics, native Swedes and Eastern Europeans improved their employment probabilities the most with a university degree.

Table 7 *about here*

Table 8 *about here*

The results on earnings showed somewhat different pattern. As Åslund and Rooth (2003) also found, Nordics, native Swedes and Eastern Europeans gained the most from a university degree, whereas Western Europeans gained less than all except Africans.

The panels in figure 5 (below) show the simulated age-employment probability and age-earnings profiles by education compared to native Swedes (dashed curves) with similar educational level[12], calculated using the means of the other variables for each educational level. The initial age is chosen as 20 except for the university-educated, for whom age 25 was used (also for university-educated native-Swedes).

In every case probability of being employed and earnings increased with education. However, while more highly-educated immigrants approached probability of employment of native Swedes, the earnings-difference increased with education. For example, lesser-educated Latin Americans reached earnings-parity with similarly educated Swede in 19 or 24 years after arrival but highly-educated ones did not, through their probability of being employed was closer to Swedes. The Swedish labour-market thus seems to absorb the highly-educated immigrants better but discounts their education, perhaps due to discrimination, or their education may not be as good. The data available does not indicate where the immigrants obtained their education, so we could not test whether Swedish education was more highly valued than country-of-origin education, though that seems quite likely.

Figure 5 *about here*

5 Discussion and conclusions

We analyzed the economic assimilation of male immigrants in Sweden, using the register-based Longitudinal Individual Data set (LINDA) for 1990-2000. We controlled for sample-selection bias by estimating employment- and earnings-equations simultaneously. We controlled unobserved heterogeneity by using a random-effects model with Mundlak's

[12] The result by country of origin classification is also available from the authors.

formulation. We compared the classical model with period-effects assumed equal, to a wage-curve model using local unemployment rates as proxy for period-effects.

We found that the classical model yielded biased results compared to the wage-curve model. Assuming equal period-effects understated initial earnings-differences (by about 0.10 log-points) and marginal assimilation-rates (by up to 5 years). Including local unemployment-rates changed the simulated employment probabilities and earnings between native Swedes and immigrants and among immigrants from different regions or countries. High local unemployment rate reduced the relative employment probabilities and earnings and much more for Middle Eastern, African and Asian immigrants than for the others. These three groups were also less likely to be employed and earned less in Sweden at any unemployment rate. Among Middle Easterners, immigrants from Iran and Turkey were able to achieve earnings-parity with native Swedes, but immigrants from Iraq did much worse. Other groups which achieved earnings-parity were Eastern Europeans (19 years) and Latin Americans (30 years). Nordic and Western European immigrants did the best. The impact of local unemployment on their employment probabilities and earnings was very weak, similar to that for native Swedes.

The declining cohort effect hypothesis is not rejected except Middle Easterners, Asians and Africans. The relative earnings and employment probabilities of these immigrant groups were declined much higher after the 1985-1989 cohorts compared to the others. This result indicated that the effect of downward trend in economy-wide conditions that occurred in the 1990s was reflected on the employment probabilities and earnings of these three immigrant groups due to their high negative unemployment elasticities.

More education resulted in higher employment-probabilities and earnings, but lesser-educated immigrants earned more compared to native Swedes than did highly-educated ones. This could indicate that university education in immigrants' country of origin was discounted more in Sweden than were lower levels of education, but we could not test this hypothesis.

In general, results presented a pessimistic portrait about the economic success of immigrants to Sweden. However, the assimilation exists, although it is weak, and the length of earnings convergence almost covers individuals' working life. The Immigrants from Middle East, Asia and Africa experienced large welfare disparity and when their declining quality is considered, earnings of the recent cohorts of these immigrants will be far from being assimilated in the future.

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Figure 1. Registered unemployment-rates in Sweden, 1976-2004.

Table 1. *Mean values of variables for native Swedes and immigrants by region of origin,1990-2000*

