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ABSTRACT

We present hedonic general-equilibrium estimates of quality-of-life and productivity differences across Canada's metropolitan areas. These are based off of the estimated willingness-to-pay of heterogeneous households and firms to locate in various cities, which differ in their wage levels, housing costs, and land values. Using 2006 Canadian Census data, our metropolitan quality-of-life estimates are somewhat consistent with popular rankings, but find Canadians care more about climate and culture. Quality-of-life is highest in Victoria for Anglophones, Montreal for Francophones, and Vancouver for Allophones, and lowest in more remote cities. Toronto is Canada's most productive city; Vancouver is the overall most valuable city.

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1 Introduction

Wage and cost-of-living levels vary significantly across Canadian cities and provinces, despite the fact that capital and labor are largely mobile within Canada's borders. Coulombe and Lee (1995) and Coulombe (2000) find that income and price levels converged significantly between 1960 and 1980, but have converged relatively little since then. These persistent differences in wages and prices are most naturally explained by persistent differences in local advantages to households and firms, broadly termed as "amenities." To clarify terminology, we say consumption amenities determine an area's overall quality of life (QOL), while production amenities determine an area's overall productivity. The primary goal of this paper is to identify the overall differences in quality-of-life and productivity levels across Canadian cities.

Some places in Canada have undeniable advantages over others. Most Canadians live south, close to the United States border, where the climate is warmer and trading costs are lower than further north. Canadians are acutely aware of regional disparities in natural resource wealth, from oil in Alberta, forests in British Columbia, to depleted fish stocks in the Atlantic provinces. Much of the population is concentrated in a handful of large cities, which benefit from sizable agglomeration economies and vast cultural opportunities, but also suffer disproportionately from urban disamenities such as crime, pollution, and congestion. Strong local and provincial governments, as well as differential treatment of regions by the federal government, also lead to geographic differences in public services and taxation.

While some places appear more advantaged than others, much of the population is still located in less advantaged areas. Although heterogeneity in household tastes and production technologies may help explain this, the importance of heterogeneity should not be overstated: most individuals prefer temperatures above -40, and most firms benefit from low transportation costs. Furthermore, many Canadians are quite mobile over their lifetime and have only limited local attachments (e.g. Bernard et al. 2008).

In this setting, households and firms in areas with less advantageous amenities should be largely compensated by more advantageous local prices. Specifically, households in areas with lower QOL should be compensated either through higher nominal wages or lower costs-of-living. Firms in less productive areas should be compensated through either lower labor or non-labor costs. This is the essence of the methodology of Rosen (1979) and Roback (1982), which has been used extensively by researchers to measure QOL and productivity differences in the United States (e.g. Blomquist et al. 1988, Beeson and Eberts 1989; Gyourko and Tracy 1991; Gabriel and Rosenthal 2004; Shapiro 2006; Chen and Rosenthal 2008).

Surprisingly, this popular methodology has never been applied to Canadian data. We explain this theory in Section 2, using the framework by Albouy (2008a, 2009b), which realistically incorporates federal taxes and produced non-tradable goods, such as housing, in a manner that Roback (1982) suggested, but never implemented. In Section 3, we explain how we calibrate this model for Canada, and use the 2006 Census microdata to estimate wage and housing-cost differences across Census Metropolitan Areas (CMAs), so as to infer QOL and productivity differences across CMAs.

Several issues arise in applying the Rosen-Roback framework to Canada. First, while most areas of Canada are mainly English-speaking, areas such as Quebec, are predominantly French-speaking, while areas such as New Brunswick, are largely bilingual. Different language groups naturally have preferences for different areas, as most would prefer to live where their mother tongue is predominant. Roback (1988) and Beeson (1991) estimate QOL advantages for different groups defined by education groups; we estimate QOL for groups defined by mother tongue, a more pre-determined characteristic. We also discuss, for what appears to be the first time, how the model may be aggregated across types, and be used to estimate productivity differences across groups.

Second, unionization rates in Canada are still high relative to the United States, but vary across regions. This means that some areas may have high real wage levels not because of low amenities, but because of a strong union presence. We find it most plausible to assume that union wage premia do not reflect urban productivity or QOL differences, and use wage estimates purged of unionization effects.

Third, federal and provincial governments play a large role in taxing income and redistributing it through intergovernmental transfers. The role of taxes on residents is dealt with in the model using adjustments in Albouy (2008a; 2009a). It is less clear how the model should accommodate intergovernmental transfers and fiscal disparities due to natural resource wealth, documented in Albouy (2010). Thus, we exclude these from the main analysis, and consider them in alternative results at the end.

According to our estimates in Section 4, the CMA with the highest QOL is Victoria, followed by the BC CMAs of Vancouver, Kelowna, Abbotsford, and then Toronto, Calgary, and Montreal. The rankings for different language groups are almost completely mutually consistent in CMAs with significant quantities of each: Anglophones, Francophones, and Allophones all seem to prefer Montreal to Ottawa-Hull.

Our estimates of the productivity in tradeables, also the first of their kind for Canada, reveal Toronto to be the most productive CMA, followed by Calgary, Oshawa, Vancouver, and Ottawa-Hull. While the QOL of Anglophones in Montreal appears to be almost the same as in Toronto, their productivity is lower than that of Anglophones in Kingston. This is consistent with the reasoning in Albouy (2008b) that, since 1970, Anglophones fled Montreal more from a loss of jobs than a loss of amenities.

Under the assumption that there are no sizable differences in unobservable heterogeneity in the productivity of non-tradeables, we create aggregate measures of the value of urban amenities to households and firms, i.e. QOL and productivity in tradeables. According to this metric, the most valuable CMA per hectare is Vancouver, followed by Victoria, Toronto, Calgary, Kelowna, and Montreal.[1]

While QOL greatly interests policy-makers and the general population, published indicators of QOL for Canadian cities consist broadly of weighted sums of arbitrarily chosen amenities, with ad hoc weights. Such indices are found in *Cities Ranked & Rated*, *Places Rated Almanac*, and *Mercer's Quality-of-Living Reports*. These shed light into what cities people appreciate the most only to the extent that the ad-hoc weighting schemes used in their calculations actually reflect peoples' values. The willingness-to-pay methodology implemented here instead makes use of data on local wages and housing costs to identify the aggregate value of the different amenities. We show in Section 5 that our estimates are generally in line with the popular rankings, but that households put more weight on climate and arts and culture. Finally, in Section 6 we consider how our estimates would be influenced by including intergovernmental transfers, alternative price data from the CPI, or using housing-cost data from rental units alone.[2]

2 Theoretical Model of Spatial Equilibrium

Quality-of-life and productivity differences across cities are measured from wage and housing-cost differences across cities using the theoretical framework of Albouy (2008a, 2009a). This framework builds upon that of Rosen (1979) and Roback (1982), but also accounts for non-labor income, housing production,

[1] It should be noted that these rankings would change if interprovincial fiscal advantages were efficiently "equalized," as proposed in Albouy (2010): in this case, cities in the Atlantic and Prairie provinces fall in value, while those in Ontario rise.

[2] To our knowledge, the only attempt to measure QOL across Canadian cities in an economic framework, distantly related to the one here, is Giannias (1998), who does so for 13 cities using 1981 data. This work measures QOL according to how housing costs co-vary with six amenity measures, controlling for three housing characteristics, and assuming that incomes do not depend on where households locate. This methodology depends on a highly parametric model with strict normality assumptions and a linear housing price equation, which departs from more established log-linear specifications. Our model instead endogenizes wage differences, controls for many worker and housing characteristics, is independent of any set of chosen amenities, and is illustrated through graphs mapping the relationship of wage and housing-cost differences to QOL and productivity differences. Furthermore, our analysis covers all 33 currently defined Census Metropolitan Areas (CMAs), which we sometimes refer to as "cities," as well as the non-metropolitan areas of Canada, organized by province or territory.

cost-of-living differences from non-housing sources, and inequalities in both federal and provincial taxation. Furthermore, we account for multiple household types to allow for language groups, like Roback (1988) and Beeson (1991), but in a richer setting that deals with issues of aggregation and productivity measurement.

2.1 Setup

The national economy contains many cities, indexed by j, which trade with each other and share several types of mobile households, indexed by $g \in \{1,..,G\}$. The population in city j is denoted as the vector $\mathbf{N}^j = (N_1^j, ..., N_G^j)$. Each household consumes a numeraire traded good, x, and a group-specific non-traded local good,[3] y_g, with local price, p_g^j, which varies by city and type. This accounts for the possibility that households may consume housing in different neighborhoods or goods produced disproportionately by their own type (e.g. Anglophones in Montreal live in certain neighborhoods and are more likely to consume services produced by other Anglophones). In the empirical implementation of the model, the price of local goods for type g is equated with the cost of housing paid by that type.[4]

Firms produce traded and local goods out of land, capital, and labor. Within a city, factors receive the same payment in either sector. Land, L, within each city is homogenous and immobile, and is paid a city-specific price r^j; each city's land supply, $L^j(r)$, may depend positively on r^j, with a finite elasticity $\varepsilon_{L,r}^j \in [0.\infty)$.[5] Capital, K, is costlessly mobile across cities, and is paid the price $\bar{\imath}$ everywhere: this price may be set either nationally or internationally, although for simplicity net foreign asset holdings are set to zero. Households of each type g, N_g, are perfectly mobile within the country, have identical tastes and endowments, and each supplies a single unit of labor. Because households care about local prices and QOL, wages, denoted by the vector $\mathbf{w}^j = (w_g^j, ..., w_G^j)$, may vary across cities. The national number of worker-households is fixed at $\mathbf{N}^{TOT} = (N_1^{TOT}, ..., N_G^{TOT})$, so that the sum of populations across cities $\sum_j \mathbf{N}^j = \mathbf{N}^{TOT}$. Households of each type own identical diversified portfolios of land and capital, which pay an income R_g from land and I_g from capital, regardless of the city they live in. Gross income, $m_g^j \equiv$

[3]The productivity differences in non-traded goods may be quite variable. Without separate data on land values across cities, it is nearly impossible to identify them. However, Albouy (2009b) shows that this does not bias the quality-of-life estimates, and has only a minor bias on the trade-productivity estimates for reasonable calibrations.

[4]As shown in Roback (1980), the use of a single traded good may be used to approximate the case of multiple goods. Factor-price equalization, as in the Hecksher-Ohlin model of trade does not occur, because factors are mobile and many cities may specialize in the production of fewer tradable goods than factors. Furthermore, non-housing goods may be considered to be a combination of traded goods and non-housing local goods.

[5]The assumption of homogenous land is used for simplicity, as we do not directly observe land values in any of our datasets. As discussed in Albouy and Lue (2011), land values within CMAs may differ significantly because of local amenities as well as transportation costs. Our estimates may be taken as an average of the value of land within a city. Our QOL estimates implicitly include a penalty for areas with higher transportation costs.

$R_g + I_g + w_g^j$, varies across cities only as wages vary. Out of this income households pay a federal income tax of $\tau\left(m_g\right)$, which is redistributed in lump-sum transfers by city, T_g^j, which may vary by city. For expositional ease, provincial taxes are discussed in the Appendix.

Cities differ in two types of attributes: quality of life, which raises household utility and is given by the vector $\mathbf{Q}^j = (Q_1^j, ..., Q_G^j)$, and productivity in the traded-good sector, which varies by factor and is given by the vector $\mathbf{A}^j = (A_1^j, ..., A_G^j, A_L^j, A_K^j)$. These attributes, in turn, depend on a vector of amenities, $\mathbf{Z}^j = (Z_1^j, ..., Z_k^j)$, natural or artificial, according to some unknown functions $\mathbf{Q}^j = \widetilde{Q}\left(\mathbf{Z}^j\right)$ and $\mathbf{A}^j = \widetilde{A}\left(\mathbf{Z}^j\right)$. For a consumption amenity, e.g. safety or clement weather, $\partial \widetilde{Q}_g / \partial Z_k > 0$; for a production amenity, e.g. navigable water or agglomeration economies, $\partial \widetilde{A}_g / \partial Z_k > 0$. It is possible that a single amenity affects both productivity and QOL.[6]

Household preferences are modeled by a utility function $U_g\left(x, y_g; Q_g\right)$, that is quasi-concave over x and y_g, and increasing in Q_g. The expenditure function for a worker of type g in city j is $e_g(p_g^j, u_g; Q_g^j) \equiv \min_{x,y}\{x + p_g^j y : U_g(x, y; Q_g^j) \geq u_g\}$. Q_g is normalized so that $e_g(p_g^j, \bar{u}_g; Q_g^j) = e_g(p_g^j, \bar{u}_g)/Q_g^j$, where $e_g(p_g^j, \bar{u}_g) \equiv e_g(p_g^j, \bar{u}_g; 1)$, meaning that one-percent increase in Q_g is equivalent to a one-percent increase in disposable income. Since households are fully mobile, their utility must be the same across all the cities that they inhabit. Thus, the after-tax income households earn in each city should equal the expenditure needed to obtain the common level of utility, $\bar{u}_g$, given local prices and QOL:[7]

$$e_g(p_g^j, \bar{u}_g; Q_g^j) = m_g^j - \tau(m_g^j) + T_g^j \tag{1}$$

for all types g and cities j where $N_g^j > 0$.

