Self-selection in migration and returns to skills*

Benoit Dostie† and Pierre Thomas Léger‡

August 26, 2006

Abstract

We build a model of migration which considers both observable and unobservable individual characteristics and their returns across locations. We focus on the interprovincial migration patterns of Canadian physicians, in part, because physicians are paid on a fee-for-service basis. Because fees are exogenous, we can estimate a mixed conditional-logit model to determine the effects of individual and destination-specific characteristics (particularly earnings differentials) on physician location decisions. We find, among other things, that individuals with greater earnings potential based on unobservables are more likely to migrate to provinces where the returns to such unobservables are greater.

JEL classification: J24, J61, C23, C35

Keywords: Migration, Self-Selection, Earnings, Longitudinal Data, Productivity.

*We are grateful to seminar participants at the University of Calgary, Laval, Sherbrooke, HEC Montréal, CERF (McMaster University), the 6th European Health Economics Workshop (Liège, Belgium), the Canadian Economics Association Annual Conference (Montreal) and the American Society of Health Economists Meeting (Wisconsin). We also thank Rob Clark, Gera Surendra, Richard Roy, David Gray, Jan Erik Askildsen, Howard Thomas, Ajay Agrawal and James Walker for their comments. The authors gratefully acknowledge funding from SSHRC, FQRSC and HEC Montréal. The usual caveats apply.

†CORRESPONDING AUTHOR. Address: Institute of Applied Economics, HEC Montréal, 3000, chemin de la Côte-Sainte-Catherine, Montréal, H3T 2A7; e-mail: benoit.dostie@hec.ca; fax: 514-340-6469; phone : 514-340-6453; CIRANO, CIRPÉE and IZA.

‡Address: Institute of Applied Economics, HEC Montréal, 3000, chemin de la Côte-Sainte-Catherine, Montréal, H3T 2A7; e-mail : ptl@hec.ca; fax: 514-340-6469; phone: 514-340-6436; CIRANO and CIRPÉE.

1 Introduction

The theoretical and empirical economic literature on who migrates and to where is quite vast. The economic model of migration posits that individuals will migrate if the expected utility of moving to an alternative location is greater than the expected utility of remaining in their current location (net of transaction costs). Specifically, holding everything else constant, individuals will migrate to the location which yields them the highest expected earnings. How much an individual will earn across different locations is likely to depend on both individual-specific and location-specific characteristics. Thus, for a heterogenous population, the returns associated with migrating across different locations are also likely to be heterogenous. In fact, in Borjas (1987) and Borjas, Bronars, and Trejo (1992), the authors argue that different locations are characterized by their own wage generating process, each characterized by a mean wage-rate and a return to individual skills[1]. In such an environment, conditional on mean wages, highly-skilled individuals will wish to migrate to regions with a high-skills premium (i.e., regions with a relatively large variance in wages) whereas low-skilled individuals will wish to migrate to regions with a relatively low-skills premium (i.e., regions with a relatively small variance in wages).

Self-selection by workers based on skills is recently tested by Hunt and Mueller (2004) using Canadian and American data. They use micro-level data to predict location-specific mean wages (separately for males and females) as well as location-specific returns to skills. By using these predicted location-specific mean wages and returns to skills as well as each individual's wage-rate, they can classify individuals according to their skill-level. They then test the Borjas model of selection in a nested-logit framework. That is, they test whether individuals with greater skills are more likely to migrate, ceteris paribus, to areas with a greater skills premium. Their findings support Borjas' model. The authors do not, however, disaggregate observable and unobservable skills and their respective returns across locations in the migration decision. Furthermore, they do not estimate their model separately for each location of origin and so they cannot allow for both origin and destination specific effects when considering the migration decision. In a recent paper, Chiquiar and Hanson (2005) using American and Mexican data test the Borjas model of migration with a non-parametric approach. Their results are inconsistent with Borjas' model and suggest instead intermediate selection. Although their focus is more on who migrates and not on why individuals migrate, they do not consider unobserved skills.[2]

Although the above papers have tested the empirical validity of the migration models proposed by Borjas (1987) and Borjas, Bronars, and Trejo (1992), to our knowledge none has been able to disentangle the separate impact of observable and unobservable individual characteristics, and their respective returns across different locations, on an individual's decision to migrate. In this paper, we address these limitations and show that: (i) unobservable characteristics, and their relative returns across different locations, play an important role in the migration decisions of individuals, and (ii) ignoring unobservable characteristics may actually lead to the false rejection of the Borjas model of selection in migration.

In order to test the Borjas model of migration while considering the separate contribution of observable and unobservable characteristics in earnings, we focus on a particular set of workers: Canadian physicians. We choose this particular group of workers for several reasons. First, in Canada physicians are often singled out as a highly-skilled group who frequently experience both international and interprovincial migration (Finnie (2001) and Barrett (2001)). Furthermore, focussing on physicians allows us to study the migration decisions of a relatively homogenous set of workers which permits us to avoid issues related to different wage-generating processes across different occupations. Finally, and most importantly, Canadian physicians are generally paid on a fee-for-service where the fees are set at the provincial level. That is, unlike most other groups of workers, physicians face exogenous wage-rates (where fee-for-service rates vary uniquely by physician specialty, province of practice, and year).

In the traditional Borjas setup, observationally identical individuals face different wage-rates because of varying skill levels. This is not the case in our setup given that all observationally equivalent physicians (i.e., those with the same specialty who practice in the same province in the same year) face identical wage-rates. Thus, within group, differences in earnings are not reflected in differences in wages-rates but, rather, differences in the number of services they provide (and/or patients they treat). Individuals may provide more services and/or see more patients for a variety of reasons, including a better reputation, better diagnostic and treatment skills, and a greater taste for work. The ability to exploit such individual characteristics to increase earnings are likely to depend on where physicians practise. For example, a low reputation physician may wish to locate in an area where there is excess demand for physician services. On the other hand, a physician with a greater taste for work may wish to locate in an province without caps on earnings. By exploiting the exogeneity of wages, we can predict (for each physician) the unobserved component which contributes to total earnings - what we call (for lack of a better term) the physician's "unobserved ability". This allows us to estimate the precise role of observable and unobservable components in the earnings equation (and their respective returns across different locations) on migration decisions. It also allows us to test whether or not individuals with greater "unobservable ability" (greater unobservable ability and desire to generate earnings) are more likely to migrate to locations where the returns to such "unobserved ability" are greater (i.e., where the "ability-premium" is greater).

