Vancouver Centre of Excellence

Research on Immigration and Integration in the Metropolis

Working Paper Series

#98-09

The Substitutability and Complementarity of Canadian and Foreign-Born Labour: circa 1990

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April 1998

RIIM

Research on Immigration and Integration in the Metropolis

The Vancouver Centre is funded by grants from the Social Sciences and Humanities Research Council of Canada, Citizenship & Immigration Canada, Simon Fraser University, the University of British Columbia and the University of Victoria. We also wish to acknowledge the financial support of the Metropolis partner agencies:

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THE SUBSTITUTABILITY AND COMPLEMENTARITY OF CANADIAN AND FOREIGN-BORN LABOUR: CIRCA 1990[1]

By

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Abstract

This paper employs a generalized leontief production function to analyze substitutability and complementarity relationships between Canadian, old foreign-born and new foreign-born workers, using data from the 1991 Canadian census. The analysis was also extended to broad occupational groups. The results show that Canadian and new foreign-born workers are substitutes in production. Old foreign-born workers (earlier immigrants) on the other hand were found to be complements to Canadian-born workers. The results by occupational groupings provided further insights regarding current immigration policy. Specifically, professionally trained immigrants and unskilled Canadian-born workers were found to be substitutes contrary to theory. This may be attributed to problems associated with immigrant skills recognition in Canada and corroborates some of the proposals outlined in the report by the Canadian Immigration Legislative Review, circa 1998.

Keywords: Substitutability, Complementarity, Foreign-born, wages

J.E.L. Classification: J31, J61

[1] This paper draws from chapter 5 of my Ph.D. dissertation, submitted to the Economics department of Simon Fraser University in September 1997. I thank Professors Don DeVoretz, Jane Friesen and Dennis Maki for all their valuable comments on the earlier drafts of this paper. Financial assistance was provided by the Vancouver Centre of Excellence on Immigration and Integration. The usual disclaimer applies.

Introduction

The debate on the formulation and implementation of Canada's immigration policies has reopened, after a long hiatus. This rekindling of the debate follows the submission to the minister of Citizenship and Immigration of a panel's legislative review[2]. Under the legislative review, the proposed principal criteria for the selection of prospective economic immigrants to Canada will be narrowed to years of job experience, age (19-45 years), post secondary education and language proficiency in English or French. Occupational demand is to be omitted under these proposed changes. Under the current policy shaped in part by the points system introduced in 1967, occupation related characteristics play a key role. Specifically, points for occupational skill, experience and demand, plus special points for designated occupations make up 43 out of the necessary 70 for admission. (see Green and Green 1995; page 1009). Furthermore, Green and Green also argue that existing policy which scrutinized occupational demand led to a shift away from less-skilled categories, such as labourers, towards professionals, at least until the 1980's. Abandonment of the occupational scrutiny occurred after 1980 with the rise in the family class. Coulson and DeVoretz (1993) observed that the total value of human capital embodied in the post 1980 immigrant flow declined after 1980, even though the real value of human capital per immigrant remained roughly constant. This implies a policy shift towards increasing the numbers of less skilled occupations over time, (Coulson and DeVoretz:1993). The importance and subsequent decline and proposed omission of occupational criteria for

admission begs a central question which this paper will attempt to answer. In short, does a point system which recognizes occupational criteria for admission alter the observed substitutability and complementarity relationships between various Canadian and foreign-born workers? A secondary policy issue addressed by this paper is how does the occupational distribution of immigrants affect earning patterns of the host population?

Given the two questions concerning primarily wages and potential job displacement, the initial objective of this paper will be to estimate the Hicksian elasticities between the different types of workers and more importantly between occupational groups. The signs and magnitudes of these elasticities will in turn enable the prediction of wage impacts by the various types of labour and by occupations. My second objective for undertaking this study is policy oriented. From the results on wage compression by occupation, I will evaluate the efficacy of removing occupational criteria from the immigrant selection criteria.

Before proceeding to investigate the issue of whether immigrants and natives are complements or substitutes in production, it is imperative to describe how wages are determined in the host country's labour market. Figure 1 describes how wages are determined in the labour market for native-born workers in the absence of imperfections or distortions in the market.

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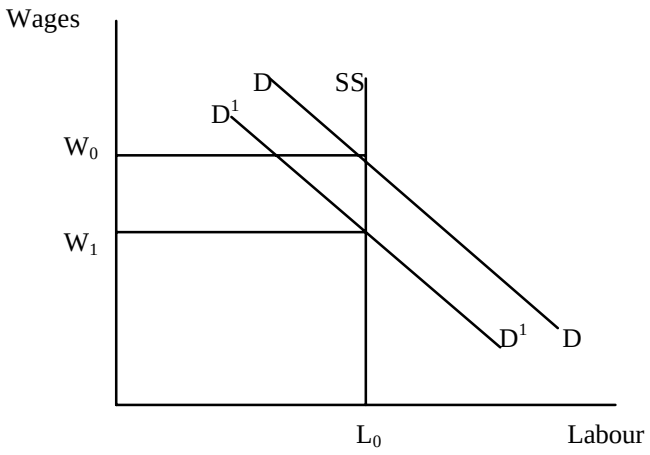
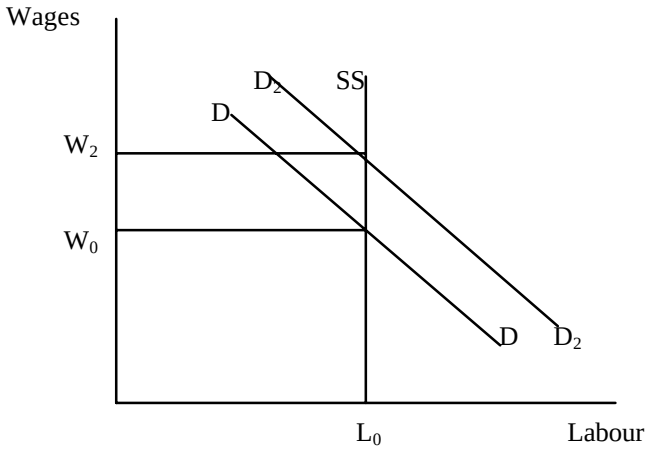
[2] See Immigration Legislative Review, "*Not just numbers: A Canadian Framework for Future Immigration*", Cat. No. Ci63-21/1998E, Minister of Public Works and Government Services Canada, 1997.

Figure 1
The Effects of Immigration on the Market for Native-Born Labour

Scenario A: Foreign-Born and Native-Born Workers are Substitutes.



Scenario B: Foreign-Born and Native-Born Workers are Complements.



The curve DD represents the initial demand for labour, that is before immigrants are admitted in the labour market. Its downward slope is derived from the assumption that an increase in the wages of that have to be paid for native born workers induces firms to reduce the employment of native born workers. The line SS depicts the supply curve for native born labour, which is assumed to be fixed at any given point in time at the level L_o.

The equilibrium wage rate is thus determined by the interaction of the supply and demand curves for labour. This occurs at W_0.

