Canadian Journal of Regional Science
Revue canadienne des sciences régionales

Canada's economic centre of gravity: New estimates using local labour market areas

Annie Seong Lee et Sébastien Breau

Volume 47, numéro 2, 2024

Canada's Economic Geography

URI : https://id.erudit.org/iderudit/1115228ar
DOI : https://doi.org/10.7202/1115228ar

Aller au sommaire du numéro

Éditeur(s)

Canadian Regional Science Association / Association canadienne des sciences régionales

ISSN

0705-4580 (imprimé)
1925-2218 (numérique)

Découvrir la revue

Citer cet article

Lee, A. S. & Breau, S. (2024). Canada's economic centre of gravity: New estimates using local labour market areas. *Canadian Journal of Regional Science / Revue canadienne des sciences régionales*, *47*(2), 29–38. https://doi.org/10.7202/1115228ar

Résumé de l'article

This paper provides new estimates of Canada's economic centre of gravity using self-contained labour market areas as the regional unit of analysis. We find that from 1986 to 2019, Canada's economic centre of gravity shifted from east to west by a net distance of 173 km, or approximately 3.1% of the distance separating Canada's most easterly point (Cape Spear, Newfoundland and Labrador) and the Yukon-Alaska border in the northwest. Within this overall westward shift, we identify five distinct movement vectors where major directional changes have taken place driven in large part by fluctuating prices in resource- (particularly energy-) based commodity prices.

CANADIAN JOURNAL OF REGIONAL SCIENCE

REVUE CANADIENNE DES SCIENCES RÉGIONALES

CANADIAN REGIONAL SCIENCE ASSOCIATION

ASSOCIATION CANADIENNE DE SCIENCE RÉGIONALE

CANADA'S ECONOMIC CENTRE OF GRAVITY: NEW ESTIMATES USING LOCAL LABOUR MARKET AREAS

Annie Seong Lee, Sébastien Breau

Annie Seong Lee*,
University of North Texas
* Corresponding author: Annie.Lee@unt.edu

Sébastien Breau,
McGill University
Department of Geography

Received: 2023-09-12
Accepted: 2024-07-29

Abstract: This paper provides new estimates of Canada's economic centre of gravity using self-contained labour market areas as the regional unit of analysis. We find that from 1986 to 2019, Canada's economic centre of gravity shifted from east to west by a net distance of 173 km, or approximately 3.1% of the distance separating Canada's most easterly point (Cape Spear, Newfoundland and Labrador) and the Yukon-Alaska border in the northwest. Within this overall westward shift, we identify five distinct movement vectors where major directional changes have taken place driven in large part by fluctuating prices in resource- (particularly energy-) based commodity prices.

Keywords: Canada's economic centre of gravity; regional estimates, local labour markets

JEL codes: R12, O51, C80, J40

INTRODUCTION

Western Canada's rapid economic and demographic growth over the last few decades has generated much debate amongst politicians and economic observers, not to mention a sense of growing frustration for some in terms of how national resources are redistributed across the country (see, for instance, Reid, 2019). Regionalism has of course long been recognized as a central feature of Canada's economic, cultural and political landscape and how we define regions as well as understand the role they play in shaping the country's political institutions has been a key challenge for scholars and policy makers alike (Ornstein, 1986; Savoie, 2019). In an effort to better understand and gauge the extent of Canada's shifting regional economic landscape, Breau et al. (2018) provide one of the first studies exploring long-term movements in the country's economic centre of gravity (ECG). A relatively new concept deriving from the literature exploring the changing dynamics of the global economy (Quah, 2011), the ECG can be thought of as the 'average location' of economic activities across a particular geography. When tracked over time, the ECG can be useful in terms of shedding light on how economic resources are distributed across regions within a country (for example) and how related distributional changes may in turn impact a country's economy and its priorities in terms of more spatially equitable or inclusive growth strategies. In initially estimating Canada's ECG, Breau et al. (2018) do so by using historical data on household incomes at the provincial level. Their analysis documented a significant westward shift in Canada's ECG over the 1926 to 2013 period (a net distance of more than 204 km in all), with six well-defined historical moments when major spatial realignments take place. The most recent of these realignments includes a substantial westerly shift from the mid-1980s onwards, which the authors describe as closely linked to the country's second energy-driven resources boom.

In tracking this shift, Breau et al. (2018) also draw attention to the need for developing estimates of the ECG using a finer spatial scale of analysis, preferably one that tracks changes at the intra-provincial level. In this paper, we answer the call and present a new set of estimates for Canada's ECG using self-contained labour areas (SLAs) as regional units of analysis. Compared to Breau et al. (2018)'s original estimates of Canada's ECG using provincial-level data, we ask how SLA-level data, which capture economic variations across local labour market areas within provinces, may allow us to produce more precise estimates of the country's ECG. Initially developed on a pilot basis by Statistics Canada, SLAs are delineated using commuting flows which are less urban centric than traditional approaches and better capable of accounting for rural-to-rural connections (see Munro et al., 2011; Alasia, 2016). We adopt this methodology and extend it to create a set of 266 regional units that are consistently defined over the 1986 to 2019 period. Combined with data on total incomes taken from the Longitudinal Administrative Databank (LAD), we are thus able to produce a more detailed set of ECG estimates that better reflect changes in the country's actual spatial distribution of economic activities over time.