We develop and estimate a two-stage model of earnings determination and migration decisions.[3] Specifically, we first estimate province-specific earnings equations and use the estimated parameters to predict each physician's potential earnings (based on both observable and unobservable individual and location-specific characteristics) for each possible destination. We then estimate a mixed conditional-logit model to examine the effects of individual- and destination-specific characteristics (particularly earning differentials) on physician location decisions. This allows us to disentangle the role and the relative importance of observable and unobservables characteristics *and* their respective returns across different locations on physician migration decisions.[4]

Our results show that unobservable physician characteristics and their returns across different locations are an important element in the migration decision. In fact, omitting such unobservables can lead to false and counter intuitive results. For example, we find that individuals in certain provinces appear to migrate to provinces where they would earn less if potential earnings across different locations were based exclusively on the individual's observable characteristics and the province-specific returns to such characteristics. However, including unobserved "ability" in the income-generating process shows that individuals do, in fact, migrate to locations where they can expect to earn more. Our results are consistent with a modified Borjas model of selection which considers both observable and unobservable components of earnings. That is, we find that individuals who have greater (smaller) earnings-potential based on unobservables (i.e., what we call high-ability physicians) are more likely to migrate to provinces where the returns to such unobservables are greater (smaller).

The remainder of the paper is organized as follows. In section 2 we present the theoretical model. In section 3 we discuss the data used in estimation. The statistical model of earnings and migration is presented in section 4. Results are presented and discussed in section 5. Finally, conclusions are drawn in section 6.

2 Theoretical Model

In this section we present a modified version of Borjas' model of earnings determination and migrant selection. In Borjas' model, the natural logarithm of individual i's wage in region j is given by:

$$\ln(w_{ij}) = \mu_j + \phi_j(\upsilon_i - \upsilon), \tag{1}$$

where μ_j denotes the mean log wage in area j, ϕ_j denotes the returns to skills, υ_i is the individual's skill level and υ is the average skill level. Thus, an individual's wage in location j is a function of the region-specific average log wage, the individual's location in the skills distribution and the region-specific returns to such skills. As a result, spatial variation in wages is a function of both the mean wage-rate (μ_j) and the returns to skills (ϕ_j) (assuming identical skills distributions across locations). Consequently, individuals will wish to sort on both of these components in order to maximize their earnings. For example, conditioning on identical mean wages across two locations, an individual with high skills (i.e., $\upsilon_i - \upsilon > 0$) will wish to migrate to an area with a high-skills premium while a low-skill individual ($\upsilon_i - \upsilon < 0$) will wish to migrate to an area with a low-skills premium.

In our setting, however, physician wages are characterized by a simple deterministic function which reflects the fee-for-service setting in Canada:

$$\ln(wage_{ijt}) = f(specialty_i, province_j, year_t). \tag{2}$$

That is, physicians of the same specialty (i) who practise in the same province (j) in the same year (t) face an identical wage-rate (or fee-for-service rates). Thus, within a particular specialty-year-province triplet, the wage distribution is degenerate. Although wages do not vary within a same triplet, earnings do. Such variations in physician earnings reflect differences in the number of services performed:

$$earnings_{ijt} = number\_of\_services_{ijt} * wage_{ijt}. \tag{3}$$

The number of services performed by a given physician depends on the number of patients the physician can (or may wish to) attract and treat which in turn may be influenced by many variables including the physician's specialty, medical training, reputation, productivity, and taste for work. It may also be influenced by local market conditions including the demand for health care services as well as any limits placed on the total number of services performed by a particular physician. For example, in certain provinces such as Quebec, physicians face limits on the total number of services that they may provide (i.e., earnings caps). As a result, physicians may turn away patients because they may not be (fully) remunerated for their services. Such a cap limits the earnings potential of some physicians, but likely increases the earning potential of others (i.e., those who would have difficulty attracting patients).

As a result, we can rewrite:

$$\begin{aligned} earnings_{ijt} &= g(\phi_{1j}(observables_{it}), \phi_{2j}(unobservables_i)) * \\ &\quad f(specialty_i, province_j, year_t), \end{aligned} \tag{4}$$

where g represents a function translating the physician's observable characteristics and unobservable characteristics and their relative returns (ϕ_{1j} and ϕ_{2j}, respectively) into the number of services performed.

In our model, physician self-selection across different provinces is based on observable and unobservable characteristics and their province-specific returns. It is also based on the province-specific wage-rates (or fee-for-service rates). Based on this modified version of the Borjas selection model, a physician who has difficulty attracting patients (for example, because of a bad reputation) may wish to migrate to an area where there is excess demand for medical services (i.e., where the "ability-premium" is low). This may occur even if the fee-for-service rate is lower. On the other hand, a physician who has no difficulty attracting patients may wish to migrate to a province where the "ability-premium" is high (which may occur even if the fee-for-service rate and/or total demand is lower).

3 Data

This paper makes use of several complementary data sets. The National Physician Database (NPDB) includes information on almost all Canadian physicians who practiced during the 1989-1997 period.[5] The data, collected separately by each province on a yearly basis, include information on several physician characteristics such as: age, date of birth, sex, language spoken, year of graduation and medical school attended, area of specialization, as well as the physician's total annual billings. Because each physician is assigned a unique identification number, we are able to follow each physician over time.[6] However, because the data are collected at the provincial level, physicians are not tracked when they leave a given province for another or for abroad. It is important to note that only active physicians who are paid on a fee-for-service basis are included in this data set. It is this sample that we use for estimation.

