

Urban Footprints in Rural Canada: Employment Spillovers by City Size

by

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Commuting

Introduction

Nonmetro to metro commuting interest

- Agglomeration economy spillovers
- Extent and nature of rural-urban interdependencies
- Practical and policy implications
 - Planning
 - Regionalization
 - Governance
- General patterns, unique circumstances

The paper is based on commuting flows between rural and urban areas. Why is this of interest? Academically, extent of 'spread' of urban agglomeration economies, also the nature of rural-urban interdependencies. Is this the best 'rural development' strategy?

Lots of practical and policy implications—areas of interdependence, rural + urban, would be logical areas for planning, for considering regional policies of various kinds, including governance arrangements.

Of interest is both the general pattern, but perhaps more specifically, and certainly of more practical interest, the unique dimensions of this in areas surrounding particular urban centres. Both rural areas and urban centres have unique characteristics that will create unique types of interdependencies and thus unique planning and governance solutions.

Selected Literature

- Commuting sheds important:
 - Rural development literature (Berry 1970), Mitchelson and Fisher (1987), Renkow and Hoover (2000)
 - Spillovers of urban agglomeration economies (Barkley et al. 1996; Henry et al. 1997; Holland and Hughes; Partridge et al. 2007)
 - Urban extension (sprawl), McKee and McKee (2004), Cavailhès et al. (2004)
 - Regionalization, Fox and Kumar (1965), Barkley et al. (1996); Stabler et al. (1996)

Early literature on commuting included Berry 1970 who developed commuting maps for major US centres based on 1960s data—larger urban centres found to have higher commuting rates, with a min size of 10-50,000 required for centres to be a significant commuting destination. Mitchelson and Fisher conducted a couple of studies of commuting sheds in Georgia and New York, finding that 50-60 miles was the max extent of commuting—an hour's commuting time has been a common theme. More recently Renkow and Hoover investigated the relative importance of rural restructuring vs. deconcentration as the basis for non-metro to metro commuting.

Agglomeration spillovers—commuting would be one mechanism by which this occurs. A number of studies have investigated the spatial extent of spread and backwash, investigating at what point positive spillovers (commuting) may be offset by negative effects (backwash) where rural-to-urban migration may be a substitute for commuting

As a form of urban sprawl, or an extension of urban centres, McKee and McKee find commuting to be one of the many ways in which urban areas extend their spatial influence among, edge cities, urban corridors, etc. Cavailhès also investigate a particular variant of this in the form of the periurban belt around Paris, defined as the extra urban areas where farmers and other households depend on urban employment—examined the intensity and geographic extent of commuting—around Paris, the largest extent of 46kms.

Regionalization implicit in the above, but also specifically addressed by Fox and Kumar early on in their discussion of how functional economic areas may be defined and subsequently by...

Theoretical Framework

(1) $U_i = U_i(X_i, H_i, S_i, L_i)$; utility maximisation

$B_i + w_i N_i = pX_i + r_i H_i$; $T_i = N_i + L_i$; constraints

(2) $V_i^{NC} = V_i(w_i, r_i, p, S_i, L_i, e_i)$; non-commuters

(3) $V_i^C = V_i(\tau^* w_j, r_i, p, S_i, (1-t)^* L_i, e_i)$; commuters

(4) $C_{ij} = C_{ij}(e_i, e_j, D_{ij}, Z_{ij})$; aggregate commuters

$e_{i,j}$ = employment rates

D_{ij} = distance non-metro and potential urban

Z_{ij} = comparative characteristics, i and j

Representative individual in non-metro location i derives utility from traded goods (X), housing (H), site-specific amenities (S), and leisure time (L). B =endowment, w wages, prices, rent. Time allocated to labor hours and leisure

The commuting individual has an additional constraint, the monetary and time costs of commuting. W_j is the wage rate in (potential commuting destination) metro location j , τ is the reduction in the real metro wage rate after allowing for the transportation cost of commuting to work, and t is the commuting time and thus the amount by which L_i is reduced as a result of commuting. The employment rate in metro j is e_j . Both τ and t will be positive functions of the distance (D_{ij}) between nonmetro location i and metro j .

Residential choices (based on accessibility to employment, relative housing costs, etc.) precede commuting flows.

The individual faces a budget constraint (wages + other income, exp. Traded goods plus rents; where they spend their labor earnings and their endowment B on housing and traded goods; a time constraint exists in that leisure and hours of work (N) must equal the T available hours

Aggregate commuting betw i and j can then be expressed as a fn of employment rates, distance and other comparative charac.