	Native Swedes	Nordic Countries	Western Europe	Eastern Europe	Middle East	Asia	Africa	Latin America
Log earnings	10.78 (3.73)	8.99 (5.14)	8.06 (5.51)	7.83 (5.71)	5.67 (5.58)	7.54 (5.36)	6.27 (5.53)	7.84 (5.16)
Employment	0.82 (0.37)	0.68 (0.47)	0.59 (0.49)	0.49 (0.50)	0.37 (0.48)	0.51 (0.50)	0.40 (0.49)	0.56 (0.49)
Local unemployment rate	2.81 (1.18)	2.66 (1.01)	2.83 (1.26)	2.85 (1.11)	3.35 (1.55)	3.21 (1.48)	3.15 (1.34)	3.01 (1.41)
Age	38.7 (10.8)	40.7 (10.8)	39.2 (10.96)	38.9 (11.2)	35.6 (9.46)	33.3 (10.5)	33.1 (9.15)	35.4 (10.8)
Years since immigration		19.0 (9.40)	14.8 (9.76)	12.2 (9.64)	9.77 (6.49)	12.6 (7.62)	8.59 (6.32)	12.1 (6.80)
Married/cohabiting	0.40 (0.49)	0.39 (0.49)	0.47 (0.50)	0.59 (0.49)	0.55 (0.50)	0.47 (0.50)	0.44 (0.50)	0.38 (0.48)
Number of children at home	1.78 (1.16)	1.61 (1.12)	1.66 (1.12)	1.81 (1.20)	1.97 (1.47)	1.70 (1.26)	1.58 (1.54)	1.69 (1.21)
Stockholm residence	0.22 (0.43)	0.35 (0.44)	0.39 (0.47)	0.22 (0.34)	0.37 (0.45)	0.30 (0.42)	0.40 (0.48)	0.43 (0.51)
Capital (non-labour) income	0.74 (2.26)	0.49 (1.83)	0.56 (1.99)	0.45 (1.76)	0.54 (1.91)	0.62 (2.03)	0.27 (1.35)	0.30 (1.44)
Highest education level								
Lower–secondary	0.23 (0.37)	0.31 (0.44)	0.32 (0.46)	0.23 (0.39)	0.45 (0.48)	0.39 (0.47)	0.32 (0.45)	0.40 (0.47)
Upper–secondary	0.51 (0.49)	0.43 (0.50)	0.36 (0.47)	0.51 (0.50)	0.39 (0.49)	0.37 (0.48)	0.46 (0.50)	0.47 (0.49)
University degree	0.26 (0.43)	0.26 (0.42)	0.32 (0.46)	0.26 (0.43)	0.26 (0.43)	0.24 (0.43)	0.22 (0.41)	0.23 (0.42)
Arrival Cohort :								
<1970		0.22 (0.44)	0.10 (0.23)	0.10 (0.29)	0.03 (0.17)	0.03 (0.19)	0.03 (0.20)	0.04 (0.25)
1970–74		0.23 (0.42)	0.17 (0.37)	0.14 (0.35)	0.04 (0.18)	0.10 (0.31)	0.04 (0.21)	0.05 (0.22)
1975–79		0.21 (0.40)	0.16 (0.36)	0.08 (0.26)	0.11 (0.31)	0.21 (0.41)	0.07 (0.26)	0.21 (0.40)
1980–84		0.09 (0.28)	0.13 (0.33)	0.10 (0.30)	0.12 (0.32)	0.18 (0.39)	0.08 (0.27)	0.18 (0.38)
1985–89		0.13 (0.33)	0.18 (0.38)	0.14 (0.34)	0.35 (0.48)	0.19 (0.39)	0.30 (0.45)	0.33 (0.47)
1990–94		0.09 (0.29)	0.17 (0.37)	0.38 (0.48)	0.29 (0.45)	0.24 (0.43)	0.42 (0.50)	0.15 (0.36)
1995–2000		0.03 (0.17)	0.09 (0.17)	0.06 (0.24)	0.06 (0.24)	0.05 (0.22)	0.06 (0.23)	0.04 (0.20)
Sample size	540651	131647	67641	107124	121914	28381	28432	36547

(Standard deviations in parentheses)

Table 2. Local unemployment-elasticities, by region of origin,1990-2000

	Native Swedes	Nordic countries	Western Europe	Eastern Europe	Middle East	Asia	Africa	Latin America
Employment	– 0.004	– 0.003	– 0.016	– 0.034	–0.056	–0.091	–0.089	–0.057
	(0.011)	(0.003)	(0.004)	(0.030)	(0.035)	(0.046)	(0.035)	(0.039)
Earnings	– 0.007	– 0.036	– 0.017	– 0.115	– 0.234	– 0.168	– 0.141	– 0.145
	(0.001)	(0.006)	(0.001)	(0.014)	(0.027)	(0.018)	(0.019)	(0.017)

Note: Marginal effects of log local unemployment-rate in the employment and earnings equations, respectively. (Standard errors in parentheses)