I now use the above framework to analyze the impact of an inflow of foreign born workers on the native born wage rate. Consider scenario A in figure 1, where native-born and foreign-born workers are substitutes in production. This assumption implies that an inflow of foreign-born workers would reduce the demand for native labour. This is represented by a downward shift of the labour demand curve from DD to D_1D_1. As a result, the wage rates of native born workers falls from W_0 to W_1. Thus the inflow of foreign born workers lowers the earnings of native-born workers if they are substitutes.

Scenario B examines the effects of an inflow of foreign-born workers on the market for native born workers, when a complementarity relationship is assumed between the two category of workers. As in the first scenario, the curves DD and SS represent the initial demand and supply for native-born labour, and W_0 is the equilibrium wage rate. When foreign-born and native-born workers are complements in production, an inflow of foreign-born workers augments the productivity of native-born labour, inducing employers to employ more native-born workers. For example the relationship between foreign-born nurses and Canadian doctors. In figure 1B, this increase in the demand for native-born labour is depicted by a rightward shift of the labour demand curve from DD to D_2D_2. As a result, the wage rate of native born workers increases from W_0 to W_2. Thus, when foreign-born and native-born workers are complements in production, an inflow of

foreign-born workers increases the earnings of native-born workers thereby improving their economic well being.

Whether foreign-born and native-born workers are complements or substitutes in production, and what the magnitudes of such effects are, depends on the nature of the production function and can only be determined empirically. Essentially, it involves the measurement of how a change in the relative quantities of the different types of labour inputs interact with each other and affects their relative prices i.e. the Hicksian elasticities of complementarity. Armed with these Hicksian estimates, one can determine whether foreign-born workers cause Canadian-born wages to rise, fall or have no effect. Furthermore, I investigate whether these wage impacts vary by skill groups or occupations.

Most existing research on the effects of the foreign-born labour on wages requires variations in the foreign-born population across cities to model the consequent change in relative wages of the foreign-born and Canadians (see, for example, Roy 1987 and 1997). This raises the problem of endogeneity. In other words, the problem here is that the foreign-born, who are likely to be the most mobile of workers, will probably move to those regions where demand shocks have led to higher wages (see Friedberg and Hunt 1995; and Newbold 1996). For example, using data from the 1986 Canadian census, Newbold found that the foreign-born have higher in- and out-migration rates than primary migrants (native-born), with Ontario having a strong ability to attract and retain the foreign-born. As a result, there is an endogeneity problem, i.e. relative foreign-born

densities can explain changes in wages, but changes in relative foreign-born densities are also explained by higher wage rates. This leads to biased estimates. I will address this problem by adopting an instrumental variable estimation procedure.

The rest of the paper is organized as follows. The next section discusses the theoretical and econometric model. This is followed by an examination of the data and empirical results. Thereafter, a discussion of the endogeneity problem ensues along with the interpretation of the re-estimated regressions. The paper concludes with a discussion of the empirical results by skill or occupational groups and how this relates to the recent policy measures.

I. Model Specification

Let us suppose there are three inputs in the short-run production function in a given labour market. In this paper, as in the others, the local labour markets have been proxied by Census Metropolitan Areas (CMAs). The inputs are Canadian-born labour (L_c), new foreign-born labour (L_n), and old foreign-born labour (L_o). The new foreign-born are defined as all immigrants who came to Canada after 1978,[3] and the old foreign-born are those who immigrated to Canada before 1978. If the short-run production function, $f(L_c, L_o, L_n)$, exhibits the usual neoclassical properties and is linearly homogeneous in the three types of labour, then the profit-maximizing conditions can be specified as follows:

[3] The year 1978 was chosen as the cutoff for the distinction between old foreign-born and new foreign-born because in that year a new immigration policy, which, among other things, emphasized family re-unification, came into force.

$$w_i = f_i\,(p_c, p_o, p_n), \qquad (i = c, o, n) \tag{1}$$

where

w_i = wage rate of input i

$f_i = \delta f\,(L_c, L_o, L_n) / \delta L_i$

$p_i = L_i / (L_c + L_o + L_n)$

P_i is defined as the proportion of type i workers in the working age population in the kth labour market; thus, equation (1) assumes that type i workers are paid the value of their marginal product. Hence, the productivity and wage rates of Canadians not only depend on the relative number of Canadian-born workers, but also on the relative proportions of the other labour types as well. The degree of substitutability among the various types of labour will, therefore, be an important determinant of wage levels in the local labour market. Equation (1) also implies that there are no scale effects in the demand system. That is, the relative proportions of workers are invariant to scale.

The determination of wage rates depends not only on the demand functions in (1), but also on the relative supply of the labour types to the local labour market. Initially, it is assumed that the relative supplies of all labour types are perfectly inelastic for ease of estimation of the production function parameters. However, it is perfectly feasible that in the long run, type i workers will likely migrate to high wage CMAs. Thus, an endogeneity problem exists, which will be tackled in another section in this paper.

Given the assumption of perfectly inelastic relative labour supplies, the demand system in (1) describes the wage-determination process in the particular labour market. It is then relatively easy to predict the effect on wages when relative supplies shift exogenously.

The measurement of the actual extent of substitutability or complementarity requires further specification of the production technology's structure. Following Borjas (1983) and Roy (1987, 1997), the generalized Leontief production function is adopted as it yields an empirically tractable system of input demand functions. The generalized Leontief production function[4] is specified as:

$$f(L_c, L_o, L_n) = \sum_j \sum_i \gamma_{ij} (L_i, L_j)^{1/2}, \qquad (i, j = c, o, n) \qquad (2)$$

where the technology parameters are restricted so that $\gamma_{ij} = \gamma_{ji}$.

The functional form given by equation (2) can be interpreted as a second-order approximation to a concave, neoclassical production function with constant returns to scale. Equating wage rates and marginal products for the three labour types in the context of profit maximization, one can derive the following empirical specification:

[4] See Diewert (1971) and Hamermesh (1986) for a discussion on the generalized Leontief production function and its derivation from the dual cost function.

$$w_c = \gamma_{cc} + \gamma_{co} (p_o/p_c)^{1/2} + \gamma_{cn} (p_n/p_c)^{1/2} \quad (3a)$$

$$w_o = \gamma_{oo} + \gamma_{oc} (p_c/p_o)^{1/2} + \gamma_{on} (p_n/p_o)^{1/2} \quad (3b)$$

$$w_n = \gamma_{nn} + \gamma_{nc} (p_c/p_n)^{1/2} + \gamma_{no} (p_o/p_n)^{1/2} \quad (3c)$$

The production technology summarized by equation (3) implies a set of cross-equation restrictions. In particular, if γ_{ij}^{m} is the estimate of the technology parameter γ_{ij} in the m^{th} equation ($m = c, o, n$), then the cross equation restrictions are given by:

$$\gamma_{co}^{c} = \gamma_{oc}^{o}, \gamma_{cn}^{c} = \gamma_{nc}^{n}, \gamma_{no}^{n} = \gamma_{on}^{o} \quad (4)$$

The unconstrained version of equation (3) can be estimated using ordinary least squares. To impose the cross-equation restrictions in equation (4) however, a nonlinear estimation procedure is employed. This technique allows one to directly incorporate the parameter restrictions in the equation system and to be estimated jointly. By estimating both unconstrained version using equation (3) and the constrained version incorporating the restrictions in equation (4), a likelihood ratio or Wald test can be performed to test the validity of the cross-equation restrictions.