Z_{ij} refers to other factors affecting commuting.

Given the jointness of commuting and residential location decisions, some of the Z_{ij} variables include the underlying factors that affect the *joint* decision including (lagged) relative housing values, etc. Even so, distance is likely the critical intervening factor in relative metro/nonmetro economic outcomes such as wages and housing costs—i.e., distance may dominate other effects.

Empirical Implementation

Data:

1996 and 2001 CA Census of Pop; POW/POR;
2,607 CCSs (communities)

Urban CA (10K+) or CMA (100K +)—137 total;

Rural= residual

Potential “commuting shed” (137) of 200kms
surrounding; potentially 137 models

Dependent variable: CCS’s out-commuting rate,
2001: % of workers in the CCS commuting to the
focal urban center

Commuting information is for the experienced labor force 15 years and over having a usual place of work (including at home) for 2,607 Census Consolidated Subdivisions (CCS). A CCS may be considered a “community” comprised of geographical proximate municipalities forming a compact functional area, forming our unit of analysis. Statistics Canada defines a CCS as a group of adjacent census subdivisions. Generally small urban census subdivisions (towns, villages, etc.) are combined with the surrounding more rural census subdivision (du Plessis et al. 2002).

Empirical Model

$$(5) \mathbf{C} = \mathbf{X}\boldsymbol{\beta} + \mathbf{u}, \mathbf{u} = \lambda \mathbf{W}\mathbf{u} + \boldsymbol{\varepsilon}, \boldsymbol{\varepsilon} \sim N(0, \sigma^2 \mathbf{I}),$$

\mathbf{C} = out-commuting rates from the CCSs in 2001

\mathbf{X} = explanatory variables

$\boldsymbol{\beta}$ is a vector of parameters

\mathbf{u} is a vector of residuals;

λ is the spatial autocorrelation parameter;

\mathbf{W} is a row-standardized spatial-weight matrix
(inverse of the squared distance between the
centroids of the CA/CMA and the CCSs are the
weights)

$\boldsymbol{\varepsilon}$ is a vector of normally distributed errors.

A set of spatial error models is estimated. CCSs part of the focal CA/CMA excluded

The spatial error model (SEM) specification is employed to allow for potential spatial dependence in idiosyncratic local factors in nearby CCSs that cause spillovers that affect commuting flows in the CCS of interest.

200km is assumed to be the maximum distance for potentially (regularly) commuting given well-connected highways and access to modern transportation facilities; beyond 200kms commuters may not commute daily.

Explanatory Variables (1996)

- 3 distance variables—focal CA/CMA, nearest other CA/CMA, 2nd nearest CA/CMA
- Job growth rates in the CCS, the focal Urban and other CA/CMA
- % agriculture employment
- Relative housing costs
- Relative pop size, origin and destination
- Percentage of pop 25-54
- % of 25-54 w post secondary education
- Indicator for CCS being part of any other CA/CMA

Distance formulation best fit though other nonlinear specifications , incl of access to transportation were also investigated. Distance to competing destinations important in polycentric frameworks. Interregional commuting flows occur mostly be auto. For our 137 centres, public trans play little role

Model Estimation

- 115 models estimated (out of 137), Matlab
- Considerable heterogeneity with some evident patterns, most obviously by urban centre size—5 grps (largest 3, next 6 still with pop. > 500K, other 24 CMAs, 19 largest CAs (50K+), 63 small CAs.

For particular cities, the individual models are important. Presentation—cannot show all models.....