The second data set, the Southam Medical Data Base (SMDB), is a national data set containing very similar information to the NPDB and collected over the same period. Although it does not contain the physician's billing information it does include his or her postal code. Given that it is a Canada-wide panel data set, it allows us to track physicians from one geographical location to another. Thus, we are able to observe when a physician moves to a different province or abroad. Because the NPDB and the SMDB contain many common variables (such as the physician's date of birth, year of graduation, medical school attended, and medical specialty), they can be merged to form a single panel which includes many demographic characteristics and the physician's total billings *and* where we observe all physicians over-time and over geographical areas.[7]

The merged data sets include yearly information on 49,046 physicians working in Canada between 1989 and 1997. Each physician is observed for up to 10 years with 28,897 physicians observed in 1989 and 33,229 observed in 1998 (see Table 1). Several summary statistics are worth noting and are provided for 1989 (the first year of our panel). First, 21 per cent of physicians are female (although the graduating class of physicians is approximately 50 per cent female). The average age of physicians is 45. Furthermore, physicians self-identified as English-speaking represent approximately 78 per cent of the physician workforce and the remainder are self-identified as French-speaking. Finally, 60 per cent of physicians are coded as specialists while 40 per cent are coded as GPs or Family Physicians. Table 1 also summarizes migration patterns over this decade. For example, between 1992 and 1993, 2,715 out of 33,079 physicians (or 8.21 per cent) in our sample emigrated either from one province to another, or from a Canadian province to the United-States or abroad. Given that the large majority of moves were inter-provincial, inter-provincial migration is likely to have a bigger effect on the pool and composition of practising physicians than international migration.

Table 2 summarizes aggregate migration patterns for the 1989 to 1997 period for the sample discussed above. That is, it summarizes total migration from each province (source) to each of the other provinces, the United-States or abroad (destination). For example, during the 1989-1997 period, 2,817 physicians in the sample migrated from Quebec to Ontario, while 2,697 physicians migrated from Ontario to Quebec.[8]

4 Statistical Model of Migration and Earnings

As noted above, unobserved skills generally refer to the set of skills which are unobservable to the econometrician (and are generally difficult to measure) but nonetheless contribute to an individual's wage. However, as we discussed above, wage-rates are exogenous in our framework and thus skills (or, equivalently, "ability" in our setting) are assumed to contribute to higher earnings via the number of services performed. Data requirements for studies on the unobservable component which contributes to higher earnings are quite extensive as migrants must be observed long enough for the econometrician to infer them. Because our data set allows us to observe individuals prior to and post interprovincial-migration, we construct a model which allows us to estimate: (i) the link between individual characteristics and migration (including the choice of destination), (ii) the importance of potential earning differentials on migration, and (iii) whether, and to what extent, individuals consider both observable and unobservable components of earnings (and their returns across different locations) when making migration decisions.

To analyze the migration decisions of individuals, we use a discrete choice model. We define the utility for physician i in location (or province) j in year t to be:

$$U_{ijt} = \beta' X_{ijt} + \alpha_j' V_{it} + \theta_{ij} + \varepsilon_{ijt} \tag{5}$$

where X_{ijt} denotes the vector which includes the two different components of individual i's predicted wage in location j, that is, the component based exclusively on observable characteristics {denoted as $\ln \widehat{\_earnings}_{ijt}$} and the component based on unobservable characteristics {denoted as $\widehat{\mu}_{ij}$} (i.e., $X_{ijt} = \{\ln \widehat{\_earnings}_{ijt},\ \widehat{\mu}_{ij}\}$). We discuss both of these components in greater detail below. V_{it} denotes a vector of observable individual characteristics which directly affect the physician's utility of being in location j but which are (unlike X_{ijt}) invariant to the location choice. V_{it} include the physician's age, sex, language spoken (English or French), specialty type (according to the NPDB classification)[9] as well as series of year dummies[10]:

$$V_{it} = \{1, age_{it}, sex_i, language_i, specialty_i, year_t\}. \tag{6}$$

Note that the constant term in the V vector captures everything that is specific to the province which does not vary over time (for example, climate or general amenities). Time dummies, on the other hand, take into account time-varying differences between provinces which could affect a physician's utility in province j (for example, the level of health care funding or amenities in a given year or, migration costs in general). θ_{ij} (where $\theta_{ij} = \lambda_j \theta_i$) represents a random component which is composed of an individual effect θ_i (that we assume to be normally distributed with mean 0 and variance σ_θ^2 normalized to 1) and a choice specific loading factor λ_j.[11] Note that θ_i is assumed to be independent of the values of any regressor and that the identification of the load factor λ_j is achieved through the observation of the same physician across multiple location choices j. Thus, the unobservable component for choice j is given by $\lambda_j \theta_i$ where the covariance between $\lambda_j \theta$ and $\lambda_{j'} \theta$ is $\lambda_j \lambda_{j'}$. As a result, in a model without covariates, different choices would be negatively (positively) correlated if $\lambda_j \lambda_{j'}$ is negative (positive).[12] Finally, ε_{ijt} denotes a type I extreme value error term.