The system of equations derived in equation (3) above gives the determination of wage levels in a particular labour market. To apply the model to micro data available in the census, it is necessary to control for individual differences in productive skills. If it is

assumed that the individual characteristics can be approximated by a vector of socioeconomic variables, then the empirical specification of equation (3) can be modified as:

$$w_c = \gamma_{cc} + \gamma_{co}\,(p_o/p_c)^{1/2} + \gamma_{cn}\,(p_n/p_c)^{1/2} + \Sigma\beta_c X_c + \varepsilon_c \qquad (5a)$$

$$w_o = \gamma_{oo} + \gamma_{oc}\,(p_c/p_o)^{1/2} + \gamma_{on}\,(p_n/p_o)^{1/2} + \Sigma\beta_o X_o + \varepsilon_o \qquad (5b)$$

$$w_n = \gamma_{nn} + \gamma_{nc}\,(p_c/p_n)^{1/2} + \gamma_{no}\,(p_o/p_n)^{1/2} + \Sigma\beta_n X_n + \varepsilon_n \qquad (5c)$$

where X_i is a vector of skill characteristics. An additive disturbance term ε_i has also been appended to reflect a stochastic framework. The disturbance term assumes the usual properties. The empirical definition of p_i is the proportion of the working age population in the individual's local labour market, which belongs to group *i*. The variables p_c, p_o, *and* p_n were computed for each local labour market using the entire data set.

The vector X_i is composed of the standard socioeconomic and human capital variables (e.g., education, experience, marital status etc.). The vector X_i also includes a vector of industry dummies to control for wage differentials arising from differences in job environments. Furthermore, the industry dummies also capture the different capital/labour ratios which are bound to differ across the various industries and partially control for omitted capital variables.

An important motivation for estimating (3) is to obtain a measure of the Hicksian elasticity of complementarity. This measures the effects on the relative price of factor *i* of a change in the relative quantity of that factor, holding marginal cost and the quantities of

other factors constant. Since this paper focuses on the effects of changes in the quantities of inputs (immigrant flows) on relative factor prices (wages), the elasticity of complementarity (as opposed to the Allen elasticity of substitution) is the appropriate measure to capture these effects.[5] The elasticity of complementarity will be positive (negative) if the inputs are complements (substitutes). The elasticity of complementarity implied by the generalized Leontief function in equation (2) is defined as:

$$C_{ij} = \frac{\gamma_{ij}\,\bar{w}}{2w_i w_j (p_i p_j)^{1/2}}, \qquad i \neq j \tag{6a}$$

$$C_{ii} = \frac{(\gamma_{ii} - w_i)\,\bar{w}}{2 p_i w_i^2}, \qquad i = j \tag{6b}$$

where $\bar{w} = p_c w_c + p_o w_o + p_n w_n$.

II. Data and Sample Selection

The data used in this empirical analysis came from the individual file of the Public Use Sample Tape (PUST) of the 1991 Canadian Census. The sample size of the PUST

[5]The Allen elasticity of substitution measures the effect of a change in the relative price of factor *i* on the relative quantity of that factor, holding output and prices of other factors constant. For a discussion on the relationship between the elasticities of complementarity and substitution, see Sato and Koizumi (1973).

individual file is one-in-fifty of the original census file. This amounts to about 500,000 individuals.

For regression purposes, the following additional set of criteria were also imposed: individuals aged 20-64 (both men and women); annual earnings greater than $500 during the reference year 1990; positive weeks worked and positive hours worked during the reference week. The rationale behind this selection criteria is to target the economically active population. When this selection criteria was applied to the data set, the sample now comprised 143,557 Canadians, 33,021 early (old) foreign-born vintages and 15,457 recent (new) foreign-born individuals.

Table 1 presents selected summary statistics for the three population subgroups.

Table 1 Insert

From Table 1, it is observed that the recent foreign-born earn the lowest hourly wage at $16.19. Canadian and older foreign-born cohorts, earn $18.07 and $20.12 respectively. This difference could be attributed to the fact that on average the new foreign-born worked less in the reference week, 43.75 compared with 45.72 and 47.24 hours respectively for the other cohorts. In addition, new immigrants must acquire language and other skills as they integrate into the labour market. Furthermore, one can also point to the fact that most of the new immigrants are concentrated in low-paying low-skilled occupations. For example 51.9% of the new foreign-born population are in clerical,

sales/service, semi-skilled/manual and other manual occupations. This compares with only 43.1% and 40.6 % for the Canadian-born and old foreign-born populations respectively.

The new foreign-born are also comparatively younger, 35.4 years compared with 37.04 and 43.83 years for the Canadian-born and old foreign-born respectively, more educated (13.37 compared with 13.06 and 12.96 years respectively) and much more likely to be resident in a census metropolitan area: 91% percent of the new foreign-born population reside in CMAs compared with 59.6% and 83.4% for the Canadian and old foreign-born populations respectively. The census metropolitan area serves as a proxy for the local/urban labour market. In the 1991 census, there were 19 CMAs.[6] The main conclusion from this section is that the Canadian-born and foreign-born populations are different in terms of age, education, place of residence, occupational concentration etc., which might lead to different interactions in the labour market and welfare implications for the Canadian-born workers. For example, as long as immigrants bring an accumulated bundle of labour and physical or human capital that is different from that possessed by Canadians, the latter will gain from immigration. See Johnson (1967).

III. Empirical Results

The results from estimating equations 5a-5b are summarized in Tables 2 and 3. Table 2 summarizes the results for the unconstrained regression using ordinary least squares estimation procedure. Table 3 summarizes the results for the constrained regression.