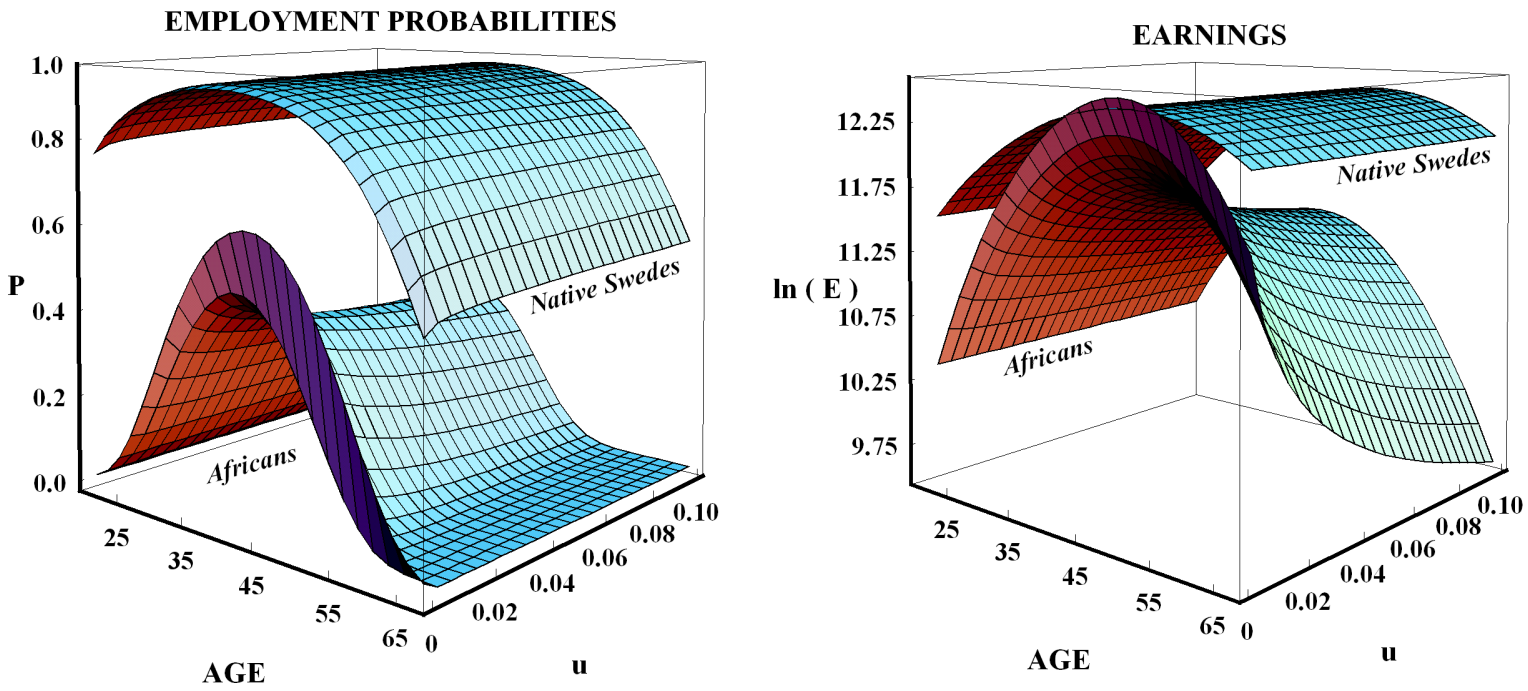

Figure 2. Employment-probabilities and earnings as joint functions of age and unemployment rates for native Swedes and Africans, 1990-2000.

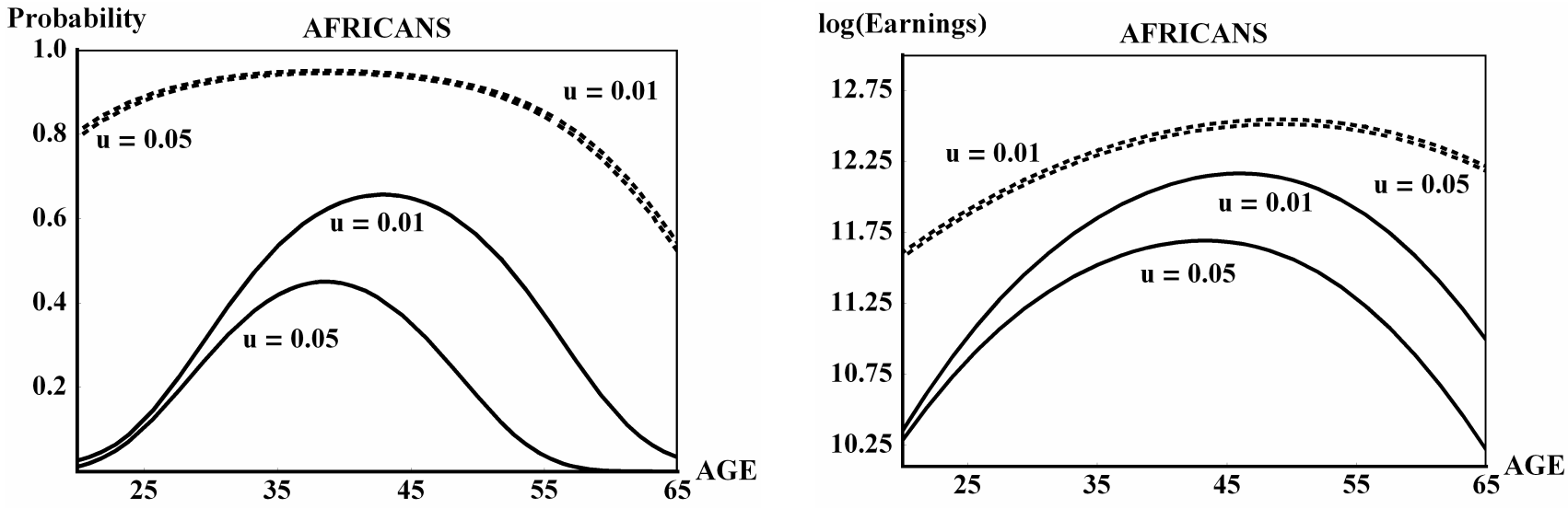

Figure 3. The effect of local unemployment rate on employment-probabilities and earnings, for Africans and (dashed curves) for native Swedes, obtained by vertical cuts of the surfaces in Figure 2 at unemployment = 0.01 and 0.05.

