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Immigrant Wage Assimilation and the Return to Foreign and Host-Country Sources of Human Capital

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Immigrant Wage Assimilation and the Return to Foreign and Host-Country Sources of Human Capital*

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Abstract

We compare predicted relative immigrant wage profiles based on returns to YSM and to foreign and host-country sources of schooling and experience. We find the biases inherent in inferring assimilation from a return to YSM appear more substantial than those emanating from the assumptions necessary to estimate foreign and host-country returns directly using standard data sources. Given the policy relevance of allowing entry effects and subsequent wage growth to depend on the foreign human capital immigrants bring and their post-migration schooling and work decisions, our findings suggest the predominance of YSM models in the literature is not well founded.

Keywords: Immigrant workers; wage differentials; human capital.
JEL Classification: J61, J31, J24.

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Executive Summary

In the textbook model of immigrant wage assimilation, immigrants experience wage disparities on arrival in a host country, relative to comparably aged and educated native-born workers, but with time following migration, these gaps close. In his seminal study of the immigrant labour market experience, Chiswick (1978) argued this pattern arises from discounting by host-country employers of foreign sources of human capital, combined with accumulation of host-country knowledge and skills following migration. To capture these ideas empirically, Chiswick began by positing a process generating wage outcomes for immigrants with separate returns to both foreign and host-country sources of training, although his estimates did not allow for these separate returns.

To directly estimate returns to foreign and host-country sources of schooling and experience, we need to observe where immigrants obtained their schooling and work experience. Unfortunately, the source country of schooling is rarely observed in available data sources, while work experience is typically measured as a residual given a worker's age and years of schooling. To overcome this data limitation, Chiswick imposed parameter restrictions on the wage generating process he had in mind, which allowed an intercept shift for immigrants – in order to capture the discounting of their foreign human capital; as well as to estimate a quadratic return to an immigrant's years since migration (YSM) - to capture the assimilation process. This approach spawned a large literature, which has come to cover many countries and time periods (see Borjas (1999) for a review). Though never explicitly acknowledged in the literature, the key advantage, besides its limited data requirements, of the YSM approach to modelling immigrant wage outcomes, is that conditional on arrival cohort, YSM is exogenous in the sense that it captures an aging process that is not a choice variable. The decision whether to begin accumulating work experience or host-country schooling following migration, in contrast, might be highly correlated with immigrant wage levels or anticipated future wage growth, thereby complicating inferences regarding wage assimilation.

Despite an extensive literature spanning 30 years, there remains considerable disagreement whether, given enough time, immigrants experience wage assimilation. In this paper we argue the inconsistency of the findings in the literature reflect, at least in part, the consequences of inferring assimilation from a return to YSM, instead of directly estimated returns to foreign and host-country sources of human capital. In particular, we show analytically that the model potentially predicts immigrant wage convergence to a comparably-aged native even when there is no convergence in the underlying data generating process (DGP). Moreover, the extent of estimated assimilation depends not only on the parameters of the underlying DGP - in particular, the relative advantage of host-country over foreign sources of human capital – but also on distributional moments of the data at hand. For example, in the model estimated by Chiswick (1978), assimilation depends critically on the sample covariance between foreign and host-country labour market experience. Since these moments may be sensitive to sample restrictions, such as age restrictions in this case, the use of YSM models contributes to the inconsistency of the results in this literature.

To obtain predictions of immigrant wage growth that reflect the parameters of the DGP, rather than the data at hand, we need to estimate separate returns to foreign and host-country sources of schooling and experience. But this requires these quantities to be observed. The few papers that have estimated separate returns have done so by assuming all schooling is strictly continuous from age 5, and one year of labour market experience is accumulated in every year after schooling is complete (Friedberg 2000; Bratsberg and Ragan 2002; Green and Worswick 2003; and Aydemir and Skuterud 2005, 2008). Behaviour such as immigrants with foreign work experience returning to school, or experiencing periods of nonemployment following migration, introduces measurement error, the consequences of which, we show, are far from straightforward. Moreover, none of these papers address the potential endogeneity of the post-migration work/schooling decision. The question is whether the biases that are introduced by indirectly estimating foreign and host-country returns using the standard data sources available are more severe than the biases that are overcome.

Using a particularly rich Canadian longitudinal data source, which identifies the age of school completion and when full-time work began, we compare predicted relative immigrant wage profiles based on returns to YSM and direct returns to foreign and host-country sources of schooling and experience. Our results suggest that the consequences of inferring assimilation from a return to YSM are more substantial than those arising from the assumptions necessary to estimate foreign and host-country returns directly using standard data sources. The more important advantage of estimating foreign and host-country returns, however, is that entry effects and subsequent wage growth directly depend on the stocks of foreign human capital immigrants bring, and their post-migration schooling and work decisions. Not only do these factors serve to control for age at migration, thereby overcoming a source of bias inherent in the YSM approach, but this data also offers a much richer set of counterfactual predictions to identify what types of migrants and post-migration behaviour obtain better wage outcomes. For example, our estimates suggest immigrants with more foreign experience not only start at lower initial wages (relative to a comparably aged native), but also experience lower subsequent wage growth. In contrast, we find little evidence that foreign schooling either lowers relative wage outcomes at entry or affects subsequent wage growth. These results, which are not attainable using the conventional YSM approach, provide valuable insights to inform immigrant selection and settlement policy.

1 Introduction

In the textbook model of immigrant wage assimilation, immigrants face wage disparities on arrival in a host country, relative to similarly aged and educated native-born workers, but with time since migration these gaps close. In his seminal study of immigrant earnings, Chiswick (1978) argued this pattern arises from discounting, by host-country employers, of foreign sources of human capital, combined with immigrant accumulation of host-country-specific knowledge and skills following migration. To capture these ideas empirically, Chiswick began by positing a process generating wage outcomes for immigrants with separate returns to foreign and host-country sources of training, though this is not what he estimated.

To directly estimate returns to foreign and host-country sources of schooling and experience, we need to observe where immigrants' years of schooling and work experience were obtained. Unfortunately, the source country of schooling is rarely observed in available data sources, while work experience is typically measured as a residual given a worker's age and years of schooling. To overcome this data limitation, Chiswick imposed parameter restrictions on the data generating process (DGP) he had in mind, which amounted to allowing an intercept shift for immigrants –to capture the discounting of their foreign human capital – and estimating a quadratic return to an immigrant's years since migration (YSM) – to capture the assimilation process. This approach spawned a large literature, which has come to cover many countries and time periods (see Borjas (1999) for a review). Though never explicitly acknowledged in the literature (to our knowledge), the key advantage of the YSM approach to modelling immigrant wage outcomes (besides its limited data requirements) is conditional on arrival cohort, and ignoring compositional effects in pseudo-panel data due to outmigration or age at migration effects, YSM is exogenous in the sense that it captures an aging process that is not a choice variable.[1] The decision whether to begin accumulating work experience or host-country schooling following migration might, in contrast, be highly correlated with immigrant wage levels or anticipated future wage growth, thereby complicating inferences regarding wage assimilation.

Despite an extensive literature spanning 30 years, there remains considerable disagreement whether, given enough time, immigrants experience wage assimilation. Borjas (1999) argues that much of the disagreement reflects confusion over what "assimilation" means (p.1721). In particular, is the relevant benchmark for immigrants other immigrants with

[1] In a cross-section of data, YSM may be endogenous though, due to a correlation with unobserved cohort effects. This is the essence of the argument in Borjas (1985).

fewer YSM (Lalonde and Topel 1992) or native-born workers with comparable total schooling and labour market experience (Borjas 1985)? The issue of comparison group is not so much a problem of identification, however, as it is a moot question about what the most meaningful research question is. In this paper we argue the inconsistency of the findings in the literature also reflect the consequences of inferring assimilation from a return to YSM, instead of direct estimated returns to foreign and host-country sources of human capital.

What exactly does the return to YSM identify in a world in which there are differential returns to foreign and host-country sources of schooling and experience? We begin by distinguishing two variants of the YSM model, which differ by whether the returns to total (foreign plus host-country) schooling and experience in the model are restricted to be the same for immigrants and natives. We then show analytically that in both cases the estimated model potentially predicts immigrant wage convergence to a comparably-aged native even when there is no convergence in the underlying DGP. More importantly, the extent of estimated assimilation depends not only on the parameters of the underlying DGP - in particular, the relative advantage of host-country over foreign sources of human capital - but also on distributional moments of the data at hand. For example, assimilation in the model estimated by Chiswick (1978) depends critically on the sample covariance between foreign and host-country labour market experience. Since these moments may be sensitive to sample restrictions, such as age restrictions in this case, the use of YSM models contributes to the inconsistency of the results in this literature.

To obtain predictions of immigrant wage growth that reflect the parameters of the DGP, rather than the data at hand, we need to estimate separate returns to foreign and host-country sources of schooling and experience. But this requires these quantities be observed. To our knowledge, Borjas (1982) is the only study of immigrant wage growth in the literature to use direct measures of post-migration schooling. Instead, the few papers that have estimated separate returns have done so by assuming all schooling is strictly continuous from age 5 and one year of labour market experience is accumulated in every year after schooling is complete (Friedberg 2000; Bratsberg and Ragan 2002; Green and Worswick 2003; and Aydemir and Skuterud 2005, 2008). To the extent that immigrants with foreign work experience return to school or experience periods of nonemployment following migration, this introduces measurement error, the consequences of which, we show, are far from straightforward. Moreover, none of these papers address the potential endogeneity of the post-migration work/schooling decision. The question is whether the biases introduced in directly estimating foreign and host-country returns using the standard data sources available are more severe than the biases overcome.

Using a particularly rich Canadian longitudinal data source, which identifies the age of school completion and when full-time work began, we compare predicted relative immigrant wage profiles based on returns to YSM and direct returns to foreign and host-country sources of schooling and experience. Our results suggest the consequences of inferring assimilation from a return to YSM are, if anything, more substantial than those arising from the assumptions necessary to estimate foreign and host-country returns directly using standard data sources. The more important advantage of estimating foreign and host-country returns, however, is entry effects and subsequent wage growth directly depend on the stocks of foreign human capital immigrants bring and their post-migration schooling and work decisions. Not only does this serve to control for age at migration, thereby overcoming a source of bias inherent in the YSM approach, but it also offers a much richer set of counterfactual predictions to identify what types of migrants and post-migration behaviour obtain better wage outcomes. For example, our estimates suggest immigrants with more foreign experience not only start at lower initial wages (relative to a comparably aged native), but also experience lower subsequent wage growth. In contrast, we find little evidence that foreign schooling either lowers relative wage outcomes at entry or affects subsequent wage growth. These results, which are not attainable using the conventional YSM approach, provide valuable insights to inform immigrant selection and settlement policy.

The remainder of the paper is organized as follows. In the following section we examine and compare the properties of the YSM assimilation model and the model based on direct foreign and host-country returns. We then study the potential consequences of measurement error and unobserved heterogeneity that arise in estimating direct returns using standard data sources. In the fourth section we describe the data, our approach to distinguishing foreign from host-country sources of schooling and experience, and the specifications we estimate. Section 5 presents the results. We conclude by summarizing the main findings.

2 Empirical Models of Immigrant Wage Assimilation

2.1 Restricted YSM model

The seminal paper examining the capacity of immigrants to integrate into host-country labour markets is due to Chiswick (1978). His approach was to estimate, using a single cross-section of data, a wage return to an immigrant's YSM conditional on observable skills. Due to the subsequent criticism of this approach by Borjas (1985), thirty years later Chiswick's paper is primarily recognized as a reference to the perils of not using repeated cross-sections of data to control for heterogeneity across entry cohorts. Here we draw attention to a different feature of the Chiswick approach. We define the restricted YSM model as:

$$w_{it} = y_t + f_x(exp_{it}) + f_s(s_{it}) + m_i \cdot (cohort_i + g(ysm_{it})) + e_{it} \tag{2.1}$$

where w_{it} is the log hourly wage of worker i observed in year t; y_t is a vector of year dummies; exp_{it} is years of labour market experience; s_{it} is years of schooling; m_i is an immigrant dummy; $cohort_i$ is a vector of dummies indicating year of migration; ysm_i is years since migration; and $f_x(\cdot)$ and $g(\cdot)$ are (typically) quadratic functions, while $f_s(\cdot)$ is linear.[2] In the usual interpretation of this model the term $g(0)$ identifies the "entry effect" and $g'(\cdot) > 0$ is taken as evidence of wage assimilation. The defining feature of the model, from our perspective, is the restriction that the returns to experience and schooling are identical for natives and immigrants.

