J Popul Econ
DOI 10.1007/s00148-008-0188-5

ORIGINAL PAPER

The substitutability of labor between immigrants and natives in the Canadian labor market: circa 1995

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Received: 21 August 2006 / Accepted: 27 December 2007

Abstract This paper examines the substitutability or complementarity between Canadian-born and immigrant workers. These are examined by estimating a set of wage equations using a generalized Leontief production function. The paper finds that, in general, there is no displacement of Canadian-born workers by immigrants. Recent immigrants affect the native-born positively, while older immigrants are neither substitute nor complement for natives. However, the effects differ across industries. Overall, the evidence that immigrants harm the opportunities of native-born workers is scant.

Keywords Immigration · Substitutability · Complementarity · Displacement

JEL Classification C39 · J61

1 Introduction

The possible effects of immigration on labor market outcomes of native-born workers are a core research agenda in recent years (see, for example, Borjas 2003, 2006; Card 2001). This concern has a long history, and investigation of this question for different immigrant-receiving countries finds mixed effects of immigration on natives' employment and wages. Possible negative effects are typically based on theoretical prediction. Most of the theoretical models, which are very sensitive to underlying assumptions, do not take into account factors such as the demand side effects (demand for goods and services by immigrants) or supply side effects (such as the capital or entrepreneurship of immigrants). In the absence of empirical testing,

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predictions of theoretical models remain at best well-reasoned speculation and are not suited to guide policy (Dustmann, Fabbai, and Preston 2005).

Canada has many immigrants and sons and daughters of immigrants. Immigration accounts for the bulk of Canadian population growth and its demographic composition. It has also created much socioeconomic diversity within Canadian society. However, recent years have seen increased debate over and fear of the immigration policy that newcomers take jobs away from the native Canadians. The debate surrounding Canadian immigration policy has become multifaceted with the controversy concerning the decline in income of recent immigrants. Using Canadian census data, Baker and Benjamin (1994) first showed that while earlier immigrants' income has caught up to the level of their Canadian-born counterparts, that of recent immigrants continues to lag behind.

Labor market performance of immigrants varies across countries depending on the types of immigrants and local labor market conditions. It is also natural to think that the sentiments of those native-born, regarding migrants, varies across countries. Traditionally, native-born Canadians view immigrants more favorably than many other immigrant-receiving countries.[1] However, this perception has been changing in recent years. Some Canadians believe that either immigrants steal jobs from Canadian-born workers or that they are less skilled and, owing to difficulties in finding jobs, put pressure on the public purse. Immigrants are therefore responsible for the decline in wage or job displacement of Canadian-born workers. Conversely, others hold the view that immigrants relieve the bottlenecks caused by skill shortages in Canada. Further, immigrants contribute to aggregate expenditure directly through their spending and indirectly through industrial and government expenditure on their behalf. Thus, immigration may expand job opportunities in general, resulting in an increased demand for labor and eventually leading to higher wages and employment of native-born workers.

An increase in labor supply through immigration should lower wages of competing workers and increase wages of complementary workers in a given labor market. This competition for jobs would tend to reduce the earnings potential of natives. If variation in the number of immigrants relative to the native-born workers across selected labor markets demonstrates that a higher ratio of foreign-born to native-born workers is associated with a lower wage rate of the latter one, then immigrants and native born are substitutable labor inputs in production. In this case, foreign-born workers would adversely affect the earnings and job opportunities of native-born workers. On the other hand, immigration flows could lead to increased wages for native born if immigrants and native born workers are complements in production. If, for example, natives pay less for the services that (immigrant) laborers provide, natives who hire the labor can specialize in producing the goods and services that better suit their skills. In this case, immigrants and native-born workers are employed in two distinct labor markets, and they are complementary inputs in production.

Immigrants are assumed to have a weak bargaining position in wage negotiations (perhaps stemming from their poor language abilities or the costs they have already

[1] See Bauer et al. (2000) for a survey of the perceptions of native-born regarding immigration in 12 Organisation for Economic Co-operation and Development countries.

paid to emigrate), which makes them impatient to start working and induces them to accept relatively low wages.[2] Thus, firms will pay a lower average wage and will therefore increase their demand for labor because the cost of hiring a worker has become cheaper. Immigrants will be better off as they will now enjoy better employment prospects and higher wages. Native workers can be better off as unemployment might fall through increased job opportunities. Besides, relatively high availability of jobs can ensure that natives now have a stronger bargaining position in wage negotiations and can therefore earn higher wages. Hence, immigration possibly makes everyone better off.

In a general equilibrium framework, immigrants can create jobs through the purchase of goods and services independently of their participation in the labor market. This has an immediate benefit on indigenous workers. Ortega (2000) and Epstein and Hillman (2003) have presented circumstances under which immigration can be pareto-improving. Chapman and Cobb-Clark (1999) develop a comparative static theoretical model to illustrate the effect of immigration on the job prospects of Australian natives. The authors, using feasible Australian values for immigrant spending and the labor force participation rate, conclude that immigration increases the overall employment prospects of unemployed natives. The vast empirical literature for the USA finds that employment effects of immigration are negligible, while there may be some negative wage effects for recent immigrants. However, recent research by Borjas (1999, 2003) led to a more negative picture of US immigration. For the UK, Dustmann et al. (2005) found no strong evidence of immigration on aggregate employment. In the case of Germany, Winkelmann and Zimmermann (1993) and De New and Zimmermann (1994) found detrimental effects, while Pischke and Velling's (1997) findings indicate no such effect of migration on employment. Zorlu and Hartog (2005) found very small effects on native wages and no dominant robust patterns of substitution and complementarity for The Netherlands, UK, and Norway. For Australia, Addison and Worwick (2002) found no significant effect of recent immigrants on Australian-born workers. However, Parasnis et al. (2006) obtain a significant positive effect on labor market outcomes for native workers. Roy (1987) found displacement effects of immigration on Canadian-born workers, while Akbari and DeVoretz (1992) find no displacement effect. Roy (1997), however, found that foreign-born workers are neither substitutes nor complement with Canadian-born workers. Islam (2007), using time series data, detected a long-run positive relationship between the immigration rate and real wages in Canada.