Table 3. Relative earnings and years-to-assimilation of immigrants, by region and country of origin, 1990-2000

	YSM									
	Initial	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	TYA
Nordic Countries	– 0.136	– 0.158	– 0.154	– 0.131	– 0.069	**0.042**	**0.094**	**0.189**	**0.311**	**22.5** (FA)
Western Europe	– 0.179	– 0.102	– 0.027	**0.045**	**0.110**	**0.169**	**0.218**	**0.259**	**0.295**	**11.8** (FA)
Eastern Europe	– 0.875	– 0.473	– 0.215	– 0.070	**0.009**	**0.031**	– 0.043	– 0.256	– 0.612	**18.4** (FA)
Middle East	– 0.812	– 0.639	– 0.518	– 0.441	– 0.404	– 0.417	– 0.494	– 0.642	– 0.858	21.4 (PA)
Asia	– 0.845	– 0.627	– 0.461	– 0.342	– 0.261	– 0.217	– 0.213	– 0.259	– 0.356	31.8 (PA)
Africa	– 0.871	– 0.611	– 0.451	– 0.371	– 0.352	– 0.395	– 0.520	– 0.748	– 1.082	19.2 (PA)
Latin America	– 0.600	– 0.442	– 0.313	– 0.209	– 0.120	– 0.046	**0.008**	**0.033**	**0.027**	**29.1** (FA)
Norway	**0.005**	**–** 0.039	– 0.060	– 0.062	– 0.048	– 0.020	**0.026**	**0.092**	**0.188**	NA
Finland	– 0.034	– 0.055	– 0.043	**0.003**	**0.061**	**0.144**	**0.240**	**0.348**	**0.470**	**14.8** (FA)
Chile	– 0.374	– 0.311	– 0.250	– 0.188	– 0.123	– 0.057	**0.002**	**0.049**	**0.083**	**26.6** (FA)
Yugoslavia	– 0.795	– 0.517	– 0.317	– 0.125	**0.042**	**0.026**	– 0.031	– 0.158	– 0.356	**17.1** (FA)
Iraq	– 1.023	– 0.664	– 0.532	– 0.573	– 0.803	– 1.286	– 2.031	– 2.571	– 2.896	8.38 (PA)
Iran	– 0.702	– 0.472	– 0.294	– 0.160	– 0.063	**0.006**	**0.032**	– 0.044	– 0.148	**24.3** (FA)
Turkey	– 0.591	– 0.510	– 0.429	– 0.345	– 0.213	– 0.100	– 0.041	**0.024**	**0.055**	**33.5** (FA)

Note: TYA is total years for assimilation and YSM is year since migration. FA and PA denote full assimilation or partial assimilation.

NA is “not applicable”.

Table 4. Relative employment-probabilities and years-to-assimilation of immigrants by region and country of origin, 1990-2000

	YSM									
	Initial	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	TYA
Nordic Countries	**0.072**	**0.028**	**0.002**	–0. 011	–0.017	–0.018	–0.019	–0.022	–0.033	NA
Western Europe	–0.194	–0.078	–0.033	–0.019	–0.013	–0.006	**0.004**	**0.014**	–0.001	**28.8** (FA)
Eastern Europe	–0.792	–0.695	–0.342	–0.155	–0.137	–0.255	–0.582	–0.617	–0.628	17.2 (PA)
Middle East	–0.712	–0.682	–0.613	–0.546	–0.603	–0.720	–0.786	–0.746	–0.628	12.1 (PA)
Asia	–0.778	–0.741	–0.574	–0.441	–0.411	–0.487	–0.647	–0.647	–0.774	18.7 (PA)
Africa	–0.773	–0.719	–0.551	–0.439	–0.449	–0.471	–0.558	–0.740	–0.821	14.4 (PA)
Latin America	–0.666	–0.561	–0.427	–0.346	–0.333	–0.388	–0.506	–0.643	–0.674	17.3 (PA)
Norway	**0.075**	**0.048**	**0.029**	**0.017**	**0.008**	–0.001	–0.014	–0.027	–0.038	NA
Finland	**0.066**	**0.029**	**0.004**	–0.012	–0.017	–0.025	–0.034	–0.075	–0.179	NA
Chile	–0.482	–0.301	–0.303	–0.257	–0.301	–0.385	–0.525	–0.664	–0.683	14.8 (PA)
Yugoslavia	–0.771	–0.644	–0.315	–0.121	–0.117	–0.220	–0.473	–0.557	–0.593	15.1 (PA)
Iraq	–0.791	–0.772	–0.636	–0.686	–0.882	–0.936	–0.908	–0.847	–0.728	9.27 (PA)
Iran	–0.712	–0.665	–0.512	–0.407	–0.509	–0.529	–0.627	–0.732	–0.783	13.6 (PA)
Turkey	–0.686	–0.621	–0.544	–0.429	–0.594	–0.621	–0.734	–0.738	–0.792	12.9 (PA)

Note: See the note on Table 3.

Figure 4. Comparison of predicted age-earnings and age-employment probability profiles of native Swedes (dashed curves) and immigrants by region of origin, 1990-2000, using median local unemployment rates: Nordics=2.89; Western Europeans=2.88; Eastern Europeans=2.81; Middle Easterners=3.17; Asians=3.02; Africans=2.99; Latin Americans=3.07 and native Swedes=2.88.