All input and goods markets are perfectly competitive, and firms produce under constant returns to scale. Let the vector $\mathbf{A}_N^j = (A_1^j, ..., A_G^j)$ denote labor productivity, the vector $\mathbf{N}_X^j = (N_{1X}^j, ...N_{GX}^j)$ denote labor used to produce the traded good, and $\mathbf{N}_{Yg}^j = (N_{Yg1}^j, ..., N_{YgG}^j)$ denote the labor used to produce each local good g, with $\mathbf{N}_Y^j = \sum_g \mathbf{N}_{Yg}^j$; similar notation is used for land and capital, with $L_Y^j = \sum_g L_{Yg}^j$, etc. Then the production functions of representative traded-good and local-good firms are $X^j = F_X(\mathbf{A}_N^j \cdot$

[6] It is worth noting that amenities may be endogenous to quantities in the model, and that this poses different problems when measuring values by using comparative statics. For example, an increase in population, N^j, may lead to greater pollution, lowering Q^j. If a city were to receive a theme-park, improving Q, this would raise N, raising pollution, and indirectly decreasing Q. The value of the theme-park could be measured empirically by controlling for pollution, although the value when accounting for pollution externalities should not control for pollution. Both direct and indirect effects of amenities have to be taken into account when using comparative statics to determine the causal effect of an amenity on the attributes and prices in a city.

[7] The mobility condition need not apply to all households, but only a sufficiently large subset of mobile marginal households.

$\mathbf{N}_X^j, A_L^j L_X^j, A_K^j K_X^j)$ and $Y_g^j = F_{Yg}(\mathbf{N}_{Yg}^j, L_{Yg}^j, K_{Yg}^j)$, for all g, where F_X and F_{Yg} are concave and exhibit constant returns to scale. All factors are fully employed: $\mathbf{N}_X^j + \mathbf{N}_Y^j = \mathbf{N}^j$, $L_X^j + L_Y^j = L^j$ and $K_X^j + K_Y^j = K^j$. Unit cost in the traded-good sector is $c_X(\mathbf{w}^j, r^j, \bar{\imath}; A^j) \equiv \min_{\mathbf{N},L,K}\{\mathbf{w}^j \cdot \mathbf{N} + r^j L + \bar{\imath} K : F_X(\mathbf{A}_N^j \cdot \mathbf{N}_X^j, A_L^j L_X^j, A_K^j K_X^j) = 1\}$. As markets are competitive, firms make zero profits in equilibrium, so that

$$c_X(\mathbf{w}^j, r^j, \bar{\imath}; A^j) = 1 \tag{2}$$

in all cities j. A symmetric definition holds for the unit costs in the local-good sectors, c_{Yg}, except that, because of data limitations, we assume uniform productivity for all g and j

$$c_{Yg}(\mathbf{w}^j, r^j, \bar{\imath}) = p_g^j \tag{3}$$

for all types g and cities j where $N_g^j > 0$.

Scalars with superscripts j refer to city-specific values, while those without superscripts refer to national averages. The share of all income that goes to households of type g is denoted $\mu_g \equiv N_g^{TOT} m_g / (\sum_{g'} N_{g'}^{TOT} m_{g'})$, with $\boldsymbol{\mu} = (\mu_1, ..., \mu_G)$; within a city, the comparable notation is $\boldsymbol{\mu}^j = (\mu_1^j, ..., \mu_G^j)$. For households, denote the average share of gross expenditures spent on traded goods and local goods as $s_{xg} \equiv x_g/m_g$ and $s_{yg} \equiv p_g y_g / m_g$; denote the shares of income received from labor, land, and capital income as $s_{wg} \equiv w_g/m_g$, $s_{Rg} \equiv R_g/m_g$, and $s_{Ig} \equiv I_g/m_g$. Each share may be put into a vector of the form $\mathbf{s}_x = (s_{x1}, ..., s_{xG})$. Using averages, it is possible to write the aggregate expenditure shares, $s_y = \boldsymbol{\mu} \cdot \mathbf{s}_y$, and income shares $s_w = \boldsymbol{\mu} \cdot \mathbf{s}_w$, and so on. For firms producing traded goods, denote the cost shares of labor, land, and capital as $\theta_{Ng} \equiv w_g N_{Xg}/X$, $\theta_L \equiv r L_X / X$, and $\theta_K \equiv \bar{\imath} K_X / X$, with $\boldsymbol{\theta}_N = (\theta_{N1}, ..., \theta_{NG})$, and the overall labor-cost share $\theta_N = \sum_g \theta_{Ng}$. Denote similarly-defined cost shares in the local -good sector $\boldsymbol{\phi}_{gN}$, ϕ_{gL}, and ϕ_{gK}, with the cost-share of local -good g from labor type g' given by $\phi_{gNg'}$, so that $\boldsymbol{\phi}_{gN} = (\phi_{gN1}, ..., \phi_{gNG})$.

2.2 Measuring Quality of Life and Productivity

We begin by considering the case of where there is only one type of household, and continue with an explanation of multiple types, showing under what assumptions we may aggregate results to reproduce the single-type case.

2.2.1 Single Household Type

To analyze the effect of city attributes on prices we log-linearize the equilibrium conditions (1), (2), and (3) around the national average. Thus, for any variable z, $\hat{z}^j = \ln z^j - \ln \bar{z} \cong \left(z^j - \bar{z}\right)/\bar{z}$, approximates the percent difference in city j of z relative to the geometric average $\bar{z}$, which is the value for a nationally representative city. Log-linearized versions of (1), (2), and (3) describe how prices co-vary with city attributes.

$$\hat{Q}^j = s_y \hat{p}_j - s_w (1 - \tau')\hat{w}^j - dT^j/m \tag{4a}$$

$$\hat{A}^j = \theta_N \hat{w}^j + \theta_L \hat{r}^j \tag{4b}$$

$$\hat{p}^j = \phi_N \hat{w}^j + \phi_L \hat{r}^j \tag{4c}$$

These equations are first-order approximations around a nationally-representative city and so the share values are national averages. Equation (4a) measures the QOL differential, $\hat{Q}^j$, from how high the cost-of-living, $s_y \hat{p}^j$, is relative to after-tax nominal income, $s_w(1-\tau')\hat{w}^j$, and transfer differences, expressed as a fraction of income, dT^j/m. Thus, $\hat{Q}^j$ expresses the fraction of income households are willing to pay – or if negative, to accept – to live in city j relative to a city with an average QOL. Equation (4b) measures the productivity differential, $\hat{A}^j$, from how high the labor costs, $\theta_N \hat{w}^j$, and land costs, $\theta_L \hat{r}^j$, are in traded-good production. It measures the percent cost-savings that firms experience from locating in city j relative to the national average. Equation (4c), constrains the local-good price differential, $\hat{p}^j$, to equal the labor-cost differential, $\phi_N \hat{w}^j$, plus the land-cost differential, $\phi_L \hat{r}^j$. It is safe to assume that local-goods are more land-intensive and less labor-intensive than traded goods, so that $\phi_L > \theta_L$ and $\theta_N > \phi_N$

In practice, wage and local -good price differentials are observable and so QOL differentials are measurable directly from (4a). Land-rents are generally unobserved, making it difficult to measure productivity directly from (4b). However, by assuming that local -good productivity is the same across cities, it is possible to infer both land-rent and productivity differentials using only data on local -good costs and wages

$$\hat{r}^j = \frac{1}{\phi_L}\left(\hat{p}^j - \phi_N \hat{w}^j\right) \tag{5}$$

$$\hat{A}^j = \frac{\theta_L}{\phi_L}\hat{p}^j + \left(\theta_N - \phi_N \frac{\theta_L}{\phi_L}\right)\hat{w}^j \tag{6}$$

Land rents are inferred in (5) by subtracting off the labor costs $\phi_N \hat{w}_j$ from $\hat{p}_j$ – which in the case of housing could be interpretable as construction costs – and dividing the remainder by the cost share of land, ϕ_L. The productivity measure in () is based off of nominal wage levels through, $\theta_N \hat{w}^j$, plus the cost share due to land, inferred through local-good prices. The coefficient $\theta_L/\phi_L > 1$ on reflects how much more local-good prices must be weighted when using them to proxy for land values, while the negative term in parentheses removes the double-counting of labor costs in $\hat{p}$.

The total value of amenity-differences for city j is equal to the QOL differential plus the productivity differential times its share of expenditure

$$\begin{aligned} \hat{\Omega}^j &= \hat{Q}^j + s_x \hat{A}^j \\ &= \frac{s_R}{\phi_L}\hat{p}^j + \left(\tau' s_w - \frac{s_R \phi_N}{\phi_L}\right)\hat{w}^j - \frac{dT^j}{m} \end{aligned} \tag{7}$$

The second equality, expressed in terms of observable variables, results from substituting in (4a) and (4b). Collecting terms and using (5), and simplifying, we obtain that the total amenity differential, which expresses the social value of land, is equal to the differential value of private land rents, measured as a percent of income, plus the fiscal externalities in terms of additional federal taxes paid net of federal transfers received.

$$\hat{\Omega}^j = s_R \hat{r}^j + \tau' s_w \hat{w}^j - dT^j/m \tag{8}$$

It is worth noting that if tradable goods are heterogeneous, a higher level of demand for goods produced disproportionately in city j may be conflated with a higher level of productivity. For instance, if the world price for oil is particularly high, and workers in Calgary are concentrated in the oil industry, then the marginal revenue product of workers in Calgary may be relatively high, even if their marginal physical product is not. Thus $\hat{A}^j$ may be interpreted as a combination of both real and pecuniary effects.

Furthermore, cities could also vary in their productivity of local goods. As discussed in Albouy (2009b), productivity in local goods cannot be identified without extensive data on land values, which is currently unavailable in Canada. Under our other assumptions, lack of such identification does not affect our measures of quality-of-life, $\hat{Q}^j$; the lack does cause our measures of tradable-good productivity, $\hat{A}^j$, to be slightly underestimated in cities where local-good productivity is high. Inferred land values both private, $\hat{r}$, and social, $\hat{\Omega}^j$, are more severely underestimated in such cities, but these are not central to our analysis.[8]

2.2.2 Multiple Household Types and Aggregation

With multiple types, the log-linearized version of the mobility condition (1) is

$$\hat{Q}_g^j = s_{yg}\hat{p}_g^j - s_{wg}(1-\tau_g')\hat{w}_g^j - dT^j/m_g \tag{9}$$

for each group g. Note that this requires each group's price and wage differentials, $\hat{p}_g^j$ and $\hat{w}_g^j$, but also each group's specific marginal tax rate, τ_g', expenditure share s_{yg} and income share s_{wg}. It is possible to define an aggregate quality-of-life index $\hat{Q}^j \equiv \boldsymbol{\mu}^j \cdot \hat{\mathbf{Q}}^j$ that is consistent with the single-type index in (4a) if we define the aggregate local -good price differential as $\hat{p}^j \equiv (1/s_y)\sum_g \mu_g^j s_{yg}\hat{p}_g^j$, the aggregate wage as differential as $\hat{w}^j \equiv (1/s_w)\sum_g \mu_g^j s_{wg}\hat{w}_g^j$, and assume that all groups face the same marginal tax rate τ'.