To make clear the consequence of restricting the experience and schooling returns, suppose for the sake of simplicity, the true latent DGP in the population of immigrants and natives is given by:

$$w_i = \alpha_0 + \alpha_1 exph_i + \alpha_2 expf_i + \varepsilon_i \tag{2.2}$$

where $exph_i$ and $expf_i$ are years of host-country and foreign labour market experience respectively; $\alpha_1 > \alpha_2$; $cov(exph_i, expf_i)|m_i < 0$; and ε_i is some random influence. Do immigrants assimilate? Since foreign experience is discounted, if the comparison group is other immigrants with fewer YSM, but the same total experience, the answer is yes. But if the benchmark is natives with the same total experience, the answer is no, since immigrants and natives share a constant linear return to host-country experience. The restricted YSM model, however, *necessarily* implies assimilation given this DGP. To see this, consider estimating:

$$w_i = \beta_0 + \beta_1 exp_i + m_i \cdot (\beta_2 + \beta_3 ysm_i) + e_i \tag{2.3}$$

where $exp_i = exph_i + expf_i$; $ysm_i = exph_i$ and β_3 estimates the extent of assimilation. As long as $0 < \bar{m} < 1$, we know that $\alpha_2 < \hat{\beta}_1 < \alpha_1$. Given $\hat{\beta}_0$ and $\hat{\beta}_1$, the estimates of β_2 and β_3 can then be thought of as coming from the restricted least squares regression:

$$w_i = \hat{\beta}_0 + \hat{\beta}_1(exph_i + expf_i) + m_i \cdot (\beta_2 + \beta_3 exph_i) + e_i. \tag{2.4}$$

[2] Note that conditional on y_t and $cohort_i$, ysm_{it} is necessarily a constant in the immigrant sample, so that the year effects are not separately identified. The key underlying assumption is, therefore, that any period effects over the sample period are common for natives and immigrants. We maintain this assumption until we introduce individual fixed effects, when we use a provincial unemployment rate to identify period effects.

which amounts to estimating the third term in (2.4) using only the sample of immigrants and the adjusted dependent variable:

$$\tilde{w}_i = (\alpha_0 - \hat{\beta}_0) + (\alpha_1 - \hat{\beta}_1)exph_i + (\alpha_2 - \hat{\beta}_1)expf_i + \varepsilon_i. \tag{2.5}$$

It is then straightforward to show the probability limit of estimated assimilation is:

$$\text{plim } \hat{\beta}_3 = (\alpha_1 - \hat{\beta}_1) + \frac{(\alpha_2 - \hat{\beta}_1)\text{cov}(exph_i, expf_i)}{\text{var}(exph_i)} > 0. \tag{2.6}$$

Borjas (1999, p.1721) and Friedberg (2000, footnote 16) claim the correct interpretation of the positive return to YSM in estimating (2.3) is, holding total experience constant, immigrants with less of the foreign variety face a relative wage advantage. The result in (2.6) reveals the estimated YSM return, in fact, depends not just on the relative advantage of host-country experience, but also on the correlation in the data between host-country and foreign experience. Given a large enough positive correlation, the estimated return could, in fact, imply *dissimilation*, even if host-country experience is more valued.[3] The correlation will, however, tend to be negative, since individuals are finite lived, (though if one thinks about measuring actual, instead of potential, labour market experience, this is less obvious). The important point is the extent of assimilation estimated depends in an important way on the data at hand. Perhaps the most obvious way to see this is to consider what happens when narrower age sample restrictions are imposed – the correlation between host-country and foreign experience will tend to rise, which in turn will, imply a higher assimilation rate, ceteris paribus. This result would appear to help explain the inconsistency of the results in the literature.

2.2 Unrestricted YSM model

The distinguishing feature of what we define as the unrestricted YSM model is it relaxes the restriction of identical returns to experience and schooling across immigrants and natives. Specifically, the model is given by:

$$\begin{aligned} w_{it} &= y_t + f_x(exp_{it}) + f_s(s_{it}) + m_i \cdot [cohort_i + g_x(exp_{it}) + g_s(s_{it}) \\ &\quad + g_y(ysm_{it})] + \varepsilon_{it} \end{aligned} \tag{2.7}$$

[3]The bias is a bit more complicated than equation (2.6) suggests since $\hat{\beta}_1$ itself depends on the sample moments of the distribution. Setting $\alpha_1 = 0.05$; $\alpha_2 = 0.01$; $\bar{m} = 0.2$; $\overline{exph}_i = 17$; $\overline{expf}_i = 6$; $\text{var}(exph_i) = 64$; and $\text{var}(expf_i) = 25$ in a Monte Carlo simulation, $\hat{\beta}_3$ becomes positive as $\text{corr}(exph_i, expf_i) > 0.1$. All of our analytical results in this section and the next have been confirmed by simulations. The programming code for these are available upon request.

where again the returns to experience and YSM are typically assumed to be quadratic and the returns to schooling linear. If the comparison group is other immigrants with fewer YSM, evidence of assimilation is given by $g'_y(\cdot) > 0$. This appears to be the approach taken by, for example, Lalonde and Topel (1992), Hu (2000) and Antecol, Kuhn and Trejo (2006). If, on the other hand, the benchmark of interest is native-born workers with the same total schooling and experience, assimilation depends on the post-migration work/schooling behaviour of immigrants. Assuming they begin to accumulate host-country experience immediately upon arrival, assimilation amounts to $g'_x(\cdot) + g'_y(\cdot) > 0$.

Given the same DGP in (2.2), estimating the restricted model:

$$w_i = \beta_0 + \beta_1 exp_i + m_i \cdot (\beta_2 + \beta_3 exp_i + \beta_4 ysm_i) + e_i \tag{2.8}$$

now produces $\hat{\beta}_1 = \alpha_1$; $\hat{\beta}_3 = \alpha_2 - \alpha_1$; and $\hat{\beta}_4 = \alpha_1 - \alpha_2$.[4] So the YSM approach now correctly identifies assimilation as either (purely) a difference in the underlying true returns to host-country and foreign experience $(\alpha_2 - \alpha_1)$, in the case of the immigrant benchmark, or no assimilation $(\hat{\beta}_3 + \hat{\beta}_4 = 0)$, in the case of the native benchmark.

Estimated assimilation again becomes sensitive to the data at hand, however, if the process determining wage outcomes in the labour market also depends on (potentially unequal) returns to host-country and foreign schooling. Suppose the DGP is given by:

$$w_i = \alpha_0 + \alpha_1 exph_i + \alpha_2 sh_i + \alpha_3 expf_i + \alpha_4 sf_i + \varepsilon_i \tag{2.9}$$

and we estimate the unrestricted YSM model:

$$w_i = \beta_0 + \beta_1 exp_i + \beta_2 s_i + m_i \cdot (\beta_3 + \beta_4 exp_i + \beta_5 s_i + \beta_6 ysm_i) + e_i \tag{2.10}$$

where now $ysm_i = exph_i + sh_i$. Again, relative to native-born workers, there is no sense in which immigrants assimilate in this DGP, since host-country returns are linear and equal for immigrants and natives. If $(\alpha_1 - \alpha_3) = (\alpha_2 - \alpha_4) \equiv \theta$, then least squares produces $\hat{\beta}_1 = \alpha_1$; $\hat{\beta}_2 = \alpha_2$; $\hat{\beta}_4 = \hat{\beta}_5 = -\theta$; and $\hat{\beta}_6 = \theta$, and the estimates correctly predict no assimilation relative to a native-born comparison (since $\hat{\beta}_4 + \hat{\beta}_6 = 0$ and $\hat{\beta}_5 + \hat{\beta}_6 = 0$). In general, however, $(\alpha_1 - \alpha_3) \neq (\alpha_2 - \alpha_4)$. In this case, $\hat{\beta}_6$ is estimated as a weighted average of the two differences. Defining $\theta_1 \equiv (\alpha_1 - \alpha_3)$ and $\theta_2 \equiv (\alpha_2 - \alpha_4)$, the problem amounts to estimating a single linear return θ when the DGP is given by:

$$y_i = \theta_0 + \theta_1 exp_i + \theta_2 s_i + \mu_i. \tag{2.11}$$

[4] To see this simply replace exp_i in (2.8) with $exph_i + expf_i$ and ysm_i with $exph_i$.

We then know:

$$\text{plim } \hat{\theta} = \frac{\theta_1 \text{var}(exp_i) + \theta_2 \text{var}(s_i) + (\theta_1 + \theta_2)\text{cov}(exp_i, s_i)}{\text{var}(exp_i) + \text{var}(s_i) + 2\text{cov}(exp_i, s_i)} \tag{2.12}$$

which is bounded by θ_1 and θ_2. This tells us the return to YSM in the unrestricted model is a weighted average of the advantage in host-country sources of schooling and experience (over foreign sources), where the weighting depends on the relative magnitudes of var($exph_i + expf_i$) and var($sh_i + sf_i$), as well as the covariances of $exph_i$, sh_i, $expf_i$, and sf_i. It does not depend on the levels (means) of these variables; this is captured by β_3 in (2.10). What does this imply for estimates of assimilation? Suppose, for example, the advantage of host-country sources is larger in schooling than experience ($\theta_2 > \theta_1$) and var(s_i) is large relative to var(exp_i). Then the estimate of β_6 will tend to exceed the estimate of β_4 (in absolute value), implying assimilation relative to natives (assuming the immigrant works following migration), when there is, in fact, no assimilation in the underlying DGP. Of course, in real world data, the variance in experience will exceed the variance in schooling, so the estimated return to YSM will be weighted towards the host-country advantage in experience (θ_1). But because the model does not distinguish whether the immigrant's YSM are spent in work or school, the model's estimates regarding assimilation are potentially misleading. A common sample restriction imposed in estimating YSM models is to exclude child immigrants (e.g., Antecol, Kuhn and Trejo 2006). This serves to limit host-country schooling in the data, thereby limiting the bias of the restricted YSM model, but it does not eliminate it. And as immigrant-receiving countries such as Australia and Canada move to put more emphasis on host-country educational credentials in their selection criteria, more adult migrants will obtain host-country schooling, and this issue will become more relevant.

2.3 Direct returns model

The essential problem with the YSM model is it is a reduced-form approach, in that it imposes parametric restrictions on the underlying human capital returns. Since these restrictions will, in general, not be satisfied, inferences drawn regarding immigrant wage assimilation will tend to vary across studies, not only because the true returns to host-country and foreign sources of human capital vary across countries and time periods, but also because immigrant behaviour (perhaps in response to changing returns) and therefore the data used to estimate the models, varies.

To our knowledge, Friedberg (2000) is the first study to estimate what we refer to as the direct returns model of immigrant assimilation. Although she estimated the model using a single cross-section of data, assuming entry cohort effects are negligible in the Israeli data she employed, subsequent papers have estimated separate returns to foreign and host-country sources of schooling and experience using repeated cross-sections (e.g., Aydemir and Skuterud 2005). The base direct returns model that we compare to the YSM models of assimilation is given by:

$$\begin{aligned} w_{it} &= y_t + f_x(exph_{it}) + f_s(sh_{it}) + m_i \cdot [cohort_i + g_{xf}(expf_{it}) + \\ &\quad g_{xh}(exph_{it}) + g_{xhf}(expf_{it} \cdot exph_{it}) + g_{sf}(sf_{it}) + g_{sh}(sh_{it})] + \varepsilon_{it}. \end{aligned} \tag{2.13}$$

If the return to experience is nonlinear, the return to host-country experience must depend on the stock of foreign experience held.[5] The interaction of foreign and host-country experience function (g_{xhf}) in equation (2.13) captures this dependence.

There are two main features of this model worth emphasizing. First, as in the unrestricted YSM model, evidence of assimilation depends on whether, and to what extent, immigrants accumulate schooling and work experience following migration. But it now also depends on the immigrant's stock of foreign work experience. For example, comparing an immigrant with $expf_m^*$ and $exph_m^*$ years of foreign and host-country experience, respectively, to a native with $exph_n^*$ years of experience, where $expf_m^* + exph_m^* = exph_n^*$, and assuming the immigrant accumulates experience upon entry, the immigrant wage converges to the native's if and only if $g'_{xh}(exph_m^*) + g'_{xhf}(expf_m^* \cdot exph_m^*) > f'_x(exph_n^*)$. Second, the relative immigrant wage at entry is no longer a constant across immigrants from a common entry cohort. The entry effect now depends on the stock of foreign schooling and experience that immigrants bring with them. This is also true in the unrestricted YSM model, but as we have shown, the estimated immigrant-specific schooling and experience returns are not equivalent to directly estimating returns to foreign schooling and experience. By estimating these returns directly, we in effect directly control for age at migration. This is a key advantage in the context of quasi-panel data, as failing to account for age at migration tends to bias estimated assimilation rates upward (Friedberg 1993).[6] Perhaps more importantly, what ultimately matters for immigration policy is not so much whether immigrant wages on average converge to native

[5] If the return to total experience is determined by $\beta_1 exp_i + \beta_2 exp_2^2$ and foreign and host-country experience are equivalent, then substituting $exp_i = expf_i + exph_i$ the return to post-migration experience is given by $\beta_1(expf_i + exph_i) + \beta_2(expf_i + exph_i)^2 + 2\beta_2(expf_i * exph_i)$, where the last term captures the dependence of the host-country return on the stock of foreign experience held.

[6] The reason is that as immigrant cohorts are followed through time their composition becomes disproportionately immigrants who arrived at younger ages (since those who who arrived as children are entering the labour market as those who arrived as older adults exit). Since child immigrants tend to perform better (because they, for example, have more host-country schooling), this results in a positive correlation, within cohorts, between YSM and unobserved wage heterogeneity.

wages, but rather what types of immigrants, in terms of the stock of foreign schooling and experience they bring and types of post-migration activities they engage in, increase the likelihood or speed of convergence. By allowing both the entry effect and subsequent wage growth to depend on the stock of foreign human capital, the direct returns model offers a much richer set of counterfactual predictions to inform immigrant selection and settlement policy. As noted above, there are, however, obstacles to estimating the foreign and host-country returns using standard data sources, which presumably explains the dearth of studies that do. In the following section we carefully consider the potential biases introduced.

3 Pitfalls of the Direct Returns Model

3.1 Measurement error

The practical challenge in estimating the direct returns model is foreign and host-country quantities of schooling and experience are typically unobserved.[7] The approach taken by Friedberg (2000) and other papers which estimate versions of (2.13) (e.g., Bratsberg and Ragan 2002; Green and Worswick 2003; Aydemir and Skuterud 2005, 2008) is to assume all schooling is strictly continuous from age 5 and one year of labour market is accumulated in every year after schooling is completed. One need then only observe three variables: (i) current age; (ii) age at immigration; and (iii) total years of schooling, to uniquely distinguish schooling and experience obtained abroad from that obtained in the host-country.