Consideration of labor market substitutabilities or complementarities between Canadian-born workers and immigrants can help to evaluate the validity of displacement fears because of immigration. We explore the labor market substitutability or complementarity between Canadian-born workers and immigrants. This kind of analysis may be used to answer important policy questions, including whether or not the job opportunities available to native-born workers have worsened

[2] Firms also anticipate that they will be able to pay lower wages to immigrants because of their high search costs of looking for jobs.

because of the large pool of (presumably) substitutable immigrant workers. Similarly, it is likely that immigrants are concentrated in particular occupations that are distinct from those of native-born workers. Changes in the occupational distribution of immigrants in different industries are the direct route through which the government can affect the earning patterns of natives. Thus, in evaluating the impact of immigrants on the labor market prospects of native-born, an examination of immigrants by their concentration in different industries is imperative.

A few studies focus on the effect of immigration within occupations. Using data from the 1990 US census, Card (2001) estimated the relationship between immigrant inflows and wages for occupational groups. He found, in most cases, significant negative effects. Friedberg (2001), using Israeli microdata, also studied the impact of Russian immigration by occupation on Israeli wages and employment. She did not find evidence of an adverse effect on natives. In a recent study, Orrenius and Zavodny (2006) estimated the effect of immigration inflows on wages within occupational groups in the USA. They find a significant negative impact on unskilled natives but do not find a statistically significant effect on natives in skilled occupations. This paper takes a slightly different view by distinguishing immigrants and native-born workers by their occupation in goods- and service-producing industries. We estimate the effect of immigration inflows on Canadian-born workers' job prospects by occupation in different industries. We find that, in general, there is no displacement of Canadian-born workers by immigrants. Recent immigrants affect the native-born workers positively, while older immigrants are neither substitute nor complement for natives. However, the effects differ across industries, with immigrants displacing the Canadian-born workers in some industries. Overall, the evidence that immigrants harm the opportunities of native-born workers is scant.

The rest of the paper is organized as follows. Section 2 outlines the empirical strategy to determine the substitutability or complementarity between Canadian-born workers and immigrants. This section also briefly describes the data, presents some descriptive statistics, and identifies the econometric strategy. The estimation results and their discussion are presented in Section 3. Concluding remarks are given in Section 4.

2 The empirical strategy

Our approach to study the impact of immigration on the employment of Canadian-born focuses on the labor demand side, treating immigrants as exogenous shift of labor supply. We assume that the effects of immigration in a host country with labor market frictions depend on the production structure of that economy.[3] Because recent immigrant incomes have been falling compared to their older counterparts—

[3] We consider the production function rather than the cost function to discern the underlying technology because, in this case, it is more reasonable to assume that the quantities rather than prices are fixed. In this paper, we are dealing with input categories that do not change very rapidly. Moreover, the number of immigrants allowed into Canada is restricted by an annual quota that is fixed in the previous year and is almost fully subscribed.

an event that has triggered the current policy debate regarding immigration in Canada—we divide immigrants into those two categories. Recent immigrants are those who arrived in Canada after 1978. We therefore consider three types of workers as inputs in the short-run aggregate production function: Canadian-born (N), recent immigrants (R), and older immigrants (O). We assume that these inputs are weakly separable from the fourth input, capital.[4]

Assume that the production function $h(N,R,O)$ possesses the standard neoclassical properties. Following Borjas (1983, 1987), we consider the generalized Leontief production function[5]:

$$h(L_N, L_R, L_O) = \sum_j \sum_i \gamma_{ij} \left(L_i L_j\right)^{1/2}, \quad (i,j = N, R, O) \tag{1}$$

where technology parameters are restricted so that $\gamma_{ij}=\gamma_{ji}$ (Young's theorem). The functional form given in Eq. 2 can be viewed as a second-order Taylor series approximation to a concave neoclassical production function with constant returns to scale.

Assume that firms in the labor market operate in a perfectly competitive industry. If firms face constant input price, the following system of labor demand equations (equating wage rates and marginal products) results:

$$W_i = \gamma_{ii} + \sum_{i \neq j} \gamma_{ij} \left(P_j / P_i\right)^{1/2} \tag{2}$$

where $P_i = \frac{L_i}{N+R+O}$, W_i is the wage, and L_i is the amount of labor input from the ith category of labor.

The system of equations in Eq. 2 gives the determination of wage levels in a particular labor market. The system tells us that the relative quantities of other factors of production affect group i's wage through the technology parameter γ_{ij}.

[4] Weak separability here means that the marginal rate of substitution between any two of the three inputs will be independent of the quantity of capital used in production. This is a necessary and sufficient condition for the production function to be of the form $Q = h[f(N,R,O);K]$. Grossman (1982), Borjas (1983), and Akbari and DeVoretz (1992) have concluded that capital and labor is separable for the kind of production relation we are dealing with. Borjas (1983) found that the assumption of strong separability between capital and labor is not rejected by the data. This finding is important because the difficulties in constructing a series of capital data even at the aggregate level are well known (Roy 1997).

[5] One can consider an alternative production function—the translog approximation to a production surface. There is an inconclusive debate as to which form of the production function would be more appropriate. While Akbari and DeVoretz (1992), Grossman (1982), and Grant and Hamermesh (1981) used the translog function, several other authors, e.g., Borjas (1983), Roy (1997), and Kahanec (2006), used the generalized Leontief function in the context of immigrants and native-born workers or in a similar context. The Leontief production function is empirically more tractable, as we have wage as the dependent variable and we obtain linear-in-parameter wage equations. For the translog model, we estimate the factor share equation, which requires the use of industry-specific output, wage, and proportion of the immigrant and Canadian-born employed by industry. Thus, the choice of the production technology also depends on the data at hand. The data used in this paper (census data) are suitable for the application of the Leontief production function. In practice, the choice between the two is arbitrary even with availability of appropriate data. As Borjas (1987) wrote "There is no *priori* reason to prefer one function over the other, since both are second-order approximations to any arbitrary production function." See Borjas (1986, 1987) for more details on choice between translog and the generalized Leontief functional forms.