With multiple labor types, the zero-profit condition for tradable-good producing firms is $\hat{A}^j = \boldsymbol{\theta}_N \cdot \hat{\mathbf{w}}^j + \theta_L\hat{r}^j$, where $\hat{A}^j \equiv \boldsymbol{\theta}_N \cdot \hat{\mathbf{A}}_N^j + \theta_L\hat{A}_L^j + \theta_K\hat{A}_K^j$ which estimates productivity using the labor-cost measure with $\boldsymbol{\theta}_N^j \cdot \hat{\mathbf{w}}^j$. A potential problem with this approximation is that the local cost shares, $\boldsymbol{\theta}_N^j$, may vary considerably from the national ones, $\boldsymbol{\theta}_N$. But, when each group g's fraction of total labor costs in city j, θ_{Ng}^j/θ_N,is proportional to its share of total labor income in city j, i.e.,

$$\frac{\theta_{Ng}^j}{\theta_N} = \mu_g^j\frac{s_{wg}}{s_w} \quad \text{for all } g \tag{10}$$

the single wage measure proposed above, $\hat{w}^j$, reflects labor costs with local cost shares, $\boldsymbol{\theta}_N^j$, so that $\theta_N\hat{w}^j = \boldsymbol{\theta}_N^j \cdot \hat{\mathbf{w}}^j$. Thus, estimates from equation (4b) still measure overall productivity, as before, although they reflect the factors in proportion to how they are used locally, rather than nationally.

In Appendix A.1, we show that using this same assumption it is possible to estimate the land-rent differential using equation (5) from aggregate wage and housing-cost differences, using the approximations $\phi_L = (s_R - s_x\theta_L)/s_y$ and $\phi_N = (s_w - s_x\theta_N)/s_y$. Thus we can have a feasible estimate of productivity from (6) above that estimates the marginal productivity of land through residential housing. Furthermore, if federal marginal tax rates for groups are the same, then the total value of amenities is still given by (7).

[8] Higher productivity in non-tradables tends to lower wages and prices by a relatively small amount, and in the same proportion that trade productivity raises them. More generally, the measure of productivity we use strongly reflects higher levels of tradable productivity and, more weakly, lower levels of non-tradable productivity.

As households are perfectly mobile and each type has homogenous tastes, we should expect households to sort across CMAs according to their tastes for local amenities. The centrifugal forces of household preferences may be countered by centripetal forces in production, if different labor types are imperfectly substitutable. In fact, when labor types are imperfect substitutes, the relative productivity of individual types is not inferrable from wage and price information alone. Such inference also requires information on relative factor usage in the traded sector. Using the labor-demand equations for the traded sector, it is possible to show that the relative demand for labor depends on relative wages and relative productivity levels:

$$\hat{N}_{1X}^{j} - \hat{N}_{2X}^{j} = -\sigma_{12}(\hat{w}_{1}^{j} - \hat{w}_{2}^{j}) + (\sigma_{12} - 1)\,(\hat{A}_{1}^{j} - \hat{A}_{2}^{j}) \tag{11}$$

where σ_{12} is the elasticity of substitution between type-1 and type-2 labor.[9] Intuitively, this (along with fixed land supplies) produces downward sloping demand for particular labor types. For instance, one can imagine that producers of tradable output in Montreal could find that having a few native English speakers to be very productive for helping to export its products. However, because of provincial laws requiring the use of French in the workplace, these workers would be less productive than comparable native-French speakers if they were employed in equal proportion. Similarly, Allophones may have some idiosyncratic skills that are imperfect substitutes for those possessed by other language groups, much as Ottaviano and Peri (2006) found for immigrants relative to natives in the United States.

As derived in Appendix A.1.2, equation (11) implies that the productivity of one type is

$$\hat{A}_{2}^{j} = \frac{\theta_{N1}^{j}}{\theta_{N1}^{j} + \theta_{N2}^{j}} \frac{\hat{N}_{2X}^{j} - \hat{N}_{1X}^{j} + \sigma_{12}(\hat{w}_{2}^{j} - \hat{w}_{1}^{j})}{\sigma_{12} - 1} + \hat{A}^{j} \tag{12}$$

This formula implies that the greater the elasticity of substitution between the two labor types, the more important wage differences are relative to employment differences in reflecting productivity differences. When labor types are strong substitutes, wages must offset the productivity differences of different types: as $\sigma_{12} \to \infty$, $\hat{A}_{2}^{j} = (\hat{w}_{2}^{j} - \hat{w}_{1}^{j})\theta_{N1}^{j}/(\theta_{N1}^{j} + \theta_{N2}^{j}) + \hat{A}^{j}$, which in the case where N_1 and N_2 are the only two factors is just $\hat{A}_2 = \hat{w}_2$. But when substitution possibilities are more limited, firms are less able to bid up the relative wage of more productive labor, and information on relative factor usage becomes more important.

[9] This equation is often seen in the analysis of skill-biased technical change (e.g. Violante 2008).

3 Empirical Implementation

To apply our model to Canada, we estimate city-specific wage and price differentials using Census micro-data for the reference year 2005 and calibrate the cost, income, expenditure, and tax parameters from other sources.[10]

3.1 Data and the Estimation of Wage and Housing-Cost Differentials

We estimate wage and housing-cost differentials using the 20 percent sample of Canadian Census data from the 2006 Masterfile Microdata Files. Most of the differentials apply to a Census Metropolitan Area (CMA), which consist of municipalities located around an urban core with a population of at least 100,000. The remaining differentials are for non-CMA areas grouped by province. In total, there are 33 CMAs and 13 non-CMA areas.

3.1.1 Wage Differentials and Union Adjustments

The inter-urban wage differentials come from a sample of full-time workers, ages 25 to 55, and control for observable skill differences across workers. Thus, for each language group, determined by the mother tongue of the worker, we regress log wages on CMA-indicators (ν_w^j) and on extensive controls (X_w^i) in the equation $\ln w^{ij} = X_w^i \beta_w + \nu_w^j + \varepsilon_w^{ij}$.[11] The estimated values of ν_w^j, normalized to have a population-weighted average of zero, are our estimates of the log-wage differentials, $\hat{w}_g^j$. We interpret them as the causal effect of city characteristics on a worker's wage. Identifying these differentials requires that workers do not sort across cities according to their unobserved skills.[12] The overall differential for each city, $\hat{w}^j$, is equal to the average of the $\hat{w}_g^j$ for each language group, weighted by the number of workers in each city.[13]

[10]The reference year for the earnings is the 2005 calendar year. For housing costs, it is the monthly average over the past 12 months with the reference day of interview being May 16, 2006. For renters, it is the current monthly rent paid.

[11]We include a quartic in potential work experience, highest level education (12 indicators), field of study (17 indicators), occupation (24 indicators), industry (15 indicators), immigrant status interacted with the visible minority status (except for Aboriginal status), years since immigration, citizenship status and bilingualism interacted with mother tongue. These variables are all fully interacted with gender. Appendix B provides greater detail on the covariates and regressions. The estimates of the coefficients of the controls are available in an online appendix.

[12]This assumption may not hold completely: Glaeser and Maré (2001) argue that up to one third of the urban-rural wage gap could be due to selection, suggesting that at least two thirds of wage differentials are valid, although this issue deserves greater investigation. At the same time, it is possible that the estimates could be too small, as some control variables, such as occupation or industry, could depend on where the worker locates.

[13]Note that in practice, some workers live and work in different CMAs. We determine the CMA of a worker by their place of work, so that our productivity estimates are clearly characteristic of the city. The QOL estimates should on the whole be more accurate, since they will represent the wages and costs faced by workers with relatively modest commutes. Regardless, the results are almost identical if we assign wage differentials by place of residence, rather than place of work.

When controlling for location and additional controls, Allophones earn wages 19.7 percent lower than Anglophones while Francophones earn 2.9 percent less.[14] These differences within CMA's could be due to a variety of reasons, such as school quality or discrimination (Albouy 2008b).

As we document in Appendix Table A3, union coverage rates in Canada are high and differ substantially across CMAs, with coverage rates varying from 23 percent in Calgary to almost 50 percent in Quebec, Sherbrooke, and Thunder Bay. To the extent that wages reflect marginal productivity and unions raise them beyond this competitive rate, it is appropriate to adjust them in order to estimate productivity levels. It is theoretically ambiguous whether union wage premia should be discounted when estimating QOL. If union jobs are readily accessible to new migrants, and these higher premia are reflected in higher rents and other costs-of-living, then it would be inappropriate to discount the premia. However, if workers union wage premia do not result in higher local costs-of-living, then it is sensible to discount them. Otherwise, real incomes in highly unionized areas may be high relative to the local QOL, and QOL estimates in highly unionized areas will be biased downwards.

Unfortunately the Census data does not contain information on union coverage. We were able to calculate CMA-level unionization rates from the Labour Force Survey, although these rates are not available by mother tongue. We eliminate inferred union-wage premia by multiplying the union coverage rates by a premium of 7.7 log points, taken from Fang and Verma (2002), and subtracting them from the original estimates of $\hat{w}^j$, renormalizing them to have a population-weighted average value of zero.

The importance of the public sector varies greatly by cities. For example, a little less than 40 percent of workers are employed in the public sector in Ottawa compared to less than 15 percent in Toronto. Like unionization, this potentially has an impact on wages. To control for this, we account for the percentage of the workforce in each CMA that works in a public sector job.[15]

[14] Although these differentials control for what official languages the worker speaks, the Census does not indicate how proficient respondents are in their languages. It seems likely that self-reported bilingual Anglophones speak English better than self-reported bilingual Francophones do, and vice versa.

[15] We also imposed the restriction that β_w is constant across cities. In analyses that we do not report, we did find evidence that there are some differences in the returns to characteristics across cities. For instance, university-educated workers receive less of a premium for working in Vancouver than high-school-educated workers. This suggests that the former enjoy a higher quality-of-life in Vancouver. While interesting, most of these return differences are relatively minor, and for the sake of simplicity, are left for future work.

3.1.2 Housing-Cost Differentials

Following previous studies (e.g. Gabriel and Rosenthal 2004), we use both housing values and gross rents, including utilities, to calculate housing-cost differentials. For owned units, we multiply housing values times a discount rate of 7.85 percent (Peiser and Smith 1985), and add utility costs, to impute rents comparable to gross rents. We regress the logarithm of these rents on flexible controls (X_w^i) in the equation $\ln p^{ij} = X_p^i \beta_p + \nu_p^j + \varepsilon_p^{ij}$.[16] The coefficients ν_p^j, normalized to have a population-weighted average of zero, are our estimates of the housing-cost differentials, $\hat{p}^j$. Proper identification of housing-cost differences requires that average unobserved housing quality, and the extent of foreign investment, do not vary systematically across cities.[17]

Controlling for CMA and additional controls, we find that Allophones have housing costs that are almost identical to Anglophones, while Francophones have housing costs that are 15 percent lower. The lower housing costs of Francophones potentially reflect that Anglophones may live in more amenable areas within CMAs, such in Montreal, where historic Anglophone neighborhoods are generally considered very amenable. It may be that Anglophones face a more restricted housing market or enjoy better housing quality that we cannot control for.

3.2 Calibration

The calibrated values for the parameters are similar to those for the United States found in Albouy (2009b), except that we amend them for Canada to account for a smaller share of income received by labor, and a smaller proportion of expenditures spent on locally-produced goods.

$$
\begin{array}{llll}
s_x = 0.67 & \theta_L = 0.025 & \phi_L = 0.25 & s_R = 0.10 \\
s_y = 0.33 & \theta_N = 0.775 & \phi_N = 0.55 & s_w = 0.70 \\
 & \theta_K = 0.20 & \phi_K = 0.20 & s_I = 0.20
\end{array}
$$

[16]The controls, which are interacted with renter-status, include number of rooms (9 indicators), number of bedrooms (5 indicators), number of rooms interacted with number of bedrooms, number of rooms per household member, type of building (7 indicators), age of building (9 indicators), and state of repair (2 indicators). For owner-occupied units, we include an indicator for condominium status and interact the controls with mortgage status. See Appendix B for more detail. The estimates of the coefficients of the controls are available in an online appendix.

[17]Unobserved housing quality differences should be minor, as Malpezzi et. al. (1998) determine that housing-cost indices derived from the U.S. Census in this way perform as well or better than most other indices. As well, in the admittedly limited data available, foreign investments in major Canadian housing markets appear to be small. For instance, Tal (2011) uses Landcor data, a comprehensive database on historical sales and current information on the BC residential and commercial markets, to document that only 2.6% of all sales over the past five years can be accounted by owners whose tax notice is sent to addresses outside of Canada.

Information on income and expenditure share differences by language group is lacking, and so we assume they are the same, which allows us to use equation (10) for our estimates.