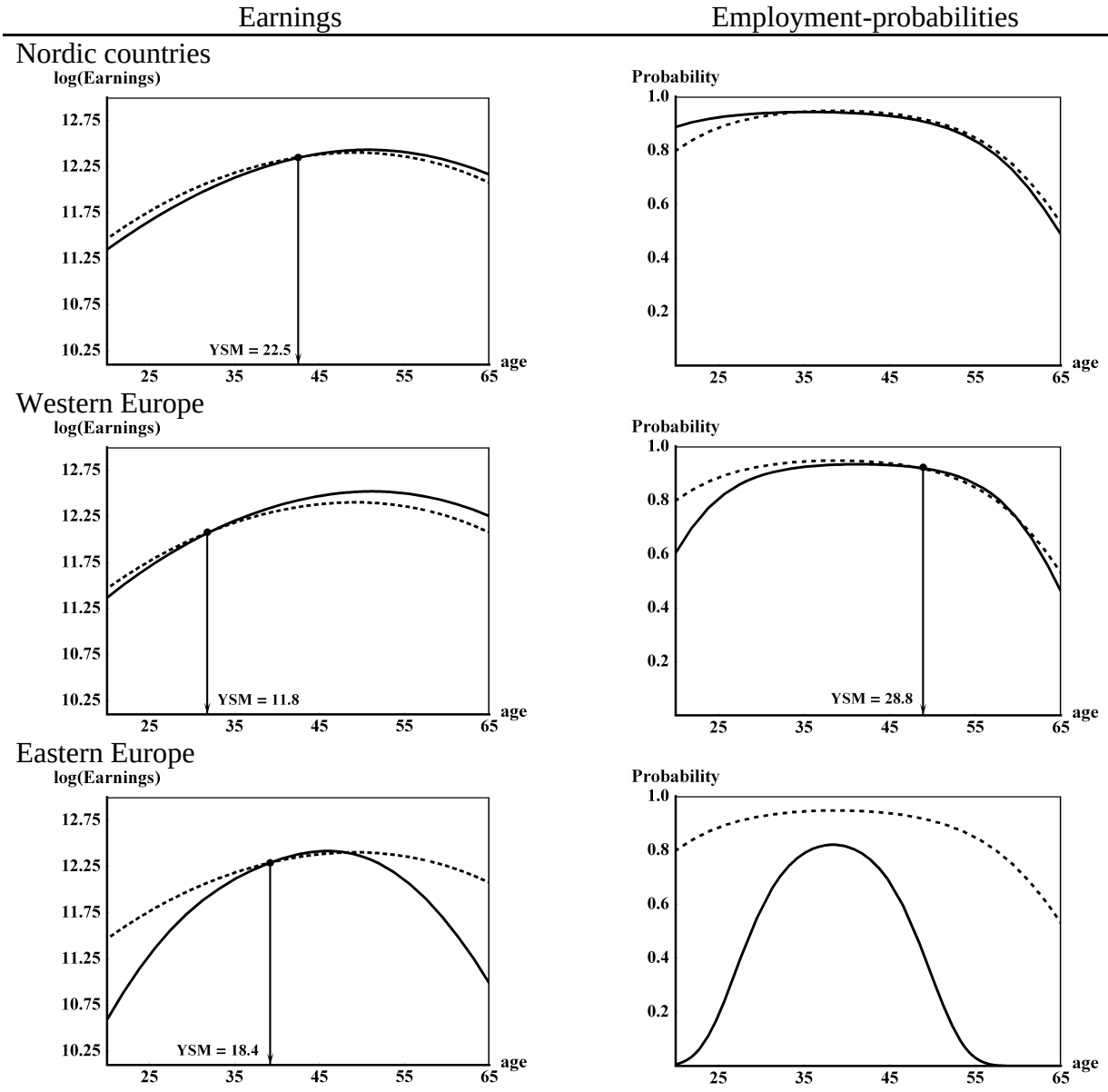

Figure 4. *Continued*

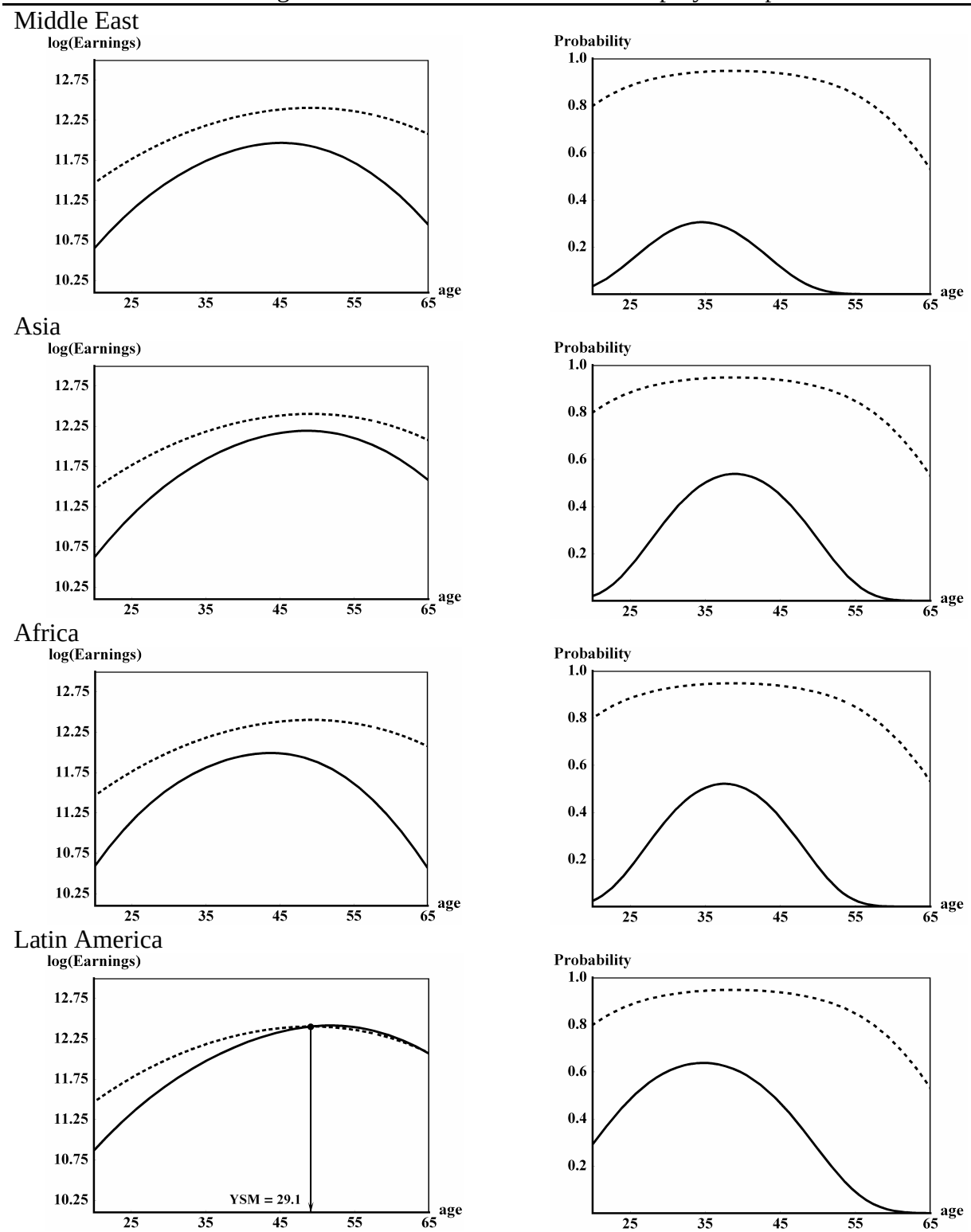

Table 5. Estimated cohort effects on employment probabilities, by region of origin, 1990-2000

Arrival cohort	Nordic countries	Western Europe	Eastern Europe	Middle East	Asia	Africa	Latin America
1970-74 (5 years)	– 0.233	– 0.171	– 0.410	– 0.305	– 0.205	– 0.503	0.008
	(0.018)	(0.036)	(0.036)	(0.064)	(0.085)	(0.072)	(0.072)
1975-79 (5 years)	– 0.403	– 0.406	– 0.617	– 0.395	– 0.285	– 0.627	– 0.116
	(0.022)	(0.042)	(0.045)	(0.065)	(0.086)	(0.071)	(0.069)
1980-84 (5 years)	– 0.545	– 0.463	– 0.558	– 0.483	– 0.296	– 0.697	– 0.276
	(0.027)	(0.046)	(0.047)	(0.070)	(0.090)	(0.075)	(0.072)
1985-89 (5 years)	– 0.647	– 0.718	–0.423	–0.541	–0.396	–0.759	–0.277
	(0.029)	(0.050)	(0.048)	(0.071)	(0.092)	(0.075)	(0.073)
1990-94 (5 years)	– 0.8176	– 0.983	– 0.602	– 0.718	– 0.618	– 1.034	– 0.573
	(0.033)	(0.055)	(0.049)	(0.071)	(0.092)	(0.075)	(0.074)
1995-2000 (6 years)	–0.937	–0.849	–0.500	–0.719	–0.690	–0.962	–0.487
	(0.042)	(0.058)	(0.055)	(0.073)	(0.096)	(0.078)	(0.076)