When group i is a substitute (complement) with group j, an increase in the supply of group j decreases (increases) group i's wage.

The estimation of the demand system in Eq. 2 implicitly assumes that all group i workers are homogeneous within and across labor markets. It is natural to think that individuals within each of these groups differ in terms of their level of skills. Hence, wage differentials across labor markets may simply reflect an unequal distribution of skill levels, seriously biasing the estimates of the production function. It is also natural to think that post-1978 immigrants are more heterogeneous (especially those arrived since the late 1980s) because of changing the country of origin and skill components. However, it is likely that these immigrants differ by age, education, occupation, race, area of source country, etc. from those who migrated early. Because most of these immigrants are admitted into Canada based on a points system, the differences among different cohorts of immigrants are likely to be observable. Therefore, it is plausible to assume that these immigrants are homogenous conditional on a vector of observable attributes. In our regression analysis, we address this aspect of heterogeneity using a vector of covariates that are potential determinants of the immigrant's entry and labor market participation in Canada. We also consider an analogue of the technique adopted by Borjas (1983, 1987) to address the issue of heterogeneity that are due to labor market outcomes. The idea is to view the wage of the individual of type i as being determined by both the market wage, W_i, for type i, and by an individual-specific fixed effect. This fixed effect, f_{ik}, measures the individual's deviation in productive skills from the average type i individual in the local labor market, k, so that the wage of the individual of type i in labor market k is given by $W_{ik} = W_i + f_{ik}$. That is, the demand system in Eq. 2 determines the basic wage level, and the additive fixed effect captures the individual differences in effective labor supply. The definition of f_{ik} implies that the individual components have a zero mean so that the demand system in Eq. 2 determines the average wage level of the type i individual in the local labor market.

We use Mincer's earning function adopted by Chiswick (1978) to identify the individual fixed effects. Following Chiswick, assume that a vector of socio-economic variables can approximate the individual fixed effects, f_{ik}. The empirical specification is then given by:

$$W_i = \gamma_{ii} + \alpha_i X_i + \sum_{i \neq j} \gamma_{ij} \left(P_j / P_i\right)^{1/2} + \varepsilon_i \tag{3}$$

where $\boldsymbol{X}_i$ is the vector of skill characteristic of the individual (a proxy of the socio economic characteristics). The vector $\boldsymbol{X}_i$ of Eq. 3 includes: age, marital status, sex, education, language ability, years since migration (YSM), experience, a dummy for whether living in census metropolitan area, and industry fixed effects to control for wage differentials arising from differences in job environment. The industry fixed effects capture the different capital–labor ratios across industries and partially control for omitted capital variables. $\boldsymbol{\varepsilon}_i$ is the disturbance term with mean vector zero and constant covariance matrix, $\boldsymbol{\Omega}$. The rational for the stochastic specification follows the argument that firms make random errors in choosing their profit-maximizing input bundles. Alternatively, one might argue that errors are in the eyes of the beholding econometrician and are not related to the firms' optimization problem.

2.1 Parameters of interest

The parameters of main interest are those with symmetry constraints, $\gamma_{NR}^{N} = \gamma_{NR}^{R}$, $\gamma_{RO}^{R} = \gamma_{RO}^{O}$, and $\gamma_{NO}^{O} = \gamma_{NO}^{N}$, where the superscript *i* corresponds to the relevant wage equation. For instance, γ_{NR}^{N} greater than zero means that an increase in the share of recent immigrants, *R*, relative to native-born Canadians, *N*, increases the earnings of the Canadian born. Thus, recent immigrants and Canadians are complementary inputs in the labor market. On the other hand, a negative coefficient implies that they are substitutes so that recent immigrants have an adverse impact on the earnings and employment opportunities of native Canadians.

The motivation for estimating Eq. 3 is to identify the degree of substitutability and complementarity between native-born, recent immigrant, and older immigrant workers. Because we are assuming that quantities, not factor prices, are exogenous, the appropriate measure of factor substitutability is the Hicks (gross) partial elasticity of complementarity. In the context of the generalized Leontief production function, this is defined as (Borjas 1983):

$$\eta_{ij} = \frac{\gamma_{ij}\overline{w}}{2w_i w_j \left(p_i p_j\right)^{1/2}} \quad i \neq j \tag{4a}$$

$$\eta_{ii} = \frac{(\gamma_{ii} - w_i)\overline{w}}{2p_i w_i^2}, \quad i = j \tag{4b}$$

where $\overline{w} = p_R w_R + p_O w_O + p_N w_N$.

2.2 Data and descriptive statistics

The data is drawn from a 20% sample of the public use microdata file from the Statistics Canada 1996 census. The analysis is restricted to all working age individuals (24–64 years) who were not in the military, self-employed, students, or working without pay. The age group 24–64 is considered because immigrants who migrate at an earlier age (age below 24 in the sample) are more likely to be different than native-born citizens along a number of observable dimensions (they are more dependent on their parents, and they are more likely to be without any job, for example). A disproportionate share of individuals among recent immigrants of age below 24 is students. Although we exclude students from our sample, it is important that the proportion of the two groups in the sample is similar to that observed in the population. The two groups of workers should also be comparable in terms of observable attributes. Therefore, we think the age group 24–64 is appropriate when considering the labor market outcomes.[6] The census contains information on demographics, place of residence, education, and labor force activity during the reference month. It also collects data on annual earnings received by individuals in the previous year, the number of weeks the individual worked during the previous year, and whether or not they worked mainly full time during those weeks. There are

[6] However, the results are qualitatively similar if we include individuals of age 15–64.

6,651 observations for recent immigrants, 7,663 for the older immigrants, and 49,707 for the Canadian-born population.