This set of assumptions introduces three forms of measurement error, the consequences of which are far from straightforward. First, the assumption of strictly continuous schooling implies an individual cannot hold both foreign labour market experience and host-country schooling ($expf_i > 0 \Rightarrow sh_i = 0$). To the extent that immigrants with foreign work experience return to school after migrating, host-country schooling will be under measured by exactly the same amount as foreign schooling is over measured. Further, foreign (host-country) potential experience will be over measured (under measured) by that same amount. Second, temporary work permits and student visas make it possible for immigrants to obtain host-country schooling or experience prior to immigrating. The use of age at immigration instead of age at migration will have a similar effect as assuming continuous schooling:

[7] Borjas (1982) is the only paper we are aware of that uses direct measures of post-migration schooling to examine immigrant wage growth. There is, however, a relatively large literature concerned with the determinants of post-migration schooling that uses direct measures of host-country schooling (Chiswick and Miller 1994; Khan 1997; Hum and Simpson 2003; Cobb-Clark, Connolly and Worswick 2005; Van Tubergen and Werfhorst 2006).

host-country schooling (potential experience) will be under measured (over measured) by exactly the same amount that foreign schooling (potential experience) is over measured (under measured). Third, potential experience may be a poor measure of actual labour market experience. The difference is likely to be particularly important for immigrants whose migration decisions may be motivated by nonemployment or who may experience periods of nonemployment following migration.

Beginning with Friedberg (2000), two consistent results in studies estimating direct returns are: (i) similar immigrant returns to foreign and host-country schooling; and (ii) a return to foreign labour market experience statistically indistinguishable from zero. To our knowledge this paper is the first to examine to what extent these results may be driven by measurement error. Analytically it is difficult to say much at all about the possible nature of the biases. To the extent that the errors are correlated with the true values of the observables or with unobservables, this is particularly the case. Assuming the measurement error resulting from using potential (instead of actual) experience is purely random, we know all the estimated experience returns will tend to be attenuated. To the extent that this error affects foreign experience measures more than host-country experience, this could account for the particularly low estimated returns to foreign experience.

The measurement error resulting from assuming strictly continuous schooling and using dates of immigration is, however, more complex. Due to the nature of this measurement error, it turns out the consequences may be negligible even if the measurement error is substantial. To see this, suppose first the DGP is given by:

$$w_i = \beta_1 exph_i^* + \beta_2 expf_i^* + \varepsilon_i \tag{3.14}$$

where all variables are now expressed as deviations from their means; $exph_i = exph_i^* + u_i$; $expf_i = expf_i^* - u_i$; $u_i \sim iid[0, \sigma_u^2]$; $E(u_i\varepsilon_i) = 0$ and $E(expj_i^*\varepsilon_i) = 0$ for $j\epsilon[h, f]$. It can then be shown that using the observed values $exph_i$ and $expf_i$ gives:

$$\text{plim}\ \hat{\beta} = \beta - [Q^* + \Sigma_{uu}]^{-1}\,\Sigma_{uu}\beta \tag{3.15}$$

where $\beta = [\beta_1, \beta_2]'$; Q is a 2x2 matrix containing elements $q_{jj}^* = \text{plim}(1/n)\sum expj_i^* expj_i^*$ for $j\epsilon[h, f]$; and $\Sigma_{uu} = \sigma_u^2 ee'$, where $e = [1, -1]$ (see Greene (2008), equation (12-16)). Assuming foreign and host-country experience are uncorrelated ($q_{hf}^* = 0$), this amounts to:

$$\text{plim}\begin{bmatrix}\hat{\beta}_1\\ \hat{\beta}_2\end{bmatrix} = \begin{bmatrix}\beta_1\\ \beta_2\end{bmatrix} - \frac{\sigma_u^2}{q_{hh}^* q_{ff}^* + \sigma_u^2(q_{hh}^* + q_{ff}^*)}\begin{bmatrix}(\beta_1 - \beta_2)q_{ff}^*\\ (\beta_2 - \beta_1)q_{hh}^*\end{bmatrix}. \tag{3.16}$$

Hence, if the true returns to foreign and host-country experience are identical ($\beta_1 = \beta_2$), the measurement error in distinguishing the foreign from host-country quantities has absolutely no effect on the consistency of the estimator (though it does reduce its efficiency). This is true even if the measurement error is non-random.[8] Our expectation, however, is the host-country return dominates ($\beta_1 > \beta_2$), in which case (3.16) implies the return to foreign (host-country) experience is unambiguously overestimated (underestimated). Measurement error does not then appear responsible for the low estimated returns to foreign experience in the literature. However, this is no longer necessarily true if foreign and host-country experience are negatively correlated ($q^*_{hf} < 0$), as we argued in the previous section they likely are. If $\beta_1 > \beta_2$, $q^*_{ff} > q^*_{hh}$, and q^*_{hf} is sufficiently negative, the measurement error that results from assuming strictly continuous schooling and dates of immigration can simultaneously produce downward biases in the estimated returns to both foreign and host-country experience.[9]

The problem is more complicated if we add separate returns to schooling in the DGP. Suppose immigrant and native wage outcomes are instead determined by:

$$w_i = \beta_1 exph^*_i + \beta_2 expf^*_i + \beta_3 sh^*_i + \beta_4 sf^*_i + \varepsilon_i \tag{3.17}$$

where now $exph_i = exph^*_i + u_i$; $expf_i = expf^*_i - u_i$; $sh_i = sh^*_i - u_i$; and $sf_i = sf^*_i + u_i$. Assuming, for simplicity, all covariances between $expf^*_i$, $expf^*_i$, sh^*_i, and sf^*_i are zero, using the data containing measurement error gives:

$$\text{sgn}[\text{bias } \hat{\beta}] = \text{sgn}[e(\beta_1 - \beta_2 - \beta_3 + \beta_4)] \tag{3.18}$$

where sgn is the sign operator and now $e = [-1, 1, 1, -1]'$. A necessary and sufficient condition for consistency of all the estimated returns, regardless of the amount of measurement error or if it is non-random in nature, is the host-country advantage is equal in schooling and experience ($\beta_1 - \beta_2 = \beta_3 - \beta_4$). But if the relative advantage of host-country sources is larger in experience than schooling ($\beta_1 - \beta_2 > \beta_3 - \beta_4$), as the estimates in the literature suggest, the estimated returns to foreign (host-country) experience and host-country (foreign) schooling will be biased upward (downward). In this case, measurement error would not be contributing to the exceptionally low estimated returns to foreign experience (though of course, our assumption of a relative host-country advantage in schooling could be wrong). If we allow covariances in the data to be non-zero, however, the return to foreign experience may be downward biased, even if ($\beta_1 - \beta_2 - \beta_3 + \beta_4 > 0$). For example, if $q^*_{ff} > q^*_{hh}$ and q^*_{hf} is sufficiently negative (all other covariances are 0), the return to both host-country and foreign experience may be downward biased.

[8]The intuition is the measurement error in the two variables simply cancels out in the error term.

[9]This is easiest to show using a Monte Carlo simulation. The programming code are available upon request.

The problem is still more complicated if we introduce nonlinear terms in the DGP, such as a quadratic experience function. In this case, even if $(\beta_1 - \beta_2 - \beta_3 + \beta_4) = 0$, the estimates remain inconsistent, and in particular may be either increasing or decreasing in the relative curvature of the foreign and host-country experience profiles. The main point to take from this section is that little can be said analytically of either the direction or magnitude of the biases resulting from imperfect measures of foreign and host-country quantities of schooling and experience. Depending on the nature of the measurement errors and the underlying true relative human capital returns, however, it is possible that even a large amount of measurement produces little bias. We must, therefore, ultimately rely on better quality data to inform to what extent the estimates currently found in the literature are misleading.

3.2 Unobserved heterogeneity

It is widely recognized in the immigrant assimilation literature that non-random outmigration contaminates estimated returns to YSM if immigrant entry cohorts are followed across repeated cross-sections of data. There now exist a handful of studies using longitudinal microdata to examine the sensitivity of estimated assimilation rates to compositional changes in immigrant cohorts. Duleep and Regets (1997), Hu (2000), Duleep and Dowhan (2002) and most recently Lubotsky (2007) examine U.S. survey data, in a number of cases combined with Social Security records, while Edin, Lalonde and Åslund (2000) use Swedish Census data matched with tax records, and Hum and Simpson (2004) use the same Canadian longitudinal survey data examined in the present study. With the exception of the papers by Duleep and coauthors, a consistent finding in these studies is substantially lower immigrant wage growth when selective outmigration is accounted for. This is consistent with a higher propensity of outmigration among workers with relatively low earnings (conditional on observables).

To date, all the research using longitudinal data has inferred assimilation from estimated returns to YSM.[10] In directly estimating foreign and host-country returns, we introduce a second channel through which unobserved worker heterogeneity can bias estimates. In particular, unlike YSM, which is necessarily exogenous (conditional on cohort and ignoring any non-random sample attrition), particular post-migration schooling and experience investments reflect choices made by immigrants (and employers) and are therefore potentially correlated with unobservables. Inferring assimilation from immigrants' relative return

[10] An exception is Chiswick, Lee and Miller (2005) in that they distinguish host-country schooling and actual labour market experience. Their sample, however, contains no native-born workers and immigrants are observed at only two points in time - at arrival and 3.5 years later. As a result, their inferences regarding immigrants' capacity to obtain comparable wages to natives is severely limited.

to host-country labour market experience (comparison of the function f_x to g_{xh} and g_{xhf} in equation (2.13)) would be problematic, for example, if immigrants' propensity to accumulate work experience in the host country is correlated with the unobserved ability or motivation of immigrants. As a result, in directly estimating returns to foreign and host-country sources of human capital, it is even more critical to in some way account for the unobservable heterogeneity of workers that may, in part, determine wage outcomes. We are not aware of any attempt in the literature to account for unobserved heterogeneity in separate foreign and host-country human capital returns.

Just as distinguishing post-migration activities complicates the estimation of post-migration wage growth, distinguishing immigrants by their stock of foreign schooling and experience within entry cohorts, complicates the estimation of immigrant entry effects. The reason is, again, that pre-migration schooling and experience investments, or more generally the age when immigrants migrate, reflect choices made by immigrants, and could conceivably be correlated with unobservables. For example, it may be that as adults age their reasons for migrating have increasingly less to do with personal career ambitions and more to do with efforts to leave behind unpleasant or dangerous environments or improve the lifetime welfare of children. To the extent that these different motivations lead to different host-country wage outcomes, estimated returns to foreign experience will tend to be biased (and likely underestimated). Nonetheless, from the perspective of a policymaker deciding on the optimal immigrant selection criteria, this is not the return of interest. Regardless of what the low return to foreign experience captures, what matters to the policymaker determining selection criteria is the usefulness of the observable signal in predicting success in the host-country's labour markets. In contrast, in estimating host-country returns what is important is whether influencing the post-migration schooling and work activities of immigrants through settlement policies can be expected to produce better outcomes. Fortunately, because host-country, but not foreign, quantities of schooling and experience are time-varying, controlling for unobserved fixed effects is feasible in the estimation of the host-country, but not foreign, returns.

4 Estimation

4.1 Data

The Survey of Income and Labour Dynamics (SLID) is a nationally representative longitudinal survey of the Canadian population. An oft-cited limitation of the SLID data is individuals are followed for only 6 years. The advantage of the short-panel design is new overlapping panels are sampled every 3 years, thereby substantially increasing the number of immigrants sampled. In constructing our sample, we pool the 4 existing panels collected between 1993 and 2004 (the fourth panel contains only 3 years). When we extract longitudinal respondents, aged 18-64, with full-time work experience, and a valid wage and covariate set, we are left with 5,951 immigrants and 55,491 native-born workers who are, on average, observed for 3.7 and 3.9 years, respectively (see Table 1).[11] In order to estimate returns with reasonable precision, we pool men and women. We have tried estimating all specifications separately for men and women and none of our main findings substantively change.

In addition to providing a reasonably large longitudinal sample of immigrants, the SLID questionnaire is exceptionally rich in content providing three important pieces of information that are typically unobserved. First, the SLID collects information on total years of schooling separately for elementary, non-university postsecondary and university postsecondary, as well as all credentials received and the age when the final non-university and/or university credential was obtained. By comparing the age when credentials were obtained to the age at immigration, we are better able to distinguish foreign from host-country sources of schooling. Second, the SLID identifies the age when full-time work began and the years of actual labour market experience subsequently accumulated.[12] Lastly, the survey collects information on remuneration and hours of work in all jobs over the previous calendar year allowing for the construction of an hourly wage reflecting a weighted average of all paid work done in the reference year. The assimilation patterns we identify are therefore less likely to reflect labour supply adjustments than if earnings data – the usual outcome variable in this literature – were employed.

4.2 Variable definitions

In order to obtain evidence on the consequences of measurement error, we begin by considering three alternative definitions of foreign and host-country schooling, which we combine with the implied quantities of foreign and host-country potential experience. We then take our preferred definition of foreign and host-country schooling and combine it with three alternative definitions of foreign and host-country actual experience.

As noted above, in the absence of information on the age when schooling was completed,

[11] Longitudinal weights are used throughout the analysis and are pooled and unadjusted just as is typically done when cross-sections of data are pooled. The sample therefore is representative of some weighted average of the Canadian population between 1993 and 2004.

[12] Respondents are explicitly instructed to exclude full-time work experience obtained while a student.

the standard approach is to assume schooling is strictly continuous from age 5 and use age at migration to distinguish foreign from host-country sources. We refer to this approach, which tends to over measure (under measure) foreign (host-country) schooling, as "left-continuous schooling". Alternatively, we can assume elementary school years are again strictly continuous from age 5 (except if age when full-time work begins is less than years of elementary school plus 5), but all postsecondary schooling years are strictly continuous *up to* the age of school completion.[13] We refer to this approach, which tends to over measure (under measure) host-country (foreign) schooling, as "right-continuous schooling". Lastly, we define intermediate values between these two extremes by assuming again that elementary school years are continuous up to age 5, but only the duration of the final educational stint (which we define using information on years of non-university and university schooling and credentials obtained) is continuous up to the age of school completion. All remaining postsecondary school years are instead assumed to be uniformly distributed in the years between the age when elementary schooling was completed (or when full-time work began) and the age when the final educational stint began. This intermediate definition, which we refer to as "uniformly-distributed schooling", is illustrated in Figure 1. Since we believe schooling is not continuous for many individuals, particularly for immigrants, this is our preferred definition of schooling.