In order to define $X_{ijt} = \{\ln\_\widehat{earnings}_{ijt}, \widehat{\mu}_{ij}\}$, we must first define and estimate the income generating process. This earnings generating process for province j (which is estimated separately for each j) is given by:

$$\begin{aligned} ln\_earnings_{ijt} &= \delta_{0j} + \delta'_{1j}(wage)_{ijt} + \delta_{2j} sex_i + \\ & \quad \delta_{3j} School\_foreign_i + \\ & \quad \delta_{4j} age_{it} + \delta_{5j} age_{it}^2 + \mu_{ij} + v_{ijt}, \end{aligned} \tag{7}$$

where *wage* denotes the wage-rate for physician i at time t, *sex* denotes the physician's sex, *School_foreign* is a dummy variable which captures whether or not the physician graduated from a non-Canadian medical school and *age* denotes the physician's age. Finally, μ denotes a physician-specific time-invariant unobserved effect which affects earnings (i.e., his or her "unobserved ability") while v is a standard error term.[13]

As noted above, the wage-rate is modelled as a deterministic function to reflect the fee-for-service setting in Canada in which fees are set annually at the provincial level and are based uniquely on the specialty-type (i.e., fees are defined uniquely by their year, specialty and province):

$$wage_{ijt} = f_j(specialty_i * year_t). \tag{8}$$

For a given province j, the income generating function is given by (7) but where $wage_{jit}$ is replace by a series of year∗specialty dummies.[14] As a result, (7) becomes:

$$\begin{aligned} ln\_earnings_{ijt} \quad = \quad & \delta_{0j} + \delta'_{1j}(specialty_i * year_t) + \delta_{2j} sex_i + \\ & \delta_{3j} School\_foreign_i + \\ & \delta_{4j} age_{it} + \delta_{5j} age^2_{it} + \mu_{ij} + v_{ijt}. \end{aligned} \tag{9}$$

Using (9), we can predict earnings (more specifically, predict the observable and unobservable components of earnings) for each individual for each potential destination j. To do so, we first estimate (9) separately for each province of origin and obtain a vector of estimated parameters $\widehat{\delta}_j$ (one vector for each province). We use the best-linear-unbiased predictor for the individual's random component $\widehat{\mu}_i$. Finally, we estimate the variance of $\widehat{\mu_{ij}}$ for each location j denoted as $\widehat{\sigma^2_{\mu j}}$. Thus, provinces with a larger variance in the individual-specific (ability) component of earnings can be considered provinces with a larger ability-premium.[15]

Using the estimated parameters, $\widehat{\delta}$, we first predict earnings for each individual if they were to migrate to an alternative province k based exclusively on observable characteristics, i.e.[16],

$$\begin{aligned} \widehat{ln\_earnings_{ikt}} &= \widehat{\delta_{0k}} + \widehat{\delta'_{1k}}(specialty_i * year_t) + \widehat{\delta_{2k}} sex_i + \\ & \widehat{\delta_{3k}} School\_foreign_i + \widehat{\delta'_{4k}} age_{it}. \end{aligned} \tag{10}$$

Then, using $\widehat{\mu_i}$ and $\widehat{\sigma^2_{\mu j}}$, we calculate for each individual i the unobserved components of earnings (to be included in the vector X_{ijt}) for individual i denoted as $\widehat{\mu}_{ik}$ if he or she migrated to province k from province j (assuming that he or she retained his or her location (position) on the unobserved distribution of μ):

$$\widehat{\mu_{ik}} = \frac{\widehat{\mu_i}}{\widehat{\sigma^2_{\mu j}}} * \widehat{\sigma^2_{\mu k}}. \tag{11}$$

From equation (11) we see that a high-ability individual (i.e., with a positive $\widehat{\mu_i}$) would migrate to a location where the returns to such unobservables are higher than in their current location ($\widehat{\sigma^2_{\mu k}}$ is greater that $\widehat{\sigma^2_{\mu j}}$) in order to increase his earnings, whereas a low-ability individual (i.e., with a negative $\widehat{\mu_i}$) would migrate to a location where the returns to ability are lower than in their current location ($\widehat{\sigma^2_{\mu k}}$ is smaller that $\widehat{\sigma^2_{\mu j}}$).

As noted above, physicians will migrate to location j if doing so yields them greater utility than migrating to any other location (or staying in the current location). Given our assumption about the distribution of ε_{idt}, the probability that a physician from a given province will migrate to location j is given by:

$$P(Y_{it} = j) = \frac{e^{\beta' X_{ijt} + \alpha'_j V_{it} + \theta_{ij}}}{\sum_{d=1}^{D} e^{\beta' X_{idt} + \alpha'_d V_{it} + \theta_{id}}}. \qquad (12)$$

Estimation is done by maximizing the marginal likelihood and integrating out the heterogeneity components θ_i.[17] We use Gauss-Hermite Quadrature to approximate the normal integral.

We estimate the above model for three different provinces of origin: Ontario, Quebec, and British Columbia.[18] Furthermore, we exclude Newfoundland (3643 observations or 852 physicians) and Prince-Edward Island (852 observations or 155 physicians) as potential destination provinces since these provinces have too few physicians (and too few specialists) to credibly estimate earnings equations, and these provinces experience too little in- and out-migration (in terms of observations) to be included. We also drop four specialties across all provinces for similar reasons: Public Health, Occupational Medicine, Medical Biochemistry and Medical Scientist (for a total of 447 observations).

5 Results

In Table 3 we present results from the estimation of regression (9) for each province. Regression results suggest that many individual characteristics are important determinants of earnings (with different relative importance across provinces). In fact, we find that the returns to many individual characteristics such as sex, age, language, specialty, and school of graduation vary across provinces. For example, we find that females generally earn less than their male counterparts (across all provinces), while French speaking physicians earn more than their English counterparts in Quebec (a French-speaking province), but less in Ontario. These results suggest that physicians should sort across provinces based in part on these observable individual characteristics and their relative returns in different locations. Finally, Table 3 also presents estimation results for the variance of the unobserved random effect (σ_μ) as well as the variance of the unobserved iid error term (σ_v). If we interpret the former variance as the province-specific ability premium, the modified version of Borjas' model of selection predicts that physicians with greater unobserved ability (greater $\widehat{\mu}_{ij}$) will wish to migrate to provinces with a greater σ_μ.