Note: The omitted reference-cohort is pre-1970 arrivals. Cohort effects are the marginal effects from the employment equations. (Standard errors in parentheses)

Table 6. Estimated cohort effects on earnings, by region of origin, 1990-2000

Arrival Cohort	Nordic Countries	Western Europe	Eastern Europe	Middle East	Asia	Africa	Latin America
1970-74 (5 years)	0.015	–0.042	– 0.230	– 0.211	– 0.184	– 0.435	– 0.064
	(0.003)	(0.009)	(0.011)	(0.028)	(0.033)	(0.026)	(0.023)
1975-79 (5 years)	0.039	– 0.056	– 0.246	– 0.295	– 0.155	– 0.515	– 0.062
	(0.004)	(0.010)	(0.015)	(0.029)	(0.034)	(0.028)	(0.023)
1980-84 (5 years)	0.167	0.010	– 0.049	– 0.278	– 0.248	– 0.440	– 0.107
	(0.005)	(0.011)	(0.017)	(0.031)	(0.037)	(0.028)	(0.024)
1985-89 (5 years)	0.284	0.117	0.163	– 0.258	– 0.337	– 0.401	0.050
	(0.006)	(0.012)	(0.019)	(0.032)	(0.039)	(0.030)	(0.025)
1990-94 (5 years)	0.380	0.282	0.114	– 0.425	– 0.211	– 0.616	0.067
	(0.007)	(0.013)	(0.020)	(0.032)	(0.040)	(0.030)	(0.025)
1995-2000 (6 years)	0.525	0.477	0.274	– 0.305	– 0.347	– 0.428	0.121
	(0.009)	(0.015)	(0.022)	(0.033)	(0.043)	(0.031)	(0.025)