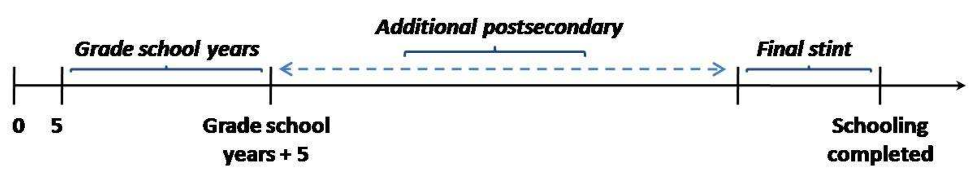

Figure 1: Uniformly-distributed schooling

Table 2 shows the means of the schooling variables. Given our definitions, it is necessarily true at the level of the individual observations, that left-continuous foreign schooling is greater than or equal to uniformly-distributed foreign schooling, which in turn must be at least as large as right-continuous foreign schooling (opposite weak inequalities for host-country schooling). The difference between the two extreme definitions is about 0.7 years for schooling and not much more than 0.6 years for potential experience. The reason is for the majority of observations the difference between the school completion age and total years of

[13]Note that roughly 20% of the sample with postsecondary school years does not have a postsecondary credential. To assure ourselves this is not a peculiarity of the SLID data, we have confirmed this result in Canadian Census data. For these individuals we assume the age of school completion is the minimum of current age and 35.

schooling plus 5 is small – less than 3 years for 52.8% of immigrants and 57.8% of natives. Nonetheless, little can be said about the relative estimated returns to these variables. If the advantage in host-country sources is very different in experience than schooling or the measurement error is highly non-random, these small differences could impact estimated returns in a meaningful way.

Less clear is how to split actual years of experience into foreign and host-country sources. Our approach begins by defining "potential working years" as the difference between current age and the age when full-time work began, net of any post-work school years. If actual years of experience equals potential working years, the problem is simple: we assume a single year of experience attained in every year spent outside of school after work began. However, to the extent that actual experience is less than potential working years, it is ambiguous whether the idle years occurred before or after migration. Our approach to this problem is similar to that used in defining the schooling variables. At one extreme we err on the side of over measuring (under measuring) foreign (host-country) experience by assuming total actual years of experience are continuous from the age when full-time work began. We refer to this as "left-continuous actual experience." At the other extreme we err on the side of over measuring (under measuring) host-country (foreign) experience by assuming that total actual years of experience are continuous up to the current age. We refer to this as "right-continuous actual experience."[14] Lastly, we define an intermediate case in which total actual years of experience are uniformly distributed between the current age and the age full-time work began. This definition, which we illustrate in Figure 2, is referred to as "uniformly-distributed actual experience". In all cases we use uniformly-distributed schooling to define

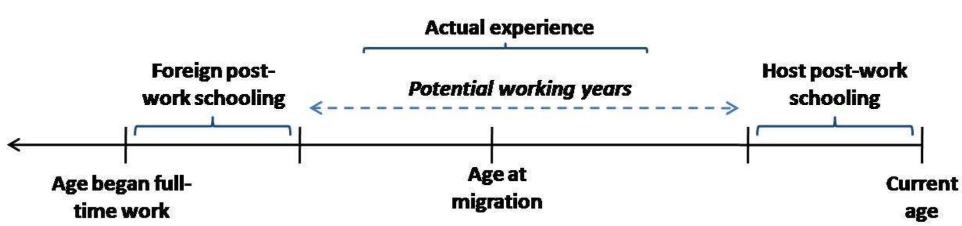

Figure 2: Uniformly-distributed actual experience

foreign and host-country potential working years.

[14]Since individuals can accumulate school years while working full time, it is possible actual experience exceeds potential working years. In this case, the difference is assumed to be all foreign, in the left-continuous case, or all host-country, in the right-continuous case. In the case of uniformly-distributed actual experience, no additional assumption is necessary, since the number of years of actual experience accumulated in each calendar year are constant and greater than 1.

Table 2 shows the means of the experience variables. As one might expect, given the challenges immigrants are likely to experience finding employment in the host-country, the difference between total potential and total actual experience – which we call "idle years" – is substantially larger for immigrants than natives (6.9 years compared to 4.1).[15] The differences in foreign and host-country quantities between the alternative variable definitions are, however, once again small – roughly one full year in the case of actual experience and slightly less for potential experience. But again, since little can be said about the relative distribution of measurement error in each variable definition, we have no priors about the relative estimated returns based on the alternative definitions.

A final complication in defining these variables arises as a result of the longitudinal dimension of our data. We know over the panel, foreign quantities of schooling and experience must be strictly time-invariant (assuming individuals are not working abroad for partial years). This is not necessarily true if we treat the data as repeated cross-sections and assume schooling and experience are uniformly distributed (our preferred definitions). This is true because an additional year of actual host-country experience is uniformly distributed over all potential working years (both foreign and host-country), so that foreign experience will rise as host-country experience is accumulated within the panel window. In order to make the results comparable to those in the literature, we begin by defining the variables first ignoring the longitudinal dimension of the data. However, in estimating models with individual fixed effects, we redefine the variables restricting all changes in schooling, actual experience, and idle years to increase only the host-country quantities. This effectively eliminates all measurement error in the host-country variables.

4.3 Extension

We have argued, if the return to experience is nonlinear, the return to host-country experience depends on the stock of foreign experience held. For exactly the same reason, if the return to schooling is nonlinear, the return to host-country schooling investments will depend on the stock of foreign schooling an immigrant brings. More generally there may be complementarities between foreign and host-country schooling. For example, Friedberg (2000) argues immigrants arriving with more schooling may experience more occupational downgrading upon arrival and greater subsequent earnings growth. Using U.S. Census data, Bratsberg and Ragan (2002) find evidence the return to host-country schooling is increasing

[15]Note that mean idle years exceed the difference between mean potential and actual experience by a small margin. The reason is idle years are restricted to be non-negative.

in the stock of foreign schooling held. The dependence of host-country returns on foreign stocks is also consistent with Duleep and Regets' (1997) view that entry earnings and earnings growth are jointly determined. In particular, the incentive to invest in host-country-specific skills may be increasing in the investment of skills abroad, perhaps due to an accreditation process.

The potential to identify these complementarities – which have important implications for immigrant selection policy, since now foreign stocks not only influence entry earnings, but also subsequent wage growth – is a key advantage of the direct returns model. To illustrate this advantage, we extend the base direct returns model in equation (2.13) by adding interaction terms between foreign and host-country sources of human capital.[16] In addition, with information on actual years of work experience we are able to identify idle years, i.e., time spent outside of school and work. By not controlling for idle years (either foreign or host-country), we are assuming this time has either no direct wage effect, through for example skill atrophy, or that it is uncorrelated with years of schooling and experience. If both assumptions are unsatisfied, the estimated returns will suffer from omitted variable bias. Both assumptions, however, seem problematic, particularly for immigrants who we have already seen in Table 2, have substantially higher values of total idle time. On the one hand, for recent immigrants, idle time could be spent improving language skills or developing social networks. Or perhaps idle time captures a return to setting a higher reservation wage. On the other hand, because individuals are finite lived, we expect a negative correlation between idle time and either experience or schooling. We, therefore, also add host-country and foreign years of idle time, and all the implied foreign/host-country interactions, to the direct returns model. Together these extensions result in a specification given by:

$$\begin{aligned}\log w_{it} &= y_t + f_x(exph_{it}) + f_s(sh_{it}) + f_{idle}(idleh_{it}) + m_i \cdot [cohort_i + \\ & g_{xf}(expf_{it}) + g_{xh}(exph_{it}) + g_{sf}(sf_{it}) + g_{sh}(sh_{it}) + g_{lf}(idlef_{it}) + \\ & g_{lh}(idleh_{it}) + g_{fh}(zh_{it} \otimes zf_{it})] + \varepsilon_{it}\end{aligned} \quad (4.19)$$

where $idlef_{it}$ and $idleh_{it}$ are foreign and host-country idle years respectively; and $zj_{it} = [expj_{it}, sj_{it}, idlej_{it}]'$ for $j \epsilon [h, f]$, so the final term includes all possible interactions of foreign and host-country quantities.

[16] Friedberg (2000) includes similar interaction terms, but assuming continuous schooling and potential experience means that the interaction of foreign experience and host-country schooling is necessarily zero in her data. This is, however, not true in our data, allowing us to identify this potential complementarity.

5 Results

We begin our analysis by examining the robustness of estimated returns to foreign and host-country sources of schooling and experience in the base direct returns model (equation (2.13)) as we depart from the usual assumptions of continuous schooling and potential labour market experience. Murphy and Welch (1990), and more recently Lemieux (2006), show the standard quadratic experience profile substantially understates early career wages and overstates mid-career growth. In all cases we, therefore, estimate quartic functions in host-country experience (f_x), but quadratic functions in foreign experience (g_{xf}) and immigrant-specific host-country experience (g_{xh}); and linear functions in schooling (f_s, g_{sf}, and g_{sh}) and the interaction of foreign and host-country experience (g_{xhf}).

Table 3 reports the results from using three alternative definitions of foreign and host-country schooling and actual labour market experience (first three columns assume potential experience; last three assume uniformly-distributed schooling). The estimates assuming left-continuous schooling are similar to those reported elsewhere. If anything, the returns tend to be slightly smaller, perhaps reflecting our use of an hourly wage, as opposed to earnings. The return to host-country schooling for both natives and immigrants exceeds the return to foreign schooling, though the differences are small – 0.064 and 0.055 respectively, compared to 0.052.[17] The estimated return to foreign experience is very close to zero and statistically insignificant. Also consistent with estimates found elsewhere, the relative host-country experience return for immigrants (the g_{xh} function) is negative, but increasing (it becomes positive at 29 years of host-country experience). This negative return is expected given the nonlinear return to experience and that, on average, immigrants already have some experience on arrival. Lastly, the estimated cohort effects substantiate the well-documented deterioration in labour market performance across immigrant cohorts to Canada, though the differences here are considerably smaller and not statistically significant.

What happens to these estimated returns when we use our more accurate measures of foreign and host-country schooling? The foreign experience return clearly tends to increase as more schooling is defined as host-country. Comparing the two extreme definitions – left- and right-continuous schooling – the linear term doubles in magnitude and becomes

[17]At first blush, this result may appear to contradict the perception that skilled immigrants to Canada experience credential recognition issues. The confusion stems from a misunderstanding of the concept of a wage return. The schooling return estimates the wage difference between what an individual with a credential actually receives and what that same individual would have received without the credential. Hence, the the return to foreign schooling involves a comparison between an immigrant with and without an additional year of schooling. Credential recognition issues, in contrast, implicitly involve a comparison between an immigrant and a native with a common level of schooling.

statistically significant. The quadratic term, however, also becomes larger (in absolute value). Twenty years of foreign experience, in the case of right-continuous schooling, implies a 0.1 log point wage increment, compared to 0.05 log points in the case of left-continuous or uniformly-distributed schooling.[18] Measurement error resulting from assuming continuous schooling, therefore, appears to contribute to the low estimated returns to foreign experience in the literature, though even under the most extreme assumptions the return continues to be small. The returns to both foreign and host-country schooling also become larger, though the differences here are smaller still. Lastly, the immigrant return to host-country experience tends to decrease. The results, overall, suggest the consequences of assuming strictly continuous schooling in the absence of better data are modest. Why is this true? Across definitions, the advantage of host-country over foreign sources is substantially higher in experience than schooling, implying the term $(\beta_1 - \beta_2 - \beta_3 + \beta_4)$ in equation (3.18) is substantially different from zero. The differences in means across alternative definitions in Table 2, in contrast, appear quite small. This suggests the robustness of the estimates probably has more to do with a small amount of measurement error, than the nature of the measurement error problem.

Replacing the potential experience measures with actual experience, shown in the remaining columns of Table 3, tends to further increase the estimated returns to foreign experience, at least up to 10 years or so. In the left-continuous case, the linear return is now close to 0.02 log points and statistically significant. Nonetheless, in all cases the foreign returns continue to be small relative to the return to host-country experience for either immigrants or natives, suggesting this result is by and large not an artifact of measuring potential experience. As for schooling, using actual experience in all cases tends to decrease the estimated returns and imply an even smaller advantage of host-country over foreign schooling. In the uniformly-distributed case, for example, the immigrant return to foreign schooling is 0.046 log points, compared to 0.048 log points for host-country schooling.

Having estimated the direct returns model, we then take our preferred variable definitions – uniformly-distributed schooling and actual labour market experience – and compare its implications for immigrant wage assimilation to the YSM models (equations (2.1) and (2.7)). In not allowing wage outcomes at entry to vary across immigrants within a particular cohort, predicted entry wages in the restricted YSM model reflect the expected wage of the average immigrant at entry. To make the comparison in predicted wage profiles across

[18]Note, we can ignore the interaction term in thinking about the effect of foreign experience on entry earnings, since at entry host-country experience is necessarily zero.

models as meaningful as possible, in all cases we predict entry log wages for a recent immigrant (cohort 1990-2002) arriving with the sample mean years of foreign schooling (9.77) and work experience (5.98). We then compare subsequent predicted wage growth to a similarly aged native-born worker assuming both accumulate one year of host-country labour market experience in every subsequent year. Assuming schooling begins at age 5 and no idle years, both representative workers are initially $5 + 9.77 + 5.98 = 20.75$ years of age.