Tables 4, 5 and 6 present the results from the estimation of the mixed conditional-logit model given by (12) for physicians initially practising in Ontario, Quebec and British Columbia, respectively.[19] In what follows we only present results from the model with unobserved heterogeneity since the more simple model without unobserved heterogeneity is easily rejected using a likelihood-ratio test.[20] We also do not show results from a model where we include only one specialty dummy (i.e., assuming that all specialties have the same propensity to migrate) as it was rejected in favour of the more general model with a dummy for each specialty type.[21]

Results suggest that individual characteristics are important determinants of migration and that their relative importance is different across origins and destinations. For example, we find that female physicians initially practising in Ontario, Quebec and British Columbia, are less likely to migrate to all provinces than their male counterparts, although the effect varies across origins and destinations. Our results also suggest that age and country of medical training also affect the likelihood of migration (and are different across origins and destinations).[22,23]

Results relating to the effect of potential earning differentials on the likelihood of migrating are somewhat surprising. Our results suggest that potential earnings differentials based solely on the physician's observable characteristic and the province-specialty specific wage-rates are positive but not statistically significant in an Ontarian physician's migration decision. This partial result would seem to suggest that physicians in Ontario do not migrate to other provinces in order to get greater expected earnings. For physicians initially in Quebec and British Columbia, they appear to migrate to provinces which yield them lower total earnings, when considering only observable physician characteristics and their returns across different locations. However, expected earnings across different provinces are not based solely on observable characteristics, the returns to such observables, and the province-specialty specific wage-rate. They also depend on a physician's unobservable ability/desire to generate earnings (what we have, loosely called ability) and the returns to such ability. In fact, our results suggest that physicians who initially practise in Ontario, Quebec and British Columbia, are more likely to migrate if they can earn more elsewhere, where the difference in earnings across locations is based on unobservables. Because of the relative importance of unobservables in the earnings equation, results show that physicians do consider potential earning differentials across locations when making their migration decisions and they are more likely to migrate if doing so will lead to greater total earnings. Given that earning more, based on unobservables, is associated with unobserved physician characteristics and their returns across provinces, our results show that physicians with higher "ability" (i.e., a higher $\widehat{\mu_i}$) are more likely to migrate to areas with a "higher ability premium" (i.e., to provinces with a higher variance in the unobservable component of earnings). This result supports a modified self-selection model in migration à la Borjas based on unobservable ability differences and relative ability premiums across provinces.

These results are important in several respect. First, they suggest that sorting based on observables and unobservables need not go in the same direction (as is implied by the literature based solely on observables). That is, a physician may move to increase his or her total earnings even though total earnings would appear to decrease if only observable characteristics were considered. And, although results based solely on observables may not be consistent with Borjas' model of selection in migration, allowing for sorting to be based on both observables and unobservables (and the returns to these across different locations) leads to results which are consistent.

6 Conclusion

In this paper, we examine self-selection of workers based on observable and unobservable characteristics and their respective returns across regions. In order to do so, we focus on the inter-provincial migration of physicians in part because physicians are paid on a fee-for-service basis (which are province-year-specialty specific). This allows us to decompose physician earnings into observable and unobservable components. The observable component includes individual physician characteristics and controls for exogenous fee-for-service rates. The unobservable component captures unobservable individual-specific characteristics (such as productivity, reputation and taste for work) which contribute to the physician's total earnings. We then estimate the impact of both of these components on the physician's likelihood of migrating and choice of destination. This allows us to test whether or not physicians migrate in order to gain greater earnings. More specifically, we test whether or not physicians migrate for potentially higher earnings assuming that potential earnings are based on observable and unobservable components separately. We find that migration decisions and earnings are negatively (or insignificantly) correlated when only considering the observable characteristics in the earnings equation (a result which seems to be counter-intuitive). However, our results suggest that physicians are sorting based on the unobservable component in total earnings. More specifically, we find that physicians who earn more (less) based on unobservables (i.e., what we loosely call unobservable ability) are more likely to migrate to provinces where there exists a larger (smaller) premium to such unobservables. These results are consistent with the idea that individuals migrate, in part, to increase their total earnings. They are also consistent with a modified Borjas model where self-selection of workers based on unobservables.

Our results also shed light on the relative importance of observables and unobservables in the migration decision and potential policy implications. For example, our results suggest that exogenous increases in fee-for-service rates (which are part of the vector of observables in the earnings equations) may not decrease the out-migration of physicians (or increase the in-migration of physicians) as migration is insignificantly (or even negatively) correlated with earnings differentials based on such observables. Our results do suggest, however, that unobserved ability and returns to unobserved ability are positively correlated in the migration decision. This would suggest that provinces that wish to retain or attract physicians may wish to exploit this dimension (possibly by eliminating limits on the amount of services a physician may perform in a given year).

References

Antolin, P. and O. Bover (1997). Regional migration in Spain: The effect of personal characteristics and of unemployment, wage and house price differentials using pooled cross-sections. *Oxford Bulletin of Economics and Statistics 59*(2), 215–235.

Axelsson, R. and O. Westerlund (1998). A panel study of migration, self-selection and household real income. *Journal of Population Economics 11*, 113–126.

Barrett, P. (2001). Who let the docs out? *Institute for Research on Public Policy: Choices 7*(6), 37–45.

Benarroch and Grant (2004). The interprovincial migration of Canadian physicians: Does income matter? *Applied Economics 36*(20), 2335–2345.

Borjas, G. J. (1987). Self-selection and the earnings of immigrants. *American Economic Review 77*, 531–53.

Borjas, G. J., S. Bronars, and S. Trejo (1992). Self-selection, and internal migration in the United States. *Journal of Urban Economics 32*(2), 159–185.

Chiquiar, D. and G. H. Hanson (2005). International migration, self-selection, and the distribution of wages - evidence from Mexico and the United States. *Journal of Political Economy 113*(2), 239–281.

Dionne, G., A. Langlois, and N. Lemire (1987). More on the geographical distribution of physicians. *Journal of Health Economics 6*, 365–374.