Table 2 Insert

From Table 2, it is observed that the socioeconomic variables are obtain the expected sign and are significant. For example, an additional year of schooling adds $1.01 to the hourly Canadian wage and 94 and 61 cents to the hourly wage of the old and new foreign-born respectively. The marital status variable, MARRIED, also obtained a positive value as expected, indicating the propensity of married individuals to strive for higher wages due to increasing financial responsibilities. The positive and highly significant values for the YSM (years since migration) variable in both foreign-born samples points to the strong effects on wage rates of the assimilation experience. The variables of interest in this paper are those indicating how the relative size of both foreign-born populations affects the wages of the Canadian-born workers. These effects are captured by the variables $(P_n/P_c)^{1/2}$, $(P_o/P_c)^{1/2}$ etc. One cannot sign the employment variables *a priori*, because this will depend on whether the labour types are substitutes or complements in production. However, the results from Table 2 show that new foreign-born workers and Canadian-born workers are substitutes in production given that the coefficients on the variables $(P_n/P_c)^{1/2}$ and $(P_c/P_n)^{1/2}$ are negative. For purposes of interpretation however, estimates from the constrained wage equations and the corresponding Hicksian elasticities will be the primary focus. This is because the theoretical restriction of symmetry is a necessary condition for the derivation of the demand system in equation (3). Thus, the estimated

[6] The CMAs in the 1991 census are Halifax, Quebec City, Montreal, Sherbrooke, Ottawa, Oshawa, Toronto, Hamilton, St. Catharines, Kitchener, London, Windsor, Sudbury, Winnipeg, Regina, Calgary, Edmonton, Vancouver and Victoria.

wage regressions can be interpreted in terms of the theoretical model only if the symmetry conditions are imposed.

Table 3 Insert

Table 3 summarizes the results from the constrained wage equations. The numbers are qualitatively similar to those encountered in Table 2.

Table 4 Insert

Table 4 presents the estimated technology coefficients and the Hicksian elasticities of complementarity after the imposition of the theoretical restrictions of symmetry, using equations 6a and 6b. With the exception of γ_{oc}, all the other elasticities were negative. If γ_{oc} is positive, then it implies that old foreign-born and Canadian-born workers are complements. The corresponding Hicksian elasticity was 0.112. This implies that a 10% increase in the number of old foreign-born workers will increase the wage rates of Canadians by 1.12%. This result is not surprising, because by definition the old foreign-born workers were those who immigrated to Canada before 1978 and therefore may have fully assimilated and acquired skills complementary to those of Canadians. The estimate of γ_{nc}, the parameter measuring the substitution possibilities between new foreign-born workers and Canadian-born workers, is -0.31, but insignificant. This implies that new foreign-born and Canadian-born workers are neither substitutes nor complements in

production. The Hicksian elasticity implied by this estimate is -0.028. The same applies to the relationship between new foreign-born workers and old foreign-born workers. The technological parameter estimate is insignificant and the corresponding elasticity is -0.04. All the own elasticities were negative as theory predicts. The own elasticities are larger in absolute terms, ranging from -1.09 for the Canadian-born workers to -5.40 for the old foreign-born workers, as compared to the cross-elasticities. The cross-elasticity estimates compare in magnitude to those obtained by Borjas (1983) who obtained elasticities ranging in magnitude between 0.0026 and 0.1579, while examining the substitutability of Black, Hispanic and White labour for the United States. Roy (1987) was also not able to distinguish whether foreign-born and native-born workers were substitutes or complements in aggregate because the elasticities were insignificant. However, when he disaggregated his study by area of origin, he found significant substitution between third world foreign-born and the native-born labour force.

IV. Endogenous Labour Supply

The empirical analysis in the previous section was based on the assumption that the relative employment values given by $(P_i/P_j)^{1/2}$ $(i \neq j)$ were exogenous. However, the distribution of both Canadian and foreign-born populations across CMAs is not exogenous[7]. To the extent that individuals have a choice over city of residence, differences in wage rates across cities may not reflect differences in labour supply. Thus, over time, migration patterns will respond to regional wage differentials creating a

[7] See Newbold (1996).

correlation between the employment variables and the disturbance term. There are several solutions to this problem. One approach is to estimate a differenced wage equation if one has data from two time periods. Another approach is to find suitable instruments for the employment variables. The latter approach is adopted because data from only one time period, i.e. 1990, are being used.

The instruments are obtained by first regressing $(p_i/p_j)^{1/2}$ $(i \neq j)$ in the relevant sample on a set of exogenous variables affecting migration decisions and then using the predicted values in the wage determination equations. Instruments include both individual and area characteristics.[8] Tables 5 and 6 summarize the results from the instrumental variable estimation. Table 5 is devoted to the constrained results from the instrumental variables estimation, whilst Table 6 focuses on the estimated Hicksian elasticities based on the instrumented and constrained wage equations.

Tables 5 Insert

The results summarized in Tables 5 and 6 are qualitatively similar to those in Tables 3 and 4. The only difference now is that in Table 5, one observes an improvement in the level of significance on the employment variables in particular. The variable $(p_n/p_c)^{1/2}$ is now significant at the 10% level. The coefficient estimate is also bigger in absolute terms i.e. -

[8]The individual characteristics included age, education, knowledge of either official languages and marital status. The area characteristics included the unemployment rate in the CMA, the proportion of families earning below the poverty line in the CMA, the proportion of individuals in government jobs by CMA, and the average level of social assistance receipts in the CMA. Most of these instruments were adapted from the existing empirical literature, especially Borjas (1983).

1.04 compared with the value of -0.31 obtained in the non-instrumental regression. Table 6 summarizes the Hicksian elasticity results using the coefficients from the instrumented constrained wage equations.

Table 6 Insert

Comparing these results to those in Table 4, one finds them qualitatively similar in terms of the signs. The exception here is that the elasticities are slightly larger in magnitude. As a result, some conclusions from the interpretation of the elasticities have also changed. The results from Table 6 indicate that γ_{nc} is -1.04 and significant. This implies that new foreign-born workers and Canadian-born workers are substitutes in production. The corresponding Hicksian elasticity of complementarity is -0.093. This also implies that a 10% increase in the number of new foreign-born workers through immigration will reduce Canadian wage rates by 0.9%. The conclusions regarding the substitution possibilities amongst the other types of workers remain the same as those obtained from Table 4. That is, old foreign-born workers and Canadian-born workers are complements in production, but the relationship between old foreign-born and new foreign-born is not statistically significant i.e. -0.55. Apparently, the improvement in the significance and magnitude of the technological estimates proves that endogenous nature of the employment variables might have negatively affected earlier results and hence instrumentation is warranted.

V. Substitutability by Occupation/Skill Groups

The regression results presented in Tables 2, 3 and 5 are for all occupation groups pooled together. This could conceal the substitutability/complementarity by occupation. Furthermore, the current immigration policy awards points for occupational attainment and thus offers the opportunity the investigate the effectiveness of this policy. Specifically, if foreign-born and Canadian-born workers are found to be substitutes in certain broad occupational groups, then it means that the wages of Canadians in those occupations are being depressed by foreign-born workers, and will call for a review of the occupational requirements.

