Local Scale Population Projection Methods: Shrinking and Aging Communities

Population Change and Lifecourse Strategic Knowledge Cluster Conference – March 18-20, 2015 – Ottawa, ON

Maxwell Hartt, School of Planning, University of Waterloo – mhartt@uwaterloo.ca

UNIVERSITY OF Waterloo

ABSTRACT

The emergence of a globalized economy has given rise to 'global cities' where knowledge, resource and human capital conglomerate – often at the cost of outmigration of resources in smaller cities. In the Canadian context, the growth of a few major centers is contrasted with many smaller and peripheral cities that may be coping with shrinking populations and economic decline. These effects are increasingly compounded by a second demographic transition, which is characterized by falling birth rates and an aging population. Continued loss of population, changing demographic structure, and economic decline can lead to a myriad of challenges, including underused infrastructure, high vacancy rates, and socio-economic inequality. As Statistics Canada's population projections are limited to the provincial, territorial and national level, individual municipalities are left to calculate their own projections, which could be hindered by a lack of resources, the complexity of calculating local-scale migration rates, or simply may not be done. This paper reviews the methodological differences reflected in the approaches taken by various levels of government and concludes that more complex, time consuming and expensive models are used at higher levels of governance and in larger cities and are more likely to provide more accurate and precise results. Smaller and peripheral cities tend to use simpler, less time- and resource-intensive methods. An assessment framework of nine criteria concluded that the share capture method is the best methodological alternative for local scale population projection. The share capture model is applied to every municipality (with population above 10,000) in Ontario and projected dependency ratios are calculated to ascertain the future distribution of aging communities in Ontario.

OBJECTIVES

1. Determine the best methodological alternative for local scale population projection.
2. Apply a consistent population projection method to every municipality (with population above 10,000) in Ontario to produce a comparable basis for population change, dependency ratio, ratio of population over 65 years of age and change in workforce.

PROJECTION METHODS

Method	Equation	Variables	Case Study
Linear Extrapolation	$P_t = a + bt$	P_t = projected population a = population at time 0 b = coefficient of linear curve t = time	Belleville
Housing Unit	$P_t = H'O_N + HO_E$	P_t = projected population H' = new housing H = existing housing O_N = average occupancy rate of new housing O_E = average occupancy rate of existing housing	North Bay
Share Capture	$P_t = kP'_t$	P_t = projected population k = population ratio P'_t = projected population of surrounding area	London
Cohort	$P_t = P_s + B - D \pm M$	P_t = projected population P_s = survived population at time 0 B = births D = deaths M = net migration	1. Waterloo 2. Ontario 3. Canada

METHODOLOGY

Following the population projection method comparison criteria of Smith, Tayman and Swanson (2001) and the subsequent additions of Rayer (2008) and Rayer and Smith (2010), a hybrid assessment framework was developed to compare the methods and results of different levels of Canadian governmental population projections. The methodologies used in different case study locations were qualitatively evaluated based on their strengths and weaknesses identified in the technical reports and the academic literature. Forecast accuracy was judged by comparing past projections with actual population estimates through the calculation of mean absolute percentage error (MAPE). The remaining criteria have been qualitatively assessed, by projection method, by Rayer (2008) based on the strengths and weaknesses identified by Smith, Tayman and Swanson (2001). Keeping consistent with Rayer (2008), for each criterion, a rating of 'good', 'average' or 'poor' will be applied, based on summative evaluations of the different population projection methods, to the case studies examined in this paper. When multiple scenarios are provided, the 'reference' or 'medium' scenario is evaluated.

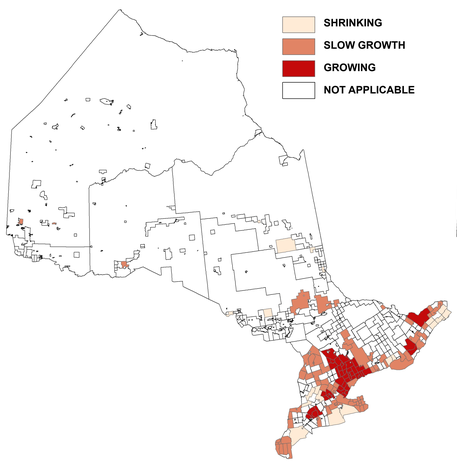
RESULTS

Method	Cohort	Extrapolation	Housing Unit	Share Capture
Forecast Accuracy	+++	++	++	-
Cost	+	+++	++	+++
Time	+	+++	+++	+++
Ease of Application	+	+++	++	+++
Ease of Explanation	++	+++	++	+++
Geographic Detail	+	+++	+++	+++
Demographic Detail	+++	+	+	+++
Temporal Detail	+++	+++	+++	+++
Use for Scenarios	++	+	+	++