Finnie, R. (2001). The brain drain: Myth and reality - what it is and what should be done. *Institute for Research on Public Policy: Choices 7*(6), 3–29.

Health Canada (1995). Physician supply, distribution and migration. Technical report, Health Information Division, Ottawa.

Heckman, J. and J. Walker (1990). The relationship between wages and income and the timing and spacing of births: Evidence from Swedish longitudinal data. *Econometrica 58*, 1411–1441.

Hunt, G. and R. Mueller (2004). North American migration: Returns to skill, border effects, and mobility costs. *The Review of Economics and Statistics 86*, 998–1007.

Hurley, J. E. (1991). Physicians' choices of specialty, location and mode. *Journal of Human Resources 26*, 47–71.

Lee, L. (1978). Unionism and wage rates: A simultaneous equations model with qualitative and limited dependent variables. *19*(2), 415–433.

McKendry (1996). Factors influencing the migration of physicians from Canada to the United States. *Canadian Medical Association Journal 154*, 171–181.

Nivalainen, S. (2004). Determinants of family migration - short moves vs long moves. *Journal of Population Economics 17*, 157–175.

Pissarides, C. A. and J. Wadsworth (1989). Unemployment and the interregional mobility of labour. *The Economic Journal 99*(397), 739–755.

Robinson, C. and N. Tomes (1982). Self-selection and interprovincial migration in Canada. *Canadian Journal of Economics 15*(3), 474–502.

Roy, A. (1951). Some thoughts on the distribution of earnings. *Oxford Economic Papers 3*, 135–146.

Sandefur, G. D. and W. J. Scott (1981). A dynamic analysis of migration: An assessment of the effects of age, family and career variables. *Demography 18*(3), 355–368.

Schlottmann, A. M. and H. W. H. Jr. (1981). Employment status and the decision to migrate. *Review of Economics and Statistics 63*(4), 590–598.

Notes

[1]Their models build on the seminal work of Roy (1951).

[2]They also make the limiting assumption that Mexican immigrants living in the US are not systematically different from those who did not migrate to the US (i.e., who remained in Mexico). Furthermore, they assume that the return to schooling is higher in all areas of Mexico than in the all areas of the United-States.

[3]The structure of our model is similar to standard statistical models of selection in wages. However, these models usually include a correction for self-selection in the wage equation (see for example Lee (1978)). In our setting, it is unlikely that movements across provinces are large enough to cause meaningful changes in the wage distribution. Therefore, as is typical in the migration literature, we do not incorporate this additional feature in our statistical model.

[4]Several studies have specifically examined the practice location and/or migration decisions of physicians (Hurley (1991); Dionne, Langlois, and Lemire (1987); Benarroch and Grant (2004)). Although previous research suggests that certain personal characteristics as well as differences in potential income across jurisdictions may help explain physician migration, several limitations should be mentioned (limitations which are often similar to those in the general migration literature). First, many studies examine only the initial practice location of recent medical students. As a result, understanding the migration decisions of physicians over the course of their careers is impossible. Furthermore, many studies are based on aggregate flow data.

Therefore, they are unable to provide information on who, within a given population, is likely to migrate. Finally, they do not consider the role of observables and unobservables, and their returns across different locations, on the migration decisions of physicians.

[5]Excluded from the data set are physicians: (i) who were inactive, (ii) who were not paid via fee-for-service, (iii) whose total billings were less than \$10,000 or more than \$500,000, (iv) who were under 25 or over 85 years old (v) who were born before 1910 or after 1975, and (vi) who made a formal request to be removed.

[6]Medical Specialties include: General Practitioner/Family Medicine, Internal Medicine, Dermatology, Neurology, Pediatrics, Physical Medicine and Rehabilitation, Public Health, Emergency Medicine, General Surgery, Cardiovascular and Thoracic Surgery, Neurosurgery, Obstetrics and Gynecology, Ophthalmology, Otolaryngology, Orthopedic Surgery, Plastic Surgery, Urology, Anesthesia, Nuclear Medicine, Medical Microbiology, Pathology, Radiology-Diagnostic, Radiology-Therapeutic, Occupational Medicine, Medical Biochemistry, Medical Scientist.

[7]In a handful of cases, more than one physician shared the same values on all common variables used for merging the data sets. These physicians were excluded.

[8]These summary statistics are consistent with the literature on physician migration (see for example, McKendry (1996), Health Canada (1995) and Benarroch and Grant (2004)).

[9]It is important to note that in certain provinces in certain years we do not necessarily observe physicians of all types of specialties migrating to all alternate provinces. As a result, the conditional logit contains at most 23 physician specialty dummies in each branch.

[10]We exclude 1989 which serves as the reference year.

[11]See Heckman and Walker (1990) who introduce unobserved heterogeneity in a similar way.

[12]Allowing for unobserved heterogeneity in this manner serves to relax the IIA assumption (embeded in many discrete choice models) as we allow choices to be correlated. In fact, as we discuss later on, IIA is rejected by our results. Taking into account unobserved heterogeneity is also important in a longitudinal data setting in order to control for spurrious relations with non-time varying individual characteristics.

[13]Several individual characteristics which could be considered observable and are likely to affect the physician's earnings potential, include the physician's marital status and the presence of children (because of greater opportunity cost of time). Because these characteristics are not included in the data set, they are considered part of the unobservable component of earnings. Nonetheless, these characteristics are likely to affect a physician's taste for leisure which we allow in our interpretation. They are also likely to affect the cost of migrating which we explicitly consider in our setup by allowing an individual-specific component θ_{ij} to affect the physician's utility of migrating to area j.

[14]Note that by adding year*specialty dummies, we are controlling for any type of earnings-cap which often exist at the province level yet are unobserved in the data.

[15]As in the previous literature (Hunt and Mueller (2004), Chiquiar and Hanson (2005)), we do not control for potential self-selection when estimating the province-specific earnings equation. As a result, we assume that the returns to observables are the same for those currently in the province as for those who have yet to enter. Atlhough controlling for self-selection might be preferable, we do not have enough data to address this issue in a reasonable way.