Our findings based on these self-contained labour areas show that by 2019, Canada's ECG had shifted west by 173 km since the mid-1980s to a point (48° 58′ N and 87° 45′ W) near Buckaday Lake, which is about 40 km due east of the township of Nipigon in Ontario on the northern most banks of Lake Superior. This point estimate lies approximately 525 km southeast of the ECG estimated in Breau et al. (2018) using provincial centroids, clearly showing the benefits of using regionally weighted measures of income. Within this broad westerly arc, we also observe five distinct directional movements, with both easterly and westerly shifts. By far, the most significant of these takes place from 2000 to 2008 as the energy-resource boom buoys regional economies in the Prairies and propels the ECG some 122 km west until the Great Recession changes its course again. To be sure, throughout this period of study, we find evidence of a very close association between movements in the country's ECG and variations in natural commodity prices.

The remainder of our paper is organized as follows. We begin in the next section with a discussion of how labour markets and regions have traditionally been defined in the Canadian context and then introduce a new definition of local labour markets developed by Statistics Canada based on the notion of the self-containment of regions. In Section 3 we discuss how regional income measures are defined and review the simple weighted mean centre approach adopted to estimate the country's ECG. Section 4 presents our results based on these new regional estimates while Section 5 concludes with a few brief comments.

DEFINING REGIONAL LABOUR MARKET AREAS

Though the region has long fascinated geographers, it is only more recently that it has re-emerged as a key unit of analysis below the national scale within the social sciences. This 'rediscovery' of the region, which happened mainly in the 1990s, is tied to the growing recognition that in a more globalized world economy, regions play an increasingly important economic role (Storper, 1997; Agnew, 2018). The timing of this 'rediscovery' of regions indeed coincides with the growing recognition that globalization is seen as exacerbating regional economic and political differences at the sub-national level, more so than attenuating them (Agnew, 2000). For economic geographers, this is about resituating the political economy of uneven development in a multi-scalar context as regions are increasingly viewed as the loci where agglomeration economies are articulated through the clustering and interaction of firms, local labour markets and innovation processes (Agnew, 2000; Scott, 2012).

From an empirical perspective, defining regions as a meaningful unit of observation remains a challenging task for geographers and regional scientists. Drawing boundaries around a region requires that we make specific assumptions about the economic or social phenomena to be observed. And even if a certain regional unit appears to be theoretically coherent, it must still confront a number of significant data availability and/or quality issues (Cheshire, 1997, Fowler & Jensen 2020; Bauluz et al., 2023).

As a regional unit of analysis, local labour markets exemplify the kind of concept that makes theoretical sense but can remain difficult to define (Kalleberg & Sorensen, 1979) and measure geographically (Fowler & Jensen, 2020). Described as places where employers and employees interact with each other, the laws of demand and supply for labour are in this case bounded by places of work and residence (Carpenter et al., 2022). There are typically two ways of delineating those places of work and residence: (i) core-based approaches that focus on areas that have large and densely populated centres with adjacent municipalities considered to be socially and economically integrated or (ii) flow-based approaches that focus on minimizing commuting-flows and connecting rural areas to larger employment centres.

In Canada, local labour markets have primarily been defined using a core-based approach where large metropolitan areas and major agglomerations serve as the urban cores to which residents from other surrounding non-metropolitan regions commute for work (Munro et al., 2011). Over time, efforts have been made to extend the delineation of labour markets to regions that fall outside of the sphere of larger urban areas. Metropolitan influence zones (MIZs), for instance, classify those outside regions as being 'strongly' to 'not' influenced by Census Metropolitan Areas (CMAs) or Census Agglomerations (CAs) (see McNiven et al., 2000). More recently, similar classification exercises have been proposed by the OECD using existing administrative data on density and population thresholds for urban cores, combined with commuter flow data, to identify 'functional urban areas' and different types of non-metropolitan regions (Dijkstra et al., 2019; Fadic et al., 2019). While these classification efforts provide more details about the country's urban-rural structure and have the benefit of encompassing all regions across the national territory, they remain based on core-periphery associations which ignore the potential for residents that live in non-CMA/CA regions to commute to other non-CMA/CA for work. This is an important point within the Canadian context as the connectivity between rural areas and small towns outside of larger urban centres is significant. Indeed, as Harris et al. (2008) have shown, while smaller in terms of overall numbers, rural commuters are nonetheless as dependent on rural-based jobs as they are upon jobs in major urban agglomerations.

To move beyond these constraints and develop a more inclusive definition of labour markets that better reflects the connectivity of rural and small-town regions, i.e., one that accounts for multidirectional commuting flows, researchers at Statistics Canada have recently developed a new approach based on the self-containment of regions (Munro et al., 2011; Alasia, 2016; OECD, 2020)[1]. The building blocks for these self-contained labour areas (SLAs) are Census subdivisions (CSDs), the smallest possible geographic unit in Canada that provides national coverage. CSDs are municipalities as defined by provincial and territorial legislation, and in 2011 there were 5253 such areas across the country. Munro et al. (2011) define an SLA as consisting of a group of two or more CSDs where at least 75% of the workers both live and work in the area[2]. Census data on commuting flows (derived from responses to the question on place of work) are used to identify clusters of CSDs based on the reciprocal importance of commuting flows, an algorithm originally developed by Bond and Combes (2007) to delineate travel-to-work-areas in the UK. By design, the algorithm will group smaller CSDs together to produce larger self-contained labour areas (Munro et al., 2011).