Summary of Signs and Significance of SEM Regression Coefficients by CA/CMA Size															
Variables	Big 3 CMAs			Next 6 CMAs			24 Oth CMAs			19 Large CAs			63 Sm. CAs		
	+	-	NS	+	-	NS	+	-	NS	+	-	NS	+	-	NS
Intercept	0	0	3	2	0	4	2	2	20	2	0	17	13	5	45
Dist to the CA/CMA	0	3	0	0	6	0	0	23	1	0	16	3	0	59	4
D. nearest oth. CA/CMA	1	0	2	2	0	4	6	3	15	9	1	9	11	7	45
D. 2 nd other CA/CMA	1	0	2	0	2	4	7	1	16	7	2	10	17	8	38
% Ag empl. 1996	0	2	1	0	0	6	1	2	21	2	6	11	5	4	54
(CA/CMA)/CCS job-growth 1996-01	0	0	3	1	1	4	3	1	20	0	2	17	2	0	61
(CA/CMA)/CCS dwelling value 1996	1	0	2	0	3	3	4	4	14	2	2	13	7	10	44
(CA/CMA)/CCS pop '96	0	0	3	1	1	4	3	5	16	3	4	12	3	10	50
(CA/CMA) ² /(CA/CMA) ¹ pop 1996	1	0	2	0	2	4	3	4	17	3	5	11	9	6	48
Job-gr. nearest other CA/CMA 1996-01	0	1	2	0	3	3	0	4	19	1	3	15	2	5	56
% pop 25-54 years 1996	0	0	3	0	2	4	5	3	15	5	2	10	16	6	41
% with PS ed. 1996	2	0	1	3	0	3	11	1	12	3	0	16	5	2	56
CCS part of CA/CMA	1	0	2	1	0	5	2	3	19	4	3	12	6	6	51

Fully 107 out of the 115 distance coefficients are negative and statistically significant at the 10% level, whereas the remaining 8 are insignificant. Yet, there clearly are idiosyncratic differences among the 115 models in terms of significance. For example, while the vast majority of the cases where either the distance to the nearest other urban area (not the focal urban area) or the distance to the 2nd closest urban area (besides the focal one) take on the expected positive sign, over 60% of these coefficients are insignificant. This illustrates how the geographic scarcity of urban areas in Canada implies fewer overlapping commuting sheds—though as shown below, this is not universal everywhere. The R-squared values (not shown) for the 115 models are consistently larger in the commuting sheds centered on larger CA/CMAs, which suggests that there are more idiosyncratic effects surrounding the smaller urban areas. This is also evident in the greater number of significant variables in the commuting sheds centered on the larger urban centers. These observed differences by size of focal CA/CMA are the basis of further analysis described below.

Summary of Individual Model results					
Explanatory Variable	Big 3 CMAs	Next 6	Other CMAs	Large CAs	Small CAs
Distance to Focal Urban	100% -	100%-	96%-	84%-	94% -
Distance to Nearest Other	33 +	50 +	25 +	90 +	17 +
Distance to 2nd Nearest other	33 +	0 +	29 +	37 +	27 +
% Ag Employment, '96	67 -	0 -	8 -	32 -	6 -
Job Growth (CA,CMA)/(CCS), 96-01	0 +	17 +	13 +	0+	3+
Dwelling Value '96 (CA,CMA)/(CCS)	33 +	0 +	17 +	11 +	11 +
Pop Size '96 (CA,CMA)/(CCS)	0 +	17+	13 +	16 +	5 +
Pop Size '96 (CA, CMA)/(nearest oth.)	33 +	0 +	13 +	16 +	14 +
Job Growth, nearest other, 96-01	33-	100 -	17 -	16 -	8 -
% 25-54 pop, '96	0 +	0 +	21 +	26 +	25+
% w. Post secondary education, '96	67+ve	50 +ve	46 +ve	16 +ve	8 +ve

Reports the % of the coefficients with the expected sign

Distance variables strongly and significantly consistent w hypotheses

Considerable variation otherwise, R sq largest for largest CA/CMAs, also greater # of sign vars.

Model Aggregation

- Individual patterns informative, means of summarizing necessary to discern general/regional and other patterns
- Mean group estimation (Peseran and Smith 1995; Peseran et al. 1999)—coefficients averaged within each group
- Canadian regions—BC, Prairies, Ontario, Quebec, Atlantic region; urban size classes
- Coefficients weighted by focal urban centre population

The 115 models were informative. In another aspect of this project, we engaged city planners and policy and administrative people in 5 cities, provided information, received feedback and produced individual reports. All Commuting shed maps were made available