Note: The omitted reference-cohort is pre-1970 arrivals. Cohort effects are the total (marginal) effects of the earnings equations. (Standard errors in parentheses)

Table 7. *Marginal effects of education on employment probabilities, by region of origin*

Native Swedes	Nordic Countries	Western Europe	Eastern Europe	Middle Eastern	Asia	Africa	Latin America
Upper-secondary							
0.231	0.157	0.298	0.191	0.064	0.175	0.118	0.185
(0.007)	(0.011)	(0.018)	(0.017)	(0.014)	(0.017)	(0.014)	(0.015)
University							
0.320	0.379	0.448	0.247	0.133	0.228	0.152	0.216
(0.008)	(0.016)	(0.020)	(0.020)	(0.016)	(0.022)	(0.018)	(0.019)

Note: Omitted reference-level is less than high-school graduation. (Standard errors in parentheses)

Table 8. *Marginal effects of education on the earnings*

Native Swedes	Nordic Countries	Western Europe	Eastern Europe	Middle Eastern	Asia	Africa	Latin America
Upper-secondary							
0.023	0.025	0.084	0.101	0.077	0.089	0.099	0.098
(0.007)	(0.002)	(0.005)	(0.001)	(0.007)	(0.007)	(0.007)	(0.006)
University							
0.357	0.379	0.244	0.340	0.296	0.304	0.179	0.246
(0.001)	(0.003)	(0.005)	(0.001)	(0.008)	(0.007)	(0.008)	(0.007)

Note: Omitted reference-level is less than high-school graduation. (Standard errors in parentheses)

Figure 5. Comparison of predicted age-earnings and age-employment probability profiles of native Swedes (dashed curves) and immigrants by education and region of origin, 1990-2000.