In this paper, we adopt SLAs to define regional labour markets across the country[3]. Based on the 2011 Census geography, the clustering algorithm applied by Statistics Canada yields an initial total of 336 SLAs[4,5]. While these represent the self-contained labour areas as identified by Statistics Canada, we face two further challenges in this paper. The first involves the dynamic aspect to our analysis where CSD boundaries change from one Census to the next. To deal with this, we begin by using the spatial join function in ArcGIS such that for each Census year, CSDs are joined to SLAs if they fall completely within their 2011 boundaries. In cases where CSDs do not fall completely within SLA boundaries, we apply a basic set of rules: (i) if less than 15% of the SLA boundary (by spatial join) for a specific year does not match up with the 2011 SLA boundary (as defined by Statistics Canada), we consider it a minor boundary change and keep it as is; (ii) otherwise, if more than 15% of the SLA boundary (by spatial join) for a specific year does not correspond to its 2011 SLA definition, we combine the SLA regions (by spatial join) that overlap with the 2011 SLA definition into one single SLA (see Appendix 1 for an example of how this boundary change rule is applied). Furthermore, if the boundary of CSDs change in certain periods, but SLAs can be kept consistent over time by correcting the SLA boundary, then we do so to maintain consistency.

Table 1. Defining self-contained labour market areas over time

	# of SLAs defined		
Provinces	**Original 2011 set**	**Time consistent**	**Final set**
NF	36	35	33
PEI	5	5	3
NS	11	11	11
NB	13	13	13
QC	55	52	47
ON	40	38	37
MB	23	21	18
SK	65	61	38
AB	27	24	24
BC	55	43	38
Territories	6	5	4
Total	336	308	266

In total, we end up with 308 SLAs that have consistent boundaries over the period of study. For the most part, these time-consistent 308 SLAs line-up closely with the original 336 SLAs defined by Statistics Canada (see Table 1). British Columbia is the province with the largest discrepancy in the number of SLAs. This is not surprising given that there have been substantial revisions in CSD boundaries in that province, especially going back in time to the 1980s and 1990s[6]. It is important to note that we recognize the geographical boundaries of labour markets will change overtime (Saunders and Maxwell, 2003). The practical trade-off for us here is that such a consistent set of boundaries allows us to focus on the temporal aspects of change across labour market areas over time.

In addition to creating time-consistent SLAs, the *second* challenge we face is to ensure that regional income measures derived from the microdata (more on this below) meet all of Statistics Canada's disclosure requirements to ensure confidentiality (e.g., minimum cell counts, etc. see Statistics Canada, 2008). This means that of the 308 time-consistent SLAs, a further 42 had to be combined or rolled into a neighbouring SLA. The rule of thumb followed to do so was to combine the SLA that did not meet disclosure requirements with its neighbour if it shared more than 70% of its boundary with the neighbouring SLA. If there were no adjacent SLAs with more than 70% of a common boundary, then the non-disclosure compliant SLA was combined with the neighbouring SLA that had the highest population density. Without exception, the 42 SLAs combined to others are small and mostly remote SLAs. The last column of Table 1 shows the final distribution of SLAs used in this study.

Table 2 shows summary statistics for these 266 SLAs (which are functional areas) as they compare to Census Divisions (the other commonly used regional unit of observation that provides full national coverage of regions below the provincial/territorial level) and CMAs/CAs (the more widely used core-based definition of local labour markets in Canada). In terms of estimating the country's ECG, we see immediately that using CMAs/CAs would leave out large

1 Similar efforts emphasizing containment and connection, even in instances where commuting flows are small, are found in the US with commuting zones and in the UK with travel-to-work-areas (see Fowler & Jensen, 2020; Carpenter et al., 2022).

2 Place of work or residence information is collected based on the workers' usual place of work or residence during the reference week (first week of May).

3 The motivation for adopting and developing SLAs as a key spatial unit of analysis for Canadian regions and considerations of supply-side and demand-side containment rates in Figure 1 (see below) stems from a broader collaborative effort to create an internationally comparable dataset of local labour markets to study patterns of income inequalities across five different countries (see Bauluz et al. 2023).

4 We thank Ash Munro and Alessandro Alasia from Statistics Canada's Centre for Special Business Projects for sharing their concordance file linking CSDs to SLAs using the 2011 Census geography.

5 It is also important to note that in developing these SLAs, a number of CSDs were suppressed (because of missing commuting flow data) or defined as out-of-scope in certain cases (like in certain areas of Saskatchewan) that involve several remote areas with a small number of commuters (Munro et al., 2011). To ensure full coverage and contiguity across the country, Statistics Canada developed a set of reclassification rules to assign these CSDs to SLAs (Alasia 2016).