The elasticity of substitution between different labor types is unknown. Ottaviano and Peri (2006) estimate the elasticity of substitution between immigrants and non-immigrant workers to be about 6.5. It would seem that the elasticity of substitution between workers of different language groups is much higher than this elasticity, given that the workers were often born and raised in Canada, and thus have even more similar skills.[18] Thus, we use two potential values for σ: ∞ and 40, where the latter illustrates the case of imperfect substitutability.

Although federal tax differences are included in the analysis, federal transfer and spending differences are not. There are three ways that these spending differences could manifest themselves. To the extent that they benefit households, they contribute to $\hat{Q}^j$; to the extent that they benefit firms, they contribute to $\hat{A}^j$; to the extent that they are wasted by governments, they show up nowhere. Since it is not theoretically clear where they belong, they are reported separately in Section 6.1.

Calculated tax differentials depend on both federal and provincial tax rates. They include direct taxes on income as well as indirect taxes on consumption: since this is a static model without an intertemporal savings decision, the two are equivalent as taxes on consumption reduce the buying power of labor. We determine provincial differentials using wage differences within province only. Across provinces, the average marginal tax rate on labor income is 28 percent. See the Appendix for more details.[19]

4 Quality-of-Life and Productivity Estimates

4.1 Main Estimates

Columns 2 and 3 of Table 1 report the estimated wage and housing-cost differentials by CMA or non-CMA areas of provinces. Figure 1 graphs these and provides intuition for how we infer overall QOL and productivity differentials, reported in columns 4 and 5. The figure displays the average mobility condition from (4a), with $\hat{Q}^j = 0$, and the combined average zero-profit conditions from (6), with $\hat{A}^j = 0$. The average mobility condition illustrates the housing costs households are willing to pay, on average, for a given

[18] We include immigrant controls to capture differences in immigrant/Canadian born earning outcomes. See the Appendix for more detail.

[19] Many workers report receiving little income other than labor income. However, given the static nature of the model, a worker's choices should be modeled to account for a worker's permanent income, which includes a large non-labor component, particularly if implicit rental earnings from one's own home are included.

wage: any premium above that housing cost level is inferred to be payment for consumption amenities, and thus the vertical distance from that condition indicates overall QOL, $\hat{Q}^j$. The combined zero-profit condition illustrates the rate at which land rents, inferred through housing costs, must fall, on average, as wages rise: any premium over this is inferred to be payment for production amenities, and thus the vertical (or horizontal) distance from that condition indicates overall firm productivity in the traded sector, $\hat{A}^j$. Through a change in the coordinate system, the two conditions in Figure 1 provide a set of axes for the new coordinate system in Figure 2, which is in the space of productivity and QOL.

Interestingly, Canada's five largest CMA's – Toronto, Montreal, Vancouver, Ottawa-Hull, and Calgary, all have above-average productivity and QOL, as they lie above the average mobility-condition, and to the right of the average zero-profit condition. The smaller cities of Halifax, and Kelowna all have above-average QOL but much lower productivity, which is commensurate with their reputations as charming tourist destinations. Kitchener, Oshawa, and Windsor have less-than-average QOL, but are quite productive given their size, although this is likely to do with their proximity to Toronto and Detroit. Also in this category are the Territories, where high wages simultaneously reflect the high marginal productivity of the workers out there, as well as the need for those workers to be compensated for the harsh climate and remote location. Finally, a large number of smaller cities, including

Moncton, Regina, St. John's, Thunder Bay, and Trois-Rivières fall in the category of cities with below-average productivity and QOL, with the compensating benefit of being affordable. All of the non-CMA areas of provinces (except for BC) also fall in this category, suggesting that on average neither firms nor households find less urban areas to be exceptionally attractive.

The rankings of the cities in terms of overall QOL, productivity, and combined value are given in Table 2. Victoria has the highest QOL, followed by Vancouver, Kelowna, Abbotsford, and Toronto. Rounding out the top ten are Calgary, Montreal, Sherbrooke, Ottawa-Hull, and Barrie. Saint John, Windsor, and Thunder Bay take the bottom three spots. This list contrasts significantly with Giannias (1998), which places Edmonton and Winnipeg in the top 4 of 13 cities, which here are ranked 17 and 24 out of 33.

From the second column of Table 2, we see that Toronto is the leader in productivity, which is not surprising given that it is the largest city, and home of the financial center of Canada. Second is Calgary, only the fifth largest CMA at that time, but with a strong oil and gas industry. Third, is Oshawa, as it is 50 kilometers from Toronto, with a strong base in automobile manufacturing. Vancouver and Ottawa-Hull round out the top five. All of these cities pay a disproportionate share of federal taxes per capita, as seen in column 7 of Table 1, as a result of being so productive. Despite being the second largest CMA in Canada, Montreal is only in tenth place, possibly because of its language barrier with the rest of Canada and the United States.

The land-rent and total-value differentials are reported in columns 6 and 8 in Table 1, with their difference caused by the tax differentials in column 7, and the ranking reported in column 3 of Table 2. Their calculation is made visually transparent in Figures 1 and 2 through the average iso-rent and iso-value curves: cities above these lines have above-average rents and total values, respectively. From these we see that Victoria has the highest private value of land, although Vancouver has the highest social value, as its higher wage levels lead to greater positive tax externalities for other Canadians.

4.2 Estimates for Separate Language Groups

QOL measures broken down by mother tongue are presented in Table 3 for CMAs with at least 100,000 inhabitants with that mother tongue, and where they constitute at least 10 percent of the population. Calculating QOL measures for cities where a smaller number of individuals have a certain mother tongue raises difficult econometric issues.[20] On the whole, the QOL rankings for the different language groups are almost identical to those pooling everyone together. For instance, all of the groups prefer Montreal over Ottawa-Hull. The only discrepancy is minor: unlike Anglophones, Allophones appear to view Hamilton slightly more favorably than Ottawa-Hull, perhaps because they make up a larger fraction of the population. Francophones do not seem to despise living in linguistically diverse CMAs, as Montreal and Ottawa-Hull are their top two cities, while the worst two are Trois-Rivières and Chicoutimi-Jonquière. Allophones prefer Canada's three largest cities, Vancouver, Toronto, and Montreal, over all other ones, supporting the notion that Allophones will prefer to live in areas with the greatest number of like-tongued speakers.

The individual productivity of different language groups is given in Table 4 for just a few cities where the supply of each group is large enough to produce credible estimates. Panel A considers the productivity differences between Francophones and Anglophones in Montreal and Ottawa-Hull. In Montreal, average productivity is 3 percent above the national average, and Francophones are better paid and much more heavily employed than Anglophones. If both types of workers are perfect substitutes, then Francophones from

[20] In places where a linguistic group is in a small minority, the calculated wage differentials tend to be relatively low and the housing-cost differentials between language groups relatively high. This would seem to suggest that these groups find places where the mother tongue are very amenable. See Warman (2007) for Canadian analysis and evidence of enclaves. It is likely that these individuals have idiosyncratic attachments, such as spouses, that cause them to sacrifice real income in order to live in these places.

Montreal are 4 percent more productive than the average Francophone, while Anglophones are 4 percent less productive, making them about as productive as Anglophones in Kingston. If Anglophones provide special skills that cannot be easily substituted for by Francophone labor, then the productivity differences are even larger: with an elasticity of substitution of 40, an Anglophone worker in Montreal is only 10 percent less productive, comparable Anglophones in Saskatoon, and wages are as high as they are only because Francophones cannot easily replace them. The results for Ottawa-Hull are much less extreme since their national wage and employment differentials are roughly the same.

Panel B considers the productivity differences between Anglophones and Allophones in Toronto and Vancouver. In both CMAs, Allophones earn less of a premium than Anglophones do, but are hired in a greater proportion, relative to the national average. Thus, the less substitutable Allophone labor is for Anglophone labor, the closer their relative productivity differentials. It appears that Anglophones in Vancouver have productivity levels just behind Calgary and ahead of Oshawa.

5 Relationship with Popular Rankings and Amenities

The press abounds with popular rankings of Canadian cities according to many characteristics aimed at capturing "livability." Here, we compare our rankings based on revealed preference with the livability ratings from *Places Rated Almanac* and *Cities Ranked and Rated*. The popular measures are not grounded in theory and are largely ad-hoc, they reflect popular perceptions of what characteristics make cities “nice” to live in. Unlike the rankings based on willingness-to-pay, the popular rankings also incorporate low cost-of-living and good job-market opportunities as “amenities”. In the hedonic framework above, if these factors are properly weighted, they should make all of the cities offer the same utility, making them equally "livable." In practice, the popular rankings put less weight on cost-of-living and job-market opportunities than the framework suggests.[21]

Table 5 reports the correlation coefficients between the rankings in these reports and the overall QOL ranking shown in Table 1. The correlations are all strongly positive, with the correlation between the two popular rankings being somewhat stronger than that between either popular ranking and the economic one. These correlations are strong despite the fact that the popular rankings include offsetting cost-of-living and job-market opportunities. The general consistency of the rankings seems to be mutually reinforcing to both

[21] For instance, in *Places Rated*, cost-of-living and employment opportunities, are counted as 2 among 9 amenities, all of which receive equal weight.

the economic and popular measures of QOL.

Table 6 estimates the relationship between the economic QOL estimates and various subindices given to cities by *Places Rated Almanac*. The overall livability index in the *Almanac* puts equal weight on all of the estimates. Hedonic estimates based on the economic measures of QOL indicate that only the indices for climate and arts and culture have a significant relationship with households' willingness-to-pay. This holds true whether or not CMAs are weighted by population. With only 24 overlapping CMAs in the sample, this test does have low power; indeed factors related to health, crime, and education may be very important in households' location decisions. But it appears unlikely that *Places Rated* was correct to assign each sub-index the same coefficient: our economic QOL index suggests that the restriction that all of the subindices should have equal coefficients is strongly rejected by the data. Understandably, Canadians care tremendously about climate, and apparently quite a bit about arts and culture, or other amenities that are correlated with those sub-indexes.

6 Additional Considerations

The model presented above has the advantage of requiring limited data, and of being intuitive to graph. Yet, additional considerations should be examined which may affect the estimates, in particular with regards to the role of non-housing costs, differences in non-tax federal fiscal benefits, and the use of rents instead of housing prices. Given that it is not clear whether or not these considerations should be incorporated into the estimation of QOL and productivity differentials, and given that they would also be based on incomplete data, available only at the provincial level, they are presented separately in Table 7. The preceding results are also summarized at the provincial and regional levels here.[22]

6.1 Intergovernmental Transfers

An adjustment for intergovernmental transfers and provincial source-based tax revenues is made in column 9. Recall that if these payments benefit households, they should be subtracted from QOL; if they benefit firms, the should be subtracted from productivity: in either case they should be subtracted from the total value. On the other hand, if these payments benefit neither households nor firms, than they should be ignored altogether. Assuming that the payments do affect the total value in some form, they raise the value

[22]CMA-level adjustments for QOL and total value, assuming that federal transfers are passed on directly to households, are presented in Tables A1 and A2.

of Ontario and Quebec, while the Atlantic and the Prairie provinces are seen as less valuable. As analyzed in greater detail in Albouy (2010), this is mainly driven by equalization payments, except for Alberta and Saskatchewan, which receive large fiscal benefits by retaining the revenues from taxes on natural resources, rather than sharing them federally.

6.2 Non-Housing Costs

According to intercity estimates of the Consumer Price Index, non-housing cost differences are not always proportional to housing-cost differences, as we assumed above. If non-housing costs in an area are high relative to housing costs, then the cost-of-living measure approximated by housing costs is biased downwards in that area. This causes QOL measures in areas with high non-housing costs to be biased downwards. This may be the case in more remote areas of Canada, such as the Territories, where housing is relatively cheap, but other goods are expensive because of transportation costs.[23]

Unfortunately, only one city per province has detailed CPI information. As a result, we need to assume that provincial cost differences are reflected in the representative CMAs, typically each province's largest. These adjustments, in column 10, suggest that QOL and total values may be underestimated in the Atlantic provinces, especially Newfoundland, and overestimated in Quebec.

6.3 Housing Rents

Our main analysis measures housing costs by combining actual rents with imputed rents for owner-occupied units. There may be reason to doubt the accuracy of these imputed rent measures, especially during our time period, as housing prices in some markets rose considerably up until 2006. We construct alternate measures using only rented units, which we plot in Appendix Figure A1 against our main estimates of housing costs. As seen in column 11 of Table 7, rents tend to differ less in value across provinces, although using these measures has a fairly minor effect on the overall rankings.