Table 1 gives the summary statistics for the data set. Note that recent immigrants have substantially lower average earnings than older immigrants and native born. Wages of older immigrants exceed wages of native-born workers by 5%. Recent immigrants earn 67% of their old counterpart and 71% of native-born workers. This earnings difference could be attributed to low employment rates of recent immigrant workers (40.04 weeks worked compared with 44.25 of older immigrant and 43.75 of native-born workers). The recent immigrant typically also works less in a week, 32.3 h compared with 34.4 h for older immigrants and 34 h for native-born workers. In addition, recent immigrants have lower skills suitable to the Canadian labor market. They also have a language barrier, with 90.6% of recent immigrants being able to speak in English as opposed to 96.6% of the older immigrants. The proportion of Canadian-born workers who are able to speak in English is less than the immigrants because of inclusion of workers from Quebec (a predominantly French-speaking province).

The higher yearly wage earnings of old foreign-born workers can be mainly attributed to differences in skill and other socio-economic characteristics. For example, old foreign-born workers have higher average experience of 28.1 years as compared to 21.3 years for native-born and 19 years for the recent immigrant labor force. The recent immigrants have a slightly higher education level of 14 years as compared to 13.6 and 13.7 years for education of old and native-born workers, respectively, but the differences are not statistically significant. Recent immigrants are more likely to stay in a census metropolitan area (CMA; 91.5% of the recent foreign-born population reside in CMAs compared with 82.5 and 62.4 for old foreign born and native born, respectively).

If we consider the proportion of each of the groups employed in broadly defined industries and occupations, the differences in employment by industry among the samples are notable. For example, native-born Canadians have much greater percentage of workers in the public sector than either recent or older immigrants.

Table 1 Descriptive statistics of selected variables

Variable	Recent Immigrant		Older Immigrant		Canadian-born	
	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Hours worked	32.34	19.81	34.38	18.82	34.02	18.97
Weeks worked	40.04	16.64	44.25	13.75	43.75	14.12
Wage (Canadian $)	19,629.8	19,666.3	29,440.2	25,850	27,557.5	23,991.7
Years of Education	14	4.01	13.59	4.09	13.67	3.42
Experience (Year)	19.03	10.19	28.12	11.39	21.34	11.25
Age (year)	38.03	8.99	46.74	9.9	40.11	9.98
Living in CMA (%)	92	–	82.41	–	61.81	–
Sex (%)	45.8	–	45.3	–	46.8	–
Language—English (%)	90.62	–	96.72	–	84.5	–
Language—French (%)	9.38	–	3.28	–	15.5	–
Employed in Goods industry (%)	44.2	–	39.9	–	38.6	–
Employed in service industry (%)	55.8	–	60.0	–	61.4	–

Computed from public use microdata file, Statistics Canada, using 20% random sample

Furthermore, recently arrived immigrants are more concentrated in low-paying jobs. For example, 54.4% of recent immigrants are in clerical, sales service, intermediate or semiskilled or manual, and other manual occupations compared to 41.5% and 43.6% of the old immigrants and the native-born workers, respectively (Table 6 in Appendix). Although these statistics are only suggestive, they do provide an institutional background for the empirical results presented below.

2.3 The econometric strategy

While it seems reasonable to use ordinary least squares (OLS) because the wage earnings functions (Eq. 3) are linear in parameters, these wage equations, however, are subject to cross-equation constraints. Even if these constraints hold in the population, for any given sample, equation-by-equation OLS estimates will not embody such restrictions. For example, γ_{NR}^{N} in the nth equation estimated by OLS will not necessarily equal γ_{NR}^{R} estimated in the rth equation. While OLS estimates of the coefficient of the variable $(P_O/P_R)^{1/2}$ are positive in the wage equation for recent immigrants, the corresponding coefficient $(P_R/P_O)^{1/2}$ is negative in the wage earnings equation for the older immigrants (Table 4 in Appendix). The Wald, likelihood ratio, and Lagrange multiplier tests also reject each of the cross-equation restrictions.

Secondly, one might argue that the relative supplies of labor inputs (P_i/P_j) are endogenous. Labor supply may respond to wages, so immigrants tend to endogenously cluster in a limited number of geographical areas. It is equally plausible to argue that immigrants are attracted to cities where large numbers of immigrants already live. Similarly, natives may respond to the immigrant supply shock in a local labor market by moving their labor and/or capital to other cities. This is addressed using CMA fixed effects (whether an individual lives in a CMA) in our estimation. Many studies address this endogeneity issue (Borjas 1987; Card 1990; Altonji and Card 1991; Kahanec 2006) using instrumental variables (IVs) where instruments are typically the vector of socio-economic characteristics of the geographical areas. However, the short-run perspectives that frame this type of research can be very misleading (Borjas 2000, 2006). According to Borjas, "...in the end, immigration affected *every* city, not just the ones that actually received immigrants." Because local labor market conditions may not provide all valuable information, Borjas et al. (1997) and Borjas (2000, 2003, 2006) proposed changing the unit of the analysis to the national level.[7]

We therefore estimate the wage equation system using seemingly unrelated estimator (SUE) incorporating the cross-equation constraints. Even if cross-equation constraints are ignored, one would still expect the SUE system estimator to yield different parameter estimates than OLS. SUE estimates are more efficient than OLS (see Berndt 1991). In effect, the SUE estimator uses equation-by-equation OLS, and repeated iteration on covariance matrix $\boldsymbol{\Omega}$ leads to parameter estimates that are numerically equivalent to those of the maximum likelihood estimator.

[7] Like Borjas (2003, 2006), we also think that endogeneity is not really an issue in our case. There is also question of appropriateness of the IVs in such case in such as raised by Borjas. This has also been highlighted by Pischke and Velling (1997) and Dustmann et al. (2005). Immigration into Canada in different time periods is not homogeneous, raising the possibility of weak instruments. Studies that use IVs also did not find the results qualitatively different from their reduced form results.