To test substitutability/complementarity by occupations, three broad occupational groups are identified for both foreign-born and Canadian-born workers. These are: professionals, skilled, and unskilled workers, definitions of which are based on the 1991 occupational classifications in the 1991 census dictionary.[9] These three broad skill groups, combined with the two types of workers, that is, foreign-born and Canadian-born workers, resulted in six estimating equations similar to those summarized in the equation system of 3 and 5. They are as follows:

$$W_{cp} = \alpha_{cpcp} + \alpha_{cpcs}(P_{cs}/P_{cp})^{1/2} + \alpha_{cpcu}(P_{cu}/P_{cp})^{1/2} + \alpha_{cpip}(P_{ip}/P_{cp})^{1/2} + \alpha_{cpis}(P_{is}/P_{cp})^{1/2} + \alpha_{cpiu}(P_{iu}/P_{cp})^{1/2} + \varepsilon_{cp}$$

$$W_{cs} = \alpha_{cscs} + \alpha_{cscp}(P_{cp}/P_{cs})^{1/2} + \alpha_{cscu}(P_{cu}/P_{cs})^{1/2} + \alpha_{csip}(P_{ip}/P_{cs})^{1/2} + \alpha_{csis}(P_{is}/P_{cs})^{1/2} + \alpha_{csiu}(P_{iu}/P_{cs})^{1/2} + \varepsilon_{cs}$$

[9] Professional workers comprises those with skill level 4 (i.e. senior and middle level managers and professionals). The skilled workers were identified as those with skill level 3 (i.e. semi-professionals and technicians, supervisors, skilled trades and crafts etc.). The unskilled category comprised those with skill levels 1 and 2 (i.e. sales and service workers, clerical, semi-skilled and other manual workers).

$$W_{cu} = \alpha_{cucu} + \alpha_{cucp}(P_{cp}/P_{cu})^{1/2} + \alpha_{cucs}(P_{cs}/P_{cu})^{1/2} + \alpha_{cuip}(P_{ip}/P_{cu})^{1/2} + \alpha_{cuis}(P_{is}/P_{cu})^{1/2} + \alpha_{cuiu}(P_{iu}/P_{cu})^{1/2} + \varepsilon_{cu}$$

$$W_{ip} = \alpha_{ipip} + \alpha_{ipcp}(P_{cp}/P_{ip})^{1/2} + \alpha_{ipcs}(P_{cs}/P_{ip})^{1/2} + \alpha_{ipcu}(P_{cu}/P_{ip})^{1/2} + \alpha_{ipis}(P_{is}/P_{ip})^{1/2} + \alpha_{ipiu}(P_{iu}/P_{ip})^{1/2} + \varepsilon_{ip}$$

$$W_{is} = \alpha_{isis} + \alpha_{iscp}(P_{cp}/P_{is})^{1/2} + \alpha_{iscs}(P_{cs}/P_{is})^{1/2} + \alpha_{iscu}(P_{cu}/P_{is})^{1/2} + \alpha_{isip}(P_{ip}/P_{is})^{1/2} + \alpha_{isiu}(P_{iu}/P_{is})^{1/2} + \varepsilon_{is}$$

$$W_{iu} = \alpha_{iuiu} + \alpha_{iucp}(P_{cp}/P_{iu})^{1/2} + \alpha_{iucs}(P_{cs}/P_{iu})^{1/2} + \alpha_{iucu}(P_{cu}/P_{iu})^{1/2} + \alpha_{iuip}(P_{ip}/P_{iu})^{1/2} + \alpha_{iuis}(P_{is}/P_{iu})^{1/2} + \varepsilon_{iu} \quad (7)$$

The above equations are subject to the appropriate cross-equation restrictions. The subscripts in the above system of equations are also defined as follows:

cp = Canadian professionals; *cs* = Canadian skilled workers; *cu* = Canadian unskilled workers; *ip* = immigrant professionals; *is* = immigrant skilled workers; *iu* = immigrant unskilled workers.

Table 7 and 8 Insert

Tables 7 summarizes the results from the unconstrained wage equations using equation (7). Table 8 on the other hand summarizes the results from constrained wage equations, while simultaneously employing the appropriate instruments for the employment variables.

Table 9 Insert

However, the estimates of primary interest in this section are the Hicksian elasticities reported in Table 9. These elasticities were calculated from the technological parameters derived from the constrained regressions with instruments for the employment variables. Out of the 15 cross elasticities reported in Table 9, only 7 of their estimated

corresponding technological parameters were statistically significant or nearly significant. These cross elasticities are $\alpha_{cs,cp}$, $\alpha_{cu,cp}$, $\alpha_{ip,cp}$, $\alpha_{iu,cp}$, $\alpha_{cu,cs}$, $\alpha_{iu,cs}$, and $\alpha_{ip,cu}$. This implies that Canadian skilled workers and Canadian professionals are substitutes in production, the same for immigrant professionals and Canadian professionals. As theory will predict, Canadian-born unskilled workers and Canadian-born professionals are however complementary inputs, and the same applies to unskilled immigrants and Canadian-born professionals. Furthermore, unskilled immigrants and Canadian-born workers are complementary to Canadian skilled workers, and professional immigrant workers are substitutes for Canadian unskilled workers. The remaining technological parameters associated with the cross elasticities were insignificant, implying that the corresponding workers belonging to those broad occupations were neither substitutes nor complements.

In order to examine the wage impacts of these underlying relationships one has to focus on the magnitudes of the cross elasticities. For example, the elasticity between professional immigrants and Canadian professionals is -0.71. Since the sign is negative (substitutes), it implies that a 10% increase in the number of professional immigrants will depress the wages of Canadian professionals by about 7.1%. This result is similar to a finding made by Roy (1997). He also concluded that U.S.-born immigrants for example, had large and statistically significant job displacement effects on Canadians in the major professional occupations (i.e. natural sciences, engineering, mathematics, managerial and related occupations).[10] The elasticity between unskilled immigrants and Canadian professionals is 0.31. This also implies that a 10% increase in the number of unskilled

immigrants will increase the wages of Canadian professionals by 3.1%. Similarly, the cross elasticity between unskilled immigrants and skilled Canadian workers is 0.43, implying a 4.3% hike in the wages of skilled Canadian workers as a result of a 10% increase in the number of unskilled immigrants.

Finally, the cross elasticity between professional immigrants and unskilled Canadian workers is -0.33. This translates into a 3.3% drop in the wages of unskilled Canadian-born workers as a result of an increase in the number of professional immigrant workers. This latter finding seems counter-intuitive at first sight, but it is not upon further reflection. One possible explanation for the drop in the wages of unskilled Canadian-born workers in the presence of immigrant professional may lie with the skill recognition in the Canadian labour market. Because some immigrants initially find it difficult to work in their field of expertise, they settle for menial jobs which are mainly unskilled. This can create an excess supply of unskilled labour thereby suppressing the wages of unskilled Canadian-born workers.

The own wage elasticities were all negative as suggested by theory, with the exception of $\alpha_{cp,cp}$, which was positive, i.e. 0.44. Immigrants also had a sizable impact on the determination of their own wage levels compared with that of Canadian workers. For example, a 1% increase in the number of professional immigrants reduces the wages of professional immigrants by 7.19%. Also a 1% increase in the number of unskilled immigrants will reduce the wages of unskilled immigrants by 2.19%.