Weighted Average Coefficients and t-values (in parentheses) for Out-commuting Rates by Economic Regions					
Variables	BC	Prairies	Ontario	Quebec	Atlantic
Intercept	-3.207 (-0.09)	166.307* (1.95)	20.320 (0.83)	29.050 (0.96)	4.692 (0.18)
Dist of CCS to the CA/CMA	-0.065** (-2.36)	-0.198** (-5.65)	-0.216** (-8.53)	-0.198** (-9.10)	-0.099** (-4.11)
Dist to nearest other CA/CMA	-0.032 (-0.60)	0.113* (1.75)	0.050 (1.11)	0.082** (2.34)	0.042 (0.98)
Dist to 2 nd nearest other CA/CMA	0.047 (0.93)	-0.062 (-1.22)	0.105** (2.42)	0.040 (1.09)	0.001 (0.01)
% agriculture employment 1996	-0.034 (-0.15)	0.246 (1.16)	-0.088 (-1.22)	-0.060 (-1.63)	0.006 (0.03)
CA/CMA to CCS job-growth 1996-01	-0.951 (-1.21)	-0.293 (-0.43)	0.005 (0.02)	-0.133 (-0.33)	0.222 (0.55)
CA/CMA to CCS dwelling value 1996	-0.934 (-0.25)	6.827 (1.41)	-1.641 (-0.94)	-0.942 (-0.96)	-2.463 (-1.21)
CA/CMA to CCS pop 1996	-3.620 (-0.55)	-51.745* (-1.89)	0.863 (0.32)	1.917 (1.11)	3.498 (0.84)
Pop. CA/CMA to nearest other CA/CMA '96	9.565 (0.74)	-88.281* (-1.83)	2.993 (0.44)	4.197 (0.62)	-3.877 (-0.25)
Job-growth of nearest other CA/CMA 1996-01	0.181 (0.76)	-1.330* (-1.94)	0.019 (0.19)	0.136* (1.70)	0.044 (0.21)
% pop 25-54 years 1996	0.332 (0.88)	1.362** (2.00)	0.444** (2.65)	0.156* (1.70)	0.277 (1.15)
% with post secondary edu 1996	-0.030 (-0.19)	-0.063 (-0.29)	0.018 (0.30)	0.062* (1.71)	-0.008 (-0.11)
If CCS belongs to other CA/CMA	-0.807 (-0.31)	-7.160 (-1.38)	-1.980 (-1.43)	-1.092 (-1.00)	-0.535 (-0.25)
No. of CA/CMA's	9	19	41	29	17

Distance of the nonmetro area from the urban center consistently negative sign., some regional variation.

If the communities' average travel distance increases by 100 kms (about a one-hour drive), for example, the average expected commuting rate declines by 22% in Ontario, 20% in Quebec and Prairies, 10% in Atlantic region, and 7% in BC.

The average coefficient of distance to nearest other CA/CMA is significant in Quebec and Prairie regions;

Average coefficient of distance to second nearest other CA/CMA is statistically significant only in Ontario.

Weighted Average Coefficients/ t-values (in parentheses) for Out-commuting Rates 2001 by CA/CMA Size					
Variables	Biggest 3 CMAs	Next 6 CMAs	Other CMAs	Large CAs	Small CAs
Intercept	30.977 (0.97)	126.448* (1.93)	-3.872 (-0.16)	13.290 (0.61)	2.393 (0.10)
Dist of CCS to the CA/CMA	-0.242** (-8.35)	-0.209** (-6.73)	-0.109** (-5.33)	-0.101** (-4.52)	-0.061** (-4.05)
Dist to nearest other CA/CMA	0.061 (1.23)	0.104* (1.84)	0.012 (0.27)	0.071** (1.99)	0.016 (0.65)
Dist to 2 nd nearest other CA/CMA	0.116** (2.35)	-0.037 (-0.78)	0.040 (1.01)	0.002 (0.07)	0.008 (0.37)
% agriculture employment 1996	-0.148 (-1.61)	0.183 (1.13)	0.035 (0.28)	-0.022 (-0.26)	0.002 (0.04)
CA/CMA to CCS job-growth 1996-01	-0.159 (-1.05)	-0.059 (-0.29)	-0.302 (-0.65)	0.035 (0.02)	-0.402 (-0.26)
CA/CMA to CCS dwelling value 1996	0.125 (1.06)	-0.925** (-2.10)	0.040 (0.25)	0.005 (0.03)	-0.017 (-0.07)
CA/CMA to CCS pop 1996	-2.605 (-1.45)	4.451 (1.18)	0.232 (0.10)	-0.251 (-0.12)	-0.081 (-0.06)
Pop. CA/CMA to nearest other CA/CMA '96	1.265 (0.41)	-37.115* (-1.93)	-0.543 (-0.13)	2.777 (0.73)	1.219 (0.43)
Job-growth of nearest other CA/CMA 1996-01	-1.441 (-0.91)	-5.708 (-1.58)	-2.119 (-1.15)	-0.116 (-0.06)	-0.565 (-0.40)
% pop 25-54 years 1996	4.708 (0.66)	-60.237* (-1.81)	3.055 (0.30)	-2.678 (-0.33)	2.844 (0.16)
% with post secondary edu 1996	0.417** (2.15)	1.001** (2.01)	0.405* (1.81)	0.105 (0.64)	0.066 (0.58)
If CCS belongs to other CA/CMA	0.022 (0.29)	-0.016 (-0.10)	0.024 (0.32)	-0.040 (-0.61)	-0.001 (-0.02)
No. of CA/CMAs	3	6	24	19	63