Table 4 reports the results from estimating the restricted and unrestricted YSM models. The results are entirely standard. Cohort effects in both models suggest wage gaps at entry, whereas the returns to YSM in both models are positive (and significant) implying wage convergence. Consistent with our expectations (given the analysis in Section 2), Figure 3 indicates the restricted YSM model predicts the highest average rate of assimilation over the 35-year period considered. Relative to the native-born comparison, immigrants on arrival face a wage gap of slightly less than 0.4 log points. Within 15 years this gap is roughly halved and after 25 years it is less than 0.1 log points. By the end of the immigrant's working life, the gap reaches a minimum of 0.04 log points. The unrestricted YSM model, in comparison, implies a much smaller wage gap on arrival – roughly two-thirds of the restricted model. The subsequent rate of assimilation is, however, also considerably smaller. In the unrestricted model the assimilation rate is, in fact, roughly constant over the full 35-year period, and unlike the restricted model, wage parity is eventually reached. The direct returns model using the standard foreign and host-country variable definitions, lies between the profiles of the two YSM models, both in terms of its entry effect and average assimilation rate. The main difference is there is considerably more change in the rate of assimilation, beginning with a very high rate of assimilation in the first 10 years following migration, followed by relatively little relative progress thereafter. From an initial gap of 0.29 log points, within only ten years the differential is more than halved. In the following 10 years and 20 years, it closes by 0.05 and 0.02 log points, respectively. When one thinks about language acquisition or acculturation processes, this pattern of decreasing returns would appear to better capture reality. In this respect, the relative wage profile of the direct returns model seems more reasonable.

Which of these three profiles, based on standard variable definitions, is closest to the benchmark case? The direct returns model using our preferred variable definitions implies an entry effect that is virtually identical to the direct returns model using standard definitions. This reflects the robustness of the foreign returns in Table 3. The assimilation rate, on the other hand, is now even higher in the first 10 years, but then subsequently decreases more quickly. The initial gap of 0.29 log points is now more than halved after only 8 years, but remains virtually unchanged at 0.09 log points between year 13 and 25. Thereafter, the rate actually begins to increase again, so that by the end of the 35-year period the immigrant has reached wage parity. This convexity in the relative wage profile is also a feature of the direct returns model using the standard variable definitions, but using actual (instead of potential) experience, the convexity kicks in earlier.[19] In terms of the entry effect and subsequent assimilation rate, our benchmark case is clearly closest to the direct returns model using standard variable definitions. In terms of value of lifetime earnings, the differences in implied wage profiles in Figure 3 are unlikely to be trivial. This suggests to us that the prevalence of YSM models in the assimilation literature is not well founded. Moreover, we think the higher relative wage growth of immigrants in the first years following migration is an appealing feature of the direct returns model, that to our knowledge has not been identified elsewhere.[20]

In Table 5 we extend the direct returns model allowing immigrant host-country wage growth to depend on the foreign human capital stock and controlling for idle years. To allow for the possibility that the relative returns to foreign and host-country sources of schooling and experience may vary widely across immigrants from different parts of the world, we also fully interact the immigrant-specific component of equation (4.19) with a dummy variable distinguishing immigrants from Canada's traditional immigrant source countries – basically the U.S., U.K., and Northern, Western and Southern Europe – from those from non-traditional source regions – Eastern Europe, Africa, and Asia. The results from the full sample, shown in the last column of Table 5, suggest a very small positive return to idle years for immigrants (and natives), whether it is foreign or host-country. This is, however, no longer true when we distinguish between immigrants from traditional and non-traditional source countries. In particular, the return to host-country idle years is significant and close to 0.02 (0.002+0.017) log points for immigrants coming from countries where language and cultural differences are likely greatest. The interactions of host-country idle years with

[19] Both the immigrant and native host-country experience profiles eventually reach a point of sharply decreasing returns. The convexity is a result of natives reaching the point of decreasing returns earlier than immigrants. When actual years of experience is used, the point of decreasing returns occurs earlier, so the convexity kicks in earlier. Because actual experience levels tend to be lower and our starting point is a native who already has 6 years experience, less than 5% of both the native and immigrant observations have host-country experience beyond the point when the convexity kicks in. By the end of the 35-year period we are essentially making out-of-sample predictions.

[20] We have tried estimating all the models using different functional forms. The patterns particularly at the end of the career are quite different if we allow only a quadratic in host-country experience. Figure 3 is virtually identical, however, when we allow a quartic function in immigrant-specific host-country experience.

foreign experience and foreign schooling are, however, also more negative. Therefore, for adult immigrants from non-traditional source countries, but not child immigrants, the return to host-country idle years appears to be, if anything, negative.

With few exceptions, the interaction terms in Table 5 suggest, if anything, modest complementarities between foreign and host-country sources of human capital. In the full sample, arriving with additional foreign experience has almost exactly a nil effect on the host-country experience profile. Additional foreign schooling appears to reduce the return to host-country experience, though the effect is again small (but statistically significant). For example, arriving with 16 years of foreign schooling (relative to none) reduces the linear return to host-country experience by only 0.006 log points. We also find little evidence here, for either traditional or non-traditional source country immigrants, that foreign schooling returns are higher for immigrants with more host-country schooling – the interaction of foreign and host-country schooling term is 0.0002 in Table 5 compared to 0.001 in Friedberg (2000, Table 6) using Israeli data. This difference is not explained by our richer information on the source of schooling – we get exactly the same result using the standard variable definitions. One wonders if the difference reflects the well-documented credential recognition issues in Canada, which have over the past decade been the focus of much discussion surrounding the country's immigrant settlement policies. To the extent that foreign-trained professionals opt to train for entirely new careers following migration, in the absence of a system for credentializing foreign training, and the skills involved are not complementary, we would expect this interaction term to be zero.

In Figure 4 we plot predicted log wages based on the estimates in Table 5. Adding idle years and interaction terms does essentially nothing to change the level or slope of the native wage profile. Distinguishing immigrants from traditional and non-traditional source countries suggests a substantially lower entry wage for non-traditional immigrants – 0.115 log points – primarily reflecting a differential cohort effect, as opposed to lower returns to foreign schooling or experience. Subsequent wage growth, however, is virtually identical over the following 35-year period for the two immigrant types. Though the sharp change in the slope of the profiles around the tenth year gives the illusion that the traditional-immigrant profile is steeper, the rate of assimilation is at all ages slightly higher for non-traditional immigrants.[21]

[21] It turns out this result is somewhat sensitive to variable definitions. Using standard variable definitions – left-continuous schooling and potential experience – suggests both a lower entry effect for traditional source country immigrants and a higher subsequent assimilation rate. For the sake of brevity we do not show these results. They are, however, available upon request.

Lastly, we address the possible endogeneity of the post-migration schooling/work decision. If we were only concerned about selective outmigration we could simply condition samples of immigrant cohorts on reaching some level of YSM and examine wage growth over this period. This is the approach of Edin, Lalonde and Åslund (2000), Hu (2000) and Lubotsky (2007). Due to the short and unbalanced nature of the panels in our data, and our interest in identifying post-migration returns to schooling, experience and idle years, our preferred strategy is to account for individual fixed effects (FE) in estimating the direct returns model. This approach has the advantage that we capture the wage growth of all immigrants and not just immigrants who remain in the host country for some specified duration. To the extent that FE purge the data of correlation between unobserved individual effects and both emigration and changes in post-migration work and schooling decisions, our approach produces consistent estimates of immigrant wage growth conditional on post-migration behaviour. It continues, however, to produce inconsistent estimates if emigration or levels of host-country experience, schooling or idle years are not strictly exogenous (conditional on the FE). This would be the case if, for example, emigration is more likely among workers who correctly anticipate relatively low future wage growth or if the incidence of obtaining additional schooling upon arrival is higher among workers that, even in the absence of additional schooling, would have experienced above average post-migration wage growth.[22]

In estimating the full direct returns model – equation (4.19) – two complications arise. First, since all the foreign human capital variables are strictly time-invariant, their returns are no longer identified (though the interactions of foreign and host-country variables are). As a result, we can no longer predict an immigrant wage level upon arrival and therefore cannot infer assimilation. Our solution is to identify returns to the time-invariant regressors in a second stage regression, which is estimated at the individual level (see Polachek and Kim (1994) for details). The second stage is estimated by either OLS or GLS exploiting information on the diagonal elements of the residual covariance matrix from the first stage. Second, since the year-to-year change in host-country schooling, experience and idle years must sum to 1 ($\Delta exph_{it} + \Delta sh_{it} + \Delta idleh_{it} = 1$), the year effects, y_t, are no longer identified in the FE estimation. We, therefore, use the annual provincial unemployment rate (and its interaction with the immigrant dummy) to identify period effects.[23]

[22]Two others sources of endogenous selection of concern – besides selective emigration – are non-random sample attrition and selection into wage employment. The latter is more of a problem here than in papers focusing on earnings. In the absence of suitable instruments to identify these selection processes, we are limited to controlling for unobserved FE.

[23]We tried using various detrended unemployment rates in the hope of isolating cyclical fluctuations, but found that since there is a substantial trend in unemployment rates (and our estimated year effects) over our

In Table 6 we present the FE results. Since we are most interested in the sensitivity of the results to the inclusion of individual FE, we also report estimates from pooled OLS. However, in order to make the results more comparable, we now include an unemployment rate and use the redefined schooling, experience, and idle years in which the within-panel changes exclusively increase the host-country quantities. We then predict log wage profiles using exactly the same approach as in Figures 3 and 4, assuming a constant unemployment rate of 7.5% (the mean level in the data). The OLS and FE(GLS) results are shown in two separate panels in Figure 5. Comparing the native profile in the top panel of Figure 5 to Figure 4, the adjustments appear to do essentially nothing to alter the native wage profile. Thirty-five-year wage growth is exactly 0.327 log points in both cases. The immigrant profile, however, does change to some extent. In particular, the entry wage is lower – the overall gap is now 0.221 log points at entry compared to 0.229 (traditional immigrants) and 0.345 (non-traditional immigrants) in Figure 4. But subsequent growth is also somewhat higher – 0.677 log points over 35 years, compared to 0.599 (traditional immigrants) and 0.636 (non-traditional immigrants). Consequently, there is more evidence of assimilation. Sensitivity analysis reveals the difference is driven by the different approaches to identifying the period effects. In particular, the fixed year effects identify a strong upward trend in wages over the sample period, which apparently does more to depress immigrant than native wage growth (net of the period effects) since the year effects, unlike the unemployment rate, are not immigrant specific.

Estimation by fixed effects, regardless of the second-stage procedure, also does little to change the results. In terms of the age-experience simulation in the lower panel of Figure 5 (for the sake of brevity we only show the GLS case), the entry effect is now 0.229 log points compared to 0.221 from pooled OLS. This is perhaps not surprising, given the entry wages are identified exclusively off time-invariant foreign stocks of human capital, and therefore include all unobserved individual heterogeneity (as argued above, in informing selection policy we do not want to purge entry wages of unobserved heterogeneity). Subsequent relative immigrant wage growth, however, also changes little. Over the full 35-year period, native wages now grow slightly more (0.343 log points compared to 0.327), while immigrant wages grow slightly less (0.631 log points compared to 0.677). As a result, the "average" immigrant considered now reaches wage parity with the comparable native roughly ten years later (age 46, instead of 36).

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data period, the resulting experience returns appear to overstate wage growth. Our preference is therefore to use unadjusted unemployment rates.

What explains the fact that our fixed effects estimates do not imply substantially lower immigrant wage growth as the U.S. literature has tended to find (e.g., Lubotsky 2007)? It turns out, it is not because we are identifying wage growth off a return to host-country experience, whereas other studies identify off YSM – we get a similar differences between pooled OLS and FE using the restricted and unrestricted YSM models. We can think of two other reasons, however, that may explain the difference. First, it may be this result is unique to Canada. Indeed, there is reason to believe the nature of emigration is different in Canada. In particular, immigration to Canada may serve as a stepping stone for onward migration to the U.S.. This onward migration may be most common among highly able, highly motivated workers, so that in the Canadian data, YSM is less positively correlated with high unobserved individual effects. Alternatively, even if the nature of selective emigration is similar in Canada and the U.S., if the propensity to emigrate in both countries is increasing in individuals' post-migration wage growth, then excluding emigrants from the sample, as the existing U.S. studies have tended to do, will imply lower wage growth. But controlling for individual fixed effects will not. Lower wage growth from longitudinal estimates does not then reflect selective emigration of workers with low wage *levels*, as has been interpreted in these studies.

We have argued that an important advantage of the direct returns model is it offers a richer set of counterfactual predictions to inform immigrant selection and settlement policy. In Figures 6 and 7 we perform two such simulations. In Figure 6 we compare predicted log wage profiles for immigrants arriving with 16 years of foreign schooling, but different quantities of foreign experience, and compare to a native with the same total schooling and experience. In Figure 7 we compare host-country wage growth across three immigrants, each arriving with 5 years of foreign experience. In the first case, the immigrant arrives at age 30 with 20 years of foreign schooling and accumulates one year of host-country experience in each subsequent year. In the second case, the immigrant arrives at age 26 with 16 years of schooling, but then completes an additional 4 years of schooling, before beginning to accumulate host-country experience. In the last case, the immigrant arrives with 16 years of foreign schooling, but accumulates 4 idle years before beginning to accumulate host-country experience.[24] These profiles are, again, compared to a comparably-aged native, who initially (age 26) has 16 years of schooling and 5 years experience.

A return to potential foreign work experience close to zero is a standard result in the literature. Though using actual experience increases the return slightly (Table 3), controlling

[24]In all cases we assume the immigrant has some foreign experience to reflect the reality of the Canadian skilled immigrant selection criteria, which essentially disqualifies applicants with no foreign work experience.

for individual FE does not (Table 6). At least over the first 8 years, the FE foreign experience returns are, if anything, slightly smaller (though still significant). This is captured in Figure 6 in the very modest improvements in entry wage rates across immigrants arriving with very different amounts of work experience. What is arguably more interesting in Figure 6, however, is that not only does additional foreign experience do essentially nothing to improve entry wages, it also appears to reduce subsequent wage growth. For example, over the first 5 years wages grow by 0.264 log points for the immigrant with 5 years foreign experience, compared to 0.254 log points for the immigrant with 15 foreign experience. This difference, which is statistically significant, is driven by the negative foreign/host-country experience interaction term. In fact, with enough YSM, the host-country experience return is lower for the immigrant arriving with 15, compared to 5, years of foreign experience, even conditioning on age. As a result, after age 51 the dashed and dotted profiles in Figure 6 are diverging. To our knowledge, this dependence of immigrant wage growth on foreign experience has not been documented elsewhere.