[16]Even if a certain kind of specialist is present in a particular province in a given year, it is possible that this is not the case for all years. For these specific cases, we run a simpler model where time and specialty dummies are not interacted and predict wages accordingly.

[17]The unobserved component θ_{ij} also controls for any unobserved cost associated with migrating (both financial and psychic) as these are likely to vary by individual and also by origin and potential destination.

[18]We do not estimate the model for other provinces as there are not enough physicians of all types (i.e., specialties) who migrate to all alternative locations in all years.

[19]Note that the estimation is not conditional on migrating. Rather, staying put (i.e., not migrating) is one of the branches of the conditional logit.

[20]This likelihood ratio test is equivalent to a Wald test with the null hypothesis that all load factors are equal to zero. Rejecting the null is also equivalent to rejecting the IIA assumption.

[21]It is important to recall that in all earnings regressions, all year-specialty specific effects (which include the fee-for-service rates) are controlled for but are omitted for presentation sake.

[22]Our results with respect to the effect of age and sex are in line with the general migration literature as well as the literature on physician migration. That is, older females are less likely to migrate than their younger male counterparts (see for example, Schlottmann and Jr. (1981), Sandefur and Scott (1981), Pissarides and Wadsworth (1989), Antolin and Bover (1997), Axelsson and Westerlund (1998), and Nivalainen (2004))

[23]It is important to note that the language spoken by the physician (French or English) is included in the mixed conditional logit model for physicians initially practising in Quebec. Results show that English physicians are more likely than French physicians to migrate to all provinces. These results are consistent with results found in (Robinson and Tomes (1982)) who study migration in a Canadian context.

Table 1: Total yearly migration

		Migration					
Year	# Physicians	International	%	Interprovincial	%	Total	% with a move
1988-1989	28,897	115	0.40	2,241	7.76	2,356	8.15
1989-1990	29,284	121	0.41	2,219	7.58	2,340	7.99
1990-1991	30,592	198	0.65	2,425	7.93	2,623	8.57
1991-1992	31,507	233	0.74	2,428	7.71	2,661	8.45
1992-1993	33,079	322	0.97	2,393	7.23	2,715	8.21
1993-1994	33,210	279	0.84	2,215	6.67	2,494	7.51
1994-1995	33,581	336	1.00	2,579	7.68	2,915	8.68
1995-1996	33,477	264	0.79	2,491	7.44	2,755	8.23
1996-1997	33,229	250	0.75	2,461	7.41	2,711	8.16

Table 2: Migratory Flows

From/To	NFLD	PEI	NS	NB	QC	ONT	MAN	SASK	ALB	BC	For	Total
NFLD	0	5	38	19	70	139	6	5	32	39	26	380
PEI	0	0	4	4	7	23	5	4	6	9	7	69
NS	22	3	0	44	232	444	44	25	63	153	116	1,152
NB	9	1	45	0	157	248	35	22	45	91	49	704
QC	108	10	252	156	0	2,817	269	227	764	1,110	433	6,153
ONT	144	30	406	242	2,697	0	321	309	774	1,418	676	7,132
MAN	9	5	55	39	280	327	0	13	73	161	94	1,056
SASK	10	5	17	25	217	337	20	0	128	194	126	1,080
ALB	35	4	77	52	747	779	65	69	0	353	215	2,403
BC	36	8	123	81	1,062	1,268	113	111	302	0	282	3,402
Total	373	71	1,018	662	5,474	6,398	878	785	2,192	3,537	1,272	

Total emigration from a province includes emigration to all provinces, territories and abroad.

Table 3: Ln-Earnings Regressions

	NS	NB	QC	ONT	MAN	SASK	ALB	BC
Dummy: 1 if speaks english	0.173	-0.020	-0.070***	0.271***	0.034	-0.342	0.249*	0.278**
	(0.181)	(0.056)	(0.015)	(0.043)	(0.188)	(0.321)	(0.144)	(0.114)
Dummy: 1 if female	-0.281***	-0.397***	-0.369***	-0.377***	-0.421***	-0.336***	-0.308***	-0.392***
	(0.040)	(0.056)	(0.015)	(0.013)	(0.044)	(0.046)	(0.025)	(0.020)
Dummy: 1 if foreign diploma	-0.092**	-0.080	0.046**	0.051***	0.210***	0.192***	0.096***	0.048**
	(0.041)	(0.059)	(0.019)	(0.013)	(0.040)	(0.037)	(0.025)	(0.019)
Age (in years)	0.160***	0.144***	0.140***	0.156***	0.132***	0.148***	0.171***	0.172***
	(0.007)	(0.009)	(0.002)	(0.002)	(0.007)	(0.008)	(0.005)	(0.004)
Age squared divided by 100	-0.166***	-0.153***	-0.153***	-0.161***	-0.137***	-0.152***	-0.179***	-0.182***
	(0.007)	(0.010)	(0.002)	(0.002)	(0.007)	(0.008)	(0.005)	(0.004)
Constant	7.855***	8.512***	8.492***	7.945***	8.529***	8.594***	7.609***	7.598***
	(0.243)	(0.215)	(0.056)	(0.065)	(0.244)	(0.362)	(0.177)	(0.139)
σ_μ	0.642	0.644	0.621	0.662	0.680	0.610	0.619	0.617
σ_v	0.380	0.370	0.370	0.393	0.352	0.381	0.389	0.379
# Observations	9331	5471	76152	104333	8774	7115	22643	36602
# Physicians	1661	974	11384	16684	1602	1346	3841	6154

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Includes cross year * specialty dummies

Newfoundland and PEI as well as specialists in public health, occupational medicine, medical biochemistry, medical scientist are excluded