6 In addition to British Columbia, a number of other provinces, including Quebec and Ontario, underwent significant boundary changes in CSD delineations prior to 1986. This partly explains why we chose to focus on 1986 as the starting point to our analysis.

Table 2. Comparison of labour market and regional geographies across Canada, 2016

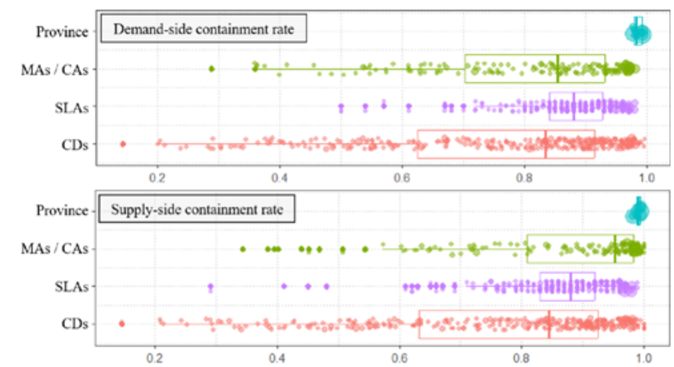
Province / territory	CMAs / CAs					SLAs				CDs			
	#	avg pop	% pop	avg size (km^2)	avg pop density	#	avg pop	avg size (km^2)	avg pop density	#	avg pop	avg size (km^2)	avg pop density
NL	5	55,272	53.2%	1,000	122.6	33	15,749	12,048	5.3	11	47,247	36,145	4.3
PEI	2	42,956	60.1%	552	121.9	3	47,636	2,008	15.9	3	47,636	2,008	22.8
NS	5	121,715	65.9%	2,908	34.7	11	83,964	5,276	12.1	18	51,311	3,196	13.9
NB	6	75,822	60.9%	4,068	22.3	13	57,469	5,756	8.3	15	49,807	4,968	13.3
QC	28	225,150	77.2%	1,309	152.9	47	173,710	31,151	17.1	98	83,310	15,065	151.5
ON	45	275,469	92.2%	1,431	254.0	37	363,473	26,803	43.5	49	274,459	20,005	186.4
MB	6	151,600	71.2%	1,438	329.9	18	71,020	34,802	26.6	23	55,581	27,287	58.3
SK	10	72,692	66.2%	1,868	83.4	38	28,904	16,609	1.7	18	61,020	35,123	3.3
AB	17	194,968	81.5%	5,966	431.6	24	169,466	26,742	7.0	19	214,062	33,681	14.1
BC	26	158,005	88.4%	2,826	141.1	38	122,317	24,161	22.9	29	160,278	31,646	43.2
Territories	2	23,897	42.1%	4,245	77.8	4	28,401	935,868	0.6	10	11,360	374,347	0.0
CMAs	35	712,718	71%	3,056	234.6								
CAs	117	36,648	12.2%	2,135	193.5								
Total	152	192,322	83.2%	2,347	203	266	132,149	35,914	16.8	293	119,972	32,605	93.7

Notes: % pop represents the % share of CMA/CA populations to total provincial populations; avg pop density is the average of each labour market/regional unit (in the same province)' population densities.

portions of the population given that several provinces (NL, PEI, NS, NB and SK) and territories have urbanization rates that are well below 70%. As mentioned earlier, since SLAs are by design intended to group smaller CSDs together into larger self-contained labour areas, it is not surprising to see that they are slightly larger (in terms of size in km), on average, than CDs and therefore also less densely populated. The significant difference in the average density measures of SLAs compared to CDs comes from the fact that metropolitan areas are defined as one single region in the SLA delineation, compared to an amalgamation of multiple CDs in the latter case. For instance, if we take the case of Toronto, the country's most populated metropolitan area, it has a total population of 5.3 million in 2016 according to its SLA delineation, which is very close to its CMA population (5.9 million). Its total land area (size) is roughly 10,700 km^2, which gives it an approximate density of 500 people per square kilometer. In the CD delineation, the Toronto CD per se has an enumerated population of 2.8 million with a much smaller footprint of 665 km^2, giving it a population density well above the 4,200 people per km^2. A closer geographic approximation of Toronto as a regional labour market would involve amalgamating six CDs together (Toronto, Durham, York, Peel, Dufferin and the Kawartha Lakes CDs). Taken as a whole, these six CDs account for a total population of 6.2 million over 12,000 km^2, with a population density of approximately 517 people per km^2, a figure that is very close to its SLA definition.

We can also get a better sense of how SLAs compare to CDs in terms of regional units of analysis by looking at Figure 1. Here, the horizontal box plots show the distribution of self-containment rates across CMAs/CAs, SLAs and CDs (we also include provinces as a general benchmark). Self-containment rates can be measured in two ways: as the proportion of people who work and live in the area relative to (i) the number of employees in the area (demand-side) or (ii) the number of residents in the area (supply-side) (Munro et al., 2011; OECD, 2020; Bauluz et al., 2023). We see clearly that SLAs have higher median and average containment rates and a much tighter distribution of self-containment compared to CDs where the latter have a substantially larger number of small regions in remote locations. The benefit is that SLAs better capture the functionality of multi-directional commuting flows across the country.