Average Weighted coefficients for 5 size classes of CA/CMAs --size of the distance-to-nearest CA/CMA coefficient declines monotonically across size groupings. This pattern is consistent with larger absolute commuting rates for the largest cities, in which all commuting rates ultimately decline to zero. Even though the point at which commuting rates fall to zero is expected to be more distant for the largest centers, the much higher initial rates would still require a steeper rate of decline for larger centers.

-competing destinations influence for some

-largest 3 CA/CMA group, post-secondary education variable now has the expected positive sign, ? only larger centers offer the types of professional and highly skilled jobs that attract highly educated commuters from nearby nonmetro areas. Deconcentration evidence.

Summary of Commuting Shed Models

- Individual commuting sheds—distance rules
- By region, distance effect paramount, size varies by region.
- By Focal Urban Centre, clearer patterns—best fit for largest centers
- Considerable variation among models—unique characteristics of regions

Distance of the nonmetro area from the urban center consistently negative sign., some regional variation.

If the communities' average travel distance increases by 100 kms (about a one-hour drive), for example, the average expected commuting rate declines by 22% in Ontario, 20% in Quebec and Prairies, 10% in Atlantic region, and 7% in BC.

The average coefficient of distance to nearest other CA/CMA is significant in Quebec and Prairie regions;

Average coefficient of distance to second nearest other CA/CMA is statistically significant only in Ontario.

The two population ratio variables are negative and significant (at 10% level) only on the Prairies. The insignificance of the agriculture employment share may simply reflect that the distance variable coefficients are capturing the fact that agricultural intensity is related to remoteness. The same likely explains why relative housing costs are insignificant—i.e., distance or remoteness underlies relative housing costs.

Population of 25-54 years +ve, except the Atlantic region. Strongest impact in the Prairie region, – a 1% increase in the active age population is associated with an almost 1% increase in commuting rates.

Implication--vibrant rural areas with a large prime working-age population are associated with more urban commuting. Finally, the average impact of education levels on commuting pattern is small for the overall sample; the post secondary education variable is moderately positive only in Quebec.