3 Estimation results

3.1 Estimates of elasticity

Equation 3 is estimated using full information maximum likelihood method (FIML) that takes into account the symmetry restrictions and cross equation correlations. A full set of estimation results is presented in Table 5 in Appendix. Table 2 presents the estimated technology parameters and the corresponding elasticity estimates, η_{ij} and η_{ii}. Factors are substitutes if η_{ij} is negative and complements if positive. The results support the hypothesis that Canadian-born workers and recent immigrant are complements in production. The estimated γ_{ij}, upon which η_{ij} is based, is highly statistically significant (t ratio=5.32). The corresponding Hicksian elasticity is 0.16, which implies that a 10-percentage point increase in the supply of recent immigrants will increase the wage earnings of Canadians by 1.6%. This indicates that an increase in the share of recent immigrants relative to the native-born Canadians would increase the earnings of the Canadian born. Therefore, recent immigrants and Canadians are complementary inputs in the labor market.

The above finding may lend support to the view that the skill characteristics of immigrants are different from those of the domestic workforce and/or recent immigrants take jobs that native-born workers are unwilling to accept. The result does not contradict the relative declining performance of recent immigrants in the Canadian labor market. Recent immigrants do appear to have high levels of education and foreign credentials, but their human capital is not highly rewarded in the Canadian labor market. They tend to work in low-paying jobs despite their high levels of human capital. This may be the result of dismissed foreign credentials, language barriers, or the inability to quickly adapt to a different working environment in Canada. It is also possible that the high human capital levels of recent immigrants might be a good substitute for physical capital, which would be the source of the complementarity to the Canadian born workers.

Table 2 shows that older immigrants and Canadian-born workers are neither substitutes nor complements. The estimate of γ_{NO}, the parameter measuring the substitution possibilities between recent foreign-born workers and Canadian-born workers, is positive but statistically insignificant. This might be due to the high Canadian job market experience of old immigrants, which may cause them to be substitutes in some sectors, while, having assimilated into the Canadian job market,

Table 2 Coefficient estimates and Hicksian elasticity of complementarity

Technology parameter	Coefficient estimate	t statistic for coefficient	Elasticity of complementarity
γ_{nr}	1,788.46	5.32	0.160
γ_{no}	461.23	0.74	0.025
γ_{ro}	−1,746.99	−2.13	−0.348
γ_{nn}	−33,775.01	−14.88	−1.388
γ_{rr}	−19,841.10	−9.60	−12.897
γ_{oo}	−31,071.83	−8.38	−7.333

The coefficient estimates are those obtained using FIML method of a system of equations represented by Eq. 3. The elasticities are computed using the formula provided in Eqs. 4a and 4b

may in turn result in them acquiring skills complementary to those of Canadian-born workers in some other sectors. The sign of the coefficient indicates that older immigrants are not, at least, substitutes, and may have complementary effects, although the corresponding coefficient estimates are not statistically significant. Further disaggregating data by industry or occupation may clarify the picture. For example, Roy (1987) was not able to distinguish whether foreign-born and native-born workers were substitutes or complements in the aggregate because of the corresponding statistically insignificant coefficient. However, when Roy disaggregated his study by area of origin, he found significant substitution between third-world immigrants and the native-born labor force.

The hypothesis that there is no displacement of native-born workers by immigration cannot be rejected for both the earlier and recent immigrant flows. However, it is important to note that recent immigrants have a positive and statistically significant influence on the wage earnings of Canadian-born workers, while the older immigrants have an insignificant positive effect on the earnings of this group. Hence, pre- and post-1978 immigrants have a differential complementary effect with respect to the Canadian-born workers.

The regression results also indicate that recent immigrants substitute for older immigrant workers as suggested by the negative and statistically significant coefficients. The estimated elasticity of −0.348 suggests that recent immigrants compete with older immigrants for the same jobs in the Canadian labor market. This result contrasts with the findings of Akbari and DeVortez (1992), who find that recent immigrants and older immigrants are neither substitutes nor complements in production. They also do not find that earlier and recent immigrants have any differential substitution effects with respect to the native-born labor force.[8] Note that recent immigrants are complements and older immigrants are neither substitutes nor complements to the Canadian-born workers, while recent and older immigrants are substitutes. Therefore, it might seem that these results are contradictory, yet neither of these categories represents perfect substitutes or perfect complements. Hence, our results are still meaningful.[9]

All the own quantity factor price elasticities are negative as predicted by theory but are larger in absolute terms, ranging from −1.39 for the Canadian-born workers to −7.33 for the old immigrant workers, as compared to cross-elasticities. They

[8] Akbari and DeVoretz (1992) used the 1981 census data and assume pre- and post-1971 immigrants as older and recent immigrants, respectively, at the time of the 1981 census. They obtained negative and larger estimates of elasticity (but statistically insignificant) between immigrants and native-born workers, while we find positive but smaller elasticity in terms of absolute value. Note that Akbari and DeVoretz (1992) used industry-level value addition to get the share equation derived from the translog production function. The use of industry-level data and matching it over the census data requires some unique identifier. Moreover, the industry-level data are aggregated and confidential. Therefore, one must be cautious while using industry-level output, employment, etc. to match with the census identifier.

[9] Borjas (1987) estimated the elasticity of complementarity using the same production technology (using the 1976 survey of Income and Education in the USA) and found that the cross-elasticity of earnings of white native-born men with respect to quantity of Asian immigrant men is −0.002. None of his elasticity estimates takes on a value exceeding |0.03|. Thus, if the immigrant group compete on native-born workers in the labor market, the numerical impact of this competition is trivial. Borjas also found, similar to ours, that immigrants' main competitors in the labor market are other immigrants. Grossman (1982), using translog production functions and a different data set (1970 US census), obtained results similar to those obtained by Borjas.

suggest that the relative increases in the supply of one type of labor can be absorbed only by a large decline in its relative wage (if wages are free to adjust).