We believe rent-only measures are less accurate than our main measures. Rental units tend to be more centrally located than owned units, and hence less representative of the overall CMA, especially as the

[23]Unfortunately, the intercity CPI estimates do not reliably measure housing costs as they rely on a subsample of new housing generally built on the urban fringe. "The sample of builders for each metropolitan area is determined through the use of local market intelligence and verified against relevant building permit data. Where possible, prices are collected from builders who develop entire subdivisions, usually on large tracts of land." The Census sample is more reliable as it samples all housing. For example in Vancouver, the CPI estimates that housing is only 10 percent over the national average, as opposed to 43 percent according to the Census data.

majority of Canadians own their homes. In addition home-ownership rates are generally higher in larger CMAs. Our main housing-cost measures are less prone to potential bias resulting from sample-selection issues.

7 Conclusion

This paper presents the first hedonic estimates of QOL and local productivity differences for Canada, accounting for heterogeneity in mother tongues and unionization rates. These estimates are rather sensible and intuitive, with the QOL measures exhibiting a strong positive correlation with popular rankings. We find Victoria has the greatest quality of life, Toronto has the highest productivity, and Vancouver has the most valuable combination of the two. Among cities that they jointly inhabit, Canada's different language groups appear to largely agree on what cities are more attractive, even when they live in different neighborhoods. Local productivity is largely determined by size, but is also affected by other factors such as predominant language, access to natural resources, and proximity to other large cities.

Overall, our estimates measure how valuable different Canadian cities are, not only in producing the goods that households value, but also in delivering the amenities that households want. Most Canadians seem to prefer the amenities of larger metropolitan areas and are willing to consume fewer goods in order to live in them. Despite Canada's enormous wealth in natural resources, the greatest resource Canadians seem to value in production and consumption is each other.

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Appendix

A Additional Theoretical Details

A.1 Multiple Household Types

A.1.1 Land-Rent Estimate

With multiple types, the estimate of land rents are over-determined, but the cost-shares are typically unknown:

$$\hat{r}^j = \frac{1}{\phi_{gL}} \left(\hat{p}_g^j - \phi_{gN} \cdot \hat{\mathbf{w}}^j \right)$$

Instead of trying to estimate land rents directly, we take an indirect approach, using the fact that aggregate value of land rents differences should equal the weighted value of amenities minus federal tax payments, and then substituting in our disaggregated indices:

$$\begin{aligned} s_R \hat{r}^j &= \hat{Q}^j + s_x \hat{A}_X - \tau' s_w \hat{w}^j \\ &= \sum_g \mu_g^j \left[s_{yg} \hat{p}_g^j - s_{wg} \hat{w}_g^j \right] + s_x \sum_g \theta_{Ng}^j \hat{w}_g^j + s_x \theta_L \hat{r}^j \\ &= s_y \hat{p}^j - \sum_g \left(\mu_g^j s_{wg} - s_x \theta_{Ng}^j \right) \hat{w}_g^j + s_x \theta_L \hat{r}^j \end{aligned}$$

Solving again for the land-rent differential,

$$\hat{r}^j = \frac{1}{s_R - s_x \theta_L} \left[s_y \hat{p}^j - \sum_g \left(\mu_g^j s_{wg} - s_x \theta_{Ng}^j \right) \hat{w}_g^j \right]$$

and assuming $\theta_{Ng}^j / \theta_N = \mu_g^j s_{wg} / s_w$

$$\begin{aligned} \hat{r}^j &= \frac{1}{s_R - s_x \theta_L} \left[s_y \hat{p}^j - \sum_g \mu_g^j \left(s_{wg} - s_x \theta_N \right) \hat{w}_g^j \right] \\ &= \frac{1}{s_R - s_x \theta_L} \left[s_y \hat{p}^j - (s_w - s_x \theta_N) \hat{w}_g^j \right] \\ &= \frac{s_y}{s_R - s_x \theta_L} \left[\hat{p}^j - \frac{s_w - s_x \theta_N}{s_y} \hat{w}^j \right] \\ &= \frac{1}{\phi_L} \left[\hat{p}^j - \phi_N \hat{w}^j \right] \end{aligned}$$

So each type just needs to be weighted by their share of income when producing rent and productivity estimates.

A.1.2 Factor-Specific Productivity Estimates

Factor-specific productivity differences do have first-order effects on quantities in the model. For example, in the case where partial elasticities of substitution across factors within sectors are equal, the relative employment of 1-types relative to 2-types is given by

$$\hat{N}^j_{1X} - \hat{N}^j_{2X} = -\sigma_{12}(\hat{w}^j_1 - \hat{w}^j_2) + (\sigma_{12} - 1)\left(\hat{A}^j_1 - \hat{A}^j_2\right)$$

The productivity differential may be split into the two components for the labor types of interest, and all of the other factors:

$$\hat{A}^j = \theta^j_{N1}\hat{A}^j_1 + \theta^j_{N2}\hat{A}^j_2 + \sum_{g=3}^{G}\theta^j_{Ng}\hat{A}^j_g + \theta^j_L\hat{A}^j_L + \theta^j_K\hat{A}^j_K = \theta^j_{N1}\hat{A}^j_1 + \theta^j_{N2}\hat{A}^j_2 + \theta^j_{-}\hat{A}^j_{-}$$

then

$$\hat{A}^j_1 = \frac{1}{\theta^j_{N1}}\left(\hat{A}^j - \theta^j_{N2}\hat{A}^j_2 - \theta^j_{-}\hat{A}^j_{-}\right)$$
$$\hat{A}^j_1 - A^j_2 = \frac{1}{\theta^j_{N1}}\left[\hat{A}^j - \left(\theta^j_{N1} + \theta^j_{N2}\right)\hat{A}^j_2 - \theta^j_{-}\hat{A}^j_{-}\right]$$

Substituting back in

$$\hat{N}^j_1 - \hat{N}^j_2 = -\sigma_{12}(\hat{w}^j_1 - \hat{w}^j_2) + (\sigma_{12} - 1)\frac{1}{\theta^j_{N1}}\left[\hat{A}^j - \left(\theta^j_{N1} + \theta^j_{N2}\right)\hat{A}^j_2 - \theta^j_{-}\hat{A}^j_{-}\right]$$

which implies

$$\hat{A}^j_2 = \frac{\theta^j_{N1}}{\theta^j_{N1} + \theta^j_{N2}}\frac{\hat{N}^j_1 - \hat{N}^j_2 + \sigma_{12}(\hat{w}^j_1 - \hat{w}^j_2)}{\sigma_{12} - 1} + \frac{\hat{A}^j - \theta^j_{-}\hat{A}^j_{-}}{\theta^j_{N1} + \theta^j_{N2}}$$

We assume that all of the other factors have the same relative productivity levels, i.e. $\hat{A}^j_{-} = \hat{A}^j$ it follows that

$$\hat{A}^j_2 = \frac{\theta^j_{N1}}{\theta^j_{N1} + \theta^j_{N2}}\frac{\hat{N}^j_2 - \hat{N}^j_1 + \sigma_{12}(\hat{w}^j_2 - \hat{w}^j_1)}{\sigma_{12} - 1} + \hat{A}^j$$

It is easy to take the limit $\sigma_{12} \to \infty$ then $\frac{\theta_{N1}}{\theta_{N1}+\theta_{N2}}(\hat{w}^j_2 - \hat{w}^j_1) + \hat{A}^j$.When $\sigma_{12} = 0$, relatively more productive factors are used less, $\hat{A}^j_2 = \frac{\theta_{N1}}{\theta_{N1}+\theta_{N2}}(\hat{N}^j_1 - \hat{N}^j_2) + \hat{A}$

A.2 Provincial and Federal Taxes Combined

Individual provinces may not only have significant tax rates on income, but also significant wage differences within them. This means that the tax differentials faced by households in different cities consist of two components: a federal component and a provincial component. Let the tax burden be given by two components, a federal F and a provincial, P: $\tau(m) = \tau_F(m) + \tau_P(m)$. Assuming that federal revenues are distributed evenly across the country, and provincial revenues are distributed even within the province, the federal tax differential is

$$\frac{d\tau^j}{m} = \frac{d\tau^j_F}{m} + \frac{d\tau^j_P}{m} = s_w\tau'_F\hat{w}^j + s_w\tau'_P\left(\hat{w}^j - \hat{w}^P\right) = s_w\left(\tau'_F + \tau'_P\right)\hat{w}^j - s_w\tau'_P\hat{w}^P$$

where $\hat{w}^P$ is the wage differential of the province on average. At the provincial level, the provincial burden is even and so we may easily calculate

$$Q^P = s_y\hat{p}^P - \left(1 - \tau'_F\right)\hat{w}^P$$

While for a given city the formula is slightly more complicated.

$$\hat{Q}^j = s_y \hat{p} - s_w \left[\left(\tau'_F + \tau'_P \right) \hat{w}^j - \tau'_P \hat{w}^P \right]$$

B Data and Estimation

We use Canadian Census data from the 2006 Master Microdata Files to calculate wage and housing-cost differentials. The wage differentials are calculated for workers ages 25 to 55, who report working at least 30 hours a week, 26 weeks a year. The CMA assigned to a worker is determined by their place of work. The wage differential of an CMA is found by regressing log hourly wages on individual covariates and indicators for a worker's CMA, using the coefficients on these CMA indicators. The covariates consist of

- 12 indicators of educational attainment: no degree (default); high school degree; other trade; registered apprentice; college <1 years; college 1 to 2 years; college $2+$ years; university certificate; bachelors degree; above bachelor; degree in medicine, dentistry, veterinary medicine or optometry; masters; doctorate;
- a quartic in potential experience (years of school are calculated using the 2001 Master Microdata Files for the highest level of education);
- 17 indicators for major field of study: education (default); arts; humanities; social and behavioural sciences; commerce; bio science; engineering and applied science; health; math and physical science; other; natural resource; protect and transport; law; public administration; technologies; computers; information sciences; transportation;
- 15 indicators of industry (2002 NAICS): agriculture (default); other primary; manufacturing; construction; transportation and storage; communication and utilities; wholesale trade; retail trade; finance, insurance, and real estate; business services; public administration federal; public administration other; education; health and social services; accommodations, food, and beverage services; other services;
- 24 indicators of occupation (2006 NOC-S): senior management (default); other management; professional occupations in business and finance; financial, secretarial and administrative occupations; clerical; sciences; professional health; assist health; social science, government service and religion; teachers and professors; arts, recreation and sports; wholesale trade; retail trade; food; protective services; childcare/home support; sales and service occupations n.e.c.; contractors and supervisors in trades/transportation; construction trades; other trades; transport/equipment; trades helpers; primary industry; machine operators and assemblers in manufacturing including supervisors; laborer manufacturing;
- An indicators for immigrant status, and controls for time since immigration and citizenship status;
- 5 indicators of minority status (Aboriginal, Black, Chinese, South Asian, and other) with the last 4 interacted with immigrant status;
- Indicators for bilingualism interacted with mother tongue – French, English, or other – and for other mother tongue interacted with speaking only French and only English;

All covariates are interacted with gender.

We first run the regression of log wages on the individual covariates and CMA indicators using census-person weights. From the regressions a predicted wage is calculated using individual characteristics alone to form a new weight equal to the predicted wage times the census-person weight. The new weights (which have only a small effect) are then used in a second regression, which regresses the residuals from the first regression on mother tongue and CMA indicators. The coefficients on the CMA indicators are taken as the overall wage effect. For the mother-tongue specific wage effects, the residuals from the first regression are regressed on CMA indicators interacted with mother tongue indicators, using the coefficients on these interactions.

Housing-cost differentials are calculated using the logarithm of housing costs, which are either reported gross rents or imputed rents derived from housing values. The differential housing cost of a CMA is calculated in a manner similar to wages, except using a regression of rent on a set of covariates at the unit level. The covariates for the adjusted differential are

- 9 indicators for the number of rooms (1 room (default), 2 rooms, ..., 10 or more rooms), 5 indicators for the number of bedrooms (no bedrooms (default), 1 bedroom, ..., 5 or more bedrooms), number of rooms interacted with number of bedrooms, and the number of rooms per household member;
- 7 indicators for the type of building: single-detached house (default); semi-detached or double house; row house; apartment/flat in a duplex; apartment in a building that has five or more storeys; apartment in a building that has fewer than five storeys; other single-attached house; movable dwelling;
- 9 indicators for when the building was built: built in 1920 or before (default); built during period 1921-1945; built during period 1946-1960; built during period 1961-1970; built during period 1971-1980; built during period 1981-1985; built during period 1986-1990; built during period 1991-1995; built during period 1996-2000; built during period 2001-2006;
- 2 indicators for the condition of the dwelling: only regular maintenance (default); minor repairs; major repairs;
- an indicator for condominium status (owned units only).