Recent years have seen a shift in Canadian and Australian immigrant selection criteria towards greater emphasis on host-country educational credentials. Assuming the primary objective of these criteria are to select immigrants who will be most successful competing in the host-country's labour markets, the evidence in Figure 7 does not suggest the emphasis on host-country credentials is well justified. In particular, providing immigrants with 4 additional years of schooling (20 instead of 16 years) has almost exactly the same effect on wage levels and wage growth whether the additional 4 years were obtained in Canada or abroad. It is, of course, possible the advantage of host-country credentials lies primarily in employment probabilities, though as long as reservation wages are decreasing in unemployment durations, we would expect this to show up in wage outcomes. Nonetheless, to the extent that foreign schooling reduces employment probabilities, the decreasing wage outcomes that come with host-country idle years suggests the push to more emphasis on host-country schooling may be justified.

6 Summary

Thirty years after Chiswick's (1978) seminal study of immigrant labour market assimilation, there remains considerable disagreement regarding the capacity of immigrants to overcome labour market challenges experienced following arrival in a host country. We argue the disagreement, in part, reflects parameter restrictions implicit in the YSM approach. In particular, assuming a wage determining process with unequal returns to foreign and host-country sources of schooling and experience and no immigrant assimilation, we show that the YSM model potentially predicts assimilation when there is no assimilation in the underlying data generating process, the extent to which depends critically on second and higher moments of the data at hand.

The problem with directly estimating returns to foreign and host-country sources of human capital – what we refer to as the direct returns model of immigrant wage assimilation – is twofold. First, unlike YSM models, it requires the source country of immigrants' schooling and experience be identified in the data, which is typically not the case. Second, in distinguishing host-country human capital investments, it introduces an additional source of endogeneity, which complicates inferences made regarding immigrant wage growth and assimilation. We posit that these challenges explain the dearth of papers in the assimilation literature estimating direct returns. The question, which has not been explored in the literature, is whether the biases inherent in the reduced-form YSM approach are more substantial than those emanating from the assumptions necessary to estimate the direct returns model using standard cross-sectional data sources.

Using a single, particularly rich, Canadian longitudinal dataset on roughly 6,000 immigrants, we estimate three different immigrant wage assimilation models paying close attention to the sensitivity of the results to model specification, measurement error, and the potential endogeneity of post-migration schooling and work activities. Our main finding is that the biases inherent in estimating foreign and host-country returns directly using standard data sources appear, if anything, more modest than those of the YSM approach, suggesting the predominance of YSM models in the literature is not well founded. The predominance of the YSM approach appears particularly questionable given the relative richness of the direct returns model in informing immigrant selection and settlement policy. For example, our preferred specification suggests that additional foreign work experience not only does essentially nothing to raise immigrant wage outcomes at entry, but also lowers subsequent returns to host-country work experience. The return to foreign schooling for immigrants from both traditional and non-traditional source countries is, in contrast, virtually identical to their return to host-country schooling, raising questions about recent efforts to attach greater weight to host-country educational credentials in Canadian immigrant selection policy.

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Table 1: Unweighted sample sizes from pooling 4 SLID panels, 1993-2004.

	Immigrants		Natives	
	Person	Person/year	Person	Person/year
Immigrant status identified	16,263	65,644	127,467	526,471
Longitudinal respondent	14,262	61,123	105,230	479,794
Age 18-64	10,688	43,856	85,994	365,944
Ever work full-time	8,719	36,336	72,652	312,027
Valid hourly wage[1]	6,938	25,496	61,666	237,195
Valid covariate set[2]	5,951	22,098	55,491	214,286

[1] Composite hourly wage is observed only if individual was a paid employee for at least one job during the reference year.

[2] Non-missing information on following variables: actual labour market experience; total years of schooling; age obtained postsecondary credential; age began full-time work; and age at migration.

Table 2: Weighted sample means.

	Immigrants						Natives	
	Foreign				Host-country			
Log hourly wage			2.781	(0.500)			2.757	(0.501)
Potential experience:								
Left continuous	5.976	(7.619)			17.251	(10.677)	19.083	(11.880)
Uniform	6.398	(7.631)			16.830	(10.686)	19.083	(11.880)
Right continuous	6.597	(7.702)			16.642	(10.767)	19.083	(11.880)
Actual experience:								
Left continuous	2.927	(5.545)			13.381	(10.176)	14.972	(10.845)
Uniform	2.302	(5.180)			14.006	(10.299)	14.972	(10.845)
Right continuous	2.008	(4.869)			14.300	(10.302)	14.972	(10.845)
Years of schooling:								
Left continuous	9.774	(6.208)			4.192	(6.168)	13.874	(3.310)
Uniform	9.338	(5.855)			4.628	(6.006)	13.874	(3.310)
Right continuous	9.115	(5.681)			4.851	(6.006)	13.874	(3.310)
Idle years:								
Left continuous	3.856	(6.119)			3.544	(5.319)	4.464	(6.270)
Uniform	4.174	(6.164)			3.256	(5.213)	4.464	(6.270)
Right continuous	4.414	(6.236)			3.072	(5.190)	4.464	(6.270)
Cohort <1960			0.112	(0.316)			—	
Cohort 1960-1969			0.169	(0.374)			—	
Cohort 1970-1979			0.254	(0.435)			—	
Cohort 1980-1989			0.251	(0.433)			—	
Cohort 1990-2002			0.214	(0.410)			—	
Female			0.476	(0.499)			0.470	(0.499)
Rural			0.028	(0.165)			0.130	(0.336)
Small			0.084	(0.277)			0.249	(0.432)
Medium			0.133	(0.340)			0.189	(0.392)
Large			0.755	(0.430)			0.432	(0.495)
Ontario			0.560	(0.496)			0.327	(0.469)
Atlantic			0.014	(0.116)			0.097	(0.297)
Quebec			0.115	(0.319)			0.277	(0.448)
Prairies			0.040	(0.196)			0.076	(0.266)
Alberta			0.099	(0.299)			0.106	(0.308)
British Columbia			0.173	(0.378)			0.116	(0.320)

Table3: Pooled OLS estimation of direct returns model using alternative definitions of foreign and host-country sources of schooling and experience.

	Schooling measure:			Actual experience measure:		
	Left continuous	Uniform	Right continuous	Left continuous	Uniform	Right continuous
exph	0.0815*	0.0810*	0.0797*	0.0820*	0.0831*	0.0831*
	(0.0023)	(0.0023)	(0.0023)	(0.0021)	(0.0021)	(0.0021)
exph^2/10^2	-0.3108*	-0.3065*	-0.2953*	-0.4118*	-0.4235*	-0.4241*
	(0.0209)	(0.0209)	(0.0209)	(0.0225)	(0.0222)	(0.0223)
exph^3/10^3	0.0524*	0.0510*	0.0476*	0.1023*	0.1065*	0.1067*
	(0.0067)	(0.0067)	(0.0067)	(0.0083)	(0.0082)	(0.0082)
exph^4/10^4	-0.0033*	-0.0031*	-0.0028*	-0.0099*	-0.0104*	-0.0104*
	(0.0007)	(0.0007)	(0.0007)	(0.0010)	(0.0010)	(0.0010)
sh	0.0640*	0.0640*	0.0640*	0.0522*	0.0522*	0.0522*
	(0.0009)	(0.0009)	(0.0009)	(0.0008)	(0.0008)	(0.0008)
immigrant	0.2507*	0.2588*	0.2354*	0.1628*	0.1641*	0.1866*
	(0.0792)	(0.0782)	(0.0777)	(0.0475)	(0.0477)	(0.0474)
cohort 1960-1969	0.0062	0.0013	0.0120	0.0004	-0.0041	-0.0070
	(0.0326)	(0.0328)	(0.0328)	(0.0270)	(0.0273)	(0.0272)
cohort 1970-1979	-0.0071	-0.0146	-0.0005	0.0045	-0.0003	-0.0062
	(0.0411)	(0.0413)	(0.0411)	(0.0286)	(0.0287)	(0.0286)
cohort 1980-1989	-0.0738	-0.0773	-0.0612	-0.0604	-0.0672*	-0.0809*
	(0.0522)	(0.0522)	(0.0521)	(0.0338)	(0.0340)	(0.0341)
cohort 1990-2002	-0.0551	-0.0545	-0.0440	-0.0637	-0.0687	-0.0919*
	(0.0617)	(0.0618)	(0.0621)	(0.0391)	(0.0397)	(0.0402)
expf	0.0043	0.0055	0.0096*	0.0173*	0.0101	0.0088
	(0.0035)	(0.0035)	(0.0034)	(0.0045)	(0.0051)	(0.0057)
expf^2/10^2	-0.0091	-0.0142	-0.0232*	-0.0651*	-0.0456*	-0.0433*
	(0.0099)	(0.0101)	(0.0101)	(0.0155)	(0.0171)	(0.0188)
immigrant*exph	-0.0093*	-0.0104*	-0.0121*	-0.0122*	-0.0110*	-0.0119*
	(0.0027)	(0.0027)	(0.0027)	(0.0023)	(0.0022)	(0.0022)
immigrant*exph^2/10^2	0.0166*	0.0183*	0.0236*	0.0261*	0.0234*	0.0244*
	(0.0059)	(0.0060)	(0.0059)	(0.0062)	(0.0059)	(0.0059)
expf*exph/10^2	-0.0047	-0.0047	-0.0136	-0.0159	0.0005	0.0049
	(0.0108)	(0.0109)	(0.0109)	(0.0165)	(0.0183)	(0.0197)
sf	0.0515*	0.0523*	0.0529*	0.0462*	0.0458*	0.0454*
	(0.0020)	(0.0020)	(0.0021)	(0.0019)	(0.0019)	(0.0019)
immigrant*sh	-0.0094*	-0.0088*	-0.0071*	-0.0033	-0.0038	-0.0043
	(0.0028)	(0.0027)	(0.0027)	(0.0020)	(0.0021)	(0.0021)
R-squared	0.3693	0.3691	0.3688	0.3736	0.3732	0.3732
# of observations	236,384	236,384	236,384	236,384	236,384	236,384

Note: First three columns assume left-continuous potential experience. Following three columns assume uniformly distributed schooling. All regressions also include controls for city size (4 categories); region (6 categories); a full set of fixed year effects (12 categories); and a female dummy and its interaction with the immigrant dummy. Standard errors, shown in parentheses, are clustered allowing for correlations between observations of the same individual. * indicates significance at the 5% level.

Table 4: Pooled OLS estimation of restricted and unrestricted YSM models.

	Restricted	Unrestricted
exp	0.0824*	0.0833*
	(0.0023)	(0.0023)
exp^2/10^2	-0.3231*	-0.3248*
	(0.0204)	(0.0196)
exp^3/10^3	0.0545*	0.0560*
	(0.0064)	(0.0061)
exp^4/10^4	-0.0033*	-0.0036*
	(0.0007)	(0.0006)
s	0.0622*	0.0641*
	(0.0008)	(0.0009)
immigrant	-0.3334*	0.0047
	(0.0750)	(0.0798)
cohort 1960-1969	-0.0167	-0.0128
	(0.0359)	(0.0362)
cohort 1970-1979	-0.0011	0.0043
	(0.0447)	(0.0449)
cohort 1980-1989	-0.0271	-0.0174
	(0.0539)	(0.0543)
cohort 1990-2002	-0.0528	-0.0286
	(0.0634)	(0.0634)
ysm	0.0187*	0.0213*
	(0.0035)	(0.0034)
ysm^2/10^2	-0.0255*	-0.0260*
	(0.0060)	(0.0058)
immigrant*exp		-0.0166*
		(0.0019)
immigrant*exp^2/10^2		0.0238*
		(0.0040)
immigrant*s		-0.0123*
		(0.0022)
R-squared	0.3666	0.3692
# of observations	236,384	236,384

Note: Both specifications assume left-continuous schooling and left-continuous potential experience. Both regressions also include controls for city size (4 categories); region (6 categories); a full set of fixed year effects (12 categories); and a female dummy and its interaction with the immigrant dummy. Standard errors, shown in parentheses, are clustered allowing for correlations between observations of the same individual. * indicates significance at the 5% level.

Table 5: Pooled OLS estimation of direct returns model with idle years and interaction terms.