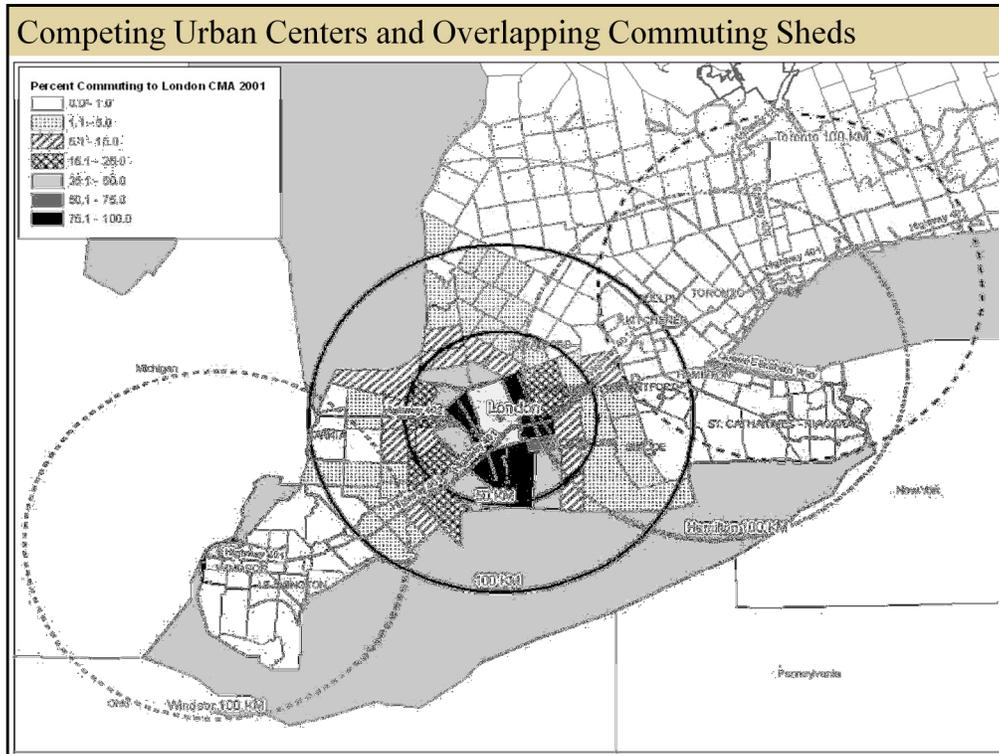


Figure 1 illustrates how competing urban areas alter commuting patterns. The figure shows the percent of the local workforce that commutes to the London CMA (Ontario), 2001 population of 406,000. Rings are placed at 50kms, 100kms, and 150kms around its centroid. Then we add 3 additional rings: 1) 100km from the center of the Toronto CMA (4.7 million population in 2001); 2) 100km ring surrounding the Hamilton CMA (655,000 population in 2001); and 3) 100km ring surrounding Windsor CMA, Ontario (297,000 people in 2001). The map clearly shows a discontinuous increase in commuting rates into London from the east beyond a distance of 100kms from Toronto. Likewise, commuting rates to the east take another discreet jump when Hamilton is no longer within 100kms. Toward the west, commuting rates into London quickly fall below 5% when moving within 100kms of Windsor. In sum, commuting flows into London are significantly shaped by proximity to these other competing urban areas. Similar interdependencies exist in any area densely populated with urban centers.

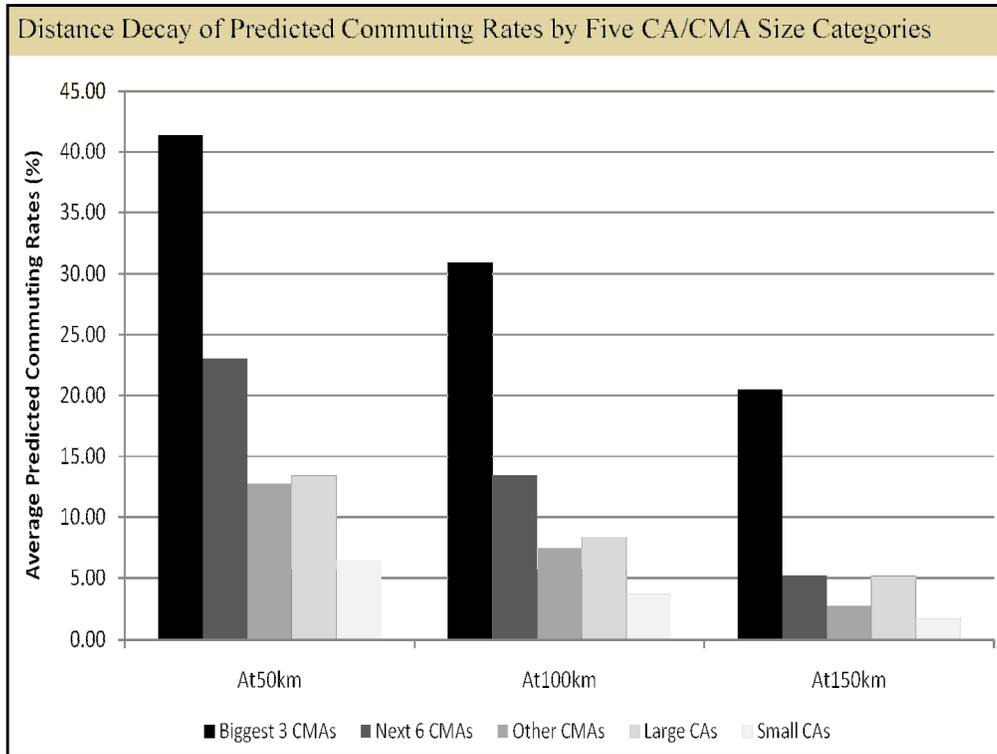
Implications of Results

Results used to address three questions:

- (a) how does distance from the urban center affect the predicted decay in commuting rates;
- (b) how does the CA/CMA population affect the decay; and
- (c) what is the geographic size of the urban region's footprint?

In addition to the information yielded by the individual commuting shed models, what are the underlying messages/extensions of this work?

Will look at each of these in turn.