All of the variables are interacted with indicators for rental status and among owner-occupied units, an indicator for the presence of a mortgage. Housing-cost differentials are calculated to a series of regressions similar to the ones above, with the mother tongue of the housing unit determined by the household head.

To calculate the marginal tax rates faced by a nationally representative agent in each of the provinces, we first divide the total population into 17 income groups (from 1-10.000 to 250.000+). We then use Income Statistics (Table 2A, Taxable Returns by Income Class) from Canada Revenue Agency Data to calculate the share of the total population in each of the income groups. Subsequently, we obtain the marginal income tax rate (federal plus provincial) that applies to each income group and each province, using the midpoint of each income group as the income of the group. The marginal tax rates for year 2006 are obtained from Walter Harder.

Non-housing cost data are taken from CANSIM and averaged over 2006. They cover the cities of St. John's, NL; Charlottetown-Summerside, PEI; Halifax, NS; Saint John, NB; Montreal, QC; Ottawa, ON; Toronto, ON; Winnipeg, MB; Regina, SK; Edmonton, AB; and Vancouver, BC. Federal transfer differentials are calculated using the total federal intergovernmental transfers data in 2005-2007 from CANSIM Table 384-0011. CMA level unionization rates are calculated using the 2005 Labour Force Survey Master File. It is the proportion of unionized workers to the number of workers. The fraction of the employment in each CMA that is accounted for by the public sector is also calculated using the 2005 Labour Force Survey Master File."

TABLE 1: PRICES, ATTRIBUTES, AND VALUES ACROSS CANADIAN CITIES

		Observed Prices		Attribute		Value Capitalization		
City/Area Name	Population (1)	Wages (2)	Housing Costs (3)	Quality of Life (4)	Productivity (5)	Land Rent (6)	Tax Burden (7)	Total Value (8)
Panel A: Census Metropolitan Areas								
Vancouver	2,047,650	0.04	0.45	0.13	0.07	1.70	0.009	0.180
Victoria	320,920	-0.04	0.46	0.17	0.02	1.91	-0.012	0.179
Toronto	4,966,660	0.10	0.29	0.05	0.10	0.93	0.022	0.115
Calgary	1,053,840	0.09	0.24	0.04	0.09	0.78	0.021	0.098
Kelowna	159,490	-0.07	0.24	0.11	-0.03	1.09	-0.018	0.091
Montréal	3,534,850	0.02	0.14	0.04	0.03	0.52	0.008	0.061
Abbotsford	154,830	-0.03	0.12	0.06	-0.01	0.56	-0.007	0.049
Ottawa-Hull	825,790	0.07	0.11	0.00	0.06	0.29	0.015	0.044
Guelph	125,070	0.04	0.05	0.00	0.03	0.13	0.007	0.020
Hamilton	676,780	0.03	0.05	0.00	0.03	0.14	0.006	0.020
Oshawa	326,890	0.11	0.02	-0.04	0.08	-0.16	0.028	0.012
Edmonton	1,013,400	0.03	-0.01	-0.02	0.02	-0.12	0.006	-0.006
Québec	701,420	-0.02	-0.01	0.00	-0.01	-0.01	-0.005	-0.006
Kitchener	441,420	0.05	-0.02	-0.03	0.03	-0.18	0.010	-0.007
Barrie	174,420	-0.04	-0.03	0.01	-0.03	-0.02	-0.014	-0.016
Kingston	147,230	-0.05	-0.04	0.00	-0.04	-0.07	-0.015	-0.023
Sherbrooke	182,330	-0.08	-0.05	0.02	-0.06	-0.02	-0.024	-0.026
Peterborough	114,580	-0.06	-0.05	0.01	-0.05	-0.09	-0.018	-0.027
St. Catharines-Niagara	381,170	-0.02	-0.12	-0.04	-0.02	-0.45	-0.006	-0.050
Brantford	122,420	-0.03	-0.13	-0.03	-0.03	-0.45	-0.009	-0.054
Halifax	366,790	-0.11	-0.16	0.01	-0.09	-0.39	-0.018	-0.056
London	447,310	0.01	-0.15	-0.06	-0.01	-0.64	0.002	-0.062
Windsor	316,170	0.09	-0.21	-0.11	0.05	-1.06	0.026	-0.080
Sudbury	155,990	0.03	-0.23	-0.09	0.00	-0.96	0.006	-0.090
Trois-Rivières	138,160	-0.01	-0.25	-0.08	-0.03	-0.99	0.000	-0.099
Chicoutimi-Jonquière	149,440	0.01	-0.28	-0.09	-0.02	-1.13	0.006	-0.106
Winnipeg	677,500	-0.08	-0.29	-0.05	-0.09	-0.99	-0.014	-0.114
Saskatoon	228,080	-0.10	-0.30	-0.05	-0.10	-0.98	-0.018	-0.117
Regina	190,790	-0.04	-0.34	-0.09	-0.06	-1.26	-0.001	-0.127
Moncton	123,580	-0.13	-0.35	-0.05	-0.13	-1.11	-0.024	-0.135
Thunder Bay	120,720	-0.01	-0.39	-0.13	-0.04	-1.54	0.000	-0.154
St. John's	178,170	-0.13	-0.44	-0.09	-0.13	-1.50	-0.025	-0.175
Saint John	119,800	-0.11	-0.49	-0.11	-0.13	-1.73	-0.016	-0.189
Non-CMA Areas								
British Columbia	1,327,040	-0.05	-0.05	0.01	-0.04	-0.08	-0.010	-0.018
Northwest Territories	40,770	0.19	-0.06	-0.12	0.13	-0.66	0.038	-0.028
Yukon	29,960	0.04	-0.12	-0.06	0.02	-0.55	0.009	-0.047
Alberta	1,153,770	-0.03	-0.16	-0.04	-0.04	-0.58	-0.009	-0.066
Ontario	2,530,520	-0.06	-0.20	-0.04	-0.06	-0.68	-0.016	-0.084
Québec	2,386,520	-0.08	-0.29	-0.06	-0.09	-0.99	-0.021	-0.120
Prince Edward Island	133,830	-0.25	-0.48	-0.04	-0.23	-1.36	-0.049	-0.185
Nunavut	29,270	0.25	-0.55	-0.31	0.13	-2.75	0.050	-0.225
New Brunswick	473,080	-0.19	-0.58	-0.10	-0.19	-1.93	-0.039	-0.232
Nova Scotia	532,270	-0.23	-0.59	-0.09	-0.22	-1.88	-0.049	-0.237
Manitoba	445,220	-0.19	-0.63	-0.12	-0.20	-2.08	-0.043	-0.251
Saskatchewan	529,430	-0.20	-0.75	-0.15	-0.22	-2.54	-0.045	-0.299
Newfoundland	320,930	-0.18	-0.95	-0.23	-0.23	-3.39	-0.036	-0.375
Canada	30,616,270	0.09	0.30	0.07	0.06	0.71	0.020	0.082

Wage and housing cost data are taken from the Census 2006 Masterfiles. Wage differentials are based on the average logarithm of hourly wages for full-time workers ages 25 to 55, controlling for observable skills. Housing cost differentials based on the average logarithm of rents and housing price, controlling for observable housing characteristics. Quality-of-life, productivity, land rent, tax burden, and total value differentials are based off of formulas explained in Section 2.2.1 in the text for the one household-type case. Fuller details on the data are in the Appendix

TABLE 2: CENSUS METROPOLITAN AREA RANKINGS

	Quality-of-Life Ranking	Productivity Ranking	Total Value Ranking
1	Victoria	Toronto	Vancouver
2	Vancouver	Calgary	Victoria
3	Kelowna	Oshawa	Toronto
4	Abbotsford	Vancouver	Calgary
5	Toronto	Ottawa-Hull	Kelowna
6	Calgary	Windsor	Montréal
7	Montréal	Guelph	Ottawa-Hull
8	Sherbrooke	Kitchener	Abbotsford
9	Ottawa-Hull	Hamilton	Guelph
10	Barrie	Montréal	Hamilton
11	Halifax	Edmonton	Oshawa
12	Peterborough	Victoria	Edmonton
13	Kingston	Sudbury	Kitchener
14	Québec	London	Québec
15	Hamilton	Abbotsford	Barrie
16	Guelph	Québec	Kingston
17	Edmonton	St. Catharines-Niagara	Peterborough
18	Kitchener	Chicoutimi-Jonquière	Sherbrooke
19	Brantford	Kelowna	St. Catharines-Niagara
20	St. Catharines-Niagara	Brantford	Brantford
21	Oshawa	Barrie	Halifax
22	Saskatoon	Trois-Rivières	London
23	Moncton	Kingston	Windsor
24	Winnipeg	Thunder Bay	Sudbury
25	London	Peterborough	Trois-Rivières
26	Trois-Rivières	Regina	Chicoutimi-Jonquière
27	St. John's	Sherbrooke	Winnipeg
28	Regina	Winnipeg	Saskatoon
29	Sudbury	Halifax	Regina
30	Chicoutimi-Jonquière	Saskatoon	Moncton
31	Saint John	Saint John	Thunder Bay
32	Windsor	Moncton	St. John's
33	Thunder Bay	St. John's	Saint John

Rankings based off of data in table 1.

TABLE 3: WAGE, HOUSING-COST, AND QUALITY-OF-LIFE DIFFERENTIALS BY MOTHER TONGUE

Rank	Name	Population Size	Fraction of Total	Wages	Housing Cost	Quality-of Life
Panel A: Anglophones						
1	Victoria	275,930	0.86	-0.04	0.48	0.175
2	Vancouver	1,215,480	0.59	0.06	0.52	0.143
3	Kelowna	136,450	0.86	-0.07	0.25	0.113
4	Abbotsford	111,720	0.72	-0.04	0.17	0.074
5	Toronto	2,823,580	0.57	0.14	0.38	0.059
6	Calgary	805,620	0.76	0.10	0.28	0.049
7	Montréal	448,710	0.13	-0.02	0.12	0.049
8	Ottawa-Hull	561,760	0.51	0.07	0.14	0.014
9	Guelph	101,260	0.81	0.02	0.08	0.013
10	Hamilton	521,760	0.77	0.04	0.09	0.012
11	Barrie	155,420	0.89	-0.04	-0.02	0.009
12	Kingston	130,340	0.89	-0.05	-0.04	0.006
13	Peterborough	106,690	0.93	-0.06	-0.05	0.006
14	Halifax	338,550	0.92	-0.11	-0.17	0.004
15	Edmonton	795,610	0.79	0.03	0.02	-0.011
16	Kitchener	337,780	0.77	0.04	0.02	-0.016
17	Brantford	108,240	0.88	-0.03	-0.12	-0.028
18	St. Catharines-Niagara	309,680	0.81	-0.02	-0.11	-0.030
19	Oshawa	285,270	0.87	0.11	0.03	-0.041
20	Saskatoon	198,190	0.87	-0.10	-0.29	-0.046
21	Winnipeg	515,180	0.76	-0.08	-0.27	-0.047
22	London	366,120	0.82	0.01	-0.13	-0.050
23	Regina	170,940	0.90	-0.04	-0.33	-0.082
24	St. John's	174,350	0.98	-0.13	-0.44	-0.084
25	Sudbury	101,230	0.65	0.00	-0.31	-0.101
26	Windsor	234,100	0.74	0.09	-0.19	-0.102
27	Saint John	111,370	0.93	-0.12	-0.51	-0.105
28	Thunder Bay	101,930	0.84	-0.01	-0.38	-0.122
Panel B: Francophones						
1	Montréal	2,359,840	0.67	0.06	0.21	0.045
2	Ottawa-Hull	366,230	0.33	0.10	0.21	0.027
3	Sherbrooke	165,740	0.91	-0.08	-0.03	0.020
4	Québec	672,750	0.96	-0.02	-0.01	0.006
5	Trois-Rivières	134,530	0.97	-0.01	-0.25	-0.078
6	Chicoutimi-Jonquière	146,680	0.98	0.01	-0.28	-0.093
Panel C: Allophones						
1	Vancouver	806,880	0.39	0.00	0.32	0.107
2	Toronto	2,080,620	0.42	0.04	0.15	0.028
3	Montréal	726,300	0.21	-0.10	-0.13	0.008
4	Calgary	231,480	0.22	0.06	0.06	-0.007
5	Hamilton	144,830	0.21	0.01	-0.12	-0.046
6	Ottawa-Hull	178,380	0.16	0.05	-0.09	-0.052
7	Edmonton	195,240	0.19	0.01	-0.18	-0.066
8	Winnipeg	132,890	0.20	-0.12	-0.49	-0.099

Wage and housing-cost differentials are calculated by language group according to the component orthogonal to observable characteristics but related to the CMA indicators interacted with language-group indicators.