	Traditional				Non-traditional		Pooled	
exph			0.0819*	(0.0021)			0.0820*	(0.0021)
exph^2/10^2			-0.4122*	(0.0226)			-0.4135*	(0.0225)
exph^3/10^3			0.1029*	(0.0083)			0.1035*	(0.0083)
exph^4/10^4			-0.0100*	(0.0010)			-0.0101*	(0.0010)
sh			0.0535*	(0.0009)			0.0535*	(0.0009)
idleh			0.0019*	(0.0004)			0.0019*	(0.0004)
immigrant	0.1815	(0.1048)			-0.1780	(0.1656)	0.0922	(0.0869)
cohort 1960-1969	0.0165	(0.0376)			0.1156	(0.0914)	0.0403	(0.0348)
cohort 1970-1979	0.0223	(0.0477)			0.1663	(0.0998)	0.0565	(0.0428)
cohort 1980-1989	-0.0414	(0.0634)			0.0913	(0.1140)	-0.0223	(0.0533)
cohort 1990-2002	-0.0883	(0.0816)			0.0956	(0.1240)	-0.0455	(0.0629)
expf	0.0139	(0.0075)			0.0148	(0.0090)	0.0126*	(0.0059)
expf^2	-0.0592*	(0.0213)			-0.0557	(0.0330)	-0.0541*	(0.0190)
immigrant*exph	-0.0067*	(0.0032)			-0.0080	(0.0048)	-0.0070*	(0.0026)
immigrant*exph^2/10^2	0.0215*	(0.0071)			0.0217	(0.0135)	0.0244*	(0.0061)
sf	0.0513*	(0.0054)			0.0567*	(0.0049)	0.0518*	(0.0035)
immigrant*sh	-0.0079*	(0.0040)			0.0004	(0.0049)	-0.0058	(0.0031)
idlef	0.0063	(0.0034)			-0.0009	(0.0028)	0.0004	(0.0022)
immigrant*idleh	-0.0031	(0.0029)			0.0166*	(0.0050)	0.0003	(0.0025)
expf*exph	-0.00007	(0.0002)			0.00002	(0.0003)	0.00003	(0.0002)
expf*sh	-0.0017	(0.0013)			-0.0016	(0.0019)	-0.0016	(0.0011)
expf*idleh	-0.0013	(0.0010)			-0.0049	(0.0027)	-0.0018	(0.0009)
sf*exph	-0.0004*	(0.0002)			-0.0002	(0.0003)	-0.0004*	(0.0001)
sf*sh	-0.0002	(0.0004)			0.0007	(0.0005)	0.0002	(0.0003)
sf*idleh	-0.0002	(0.0003)			-0.0012*	(0.0005)	-0.0003	(0.0002)
idlef*exph	-0.0004*	(0.0002)			-0.00005	(0.0002)	-0.0002	(0.0001)
idlef*sh	0.0001	(0.0013)			0.0002	(0.0011)	0.0004	(0.0009)
idlef*idleh	0.000001	(0.0003)			0.0003	(0.0003)	0.0003	(0.0002)
# of observations	13,989		214,286		8,109		236,384	
R-squared			0.3757				0.3744	

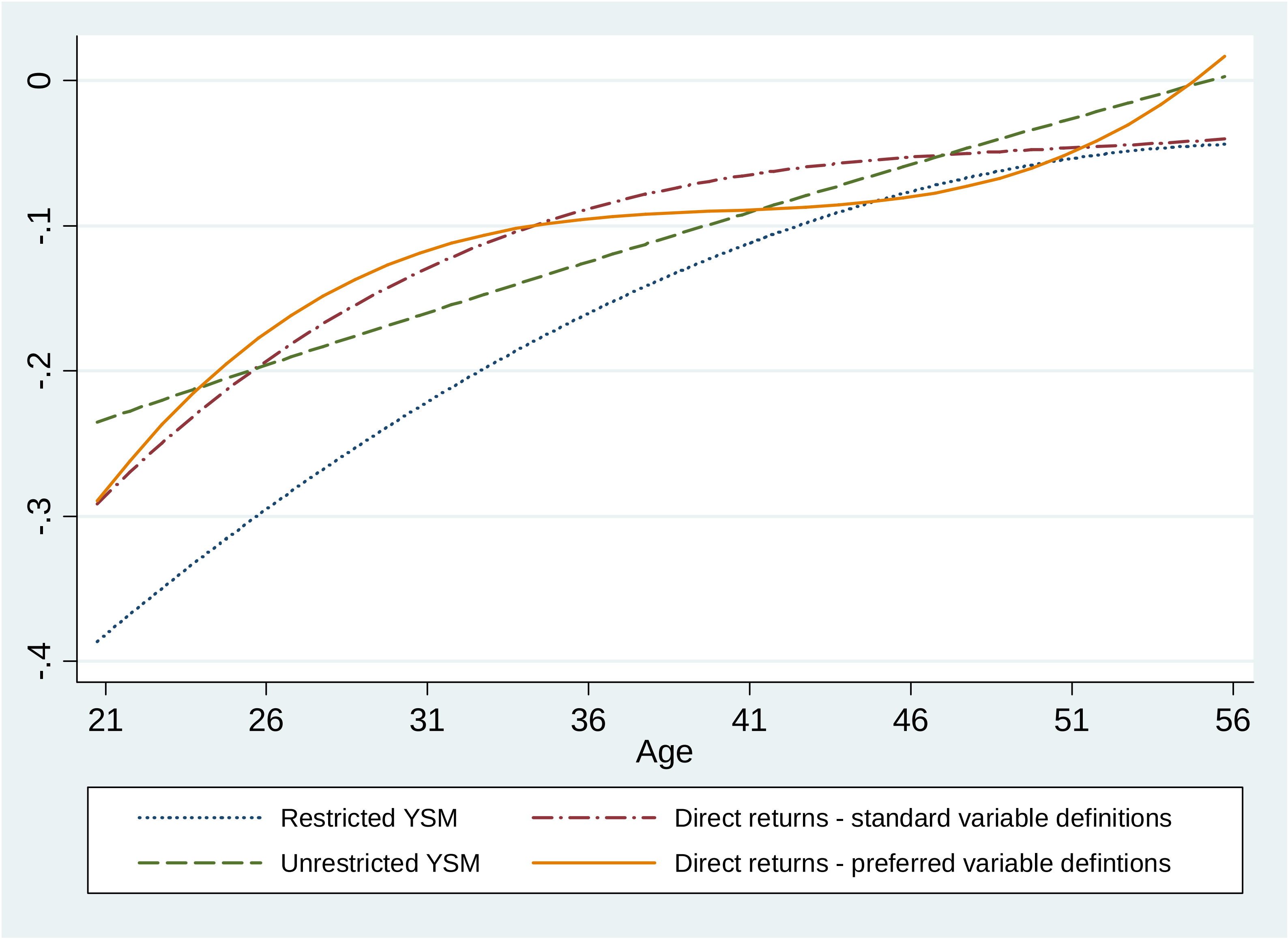
Note: Both regressions assume uniformly distributed schooling and actual experience. All regressions also include controls for city size (4 categories); region (6 categories); a full set of fixed year effects (12 categories); and a female dummy and its interaction with the immigrant dummy. Traditional immigrants include those born in the U.S., U.K., Western Europe, Northern Europe, Southern Europe, Caribbean, Mexico and Central America, South America, Australia, New Zealand, and Pacific Islands. Non-traditional immigrants are those born in Eastern Europe, the Middle East, Asia, and Africa.

Table 6: Pooled OLS and two-stage fixed effects estimation of direct returns model with unemployment rate.

	OLS		Fixed Effects					
			Two stage FE – OLS				Two-stage FE – GLS	
exph	0.0791*	(0.0016)			0.0727*	(0.0018)		
exph^2/10^2	-0.3943*	(0.0165)			-0.3452*	(0.0178)		
exph^3/10^3	0.0986*	(0.0061)			0.0835*	(0.0067)		
exph^4/10^4	-0.0097*	(0.0007)			-0.0080*	(0.0008)		
sh	0.0547*	(0.0007)			0.0368*	(0.0023)		
idleh	0.0024*	(0.0003)			0.0083*	(0.0017)		
unemp	-0.2506*	(0.0820)			-0.3871*	(0.0976)		
immigrant	0.0294	(0.0761)	0.1566*	(0.0153)			0.1271*	(0.0211)
cohort 1960-1969	0.0639*	(0.0264)	0.0853*	(0.0189)			0.0778*	(0.0257)
cohort 1970-1979	0.0634	(0.0332)	0.1155*	(0.0184)			0.0922*	(0.0247)
cohort 1980-1989	0.0430	(0.0426)	0.0466*	(0.0194)			0.0232	(0.0257)
cohort 1990-2002	0.0360	(0.0504)	0.0577*	(0.0214)			0.0308	(0.0278)
expf	0.0145*	(0.0042)	0.0109*	(0.0026)			0.0125*	(0.0028)
expf^2/10^2	-0.0515*	(0.0140)	-0.0280*	(0.0112)			-0.0392*	(0.0125)
immigrant*exph	-0.0032	(0.0022)			0.0022	(0.0044)		
immigrant*exph^2/10^2	0.0188*	(0.0049)			0.0077	(0.0081)		
sf	0.0503*	(0.0028)	0.0345*	(0.0011)			0.0369*	(0.0014)
immigrant*sh	-0.0075*	(0.0026)			-0.0181	(0.0112)		
idlef	-0.0025	(0.0017)	-0.0040*	(0.0009)			-0.0020	(0.0011)
immigrant*idleh	0.0013	(0.0021)			0.0097	(0.0095)		
immigrant*unemp	0.5308	(0.2880)			-0.4465	(0.3188)		
expf*exph	-0.0002	(0.0001)			-0.0008*	(0.0003)		
expf*sh	-0.0016	(0.0010)			0.0008	(0.0038)		
expf*idleh	-0.0020*	(0.0008)			0.0009	(0.0012)		
sf*exph	-0.0004*	(0.0001)			-0.0002	(0.0003)		
sf*sh	0.000003	(0.0003)			0.0003	(0.0017)		
sf*idleh	-0.0003	(0.0002)			-0.0018	(0.0009)		
idlef*exph	-0.0001	(0.0001)			-0.0012*	(0.0002)		
idlef*sh	0.0012	(0.0008)			0.0030	(0.0025)		
idlef*idleh	0.0006*	(0.0002)			0.0017*	(0.0009)		

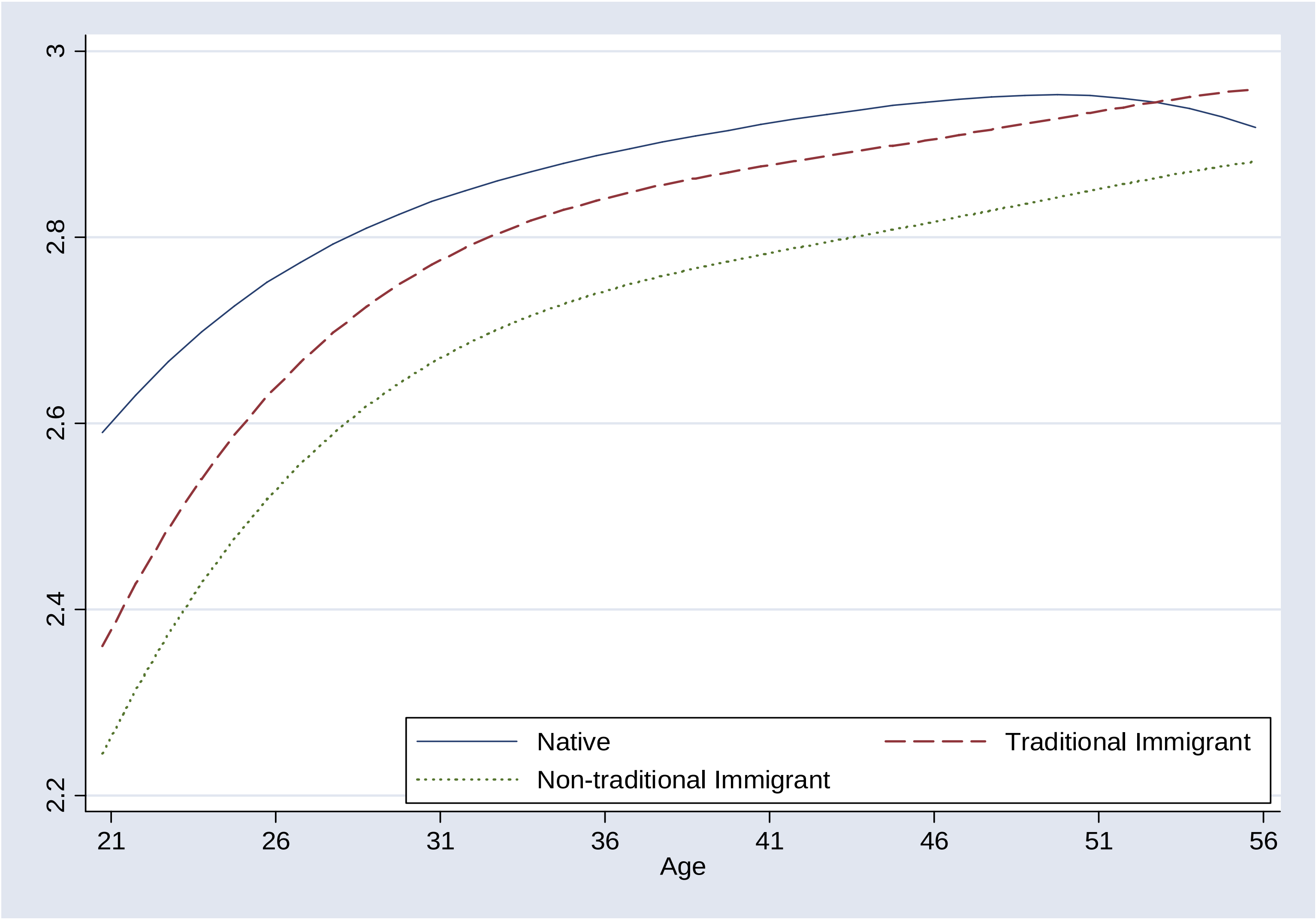
Note: All regressions also include controls for city size (4 categories); region (6 categories); a full set of fixed year effects (12 categories); and a female dummy and its interaction with the immigrant dummy. Foreign and host-country years of actual experience and schooling are based on the uniformly-distributed definition. Standard errors, shown in parentheses, are clustered allowing for correlations between observations of the same individual. * indicates significance at the 5% level.

Figure 3: Predicted relative immigrant log wage across three assimilation models.