Figure 1. Self-containment rate of labor markets, 2016



MEASURING REGIONAL INCOMES AND ECONOMIC CENTRES OF GRAVITY

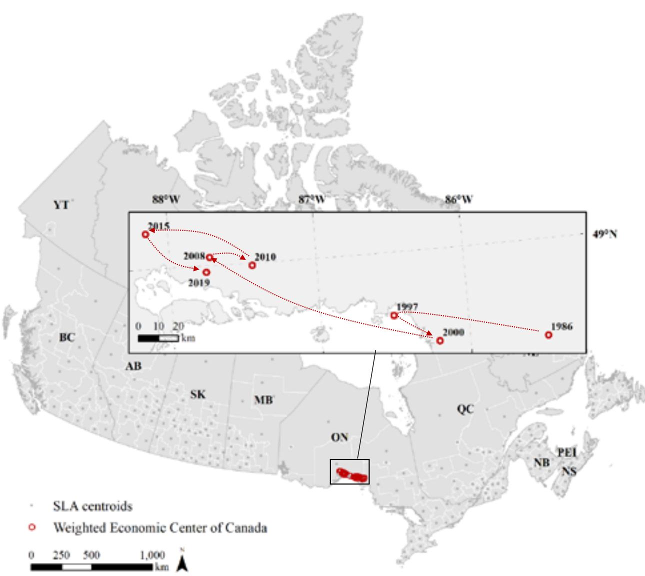
With a consistent set of 266 self-contained labour areas defined across the country, data for our regional income measures come from the Longitudinal Administrative Databank (LAD) for the years 1986 to 2019. The LAD is a subset (20% sample) of the T1 Family File (T1FF), a yearly cross-sectional file of all personal income tax returns filed with the Canada Revenue Agency (CRA). We use the individual as a unit of analysis, with geographical information on one's primary mailing address (i.e., place of residence) linked to CSDs and in turn to SLAs. Total income is our key variable of interest which includes each tax filer's total income from various sources (i.e., both market and non-market incomes). It is important to point out that total income is measured on a pre-tax basis and in nominal terms. While there are occasional changes in the CRA tax forms over time (e.g., following changes in refundable tax credits, and income calculations), the LAD files provide us with a very large sample to reliably analyze the changing dynamics of income at a geographically disaggregated level (Frenette et al. 2007). The LAD files are particularly useful in that they are available on an annual basis (compared to the quinquennial Census), which allows us to track changes in the country's economic centre of gravity in much finer temporal detail.

To calculate the country's economic centre of gravity, we follow Breau et al. (2018) and use the weighted mean centre of the X and Y coordinates of each SLAs centroids such that:

$$\bar{X}_t = \frac{\sum_{i=1}^{n} II_{it} X_i}{\sum_{i=1}^{n} II_{it}}, \bar{Y}_t = \frac{\sum_{i=1}^{n} II_{it} Y_i}{\sum_{i=1}^{n} II_{it}}, \quad (1)$$

where X_i and Y_i represent the longitudinal and latitudinal coordinates of each SLA's centroids (i.e., its geographic centre) and II_{it} represents the sum of individual incomes for each region (i.e., its relative economic weight) at time t (1986 to 2019). As with most of Statistics Canada's cartographic boundary files, the shapefile features used to create our SLA map are based on a Lambert conformal conic projection system and NAD-83[7] as the horizontal and geometric control datum (i.e., an earth-centred datum that uses a more accurate ellipsoid) (Statistics Canada, 2021).

Figure 2. Canada's economic centre of gravity, based on self-contained labour market areas, 1986 to 2019



RESULTS FROM REGIONAL ESTIMATES

Canada's ECG, and its movements from 1986 to 2019, are shown in Figure 2. The inset map provided helps us zoom-in and identify the dates associated with major directional shifts in the ECG's track over time. In 1986, the country's ECG was situated at a latitude of 48° 33′ N and 85° 28′ W, which is about 15 km due west of White River, Ontario, on the northeast end of Lake Superior close to Pukaskwa National Park. Some 33 years later, Canada's ECG had shifted westward with new coordinates of 48° 58′ N and 87° 45′ W, which is located on the shores of Buckaday Lake, just 6 km north of Gravel River Provincial Nature Reserve along the Trans-Canada Highway and roughly 40 km due east of the township of Nipigon, colloquially known as "The Lakehead" given that it is the northernmost community in the Great Lakes region.

All told, Canada's ECG shifted from east to west by 173 km over the 1986 to 2019 period. To help put things into perspective, this 'net' westerly shift is close to the distance required in driving from Montreal to Ottawa. Or roughly 3.1% of Canada's longest distance (5500 km) from east (Cape Spear, NL) to west (the Yukon and Alaska boundary). Such a movement fits well within the sixth historical directional shift identified in Breau et al. (2018), which they describe as the country's second major energy resource boom. The key difference here is that the new ECG coordinates we provide are well south of the original center identified. Indeed, by using regional estimates of income based on self-contained labour areas, we are able to produce a more accurate picture of the country's ECG, which essentially lies more than 400 km south and 200 km east of the one originally calculated in Breau et al. (2018)[8].