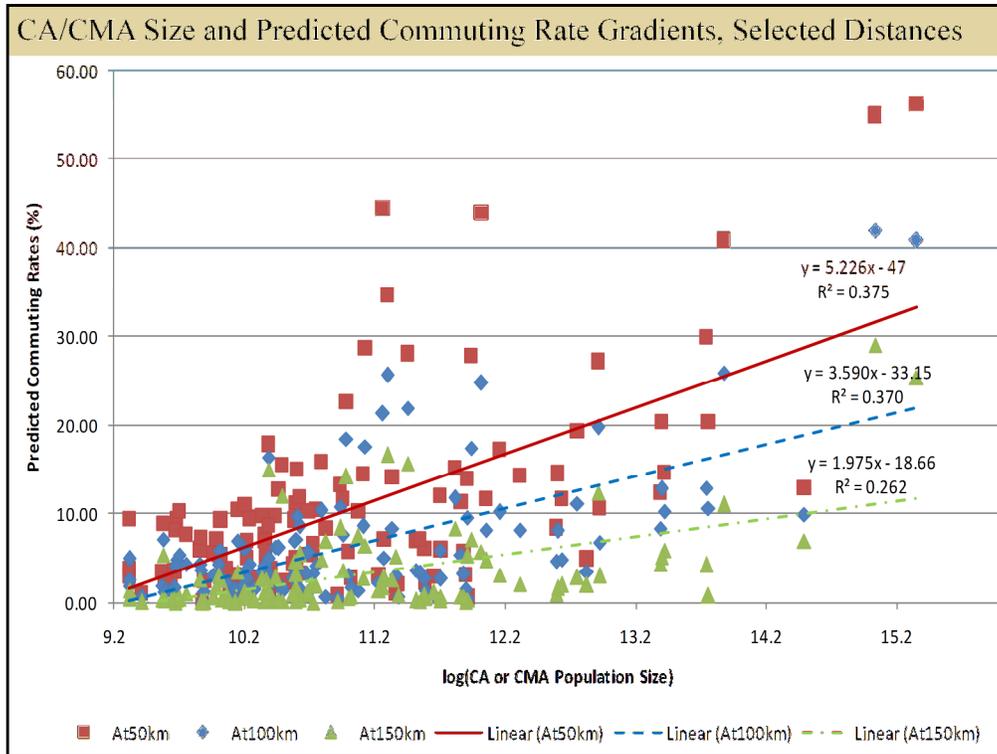
Predicted values of the commuting rates, for CA/CMA size groups at three discrete distances from the core, all other variables set to their mean value.

Begins to address three questions: (a) how does distance from the urban center affect the predicted decay in commuting rates, (b) how does the CA/CMA population affect the decay, (c) what is the geographic size of the urban region's footprint?

Shows monotonic decay over distance for each grp

Also monotonic ordering at each distance across size grps, except large Cas

Compare absolute size of rates



Three scatter plots of the predicted commuting rates (%) at 50, 100, and 150kms distances based on all 115 individual commuting-shed models. The horizontal axis represents CA/CMA population (in log scale). For example, at the far right, the two largest urban centers—Montreal and Toronto—have by far the highest commuting rates at each three distance.