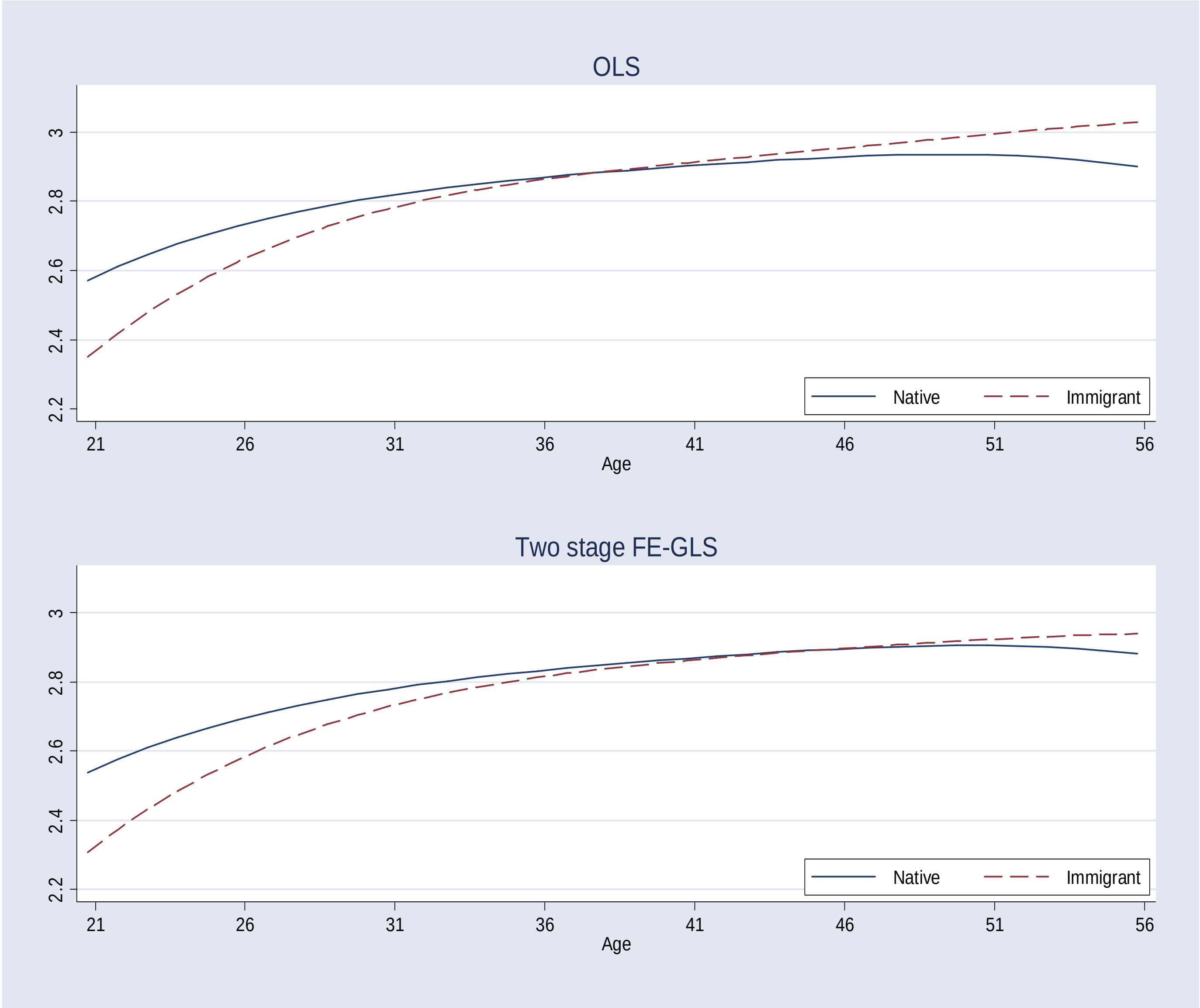
Note: Predictions based on estimates in Tables 3 and 4. Immigrant predictions are for a foreign-born worker arriving in Canada between 1990 and 2002 with 9.77 years of foreign schooling and 5.98 years of foreign experience, who accumulates one year of host-country experience in every year since migration. The native predictions are for a comparable native-born worker. Standard variable definitions are left-continuous schooling and potential experience. Preferred variable definitions are uniformly-distributed schooling and actual experience.

Figure 4: Predicted log wages of immigrants from traditional and non-traditional source countries, direct returns model.



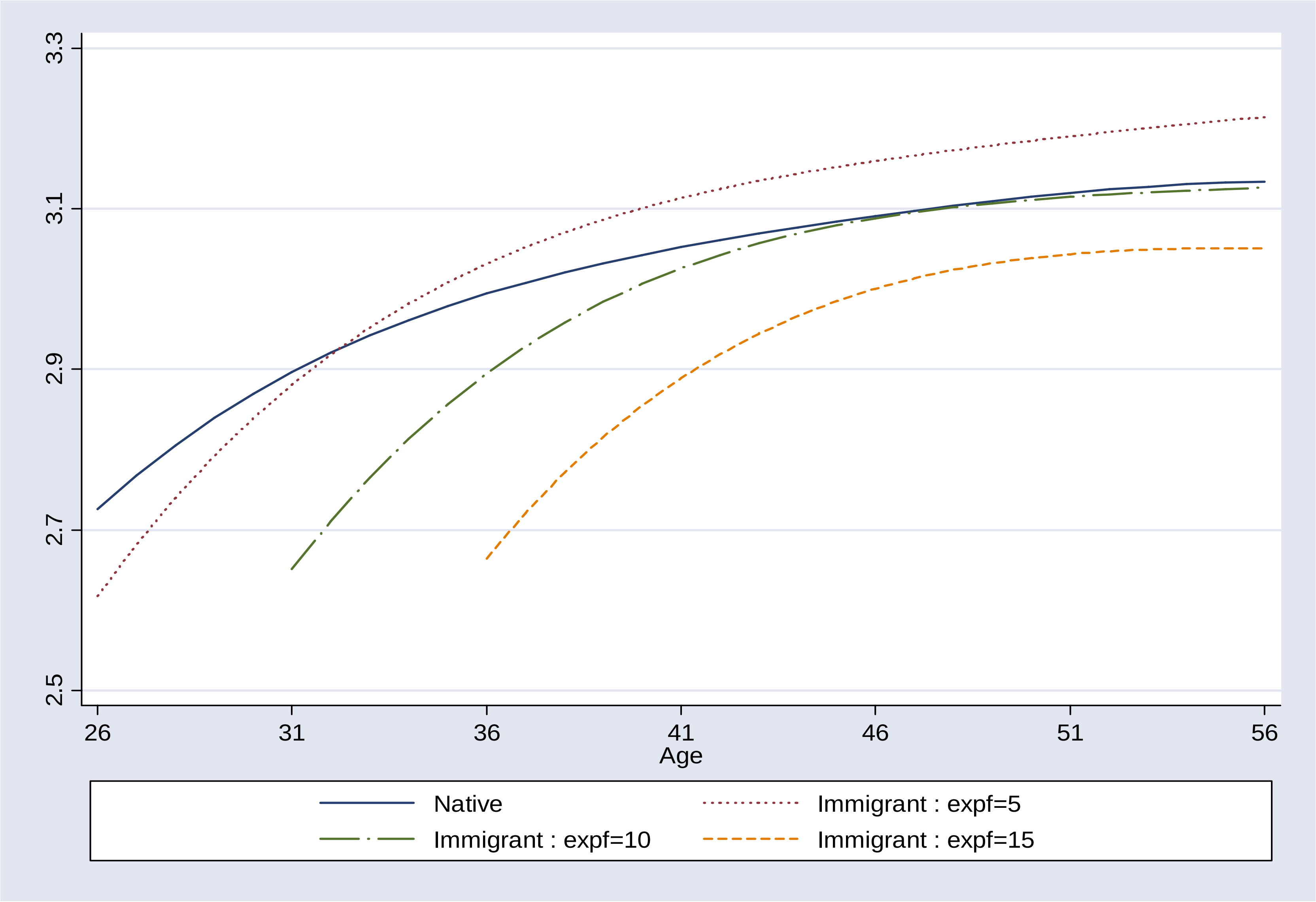
Note: Predictions based on estimates in Table 5. Immigrant predictions are for a foreign-born worker arriving in Canada between 1990 and 2002 with 9.77 years of foreign schooling and 5.98 years of foreign experience, who accumulates one year of host-country experience in every year since migration. The native predictions are for a similarly-aged native-born worker. Traditional immigrants include those born in the U.S., U.K., Western Europe, Northern Europe, Southern Europe, Caribbean, Mexico and Central America, South America, Australia, New Zealand, and Pacific Islands. Non-traditional immigrants are those born in Eastern Europe, the Middle East, Asia, and Africa. All predictions are for a male, residing in Ontario, in 2004, in a city with at least 500,000 inhabitants.

Figure 5: Predicted log wages from direct returns model with and without individual fixed effects.



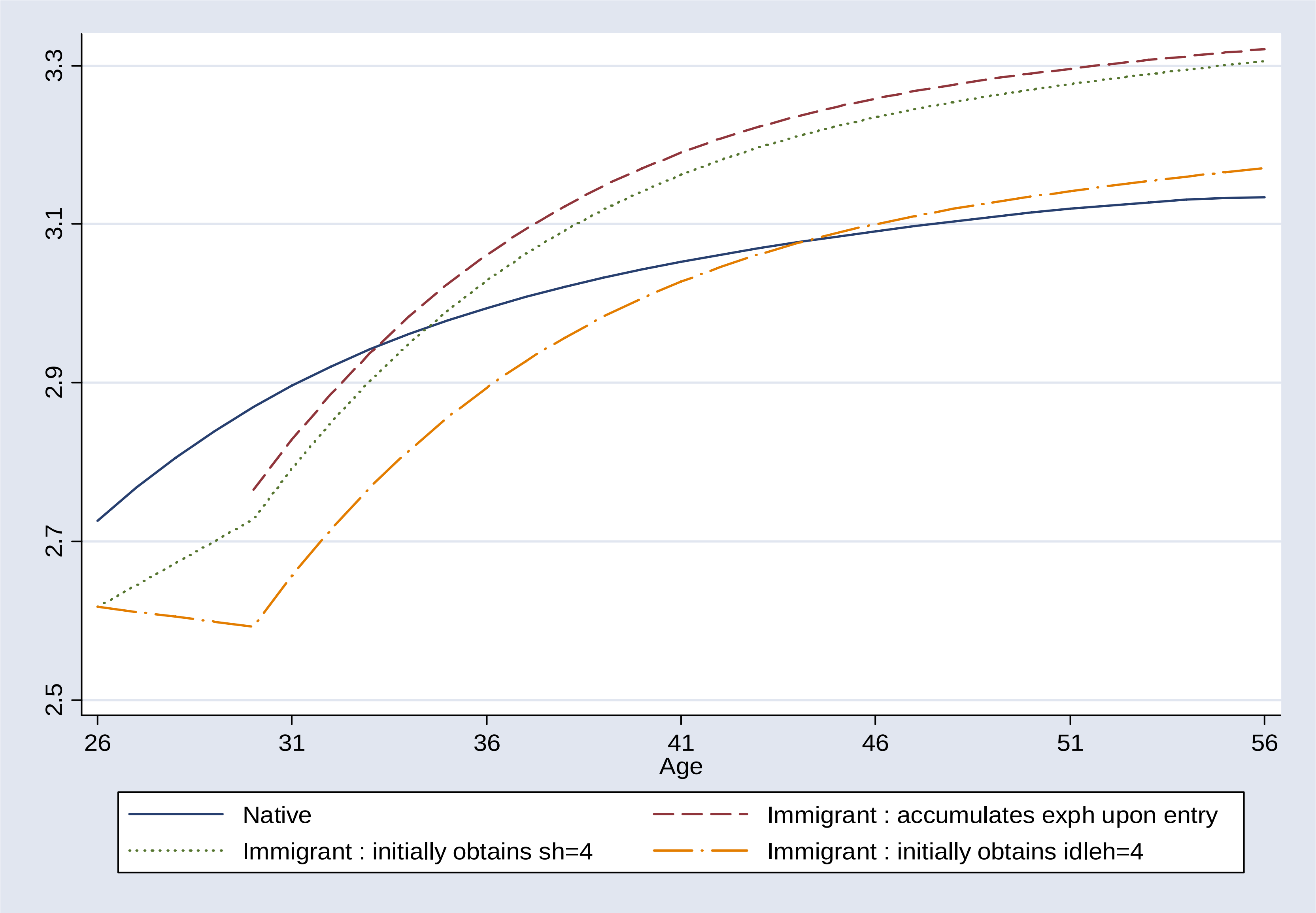
Note: Predictions based on estimates in Table 6. Immigrant predictions are for a foreign-born worker arriving in Canada between 1990 and 2002 with 9.77 years of foreign schooling and 5.98 years of foreign experience, who accumulates one year of host-country experience in every year since migration. The native predictions are for a similarly-aged native-born worker. All predictions are for a male, residing in Ontario, in 2004, in a city with at least 500,000 inhabitants, facing an unemployment rate of 7.5%.

Figure 6: Effect of foreign experience on predicted log wage profiles, direct returns model.



Note: Predictions based on fixed effects (GLS) estimates in Table 6. Immigrant predictions are for a foreign-born worker arriving in Canada between 1990 and 2002 with 16 years of foreign schooling and various quantities of foreign experience. In all cases, immigrants accumulate one year of host-country experience in every year since migration. The native predictions are for a similarly-aged native-born worker. All predictions are for a male, residing in Ontario, in 2004, in a city with at least 500,000 inhabitants, facing an unemployment rate of 7.5%.

Figure 7: Effect of host-country schooling relative to foreign schooling on predicted log wage profiles, direct returns model.



Note: Predictions based on fixed effects (GLS) estimates in Table 6. Immigrant predictions are for a foreign-born worker arriving in Canada between 1990 and 2002 with either 16 or 20 years of foreign schooling 5 years of foreign experience. The native predictions are for a similarly-aged native-born worker. All predictions are for a male, residing in Ontario, in 2004, in a city with at least 500,000 inhabitants, facing an unemployment rate of 7.5%.