As shown in the inset map, the overall westward shift in the country's ECG over time involves a number of distinct directional moves, which we can summarize as five broad movement vectors (see also Table 3). The first of these stretches from 1986 to 2000 and is characterized by both westward and eastward movements in the ECG. For a period of almost ten years during this stretch, the ECG moved westward before receding eastward again after 1997 as world oil prices began a 2-year downturn generally linked to weaker demand from Asian economies and an increase in OPEC supply. The period from 2000 to 2008 marks a strong and continual east-to-west progression in the country's ECG, with a total shift of 122 km over the span of eight years only. World oil markets were very tight during this time, much to the benefit of crude producing regions in western Canada (IMF, 2017). The third noticeable change in the mainly western tracking trajectory of the ECG occurs between 2008 and 2010. As

Table 3. Major directional movements in Canada's economic centre of gravity

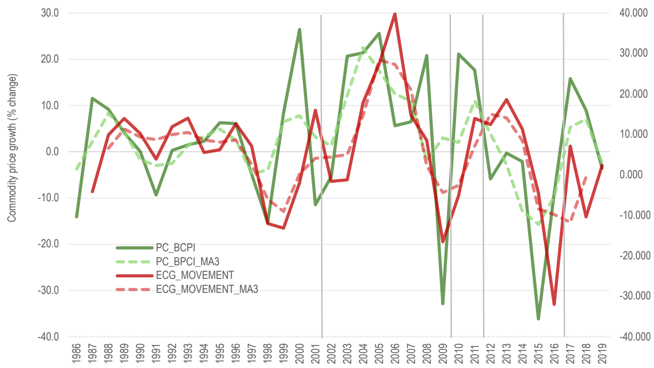
Years	ECG coordinates (year*)	Distance (km)	Direction of movement	Important economic events
1986	48° 33' N 85° 29' W	Starting point for time series of ECG estimates		
1986 to 2000	48° 34' N 86° 13' W (2000)	54	West	Volatile energy markets
2000 to 2008	49° 2' N 87° 43' W (2008)	122	West	Energy-resource boom
2008 to 2010	48° 59' N 87° 25' W (2010)	22	East	Financial crisis and ensuing Great Recession
2010 to 2015	49° 9' N 88° 8' W (2015)	55	West	Gradual recovery of ECG's westerly movement
2015 to 2019	48° 58' N 87° 45' W (2019)	36	East	Collapse and slow recovery of world oil markets
Net shift		173	West	

Notes: * year shown in parenthesis corresponds to the ECG at the end of a major directional movement.

7 The Lambert conformal conic project is a conic projection best suited to represent east to west land, such as Canada, and the North American Datum of 1983 (NAD83) is Canada's official spatial reference system.

8 Breau et al. (2018) estimate the ECG using provincial centroids up until the year 2013. For reference, here we also update the estimates using provincial centroids until the year 2019. Appendix 2 provides a visual representation of the ECG's trajectory using the provincial centroids instead of the SLAs.

Figure 3. Annual growth in commodity-price index vs. movements in Canada's economic centre of gravity



Notes: BCPI: Bank of Canada commodity price index; ECG: economic centre of gravity; Annual ECG movements are measured in kilometers, (+ if from east to west, - if from west to east); MA: 3-year moving average.

Table 4. Movements in the ECG following changes in the BCPI

	Dep. variable: ECG_MOVEMENT		Dep. variable: ECG_MOVEMENT_MA3	
BCPI	.538**	.588**		
BCPI_MA3			.969**	.985**
Dummy_GR		-16.91**		-9.29**
Constant	4.02**	4.90**	3.19**	3.75**
Prob > F	.001	.001	.001	.001
R-squared	.352	.439	.638	.692
N	33	33	31	31

Notes: ** indicates significance at the .05 level; ECG: economic centre of gravity; BCPI: Bank of Canada commodity price index; MA3: 3-year moving average; Dummy_GR: binary variable for the Great Recession.

the housing market crashed in the US, setting off the global financial crisis of 2007-08, the subsequent collapse of world oil prices and key export commodities combined to plunge the Canadian economy into recession in the fall of 2008 and for the two following years, the country's ECG moved eastward by some 22 km. As the economy slowly recovered, the western shift in the ECG eventually resumed up to 2015 when once more, a sharp downturn in oil prices (over a brief seven-month period starting in 2014, petroleum prices dropped by 60%) sent western Canadian regions into a tailspin (G&M, 2020).

The trajectory of Canada's ECG and the five directional shifts described above do indeed appear to be closely linked to developments and the cyclical nature of resource-based commodities, particularly so with regards to energy-based exports. To investigate this more closely, Figure 3 shows the annual percentage change in the Bank of Canada's commodity price index (BCPI) (in green based on the primary axis) as it tracks against movements (measured in km) in the country's ECG (in red using the secondary axis). An east-to-west movement of the ECG is recorded as a positive (+) while a west-to-east movement registers as a negative (-).