TABLE 4: RELATIVE PRODUCTIVITY OF SPECIFIC MOTHER TONGUES IN SELECTED CITIES

Panel A: Francophones and Anglophones

	Relative Log Ratio			Mother-tongue-specific productivity			
				σ = ∞		σ = 40	
CMA	Wages	Employ ment	Total Prod	Franco-phone	Anglo-phone	Franco-phone	Anglo-phone
Montréal	0.075	2.802	0.029	0.038	-0.036	0.048	-0.100
Ottawa-Hull	0.028	0.560	0.068	0.085	0.057	0.094	0.051

Panel B: Allophones and Anglophones

	Relative Log Ratio			σ = ∞		σ = 40	
CMA	Wages	Employ ment	Total Prod	Allo-phone	Anglo-phone	Allo-phone	Anglo-phone
Toronto	-0.097	0.878	0.101	0.046	0.143	0.058	0.135
Vancouver	-0.064	0.643	0.073	0.034	0.098	0.043	0.092

Wage and employment ratios expressed in logarithms relative to the national log ratio (i.e. subtracting the national log ratio). Productivity levels are relative to others in the

TABLE 5: CORRELATION OF HEDONIC QUALITY-OF-LIFE AND *PLACES RATED ALMANAC "LIVABILITY"* & CITIES RANKED AND RATED RANKINGS

	Places Rated Almanac (1)	Cities Ranked & Rated (2)
Hedonic QOL Rank	0.70	0.72
Places Rated Almanac		0.84

TABLE 6: QUALITY OF LIFE, PRODUCTIVITY, AND DISAGGREGATED AMENITIES FROM PLACES RATES

	Quality of Life (unweighted) (1)	Quality of Life (pop weight) (2)
Arts & Culture	0.08	0.13
	(0.04)	(0.05)
Climate	0.20	0.16
	(0.06)	(0.05)
Crime	0.05	0.04
	(0.06)	(0.05)
Education	0.07	0.06
	(0.07)	(0.08)
Recreation	-0.01	-0.03
	(0.07)	(0.06)
Health	0.07	0.08
	(0.07)	(0.06)
Transportation	-0.04	0.00
	(0.07)	(0.07)
Constant	-0.21	-0.24
	(0.06)	(0.06)
Adjusted R-squared	0.59	0.63
Number of Observations	24	24
p -value of test that all coefficients are equal	0.005	0.007

Robust standard errors in parentheses. Regressions in the second column are weighted by the sum of individuals in each CMA.

TABLE 7: PRICES, ATTRIBUTES, AND VALUES ACROSS CANADIAN REGIONS AND PROVINCES WITH ADDITIONAL ADJUSTMENTS

City/Area Name	Population	Observed Prices		Attribute		Value Capitalization		Total Value	Adjusted Total Values		
		Wages	Housing Costs	Quality of Life	Product-ivity	Land Rent	Tax Burden		Transfer Differ	Non-Hous Cost	Housing Rents
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A: Provinces											
British Columbia	4,009,930	-0.01	0.24	0.08	0.02	0.98	-0.002	0.096	0.090	0.071	0.028
Ontario	11,873,140	0.04	0.04	-0.01	0.03	0.08	0.007	0.014	0.040	0.038	0.017
Alberta	3,221,010	0.03	0.02	-0.01	0.02	0.01	0.005	0.006	-0.069	0.001	0.009
Northwest Territories	7,373,310	-0.03	-0.07	-0.01	-0.02	-0.22	-0.006	-0.028	-0.007	-0.060	-0.026
Quebec	40,770	0.19	-0.06	-0.12	0.13	-0.66	0.038	-0.028	-0.233	-0.028	-0.050
Yukon	29,960	0.04	-0.12	-0.06	0.02	-0.56	0.009	-0.047	-0.235	-0.047	-0.036
Nova Scotia	899,060	-0.17	-0.39	-0.04	-0.16	-1.17	-0.034	-0.151	-0.180	-0.091	-0.075
Manitoba	1,122,720	-0.12	-0.41	-0.08	-0.13	-1.37	-0.024	-0.161	-0.200	-0.139	-0.104
Prince Edward Island	133,830	-0.25	-0.48	-0.04	-0.23	-1.36	-0.049	-0.186	-0.221	-0.125	-0.100
New Brunswick	716,460	-0.15	-0.52	-0.10	-0.16	-1.74	-0.030	-0.204	-0.241	-0.146	-0.116
Saskatchewan	948,300	-0.13	-0.53	-0.11	-0.15	-1.81	-0.027	-0.208	-0.265	-0.160	-0.115
Nunavut	29,270	0.25	-0.55	-0.31	0.13	-2.75	0.050	-0.225	-0.506	-0.225	-0.303
Newfoundland	499,100	-0.15	-0.70	-0.16	-0.18	-2.47	-0.031	-0.278	-0.347	-0.186	-0.165
Panel B: Regions											
West	7,330,940	0.01	0.12	0.04	0.02	0.47	0.002	0.049	0.006	0.038	0.017
Central	19,246,450	0.01	-0.01	-0.01	0.01	-0.05	0.001	-0.004	0.020	-0.004	-0.001
Prairie	2,071,020	-0.13	-0.47	-0.09	-0.14	-1.60	-0.026	-0.185	-0.233	-0.150	-0.109
Atlantic	2,248,450	-0.17	-0.50	-0.08	-0.17	-1.62	-0.033	-0.196	-0.236	-0.129	-0.108

Calculation of differentials in columns 1 through 8 explained in table 1. Transfer differential based on federal integovernmental transfers and province-level source-based revenues, decribed in Albouy (2010). Non-housing cost adjustment based on CPI data for principal city for province. "Housing Rents" uses only housing-cost measures based on rental units, as opposed to all units.