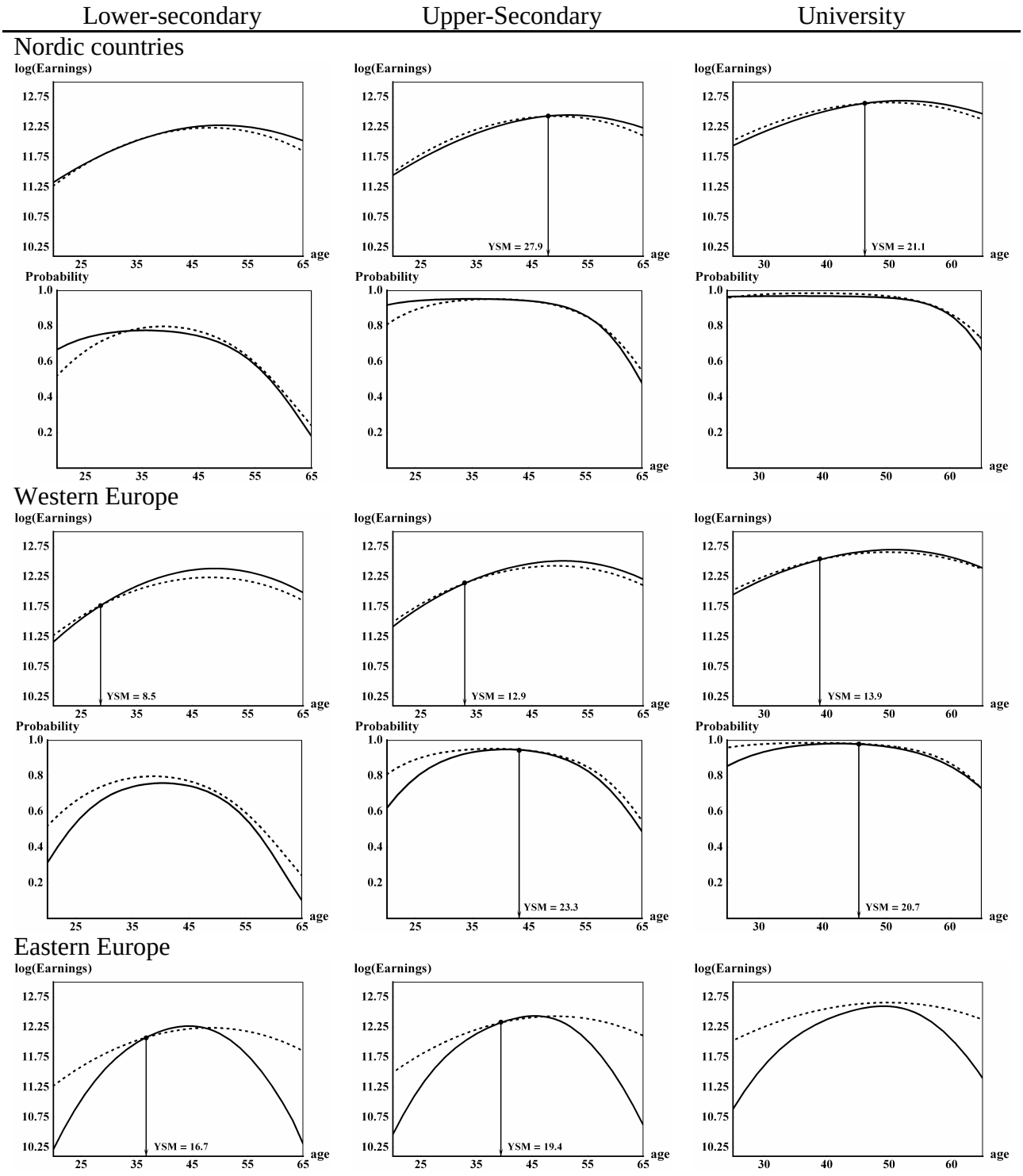

Figure 5. *Continued*

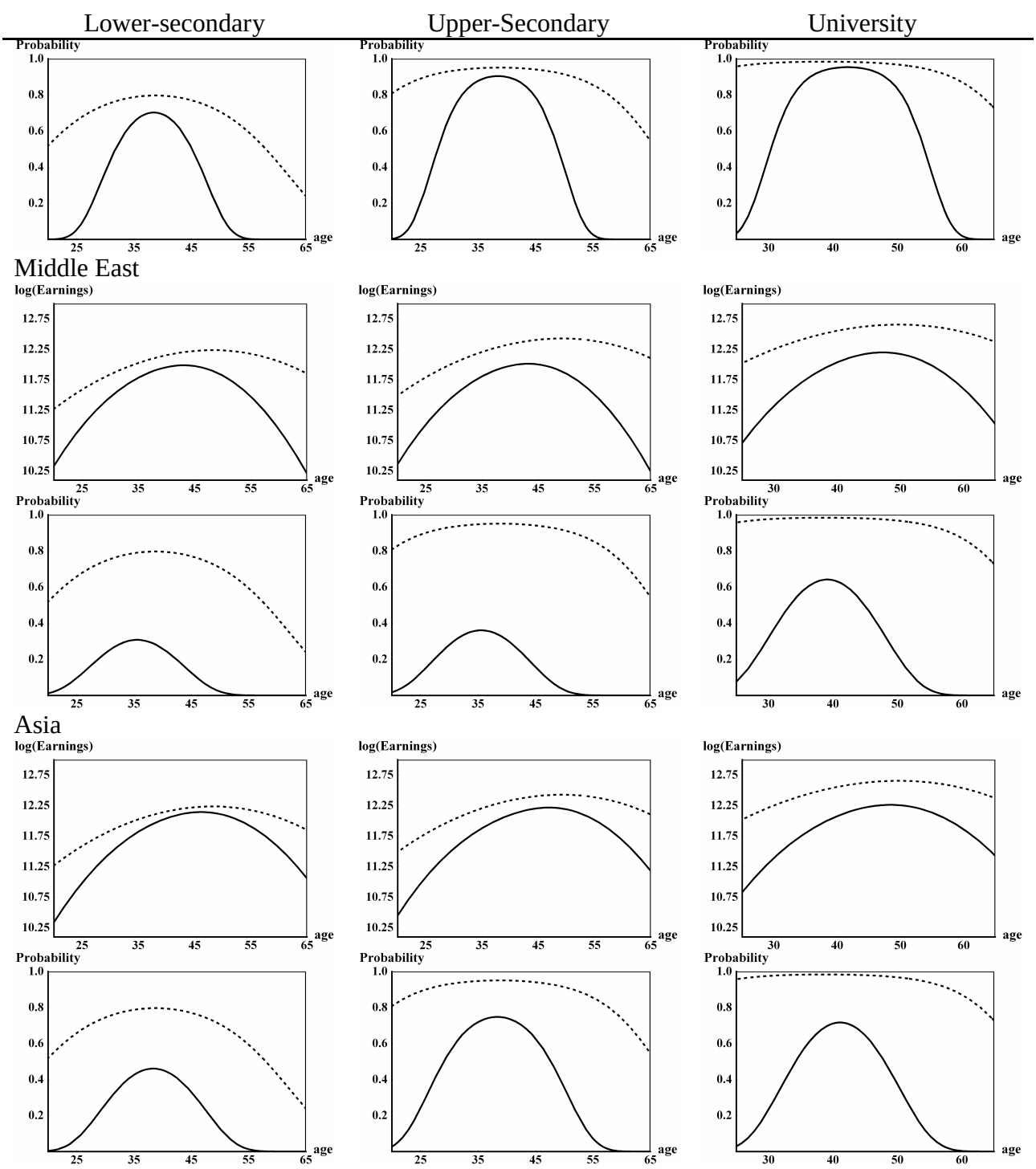

Figure 5. *Continued*