3.2 Substitutability/complementarity by industry

We now check for substitutability or complementarity by industry. This analysis could reveal the substitutability/complementarity that might be concealed in the aggregate analysis presented above. The two broad industrial groups are based on the Industry Canada classification—"goods-producing" and "service-producing" industries. If a group of foreign-born and Canadian-born workers are found to be substitutes within the same industry, it would imply that foreign-born workers employed in that industry depress the wages of Canadian-born labor. This type of consideration by industry is important because foreign-born laborers tend to be employed in different industries than Canadian natives (In our sample, 62% of native-born Canadians are working in the service sector as compared to 55% of foreign-born workers). There is also a widespread public perception that immigrants' employment is typically concentrated in a few industries, mostly exposing a declining share of total employment. Although there is no overall displacement, some groups of native workers can be strongly affected if immigrant workers are segregated in particular jobs. This is also confirmed by the simple descriptive statistics presented in Section 2.2. One such consideration is Borjas (1999) who investigated the effects of industrial and occupational concentration of immigrants on skill composition and industrial structure in the immigrant-receiving region.

The two industry groups combined with the three types of workers (native-born, recent, and older immigrants) result in six wage earnings equations that have been estimated. Table 3 reports the full set of estimates of the parameters of interest and the corresponding elasticity estimates. Nine out of 15 coefficients, upon which elasticity estimates are based, are statistically significant. The results imply that recent immigrants employed in goods- and service-producing industries are substitutes for Canadian-born workers employed in these industries, but they are complements across industries. For example, the recent foreign-born workers employed in the service-producing sectors are complements to the Canadian-born workers employed in the goods-producing sectors and vice versa. However, older foreign-born workers who are employed in the goods sector are complements to the Canadian-born in that sector, while they are substitutes for the Canadian-born workers employed in the service sector. Table 3 also reveals that the old foreign-born workers employed in the goods sector are substitutes for the Canadian-born workers employed in the service sector, while those of old foreign-born workers employed in the service sector are neither substitutes nor complements to native-born workers in the goods sector. The Canadians employed in the production of goods are complements to their counterpart employed in the service industry.

As can be seen from Table 3, recent and old immigrants compete in the goods and service sectors, while those employed in the goods-producing sector are substitutes to their counterparts in that sector. However, they are neither substitutes nor complements across sectors. Our results are not directly comparable with that of Akbari and DeVoretz (1992) as they select those industries with a high concentration of foreign-born workers. They find that both recent and older immigrants are significant substitutes for the native-born labor force in those industries. However, their findings are in sharp contrast to their

Table 3 Coefficient estimates and Hicksian elasticity of complementarity disaggregated by broad industrial classification

	Native–RI	Native–OI	RI–OI	Native–native	RR–RI	OI–OI
Goods–goods	−1.261	0.427	−0.535	−1.807	−9.173	−4.695
	[−14772.5]	[8121.3]	[−3388.4]	[−54291.2]	[−21933.7]	[−12041.3]
	(−4.65)	(2.40)	(−2.38)	(5.98)	(−7.11)	(−2.13)
Goods–service	1.321	0.283	0.346	0.431	1.812	−0.279
	[17078.2]	[5187.5]	[1988.9]	[19200.5]	[7353.6]	[−2321.6]
	(6.76)	(1.49)	(1.17)	(2.28)	(4.90)	(−0.90)
Service–goods	1.159	−0.557	0.187	–	–	–
	[16212.1]	[−10341.5]	[1041.7]	–	–	–
	(5.07)	(−2.91)	(0.86)	–	–	–
Service–service	−1.335	−0.174	−0.74	−1.718	−13.823	−4.677
	[−14709.6]	[−3068.8]	[−3832.9]	[−47486.6]	[−30304.3]	[−36371.5]
	(−5.62)	(−0.83)	(−1.99)	(−4.94)	(−7.56)	(−4.84)

The first row represents the elasticity estimates, while the corresponding coefficient estimates are reported in brackets in the second row. The *t* statistics for the estimated coefficient are shown in parentheses. The elasticity estimate corresponding to the cell "native–RI/goods–service" is the estimate of elasticity between native-born workers employed in the goods-producing industry and recent immigrants employed in the service-producing industry (which is 1.321). The coefficient estimates are those obtained using the FIML method for three types of workers and two industry groups using Eq. 3. The elasticities are computed using the formula provided in Eqs. 4a and 4b.
RI recent immigrant, *OI* old immigrants

economy-wide results. Grossman (1982) did not find any significant displacement effects by industry between US-born workers and US immigrants. Our findings neither contradict nor support their results, as we disaggregated the industry into two broad groups, goods- and service-producing industries.

Let us now focus on the magnitude of the cross-elasticities. The cross-elasticity between the Canadian-born workers in the service industries and old immigrants in the same sector is −0.174. This implies that a 10% increase in old immigrants would depress the Canadian-born wage by 1.74%. The elasticity of complementarity between Canadian-born workers in the goods sector and recent immigrants in that sector is −1.26, indicating that a decrease in Canadian-born wage in the goods sector of 12.6% is due to an increase in recent immigrants by 10%. Similarly, the cross-elasticity between Canadian-born workers in the goods sector and recent immigrants employed in the service sector is 1.32, implying that for a 10% increase in recent immigrants in the goods sector, there will be a 13.2% increase in the wage of Canadian-born workers. The cross-elasticity estimates in Table 3 suggest that a 10% increase in labor employed from the pool of recent immigrants results in a 12.6% decrease in the wages of Canadian-born workers in the goods sector but increases the wage of Canadian-born workers in the service sector by 11.6%. It is to be noted that Canadians are highly concentrated in the service sector, so the relative benefits from admitting immigrants will accrue to the Canadian-born worker. The own-wage elasticities are all negative as expected by the theory. The estimation results also imply that immigrants have a sizeable impact on the determination of their own wage. For example, a 1% increase in recent immigrants reduces the wages of immigrants employed in that sector by 9.17%, whereas a 1% increase in old immigrants in the service sector reduces the wages of the old immigrants by 4.68% in the same industry.