Figure 1: Housing Costs versus Wage Levels across CMAs, 2006

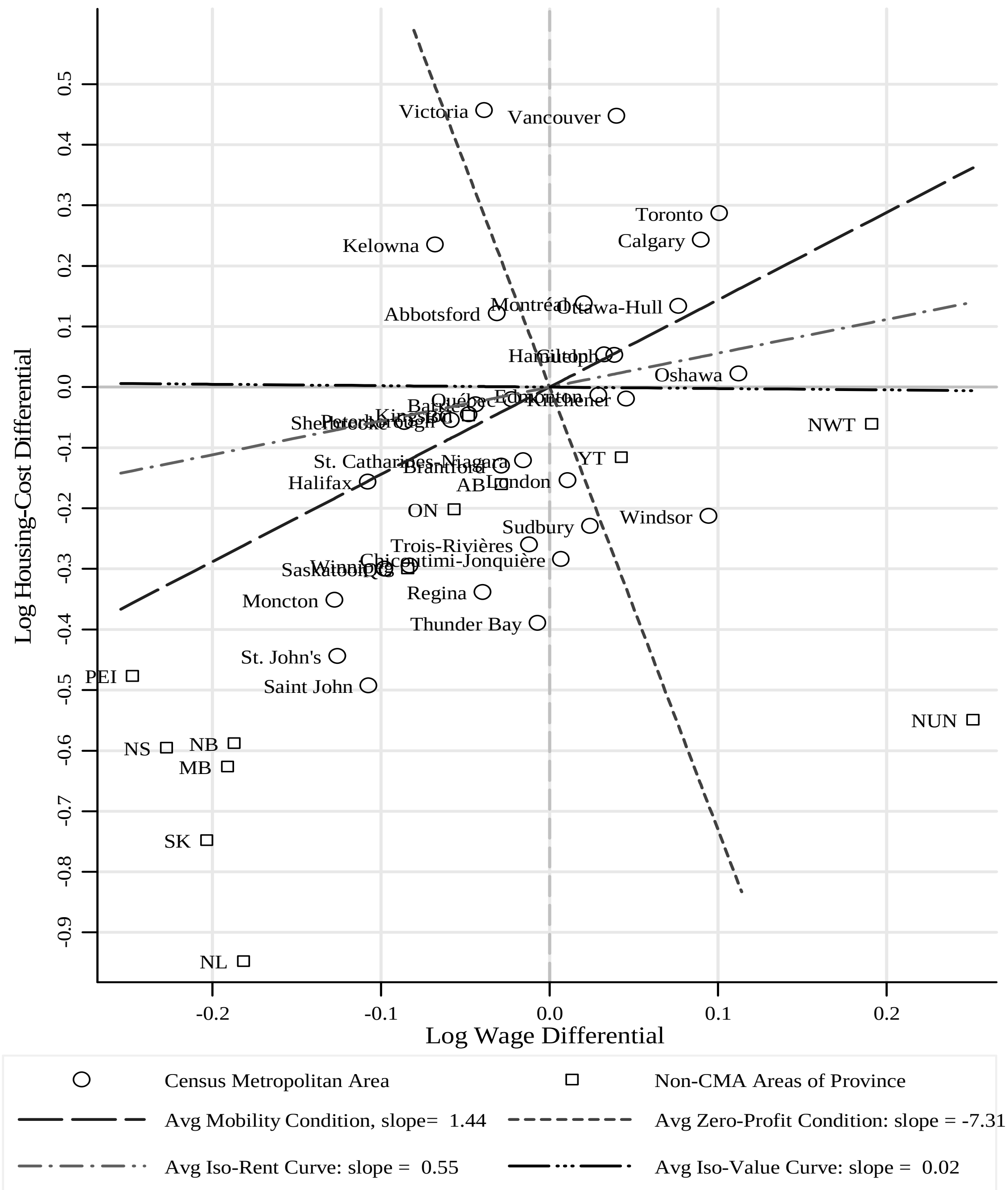

Figure 2: Estimated Productivity and Quality of Life

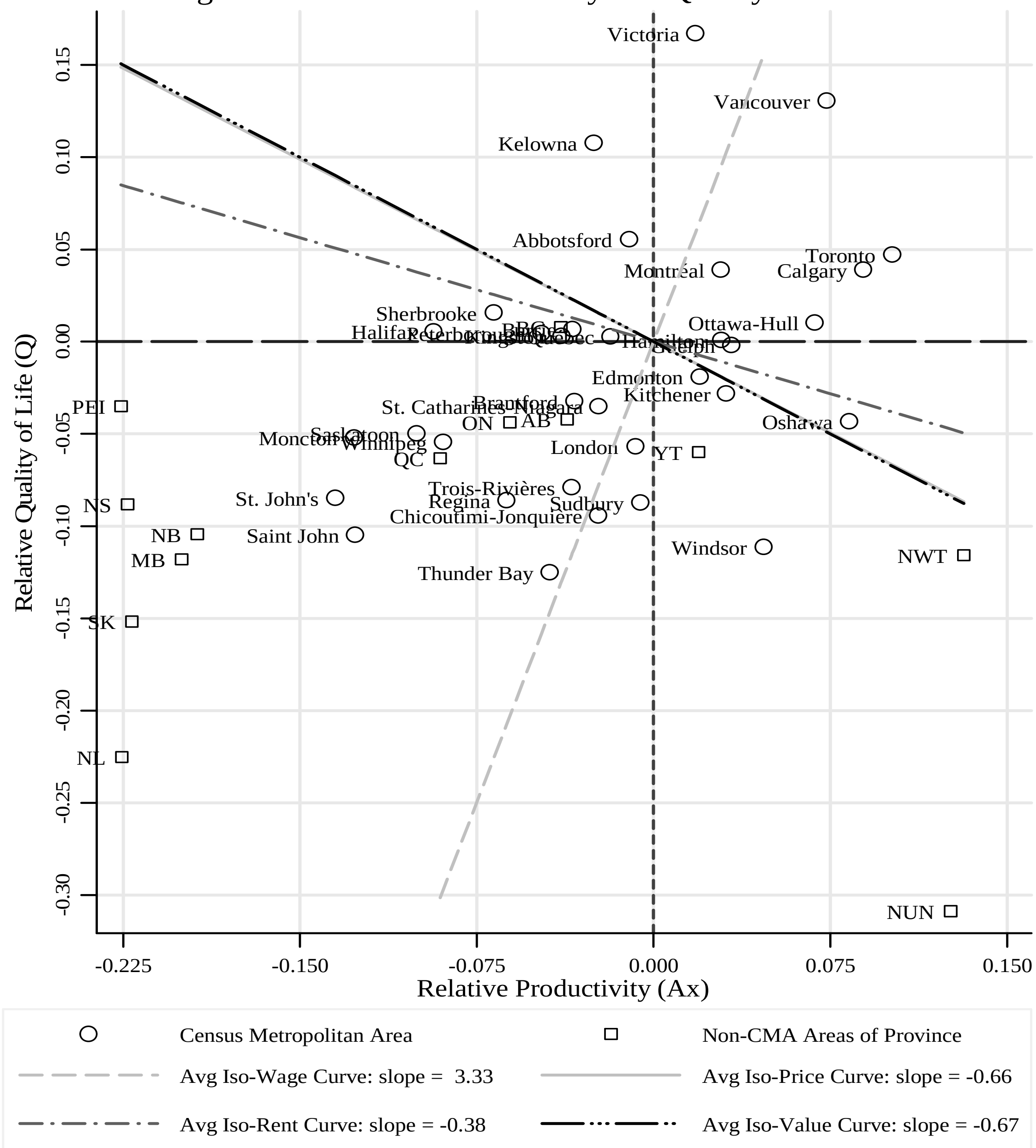

TABLE A1: ALTERNATIVE QUALITY-OF-LIFE MEASURES USING ADJUSTMENTS

	Base QOL		Transfer-adjusted QOL		Non Housing Cost-Adjusted QOL		Rent-adjusted QOL	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Victoria	0.167	1	0.161	1	0.113	1	0.056	3
Vancouver	0.131	2	0.125	2	0.078	3	0.039	5
Kelowna	0.108	3	0.102	3	0.083	2	0.059	2
Abbotsford	0.055	4	0.050	6	0.046	4	0.002	15
Toronto	0.047	5	0.073	4	0.038	8	0.024	7
Calgary	0.039	6	-0.037	21	0.004	14	-0.003	16
Montréal	0.039	7	0.060	5	-0.021	22	0.011	13
Sherbrooke	0.016	8	0.037	7	-0.018	20	0.012	12
Ottawa-Hull	0.010	9	0.035	8	-0.003	16	0.013	11
British Columbia, non-CMA	0.008	.	0.002	.	0.021	.	-0.024	.
Barrie	0.007	10	0.033	9	0.040	6	0.053	4
Halifax	0.006	11	-0.023	19	0.035	9	0.060	1
Peterborough	0.005	12	0.031	10	0.041	5	0.021	8
Kingston	0.003	13	0.029	11	0.038	7	0.021	9
Québec	0.003	14	0.024	14	-0.036	26	0.019	10
Hamilton	0.001	15	0.027	12	0.023	10	-0.009	20
Guelph	-0.002	16	0.024	13	0.020	11	-0.004	18
Edmonton	-0.019	17	-0.095	28	-0.020	21	-0.006	19
Kitchener	-0.028	18	-0.002	15	0.004	15	-0.012	21
Brantford	-0.032	19	-0.006	16	0.014	12	-0.016	24
St. Catharines-Niagara	-0.035	20	-0.009	17	0.010	13	-0.013	22
Prince Edward Island	-0.035	.	-0.070	.	0.025	.	0.051	.
Alberta, non-CMA	-0.042	.	-0.118	.	-0.024	.	-0.008	.
Oshawa	-0.043	21	-0.017	18	-0.017	19	-0.022	27
Ontario, non-CMA	-0.044	.	-0.018	.	0.012	.	-0.029	.
Saskatoon	-0.050	22	-0.107	30	-0.032	25	0.005	14
Moncton	-0.052	23	-0.089	26	-0.016	18	0.035	6
Winnipeg	-0.054	24	-0.093	27	-0.047	28	-0.004	17
London	-0.057	25	-0.031	20	-0.007	17	-0.021	26
Yukon Territory	-0.060	.	-0.248	.	-0.060	.	-0.048	.
Quebec, non-CMA	-0.063	.	-0.042	.	-0.065	.	-0.041	.
Trois-Rivières	-0.079	26	-0.058	22	-0.085	32	-0.045	29
St. John's	-0.085	27	-0.154	33	-0.028	24	-0.019	25
Regina	-0.086	28	-0.143	32	-0.063	31	-0.013	23
Sudbury	-0.087	29	-0.061	23	-0.028	23	-0.049	30
Nova Scotia, non-CMA	-0.088	.	-0.117	.	-0.001	.	0.007	.
Chicoutimi-Jonquière	-0.094	30	-0.073	24	-0.097	33	-0.057	31
New Brunswick,non-CMA	-0.104	.	-0.141	.	-0.037	.	-0.004	.
Saint John	-0.105	31	-0.142	31	-0.050	29	-0.040	28
Windsor	-0.111	32	-0.085	25	-0.054	30	-0.071	33
Northwest Territory	-0.116	.	-0.321	.	-0.116	.	-0.138	.
Manitoba, non-CMA	-0.118	.	-0.157	.	-0.067	.	-0.047	.
Thunder Bay	-0.125	33	-0.099	29	-0.044	27	-0.063	32
Saskatchewan, non-CMA	-0.152	.	-0.209	.	-0.074	.	-0.027	.
Newfoundland, non-CMA	-0.225	.	-0.294	.	-0.101	.	-0.068	.
Nunavut Territory	-0.309	.	-0.590	.	-0.309	.	-0.387	.

TABLE A2: ALTERNATIVE TOTAL VALUE MEASURES USING ADJUSTMENTS

	Base Value		Transfer-adjusted Value		Non Housing Cost-Adjusted Value		Rent-adjusted Value	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Vancouver	0.180	1	0.174	1	0.127	1	0.088	2
Victoria	0.179	2	0.173	2	0.125	2	0.068	3
Toronto	0.115	3	0.141	3	0.106	3	0.092	1
Calgary	0.098	4	0.023	11	0.063	5	0.056	5
Kelowna	0.091	5	0.085	4	0.066	4	0.042	6
Montréal	0.058	6	0.079	6	-0.002	15	0.030	9
Ottawa-Hull	0.056	7	0.080	5	0.043	6	0.059	4
Abbotsford	0.049	8	0.043	9	0.039	9	-0.005	16
Guelph	0.020	9	0.046	7	0.042	7	0.018	10
Hamilton	0.020	10	0.046	8	0.042	8	0.010	11
Oshawa	0.012	11	0.038	10	0.038	10	0.033	7
Edmonton	-0.006	12	-0.082	24	-0.007	17	0.007	13
Kitchener	-0.008	13	0.019	12	0.024	11	0.009	12
Québec	-0.009	14	0.011	13	-0.048	23	0.007	14
Barrie	-0.016	15	0.010	14	0.017	12	0.030	8
British Columbia, non-CMA	-0.018	.	-0.024	.	-0.005	.	-0.050	.
Kingston	-0.023	16	0.003	15	0.012	13	-0.005	17
Peterborough	-0.027	17	-0.001	16	0.009	14	-0.010	18
Northwest Territory	-0.028	.	-0.233	.	-0.028	.	-0.050	.
Sherbrooke	-0.029	18	-0.009	17	-0.063	24	-0.033	21
Yukon Territory	-0.047	.	-0.235	.	-0.047	.	-0.036	.
St. Catharines-Niagara	-0.051	19	-0.024	18	-0.005	16	-0.028	20
Brantford	-0.055	20	-0.028	19	-0.008	18	-0.038	22
Halifax	-0.057	21	-0.086	25	-0.028	21	-0.002	15
London	-0.062	22	-0.036	20	-0.012	19	-0.027	19
Alberta, non-CMA	-0.067	.	-0.142	.	-0.048	.	-0.033	.
Windsor	-0.080	23	-0.054	21	-0.023	20	-0.040	23
Ontario, non-CMA	-0.084	.	-0.058	.	-0.028	.	-0.070	.
Sudbury	-0.091	24	-0.065	22	-0.031	22	-0.053	25
Trois-Rivières	-0.102	25	-0.081	23	-0.109	30	-0.068	29
Chicoutimi-Jonquière	-0.110	26	-0.089	26	-0.113	31	-0.073	30
Winnipeg	-0.114	27	-0.153	28	-0.107	29	-0.063	28
Saskatoon	-0.117	28	-0.174	30	-0.099	26	-0.062	27
Quebec, non-CMA	-0.124	.	-0.103	.	-0.125	.	-0.101	.
Regina	-0.128	29	-0.185	31	-0.105	28	-0.055	26
Moncton	-0.137	30	-0.174	29	-0.101	27	-0.050	24
Thunder Bay	-0.154	31	-0.128	27	-0.073	25	-0.092	31
St. John's	-0.175	32	-0.244	33	-0.118	32	-0.109	32
Prince Edward Island	-0.186	.	-0.221	.	-0.125	.	-0.100	.
Saint John	-0.189	33	-0.226	32	-0.135	33	-0.125	33
Nunavut Territory	-0.225	.	-0.506	.	-0.225	.	-0.303	.
New Brunswick,non-CMA	-0.233	.	-0.270	.	-0.166	.	-0.133	.
Nova Scotia, non-CMA	-0.237	.	-0.266	.	-0.150	.	-0.142	.
Manitoba, non-CMA	-0.251	.	-0.290	.	-0.200	.	-0.180	.
Saskatchewan, non-CMA	-0.299	.	-0.356	.	-0.222	.	-0.174	.
Newfoundland, non-CMA	-0.375	.	-0.445	.	-0.251	.	-0.218	.

TABLE A3: ADDITIONAL STATISTICS BY CMA, 2006

CMA	Union Coverage Rate	Employment Rate	Fraction who work in CMA of residence	Log CPI Non-Housing
St. John's	0.401	0.778	0.974	-0.003
Halifax	0.346	0.818	0.980	0.010
Moncton	0.310	0.845	0.943	-0.014
Saint John	0.342	0.812	0.973	-0.014
Chicoutimi-Jonquière	0.541	0.751	0.951	-0.053
Québec	0.492	0.835	0.956	-0.053
Sherbrooke	0.499	0.789	0.885	-0.053
Trois-Rivières	0.542	0.791	0.850	-0.053
Montréal	0.377	0.788	0.975	-0.053
Ottawa-Hull	0.454	0.825	0.984	0.037
Kingston	0.460	0.783	0.935	0.037
Peterborough	0.430	0.841	0.834	0.037
Oshawa	0.425	0.841	0.566	0.037
Toronto	0.239	0.813	0.979	0.037
Hamilton	0.328	0.822	0.737	0.037
St. Catharines-Niagara	0.348	0.812	0.897	0.037
Kitchener	0.296	0.843	0.848	0.037
Brantford	0.312	0.824	0.721	0.037
Guelph	0.295	0.867	0.717	0.037
London	0.333	0.827	0.936	0.037
Windsor	0.421	0.775	0.953	0.037
Barrie	0.276	0.877	0.595	0.037
Sudbury	0.456	0.771	0.977	0.037
Thunder Bay	0.497	0.797	0.976	0.037
Winnipeg	0.423	0.837	0.973	-0.041
Regina	0.444	0.855	0.981	-0.029
Saskatoon	0.436	0.844	0.974	-0.029
Calgary	0.228	0.847	0.982	-0.004
Edmonton	0.298	0.821	0.977	-0.004
Kelowna	0.253	0.830	0.956	0.009
Abbotsford	0.343	0.808	0.644	0.009
Vancouver	0.340	0.792	0.986	0.009
Victoria	0.384	0.825	0.983	0.009
NL,non-CMA	0.438	0.619		-0.003
PEI	0.377	0.798		-0.004
NS,non-CMA	0.345	0.734		0.010
NB,non-CMA	0.338	0.724		-0.014
QC,non-CMA	0.479	0.779		-0.053
ON,non-CMA	0.389	0.808		0.037
MB,non-CMA	0.436	0.839		-0.041
SK,non-CMA	0.367	0.838		-0.029
AB,non-CMA	0.257	0.848		-0.004
BC,non-CMA	0.402	0.790		0.009

Figure A1: Housing Costs versus Wage Levels across CMAs, 2006