[10] It should be pointed out however that Roy's study focused primarily on displacement or employment

VI. Conclusions and Policy Implications

To summarize, this paper examined the issue of substitutability/complementarity between Canadian and two categories of foreign-born labor, new foreign-born and old foreign-born labour and also by broad occupational groups. The focus on occupational groups allowed for the evaluation of some aspects of Canada's immigration policy, especially the points system. The major point of departure from previous research on this topic in Canada is the recognition and attempted solution of the endogeneity problem. The other major contribution is the inferences on wages through the estimation of the Hicksian elasticities and its impact on policy. The main findings amongst others from the constrained and instrumented regressions indicate that the new foreign-born and Canadian-born workers are substitutes in production. The corresponding Hicksian elasticity was also estimated to be -0.093. This means that a 10% increase in the number of new foreign-born workers will reduce the wages of Canadian-born workers by 0.9%. The old foreign-born workers on the other hand were found to be complements to Canadian-born workers. The corresponding elasticity was 0.112. This implies that a 10% increase in the number of old foreign-born workers will increase the wages of Canadian-born workers by 1.12%. New foreign-born and old foreign-born workers were neither substitutes nor complements in production. This is because the estimated technological parameter was insignificant. When the data were disaggregated by occupations, it was discovered that professional immigrants and Canadian professionals were substitutes with an elasticity of -0.71. The relationship between unskilled immigrants and Canadian professionals was

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effects of immigration by source countries and not on wage impacts.

complementary, with an elasticity of 0.31. Similarly, unskilled immigrants and skilled Canadian workers were found to be complementary with an elasticity of 0.43. Finally, professional immigrants and unskilled Canadian workers were substitutes with a corresponding elasticity of -0.33. All the own elasticities were negative with one exception and they were larger in absolute terms compared with the cross elasticities.

These results yield important policy implications. First, the results show that the new foreign-born and Canadian-born are substitutes in production with adverse impacts on Canadian wages (i.e. Hicksian elasticity is -0.093). This may be attributed to the falling human capital content of newer immigrant vintages, which has been already alluded to (see Coulson and DeVoretz, 1993). To mitigate some of these adverse impact on wages, future immigration policy should give more priority to the independent (point assessed) class of immigrants. The results from the occupational groups were mixed. The results indicate that both skilled and unskilled immigrant workers have positive effects on the wages of Canadian professional and skilled workers. One can think of the example of foreign-born nurses and Canadian doctors. That is an example of a complementary relationship. On the other hand, the results also show that professionally trained immigrants are substitutes to both Canadian professional and unskilled workers. I rationalize the latter relationship by observing that in situations where immigrant professional skills are not recognized in Canada, they may end up settling for menial jobs which may crowd out the unskilled Canadian-born workers. In other situations where immigrants have comparable professional skills to that of Canadians (especially those from

the U.S. and western Europe), they will compete for professional jobs, and some Canadians might see their wages being depressed, as the results show.

Thus, the proposed changes outlined in the immigration legislative review is a step in the right direction, regarding the non-consideration of the occupational status of the prospective immigrant. This is because, the negative elasticities estimated in this study for the professionally trained immigrants and unskilled Canadians implies that the labour market does not put a substantial premium on occupational status for these immigrants, and that is why they end up with menial jobs, thereby reducing wages in the unskilled sector. The proposed system which emphasizes relevant job experience, post secondary education, age and language proficiency might be the way to go. Time will tell.

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Table 1
Summary Statistics

Variable	Native-Born	Old Foreign-Born	New Foreign-Born
Average Age (years)	37.04	43.83	35.4
Average Education (yrs)	13.06	12.96	13.37
Average Hourly Wage	18.07	20.12	16.19
Average Weeks Worked	45.72	47.24	43.75
Average Hours Worked in Reference Week	38.94	39.26	39.13
CMA (%)	59.6	83.4	91
Married (%)	58.7	74.5	67.9
Occupations:			
Senior Managers	1.1	1.5	0.8
Middle & Other Manag.	9.5	11.6	7.8
Professionals	15	16	13
Semi-Prof. & Techn.	6.3	5.5	5.6
Supervisors	1.7	1.7	1.2
Foremen/Women	3.3	3.2	1.7
Adm. & Snr. Clerical	7.4	6.3	4.6
Sales/Service (Skill Level 3)	4.4	5	5.7
Skilled Crafts/Trades	8.2	8.6	7.1
Clerical Workers	12	10.5	11.4
Sales/Service (SL. 2)	11.2	9.3	10.4
Semi-Skilled/Manual	10.5	10.5	14.7
Sales/Service (SL. 1)	6.2	6.7	10.6
Other Manual Workers	3.2	3.6	4.8
All Occupations	**100**	**100**	**100**
Industries:			
Agriculture	2.2	1.2	1.5
Other Primary Indus.	2.7	1.4	0.8
Manufacturing	14.5	19.5	22.6
Construction	5.9	6.3	4.7
Transportation	4.5	3.8	3
Communication	4.3	3.4	2
Wholesale Trade	4.7	4.4	4.7
Retail Trade	11.2	10.6	11.4
Finance, Insurance & Real Estate	6.7	7.1	7.7
Business Services	5.2	6	7.3
Govt. Services (Federal)	4.4	2.5	1.3
Govt. Services (Other)	5.6	4.1	2.3
Educational Services	8.4	9	4.7
Health & Social Services	10.2	9.7	8.9
Accom/Food/Beverage Services	4.4	5.3	9.6
Other Services	5.1	5.7	7.3
All Industries	**100**	**100**	**100**
No. of Observations	143557	33021	15457

Source: 1991 Census Public Use Sample Tapes and Author's Calculations.

Table 2
Unconstrained Wage Equations (Using OLS Estimation)
Dependent Variable: Hourly Wage

Variable	Canadians Coefficient	T-Statistic	Old F-B Coefficient	T-Statistic	New F-B Coefficient	T-Statistic
CONST.	-5.52	-2.26	-18.76	-3.22	-2.93	-0.58
EDUC	1.01	16.03	0.94	10.18	0.61	5.51
EXP	0.42	8.96	0.29	3.20	0.38	3.52
EXP2	-0.0049	-4.69	-0.0018	-1.02	-0.006	-2.56
MARRIED	1.14	3.26	2.20	3.11	1.85	2.31
YSM			0.089	3.56	0.14	2.59
$(P_o/P_c)^{1/2}$	1.42	3.48				
$(P_n/P_c)^{1/2}$	-1.27	-2.66				
$(P_c/P_o)^{1/2}$			4.32	1.01		
$(P_n/P_o)^{1/2}$			1.04	2.72		
$(P_c/P_n)^{1/2}$					-1.88	-0.47
$(P_o/P_n)^{1/2}$					36.03	1.58
Adj. R^2	0.048		0.018		0.0083	
No. of Obs.	143557		33021		15457	

Key to Variables

1. EDUC = Years of schooling
2. EXP = Experience = AGE - EDUC - 5 (Following the standard Mincer (1974) proxy)
3. EXP2 = Experience squared
4. MARRIED = 1 if married; and Zero otherwise.
5. YSM = Years since migration (for only foreign-born).
6. $(P_o/P_c)^{1/2}$ = ratio of old foreign-born workers to Canadian-born workers etc.
7. All regressions include a vector of industry dummies at the level of aggregation indicated in Table 1.