3.3 Discussion

The results presented above support the conclusion that recent and older immigrants are substitutes in the aggregate and within a given industry. This implies that wages of older immigrants tend to suffer from the arrival of recent immigrants. This is interesting because causal observation suggests that earlier immigrants are usually more favorably disposed to relaxing the rules of immigration and accepting more immigrants. However, this does not mean that many of the recent immigrants who come to Canada have family, friend(s), or relatives. Therefore immigrants who are already in Canada are probably willing to lose a few percentage points in their wages for their family, friend(s), or relatives to join them. The argument that personal benefits offsets the economic loss in this case does not necessarily hold because unlike USA, where immigration policy favors family reunification, most of the Canadian immigrants are required to satisfy the points system to be able to become immigrants. Thus, one explanation could be that recent and older immigrants have some characteristics in terms of the education and experience with a possibly higher education content of the recent immigrants (but less labor market experience) competing with more Canadian-experienced older immigrants (who have less education than the recent immigrants).

The empirical findings presented in this paper dispel the notion that immigrants compete with Canadian-born workers for a given number of jobs. However, it is not clear why immigrants apparently have such effect on natives' wages and employment opportunities. The answer is probably not simple. One likely factor is that, in addition to increasing the supply of labor, immigrants increase the demand for goods and services produced in Canada. Many immigrants are also entrepreneurs, creating jobs for other immigrants and natives. In a longer run, because immigrant laborers are assumed to be cheaper, employers are likely to make more capital investment to take advantage of the cheaper labor. Immigrant entrepreneurs may be particularly likely to develop export opportunities for Canadian products given their connections and language skills. The inflow of immigrants with their unique array of skills also introduces a new set of opportunities for companies and investors in Canada. A larger pool of immigrants generates opportunities for new investment and creation of new business given the diversities and personal abilities of immigrants. There could be more reasons, but it is probably more complicated than simply to say that immigrants take jobs that Canadian-born workers do not want.

4 Concluding remarks

The substitutability of labor between immigrants and native-born workers has been a key debate for a long period of time. Unfortunately, there is not enough evidence in the empirical literature, nor is there any consensus within the Canadian society, on the substitutability of immigrants and native-born workers. The influx of immigrants and their concentration on certain occupations and industries raise the question of how immigration affects the wages of natives. This study uses data on the variation of immigrants' share in labor market and natives' wage within the industry to examine this issue. Unlike many of the previous studies, this paper examines the labor market substitutability or complementarity within and across the industry

according to the classification of Industry Canada.[10] This study therefore sheds some light on many debates concerning Canadian immigration.

The paper finds that there are no significant negative effects on Canadian-born workers' wages resulting from the inflow of immigrants into Canada. Recent immigrants are complements to Canadian-born workers, while their older counterparts are neither substitutes nor complements. Our basic finding supports the many prevailing empirical findings (e.g., Akbari and De Vortez 1992) that immigration in Canada, on the aggregate, need not cause labor market outcomes of natives to deteriorate. The finding that immigrants and Canadian-born workers are not substitutes should prove useful to researchers attempting to measure the extent of wage discrimination in the labor market. It is usually assumed that immigrants and Canadians are (perfect) labor substitutes. The results indicate that measures of wage discrimination based on the assumption of perfect substitution may be seriously biased. It is important to emphasize the substantive implications of these results. The estimation of the derived demand functions implied by a generalized Leontief technology leads to our finding that Canadian-born labor is not significantly affected by the inflow of immigrants. In fact, there is evidence that the complementarities in production between native workers and older immigrants have been helped by the presence of recent immigrants.

However, when we disaggregate data by industry, we find some evidence of negative wage effects, mostly where immigrants are working with Canadians in the same industry. However, they appear to be complements across industries. Thus, although there is an adverse effect on wages among the same class of workers within industries, across industries, they appear to be complements. On average, the negative effect is offset by the increase in wage or employment. Immigration, therefore, has a potential beneficial effect on the Canadian economy, and this potential, in the future, will depend on the degree of substitutability between older immigrants and Canadian-born workers. It should be noted that our estimates are based on the census 1996 data. To the extent that the characteristics of the post-1995 immigrants are different to that of pre-1996 immigrants in terms of the way they affect the labor market prospects of native-born workers, the estimates obtained using more recent data set might be different. However, labor market effects of immigration should be evaluated in the context of long-run rather than short-run migration. Besides, there has not been any significant change in Canadian immigration policy since 1996. In addition, there has not been considerable variation in ethnic composition of labor markets since 1996. Therefore, it is likely that our estimates would remain valid even if one considers more recent census data.

[10] Akbari and De Vortez (1992) classify the industry according to concentration of native and foreign-born workers. They categorize industry in an arbitrary manner (they define a high concentration of foreign born industry as any three-digit Standard Industrial Classification industry group with a greater than 23% foreign-born share in the labor force), and they also recognize this. Our classification is based on Industry Canada and do not necessarily depend on the concentration of immigrants in a particular industry. Note that immigrants' concentration in a particular industry is endogenous because they select certain types of jobs/industries (see Friedberg 2001). Akbari and De Vortez (1992) did not address this endogeneity issue, and thus their estimates by industry are likely to be bias. Our classification of industry (see Table 6 in Appendix) does not suffer from such bias because the Industry Canada classification is exogenous to immigrants. Roy (1997), on the other hand, estimated the job displacement effects by country of origin of immigrants disaggregated by major occupation groups (two-digit levels). Our classification of industry is therefore different than those of Akbari and De Vortez (1992) and Roy (1997).

Acknowledgements I thank Dietrich Fausten, Mark Harris, Kien Tran, Robert F. Lucas, Mobinul Huq, Christopher Worswick, Christopher Hajzler, Thandinkosi Ndhlela, Salma Begum, Aaron Nicholas, Stephen Miller, and the participants at the 2003 Canadian Economic Association Conference for very helpful comments and suggestions. I am grateful to the editor and five anonymous referees whose comments have greatly improved the paper. I am responsible for all remaining errors.