The BCPI is a useful tool for assessing the general economic health of Canada's resource sector (BoC, 2012) as it uses a Fisher chain index to follow the prices (measured in US$) of 26 commodities that are produced in Canada and exported to world markets. Given that the weights for these various export commodities vary over time, the BCPI was recently revised, using Statistics Canada's input-output tables, to better reflect changes in Canadian production of key commodities over time (BoC, 2012). The basket of oil prices used for the index was also expanded to include, in addition to the West Texas Intermediate (WTI) component, the Brent benchmark (to capture some of the light oils produced offshore in Eastern Canada) and Western Canada Select (for the heavy crude oils produced in Western Canada). Taken as a whole, the oil and other energy sector components represented 53.2% of the BCPI's nominal commodity shares in 2019[9]. Because of the volatility present in both annual series, Figure 3 also shows 3-year moving averages in dashed lines of the same colour.

A quick glance at Figure 3 reveals that both series are closely related. In fact, it is striking how east-west movements in the country's ECG seem to react swiftly to changes in commodity prices, with dips in the latter pointing to an eastward (-) shift in the ECG while increasing resource prices are associated with a westward (+) shift.

In terms of the lag structure between the two variables, inspection of a cross-correlogram reveals a 1-year lag between the reaction of movements in the ECG to changes in commodity prices. In other words, it takes approximately one year before changes in commodity prices are reflected in the income levels of individuals residing in local labour markets.

To investigate this association more formally, Table 4 presents the results of simple models where changes in the BCPI (lagged 1-year as per the relationship identified above) are regressed against movements in the country's ECG. Results are presented for both the annual time series, along with the 3-year moving averages. We also include, for each time series, a model with a dummy variable to control for the Great Recession years (2008-2009) as the single year price drop in commodity prices during this time is unique. In both sets of results, the coefficient estimates for the lag of the BCPI are positive and significant such that the western extension of the ECG in Canada is indeed very closely associated with changes in commodity prices. Positive ECG movements towards the energy-rich regions of Western Canada quickly follow increases in the BCPI (see also Marchand 2015 for more on the within region distributional impacts of energy related activities), whereas a decline in energy prices leads to a slowdown of the western drift of the ECG or even an easterly shift.

Depending on the model specification, and whether or not we include the dummy variable controlling for the Great Recession years, the R-square values reported in Table 4 suggest that between 35% and 69% of the variation in east-west movements in the ECG are accounted for by changes in the commodity price index. Not surprisingly, the R-square values are higher for the 3-year moving average models as we smooth out some of the volatility reported in the annual values of the BCPI.

CONCLUSION

This paper uses a new set of income measures developed for local labour market areas across Canada to track movements in the country's economic centre of gravity. We find that from 1986 to 2019, the ECG has moved westward a net distance of 173 km to a point close to Buckaday Lake which is close to Nipigon, ON, a small community of about 1500 residents on the northern shores of Lake Superior. This westward shift is broadly consistent with the sixth major historical shift in Canada's ECG identified in Breau et al. (2018). The

9 Specifically, the BCPI's commodity shares in 2019 are: West Texas Intermediate (24.4%), Western Canada Select (19.9%), Brent (1.9%), Natural gas (4.5%), Coal (2.5%), Agriculture (15.2%), Metals and minerals (21.5%), Forestry (8.6%) and Fisheries (1.4%).

main difference is that the point estimates produced in this study, which are based on the centroids of local labour market areas instead of provincial centroids, lie more than 400 km south of those reported in Breau et al. (2018). Such a difference signals that our new estimates better capture the significant variation in incomes across local labour markets within provinces. For instance, large local labour market areas such as Toronto, Vancouver and Montreal, which together represent more than one third of the country's population, are all located in the southern edges of their respective provinces and thus have a strong gravitational pull towards the US-Canada border. Likewise, the industrial composition of regions varies significantly within provinces such that overall, using regional units of analysis yields a much more precise set of estimates for Canada's ECG.

Furthermore, by tracking the annual progress of these ECG estimates, we are able to identify five distinct movement vectors that are characterized by major directional changes (from east-to-west or west-to-east). We also show that these movements are closely tied to fluctuations in commodity prices. Given this close association, it will be particularly interesting to see how the ECG progresses in the near future. After 2019, our end point for the period of study in this paper, oil prices dropped significantly once COVID-19 hit only to bounce back to historic highs in the spring and summer of 2022 (almost matching those of 2006 prior to the Great Recession). They have subsequently retreated somewhat but overall, production levels in Western Canada's oil and gas industry have returned to their pre-COVID levels and capital expenditures in the industry are rising again (Statistics Canada, 2023a, 2023b). Such a rebound will surely translate into a further shift west of the country's ECG.

Another future area of research that would be potentially interesting to pursue is developing a counterfactual analysis of movements in Canada's ECG by constructing a regional income measure that excludes workers who are employed in the oil and gas extraction industries. Such a counterfactual would involve using the Census microdata instead of the LAD in order to isolate the industry of work of different individuals and to also collect other local labor market variables. Indeed, while the LAD gathers information from income tax reports, it does not include information on an individual's occupation, his or her industry of work, their level of education, the year they may have immigrated to the country, etc. Such information is only available in the Census microdata files, though the trade-off here is that the Census in Canada is only conducted every five years (instead of annually in the case of the LAD) which would mean a loss of temporal resolution in the process. It would, nonetheless, provide an interesting benchmark to see just how influential the oil and gas industries have been in explaining movements in the ECG over the last few decades as well as to perhaps explore the role played by other factors such international and inter-provincial migration patterns.