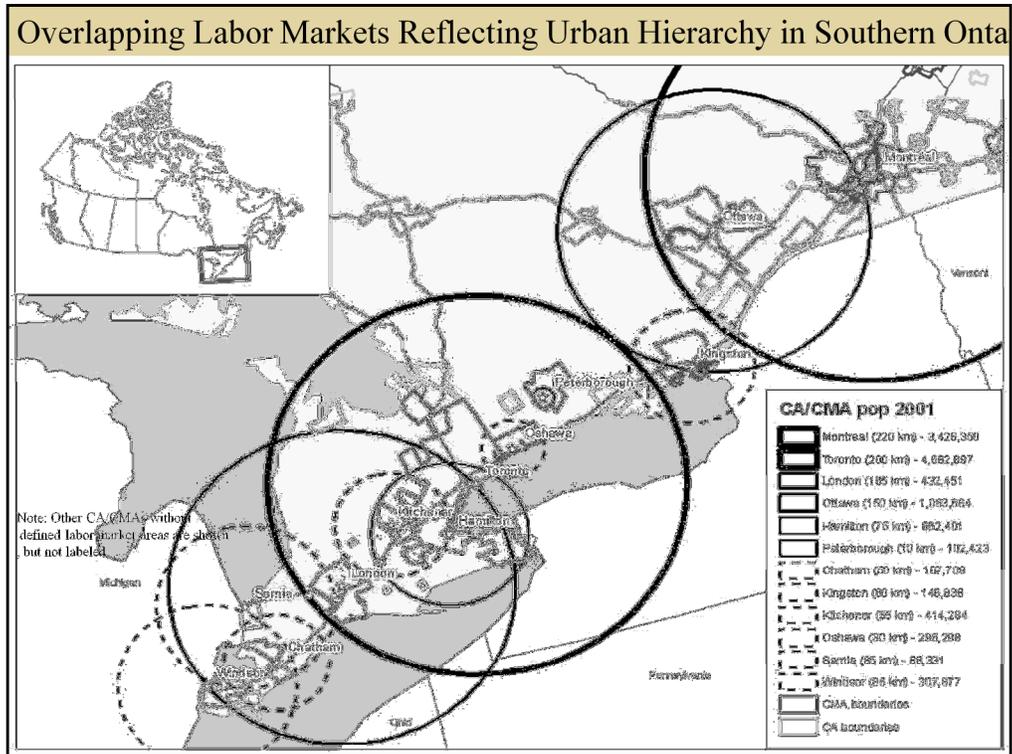
Three linear trend lines are fitted to the data. Their R^2 —CA/CMA size alone explains about 26-38% of the variation in the predicted commuting rates.

Points to the minimum urban size thresholds to achieve certain commuting rates at each of these three distances. That is, what is the minimum urban size threshold such that rural areas at 50, 100, and 150kms away would be expected to have a certain level of commuting rates with a given focal urban area? Such urban size thresholds would be useful in planning for economic development and infrastructure design. For illustration, the specific commuting thresholds we examine are 30%+ for “strong” labor market linkages, 20%+ for “medium” labor market linkages and 10%+ for “modest” labor market linkages. Though these commuting categories are somewhat arbitrary, they are analogous to the metropolitan influence zone rates used by Statistics Canada and the corresponding urban commuting influence used by the U.S. Department of Agriculture’s Economic Research Service.

Size Thresholds for Commuting Rates

- Urban rural labour market linkages at 50kms:
 - “strong” (30%+) if urban pop 2.5m+
 - “medium” (20%+) if urban pop 370,000
 - “modest “ (10%+) for pop 55,000---8,000 km² influence zone
- At 100kms:
 - “medium” if urban pop 2.7m+
 - “modest “ if urban pop 165,000
- At 150 kms:
 - “modest” if urban pop 2m-- 71,000km² influence zone
- Montreal and Toronto are outliers, nearly achieving strong labor market attachment even at 150kms.
- Transportation access and number of competing centers will determine variations around these averages.

Though these commuting categories are somewhat arbitrary, they are analogous to the metropolitan influence zone rates used by Statistics Canada and the corresponding urban commuting influence used by the U.S. Department of Agriculture’s Economic Research Service



Predicted commuting rates = 10% for each city

Figure 4 illustrates how these labor market areas overlap one another with the largest urban areas generating the largest catchment areas, either fully or partially overlapping smaller regional labor market areas. All of the CA/CMA's in Southern Ontario outlined in grey. Radius is determined by the distance at which predicted average commuting rates fall to 10% using each urban area's regression model.

-Toronto's commuting radius is 200kms

-Montreal's 220kms

-Kitchener, whose labor market region has a predicted 55km radius. Interestingly, London's labor market region extends 165kms, which exceeds Ottawa's 150kms, even though the Ottawa CMA is more than twice as populated. Yet, Ottawa's labor market area is constrained on the east by Montreal and the west by Toronto, while Toronto is London's only major competitor. Completely falling in Toronto's agglomeration shadow, note that Hamilton's reach is only 75kms and Oshawa's is 30kms.

A clear traditional urban hierarchy is also apparent in Figure 4. **Toronto-at the top of the urban hierarchy in Southern Ontario (and along with Montreal, in Quebec) has a geographical reach that fully or partially overlaps 21 additional CAs and CMA's.**

Conclusion

- Urban to rural spillovers suggest regionally integrated labor markets
- Heterogeneity by region and size of urban center—distance rules
- Distance decay varies by region and by city size
- Overlapping commuting sheds-complex rel.
- Toronto and Montreal have a huge economic footprint; significant impact of smaller places
- Functionally integrated regions suggest a regional approach to planning and governance