Appendix

Table 4 Symmetry constrained wage equations using OLS (dependent variable: annual wage Earnings)

Variable	Canadian-born		Older immigrant		Recent immigrant	
	Coefficient	*t* stat	Coefficient	*t* stat	Coefficient	*t* stat
Constant	−29,791.7	−12.23	−23,870.1	−7.02	−21,791.4	−11.83
Education	1,719.3	19.10	1,298.2	15.03	788.0	12.43
Experience	902.3	10.29	597.3	5.61	372.3	4.99
Experience^2	−14.3	−8.33	−9.6	−5.04	−7.1	−4.67
Married	−4,175.6	−6.44	−3,122.1	−3.31	−1,797.3	−3.18
CMA	5,011.7	9.52	5,906.5	8.04	1,040.7	1.38
Language	844.8	1.19	1,245.4	0.76	1,367.1	1.79
Sex	−10,389.9	−20.05	−9,411.7	−16.28	−5,764.0	−13.39
YSM	–	–	139.1	3.69	530.5	13.58
$(P_R/P_N)^{1/2}$	−22,433.0	−9.40	–	–	−22,433.0	−9.40
$(P_O/P_N)^{1/2}$	20,739.7	5.53	20,739.7	5.53	–	–
$(P_N/P_O)^{1/2}$	638.8	1.00	638.8	1.00	–	–
$(P_R/P_O)^{1/2}$	–	–	−8,342.7	−8.07	−8,342.7	−8.07
$(P_N/P_R)^{1/2}$	−207.0	−0.47	–	–	−207.0	−0.47
$(P_O/P_R)^{1/2}$	–	–	6,238.3	4.94	6,238.3	4.94
Adj R^2	0.29		0.25		0.26	

P_i is the proportion of labor input from the ith category of labor, where i=natives (N), recent immigrants (R), or older immigrants (O). For definition of variables, see Table 7 in Appendix.

Table 5 Symmetry constrained wage equations using the FIML (dependent variable: annual wage earnings)

Variable	Canadian-born		Older immigrant		Recent immigrant	
	Coefficient	*t* stat	Coefficient	*t* stat	Coefficient	*t* stat
Constant	−33,775.0	−14.88	−31,071.8	−8.38	−19,841.1	−9.60
Education	1,898.7	23.60	1,384.9	15.58	825.9	12.22
Experience	954.2	9.38	601.9	4.73	381.9	4.33
Experence^2	−14.7	−7.28	−9.7	−4.25	−7.3	−3.94
Married	−4,414.7	−5.57	−3,317.2	−3.06	−1,949.8	−3.06
CMA	5,121.1	9.12	5,770.4	7.16	1,318.1	1.99
Language	981.9	0.99	1,422.1	0.67	1,420.7	1.38
Sex	−10,724.3	−17.84	−9,667.8	−14.18	−5,950.5	−11.84
YSM	–	–	156.5	4.40	537.8	13.70
$(P_R/P_N)^{1/2}$	1,788.5	5.32	–	–	1,788.5	5.32
$(P_O/P_N)^{1/2}$	461.2	0.74	461.2	0.74	–	–
$(P_N/P_O)^{1/2}$	–	–	−1,746.9	−2.13	−1,746.9	−2.13
Adj R^2	0.28		0.24		0.25	

P_i is the proportion of labor input from the ith category of labor, where i=natives (N), recent immigrants (R), or older immigrants (O). For definition of variables, see Table 7 in Appendix.

Table 6 Employment status by industry and occupation in Canada

	Immigration status (in percentage)		
	Recent	Older	Native-born
Industries			
Agriculture	2.23	1.87	3.43
Primary industries	0.59	1.16	2.3
Manufacturing	22.75	17.6	13.85
Construction	3.70	6.67	6.02
Transportation	3.19	4.4	4.65
Communication	1.79	2.73	3.76
Wholesale	6.22	4.8	5.14
Retail	10.61	9.81	10.38
Finance Ins. and real estate	6.00	6.76	6.19
Business services	8.68	7.46	6.95
Government service (federal)	0.83	2.35	2.98
Government service (other)	1.53	2.87	4.25
Educational services	4.33	7.71	8.19
Health and social services	8.46	10.44	10.99
Accommodation, food and beverage	9.95	5.83	4.44
Other	9.14	7.53	6.49
All industries	100	100	100
Occupations			
Senior managers	0.99	1.44	1.1
Middle and other managers	7.47	10.35	8.82
Professionals	13.8	16.96	16.38
Semiprofessional and technician	5.04	5.42	5.85
Supervisor, cleric, and sales service	0.84	1.38	1.41
Crafts trades	2.15	3.5	4.1
Administrative senior clerical	3.83	5.95	6.5
Skilled sales service	5.04	4.98	4.5
Skilled crafts trades	6.47	8.48	7.79
Clerical personnel	10.12	10.34	11.77
Intermediate sales service	12.49	9.98	10.86
Semiskilled and manual work	15.98	10.84	10.98
Other sales service	10.57	7.62	6.83
Other manual workers	5.2	2.75	3.12
All occupations	100	100	100
Number of observations	6,651	7,663	49,707

Computed from Public Use Micro Data File using 20 percent random sample

Table 7 Variable definition

Variable	Definition
Wage	Wage earnings of the native-born and immigrants for the year 1995
Education	Number of years of schooling completed
Experience	Age minus education minus 5
Weeks worked	The number of weeks worked in 1995
Hours worked	Hours worked in the reference week in 1995
CMA	A dichotomous variable equal to unity for a person living in an urban/city area, otherwise it is zero
Married	A dichotomous variable equal to unity for a person who is never married, otherwise it is zero

Table 7 (continued)

Variable	Definition
Sex	A dichotomous variable equal to unity for female
YSM	The number of years since the foreign-born person migrated to Canada, defined as zero for the native born
Language—English	A dichotomous variable equal to unity for a person who speak in English, otherwise it is zero
Language—French	A dichotomous variable equal to unity for a person who speak in French, otherwise it is zero
Goods industry	Whether employed in goods-producing industry (=1), otherwise (=0)
Service industry	Whether employed in service-producing industry (=1), otherwise (=0)
Industry	A set of dummy variable for employment status in different industry (results not reported)

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