Table 3
Symmetry Constrained Wage Equations
Dependent Variable: Hourly Wage

Variable	Canadians Coefficient	T-Statistic	Old F-B Coefficient	T-Statistic	New F-B Coefficient	T-Statistic
CONST.	-11.70	-3.26	-3.24	-0.89	1.54	0.37
EDUC	0.97	8.59	0.86	9.59	0.62	5.94
EXP	0.52	6.00	0.35	4.10	0.38	3.39
EXP2	-0.0064	-3.38	-0.0031	-1.90	-0.006	-2.44
MARRIED	2.74	4.47	1.91	2.99	1.89	2.37
YSM			0.085	3.17	0.14	2.41
$(P_o/P_c)^{1/2}$	1.21	2.20				
$(P_n/P_c)^{1/2}$	-0.31	-0.51				
$(P_c/P_o)^{1/2}$			1.21	2.20		
$(P_n/P_o)^{1/2}$			-0.18	-0.79		
$(P_c/P_n)^{1/2}$					-0.31	-0.51
$(P_o/P_n)^{1/2}$					-0.18	-0.79

Key to Variables: See Table 2.

Table 4
Hicksian Elasticities of Complementarity Using Constrained Wage Equations

Technology Parameter	Estimate	Elasticity of Complementarity
γ_{oc}	1.21	0.112
	(2.20)	
γ_{nc}	-0.31	-0.028
	(-0.51)	
γ_{no}	-0.18	-0.04
	(-0.79)	
γ_{cc}	-11.70	-1.09
	(-3.26)	
γ_{oo}	-3.24	-5.40
	(-0.89)	
γ_{nn}	1.54	-3.16
	(0.37)	

T-ratios are in parenthesis.

Table 5
Constrained Wage Equations: Using Instruments for Employment Variables
Dependent Variable: Hourly Wage

Variable	Canadians Coefficient	T-Statistic	Old F-B Coefficient	T-Statistic	New F-B Coefficient	T-Statistic
CONST.	-12.55	-4.02	-3.63	-1.003	1.79	0.42
EDUC	0.97	8.48	0.86	9.64	0.61	5.39
EXP	0.52	6.01	0.34	4.09	0.38	3.38
EXP2	-0.0065	-3.41	-0.0031	-1.89	-0.0059	-2.46
MARRIED	2.73	4.55	1.91	2.94	1.87	2.32
YSM			0.087	3.31	0.13	2.36
$(P_o/P_c)^{1/2}$	1.89	2.92				
$(P_n/P_c)^{1/2}$	-1.04	-1.46				
$(P_c/P_o)^{1/2}$			1.89	2.92		
$(P_n/P_o)^{1/2}$			-0.15	-0.55		
$(P_c/P_n)^{1/2}$					-1.04	-1.46
$(P_o/P_n)^{1/2}$					-0.15	-0.55

Table 6
Hicksian Elasticities: Instrumented Constrained Wage Equations

Technology Parameter	Estimate	Elasticity of Complementarity
γ_{oc}	1.89	0.175
	(2.92)	
γ_{nc}	-1.04	-0.093
	(-1.46)	
γ_{no}	-0.15	-0.033
	(-0.55)	
γ_{cc}	-12.55	-1.13
	(-4.02)	
γ_{oo}	-3.63	-5.49
	(-1.003)	
γ_{nn}	1.79	-3.10
	(0.42)	

T-ratios are in parenthesis.

Table 7
Unconstrained Wage Regressions Disaggregated by Selected Occupational Groups
Dependent Variable: Hourly Wage

Variable	Canadian Prof.	Canadian Skilled	Canadian Unskilled	F-Born Prof	F-Born Skilled	F-Born Unskilled
CONST.	-26.25	-17.82	-14.74	-6.35	16.59	10.03
	(-2.04)	(-2.17)	(-1.75)	(-0.71)	(1.49)	(1.25)
EDUC	1.37	0.59	0.42	0.94	0.41	0.32
	(9.81)	(8.09)	(4.89)	(8.09)	(4.14)	(3.50)
EXP	0.68	0.31	0.17	0.62	0.25	0.08
	(7.23)	(5.68)	(2.95)	(6.82)	(2.67)	(1.05)
EXP2	-0.0054	-0.0031	-0.0009	-0.0056	-0.0023	0.0002
	(-2.48)	(-2.69)	(-0.81)	(-2.85)	(-1.26)	(0.11)
MARRIED	1.17	0.67	1.02	2.15	1.52	0.91
	(1.89)	(1.76)	(2.15)	(3.51)	(2.16)	(1.31)
YSM				0.026	0.008	0.03
				(2.11)	(0.49)	(2.25)
$(P_{cs}/P_{cp})^{1/2}$	1.30					
	(1.08)					
$(P_{cu}/P_{cp})^{1/2}$	-0.46					
	(-0.63)					
$(P_{ip}/P_{cp})^{1/2}$	-0.57					
	(-0.36)					
$(P_{is}/P_{cp})^{1/2}$	2.08					
	(1.01)					
$(P_{iu}/P_{cp})^{1/2}$	-0.86					
	(-0.85)					
$(P_{cp}/P_{cs})^{1/2}$		135.01				

		(2.14)				
$(P_{cu}/P_{cs})^{1/2}$		0.77				
		(1.56)				
$(P_{ip}/P_{cs})^{1/2}$		-3.42				
		(-3.28)				
$(P_{is}/P_{cs})^{1/2}$		5.64				
		(4.47)				
$(P_{iu}/P_{cs})^{1/2}$		-2.09				
		(-3.18)				
$(P_{cp}/P_{cu})^{1/2}$			-153.20			
			(-1.63)			
$(P_{cs}/P_{cu})^{1/2}$			353.51			
			(2.91)			
$(P_{ip}/P_{cu})^{1/2}$			0.93			
			(0.59)			
$(P_{is}/P_{cu})^{1/2}$			-0.81			
			(-0.44)			
$(P_{iu}/P_{cu})^{1/2}$			0.28			
			(0.29)			
$(P_{cp}/P_{ip})^{1/2}$				22.38		
				(0.51)		
$(P_{cs}/P_{ip})^{1/2}$				20.69		
				(0.37)		
$(P_{cu}/P_{ip})^{1/2}$				-41.22		
				(-1.25)		
$(P_{is}/P_{ip})^{1/2}$				0.44		
				(0.49)		
$(P_{iu}/P_{ip})^{1/2}$				-0.19		
				(-0.42)		
$(P_{cp}/P_{is})^{1/2}$					19.61	
					(0.39)	
$(P_{cs}/P_{is})^{1/2}$					-21.34	
					(-0.33)	
$(P_{cu}/P_{is})^{1/2}$					1.28	
					(0.034)	
$(P_{ip}/P_{is})^{1/2}$					-86.62	
					(-1.08)	
$(P_{iu}/P_{is})^{1/2}$					-0.26	
					(-0.51)	
$(P_{cp}/P_{iu})^{1/2}$						-86.3
						(-1.41)
$(P_{cs}/P_{iu})^{1/2}$						189.6
						(2.39)
$(P_{cu}/P_{iu})^{1/2}$						-82.75
						(-1.71)
$(P_{ip}/P_{iu})^{1/2}$						-20.93
						(-0.21)
$(P_{is}/P_{iu})^{1/2}$						-61.02
						(-0.45)
Adj. R^2	0.026	0.023	0.011	0.039	0.008	0.006
No. of Obs.	41337	42272	59948	13595	14163	23211