+++ good, ++ average, + poor, - not applicable

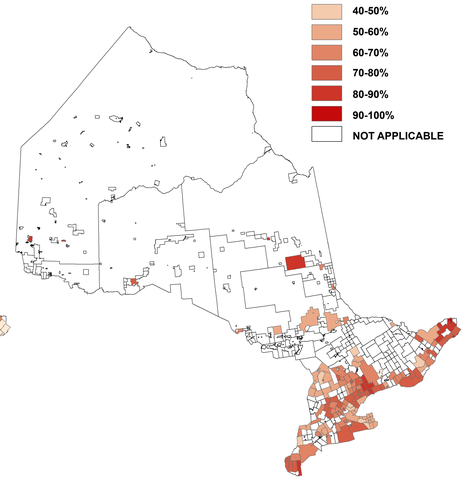
POPULATION

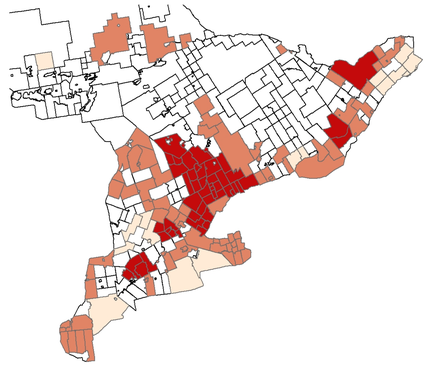
Projected change in census subdivision population between 2013 and 2036 using share capture method.

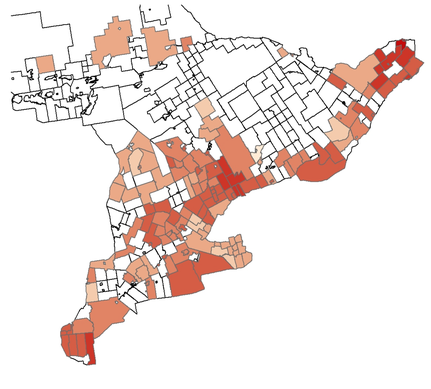


AGE

Projected change in census subdivision proportion of population 65+ between 2013 and 2036 using share capture method.







PROJECTED CHANGE

Population			Aging		Labour
Name	Absolute	Change	Dependency Ratio Change	65+ Pop Change	Workforce Change
1. Sault Ste. Marie	-5155	-6.9%	32.1%	60.8%	-23.2%
2. Chatham-Kent	-5015	-4.8%	45.9%	69.6%	-21.8%
3. Cornwall	-2602	-5.6%	45.8%	83.9%	-25.6%
4. Norfolk County	-2213	-3.5%	41.2%	78.6%	-23.0%
5. Timmins	-1636	-3.8%	28.2%	81.6%	-20.4%
6. Haldimand County	-1572	-3.5%	33.4%	78.0%	-22.8%
7. Elliot Lake	-779	-6.9%	61.9%	54.0%	-24.7%
8. South Glengarry	-739	-5.6%	37.9%	72.9%	-26.0%
9. South Stormont	-708	-5.6%	34.5%	76.1%	-25.7%
10.North Dundas	-630	-5.6%	33.7%	81.4%	-25.4%
11.South Dundas	-606	-5.6%	43.3%	74.4%	-25.4%
12.North Glengarry	-575	-5.6%	48.9%	85.4%	-25.5%
13.Belleville	-521	-1.1%	33.6%	68.6%	-17.5%
14.Quinte West	-454	-1.1%	27.4%	62.0%	-17.2%
15.South Huron	-427	-4.3%	41.0%	62.9%	-22.3%
16.Huron East	-398	-4.3%	32.2%	63.6%	-21.7%
17.Temiskaming Shores	-387	-3.7%	38.2%	61.2%	-21.1%
18.Kapuskasing	-311	-3.8%	41.7%	83.9%	-21.5%
19.Stratford	-305	-1.0%	34.5%	78.7%	-18.2%
20.Kirkland Lake	-302	-3.7%	35.4%	60.7%	-21.6%

Projected change between 2013 and 2036 using share capture method.