Table 4: Mixed Conditional Logit

	TO						
FROM ONTARIO	NS	NB	QC	MAN	SASK	ALB	BC
Individual characteristics							
Dummy variable: 1 if female	-0.942 ***	-1.356 ***	-1.344 ***	-1.559 ***	-1.257 ***	-1.014 ***	-1.116 ***
	(0.126)	(0.176)	(0.119)	(0.298)	(0.158)	(0.100)	(0.108)
Age (in years)	-0.031	-0.053	0.022	-0.030	-0.015	-0.030	0.022
	(0.044)	(0.066)	(0.033)	(0.095)	(0.050)	(0.032)	(0.031)
Age squared divided by 100	-0.068	-0.054	-0.158 ***	-0.058	-0.086	-0.073 **	-0.135 ***
	(0.048)	(0.077)	(0.035)	(0.108)	(0.055)	(0.036)	(0.034)
Dummy variable: 1 if foreign diploma	0.138	-0.202	0.388 ***	-0.847 ***	0.439 ***	-0.243 **	-0.308 ***
	(0.105)	(0.148)	(0.106)	(0.287)	(0.122)	(0.095)	(0.097)
Constant	-5.063 ***	-4.814 ***	-6.441 ***	-7.389 ***	-7.132 ***	-4.266 ***	-6.020 ***
	(0.940)	(1.449)	(0.731)	(1.999)	(1.097)	(0.708)	(0.700)
Choice attributes							
Predicted lnpay	0.031						
	(0.038)						
Predicted μ	0.964 ***						
	(0.129)						
Unserved heterogeneity							
λ	2.805 ***	2.550 ***	4.316 ***	-3.001 ***	3.645 ***	2.707 ***	3.608 ***
	(0.134)	(0.168)	(0.085)	(0.077)	(0.168)	(0.099)	(0.085)

$L = -24151.14$

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Each destination branch includes year dummies (8) and specialty dummies (up to 23)

Table 5: Mixed Conditional Logit

	TO						
FROM QUEBEC	NS	NB	ONT	MAN	SASK	ALB	BC
Individual characteristics							
Dummy variable: 1 if speaks english	0.937 ***	0.458 ***	0.512 ***	-0.701 ***	0.401 **	0.487 ***	0.814 ***
	(0.149)	(0.157)	(0.073)	(0.261)	(0.163)	(0.102)	(0.085)
Dummy variable: 1 if female	-0.017	-0.562 ***	-0.260 ***	-2.267 ***	-0.564 ***	-0.363 ***	-0.284 ***
	(0.139)	(0.183)	(0.071)	(0.245)	(0.169)	(0.107)	(0.086)
Age (in years)	-0.046	-0.018	0.002	0.527 ***	-0.077	-0.006	0.091 ***
	(0.059)	(0.096)	(0.022)	(0.099)	(0.051)	(0.034)	(0.025)
Age squared divided by 100	0.010	-0.045	-0.034	-0.688 ***	0.079	-0.027	-0.119 ***
	(0.063)	(0.111)	(0.023)	(0.109)	(0.053)	(0.037)	(0.026)
Dummy variable: 1 if foreign diploma	-0.755 ***	0.311	-0.333 ***	-1.273 ***	-1.548 ***	-0.416 ***	-1.084 ***
	(0.227)	(0.261)	(0.105)	(0.375)	(0.339)	(0.137)	(0.140)
Constant	-7.887 ***	-6.956 ***	-5.751 ***	-21.534 ***	-7.985 ***	-7.630 ***	-9.028 ***
	(1.434)	(1.973)	(0.500)	(2.191)	(1.291)	(0.815)	(0.589)
Choice attributes							
Predicted lnpay	-0.089 **						
	(0.042)						
Predicted μ	0.264 **						
	(0.126)						
Unbserved heterogeneity							
λ	2.579 ***	2.040 ***	2.376 ***	-4.543 ***	2.787 ***	2.792 ***	2.459 ***
	(0.170)	(0.131)	(0.035)	(0.178)	(0.167)	(0.100)	(0.056)

$L = -20722.48$

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Each destination branch includes year dummies (8) and specialty dummies (up to 23)

Table 6: Mixed Conditional Logit

	TO						
FROM BRITISH COLUMBIA	NS	NB	QC	ONT	MAN	SASK	ALB
Individual characteristics							
Dummy variable: 1 if female	-0.006	-1.714 **	-1.092 ***	-1.076 ***	-0.129	-1.650 ***	-0.811 ***
	(0.274)	(0.766)	(0.184)	(0.143)	(0.709)	(0.454)	(0.149)
Age (in years)	0.074	0.125	0.085	-0.049	-0.167	-0.364 ***	-0.015
	(0.108)	(0.217)	(0.055)	(0.044)	(0.265)	(0.098)	(0.065)
Age squared divided by 100	-0.187	-0.232	-0.248 ***	-0.076	0.022	0.272 ***	-0.112
	(0.122)	(0.236)	(0.059)	(0.048)	(0.325)	(0.104)	(0.078)
Dummy variable: 1 if foreign diploma	0.009	0.197	0.904 ***	0.531 ***	1.410 **	0.869 ***	0.172
	(0.305)	(0.277)	(0.165)	(0.126)	(0.671)	(0.235)	(0.135)
Constant	-7.620 ***	-8.647 *	-8.390 ***	-3.563 ***	-10.060 *	1.906	-2.738 **
	(2.502)	(4.529)	(1.251)	(0.983)	(5.155)	(2.073)	(1.315)
Choice attributes							
Predicted lnpay	-0.119 *						
	(0.061)						
Predicted μ	1.063 ***						
	(0.174)						
Unobserved heterogeneity							
λ	2.352 ***	2.486 ***	4.732 ***	3.622 ***	-5.619 ***	2.580 ***	1.580 ***
	(0.365)	(0.352)	(0.162)	(0.123)	(0.649)	(0.281)	(0.114)

$L = -10853.95$

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Each destination branch includes year dummies (8) and specialty dummies (up to 23)