Key to Variables:

1. $(P_{cs}/P_{cp})^{1/2}$ = ratio of Canadian skilled workers to Canadian professional workers.
2. $(P_{ip}/P_{cp})^{1/2}$ = ratio of immigrant (foreign-born) professional workers to Canadian professional workers etc.
3. All regressions include a vector of industry dummies at the level of aggregation indicated in Table 1.
4. T-ratios are in parenthesis.

Table 8
Symmetry Constrained and Instrumented Wage Regressions Disaggregated by Selected Occupational Groups; Dependent Variable: Hourly Wage

Variable	Canadian Prof.	Canadian Skilled	Canadian Unskilled	F-Born Prof.	F-Born Skilled	F-Born Unskilled
CONST.	27.91	-37.35	1.67	-7.67	-0.04	7.71
	(2.03)	(-1.78)	(0.73)	(-1.91)	(-0.0067)	(5.15)
EDUC	1.23	0.46	0.57	0.63	0.63	0.33
	(9.35)	(4.18)	(4.45)	(8.34)	(8.33)	(3.21)
EXP	0.68	0.45	0.23	0.66	0.23	0.16
	(7.54)	(6.03)	(2.45)	(6.83)	(2.38)	(1.44)
EXP2	-0.0068	-0.007	-0.0027	-0.0068	-0.0013	-0.0015
	(-3.28)	(-4.32)	(-1.35)	(-3.38)	(-0.67)	(-0.66)
MARRIED	2.86	2.18	2.11	2.13	1.54	1.18
	(5.03)	(4.08)	(2.99)	(3.42)	(2.24)	(1.18)
YSM				0.025	0.012	0.044
				(1.99)	(0.77)	(2.23)
$(P_{cs}/P_{cp})^{1/2}$	-7.02					
	(-2.41)					
$(P_{cu}/P_{cp})^{1/2}$	3.64					
	(1.81)					
$(P_{ip}/P_{cp})^{1/2}$	-5.01					
	(-2.62)					
$(P_{is}/P_{cp})^{1/2}$	1.11					
	(0.47)					
$(P_{iu}/P_{cp})^{1/2}$	1.89					
	(1.41)					
$(P_{cp}/P_{cs})^{1/2}$		-7.02				
		(-2.41)				
$(P_{cu}/P_{cs})^{1/2}$		3.01				
		(1.77)				
$(P_{ip}/P_{cs})^{1/2}$		-0.19				
		(-0.18)				
$(P_{is}/P_{cs})^{1/2}$		-2.33				
		(-0.96)				
$(P_{iu}/P_{cs})^{1/2}$		2.07				
		(1.43)				
$(P_{cp}/P_{cu})^{1/2}$			3.64			
			(1.81)			
$(P_{cs}/P_{cu})^{1/2}$			3.01			
			(1.77)			
$(P_{ip}/P_{cu})^{1/2}$			-1.93			
			(-1.40)			

$(P_{is}/P_{cu})^{1/2}$	1.33			
	(0.69)			
$(P_{iu}/P_{cu})^{1/2}$	0.65			
	(0.47)			
$(P_{cp}/P_{ip})^{1/2}$		-5.01		
		(-2.62)		
$(P_{cs}/P_{ip})^{1/2}$		-0.19		
		(-0.18)		
$(P_{cu}/P_{ip})^{1/2}$		-1.93		
		(-1.40)		
$(P_{is}/P_{ip})^{1/2}$		0.67		
		(0.79)		
$(P_{iu}/P_{ip})^{1/2}$		-0.09		
		(-0.15)		
$(P_{cp}/P_{is})^{1/2}$			1.11	
			(0.47)	
$(P_{cs}/P_{is})^{1/2}$			-2.33	
			(-0.96)	
$(P_{cu}/P_{is})^{1/2}$			1.33	
			(0.69)	
$(P_{ip}/P_{is})^{1/2}$			0.67	
			(0.79)	
$(P_{iu}/P_{is})^{1/2}$			0.06	
			(0.20)	
$(P_{cp}/P_{iu})^{1/2}$				1.89
				(1.41)
$(P_{cs}/P_{iu})^{1/2}$				2.07
				(1.43)
$(P_{cu}/P_{iu})^{1/2}$				0.65
				(0.47)
$(P_{ip}/P_{iu})^{1/2}$				-0.09
				(-0.15)
$(P_{is}/P_{iu})^{1/2}$				0.06
				(0.20)

T-ratios are given in parenthesis.

Table 9
Hicksian Elasticities from Constrained and Instrumented Wage Equations (Selected Occupational Groups).

Technology Parameter	Estimate	Elasticity of Complementarity
$\alpha_{cs,cp}$	-7.02	-0.80
	(-2.41)	
$\alpha_{cu,cp}$	3.64	0.39
	(1.81)	
$\alpha_{ip,cp}$	-5.01	-0.71
	(-2.62)	
$\alpha_{is,cp}$	1.11	0.19
	(0.47)	
$\alpha_{iu,cp}$	1.89	0.31
	(1.41)	
$\alpha_{cu,cs}$	3.01	0.41
	(1.77)	
$\alpha_{ip,cs}$	-0.19	-0.034
	(-0.18)	
$\alpha_{is,cs}$	-2.33	-0.52
	(-0.96)	
$\alpha_{iu,cs}$	2.07	0.43
	(1.43)	
$\alpha_{ip,cu}$	-1.93	-0.33
	(-1.40)	
$\alpha_{is,cu}$	1.33	0.28
	(0.69)	
$\alpha_{iu,cu}$	0.65	0.13
	(0.47)	
$\alpha_{is,ip}$	0.67	0.19
	(0.79)	
$\alpha_{iu,ip}$	-0.09	-0.023
	(-0.15)	
$\alpha_{iu,is}$	0.056	0.018
	(0.20)	
$\alpha_{cp,cp}$	27.91	0.44
	(2.03)	
$\alpha_{cs,cs}$	-37.35	-7.84
	(-1.78)	
$\alpha_{cu,cu}$	1.67	-1.59
	(0.73)	
$\alpha_{ip,ip}$	-7.67	-7.19
	(-1.91)	
$\alpha_{is,is}$	-0.04	-6.53
	(-0.007)	
$\alpha_{iu,iu}$	7.71	-2.19
	(5.15)	

T-ratios are given in parenthesis.

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