CONCLUSION

At the national and provincial scale, cohort component methods are generally used. These methods tend to be more expensive, time consuming, difficult to apply and explain and are lacking in specific geographic detail. However, they do provide very detailed and dynamic projections. At the local level, simpler methods for producing population projections are often applied. Linear extrapolation or share capture models are practical, as results from higher-level governmental projections are often used as a basis for the local level community projections. These methods do not rely on raw data and, as such, are inexpensive, timely and easy to explain. Depending on the method and source data, structural demographic information vital to future city plans can be retained in the local level projection, however, this is not always the case and can limit the usefulness of projections to planning decisions.

Many researchers have concluded that complex models are no more accurate at the local scale than their simple alternatives (Chi 2009; Rayer and Smith 2010; Rayer 2008; Smith and Tayman 2003; Wilson and Rees 2005), therefore it follows that the best method for population projection at the local scale would be a simple method that still produces age and gender specific projections. The specific method would depend on data availability at the regional or census division level, but of the methods presented, the share capture method would be preferred for smaller communities as they lack the human and monetary resources to produce more complex population projections.

REFERENCES

Altus Group. 2012. Employment, Population, Housing and Non-Residential Construction Projections, City of London, Ontario.
Chi, G. 2009. Can Knowledge Improve Population Forecasts at Subcounty Levels? *Demography* 46 (2): 405–27.
City of Belleville. 2010. Population and Household Statistics Population Projections 1.0 - Census Population Trends. Belleville.
Davis, H.C. 1995. *Demographic Projection Techniques for Regions and Smaller Areas*. Vancouver: UBC Press.
Keilman, N. 2008. European Demographic Forecasts Have Not Become More Accurate Over the Past 25 Years. *Population and Development Review* 34 (March): 137–153.
Klosterman, R.E. 1990. *Community Analysis and Planning Techniques*. Savage, Maryland: Rowman & Littlefield Publishers.
Myers, D. 2001. Demographic Futures as a Guide to Planning. *Journal of the American Planning Association* 67 (4): 383–397.
Ontario Ministry of Finance. 2012. Ontario Population Projections Update.
Openshaw, S., and G.A. van der Knapp. 1983. Small Area Population Forecasting: Some Experience with British Models. *Tijdschrift Voor Economische En Sociale Geografie* 74 (4): 291–304.
Rayer, S. 2008. Population Forecast Errors: A Primer for Planners. *Journal of Planning Education and Research* 27 (4): 417–430.
Rayer, S., and S.K. Smith. 2010. Factors Affecting the Accuracy of Subcounty Population Forecasts. *Journal of Planning Education and Research* 30 (2): 147–161.
Smith, S.K., and M. Shahidullah. 1995. An Evaluation of Population Projection Errors for Census Tracts. *Journal of the American Statistical Association* 90 (429): 64–71.
Smith, S.K., and J. Tayman. 2003. An Evaluation of Population Projections by Age. Demography 40 (4): 741–57.
Smith, S.K., J. Tayman, and D.A. Swanson. 2001. *State and Local Population Projections: Methodology and Analysis.* New York: Kluwer Academic/Plenum Publishers.
Statistics Canada. 2010. Population Projections for Canada, Provinces and Territories: 2009 to 2036. *Statistics Canada Catalogue No. 91-520-X.* Ottawa.
Swanson, D.A., and J. Tayman. 1995. Between a Rock and a Hard Place: The Evaluation of Demographic Forecasts. *Population Research and Policy Review* 14 (2): 233–249.
Swanson, D.A., and J. Tayman. 2012. Housing Unit Method. In *Subnational Population Estimates*, 137-163. Dordrecht: Springer.
Watson & Associates. 2009. City of North Bay Population, Housing and Employment Forecast Update, 2006-2031. North Bay, Ontario.
Wilson, T. 2014. New Evaluations of Simple Models for Small Area Population Forecasts. *Population, Space and Place*
Wilson, T., and P. Rees. 2005. Recent Developments in Population Projection Methodology: A Review. *Population, Space and Place* 11 (5): 337–360.

WATERLOO | PLANNING