In the end, the spatially disaggregated SLA-level data used in this paper has allowed us to paint a more accurate picture of Canada's changing economic landscape. This provides us with a basis to engage with important policy questions moving forward, especially in the wake of renewed calls for a more inclusive and bottom-up approach to governance and decision making within Canada's federation (e.g., Bradford, 2020).

REFERENCES

Agnew, J. (2000). From the Political Economy of Regions to Regional Political Economy, *Progress in Human Geography,* 24(1): 101-110.

Agnew, J. (2018). "Evolution of the Regional Concept", in A. Paasi, J. Harrison & Jones, M. (Eds.), *Handbook on the Ggeographies of Regions and Territories*, Cheltenham, UK: Edward Elgar, 23-33.

Alasia, A. (2016). "Operationalizing 'Self-contained Labour Areas' as a Potential Standard Geography for Disseminating Statistics Canada Data", presentation to the Canadian Rural Revitalization Foundation, Guelph: ON (October 13th).

Bank of Canada (2012). *Monetary Policy Report – July*, Ottawa, ON: Bank of Canada.

Bauluz, L., Bukowski, P., Fransham, M., Lee, A., López Forero, M., Novokmet, F., Breau, S., Lee, N., Malgouyres, C., Schularick, M. & Verdugo, G. (2023). Spatial Wage Inequality in North American and Western Europe: Changes between and within Local Labour Markets 1975-2019. *Working Paper* No.2023/14, Paris, FR: World Inequality Lab.

Bond, S. & Combes, M. (2007). *2001-based travel-to-work areas: Methodology*. London: Office for National Statistics, Centre for Urban and Regional Development Studies.

Bradford, N. (2020). Policy in Place: Revisiting Canada's Tri-level Agreements. *Institute on Municipal Finance & Governance*, Paper No. 50, Toronto, ON: Munk School.

Breau, S., Toy, B., Brown, M., Macdonald, R. & Coomes, O.T. (2018). In the Footsteps of Mackintosh and Innis: Tracking Canada's Economic Centre of Gravity since the Great Depression, *Canadian Public Policy*, 44(4): 356-367.

Carpenter, C.W., Lotspeich-Yadao, M.C. &Tolbert, C.M. (2022). When to Use Commuting Zones? An Empirical Description of Spatial Autocorrelation in US Counties versus Commuting Zones, *Plos ONE*, https://doi.org/10.1371/journal.pone.0270303.

Cheshire, P. (1999). Economic Indicators for European Cities: Why Boundaries Matter, in *The Quality of Life in the Cities and Regions of the European Union: Indicators.* Statistical Office of the European Commission.

Dijkstra, L., Poelman, H. & Veneri, P. (2019). *The EU-OECD Definition of a Functional Urban Area, OECD Regional Development Working Papers 2019/11*, Paris: OECD.

Fadic, M., Garcilazo, J. E., Moreno Monroy, A. & Veneri, P. (2019). Classifying Small (TL3) Regions based on Metropolitan Population, Low Density and Remoteness, *OECD Regional Development Working Papers 2019/06*, Paris: OECD.

Fowler, C. S. & Jensen, L. (2020). Bridging the Gap between Geographic Concept and the Data we Have: The Case of Labor Markets in the USA, *Environment and Planning A*, 52(7): 1395-1414.

Frenette, M., Green, D. A. & Milligan, K. (2007). The Tale of the Tails: Canadian Income Inequality in the 1980s and 1990s. *Canadian Journal of Economics*, 40(3): 734-764.

Globe and Mail (2020). Western Canada: Oil price crash sends Alberta's economy back into crisis (see https://www.theglobeandmail.com/canada/british-columbia/article-western-canada-oil-price-crash-sends-albertas-economy-back-into/, last accessed on 31 August 2023).

Harris, S., Alasia, A. & Bollman, R.D. (2008). Rural Commuting: Its Relevance to Rural and Urban Labour Markets, *Rural and Small Town Canada Analysis Bulletin, 7(6).*

IMF (2017) Oil Prices and the Global Economy, *IMF Working Paper 17-15*, Washington, DC: International Monetary Fund.

Kalleberg, A. & Sorensen, A. (1979). The Sociology of Labor Markets, *Annual Review of Sociology*, 5: 351-379.

Marchand, J. (2015). The Distributional Impacts of an Energy Boom in Western Canada, *Canadian Journal of Economic*s, 48(2), 714-735.

McNiven, C., Puderer, H. & Janes, D. (2000). Census Metropolitan Areas and Census Agglomeration Influenced Zones (MIZ): A Description of the Methodology. *Statistics Canada, Geography Working Paper Series No. 2000-2*, Ottawa, ON: Statistics Canada.

Munro, A., Alasia, A. & Bollman, R.D. (2011). Self-contained Labour Areas: A Proposed Delineation and Classification by Degree of Rurality, *Rural and Small Town Canada Analysis Bulletin*, Vol. 8, No. 8, Ottawa, ON: Statistics Canada.

OECD (2020). *Delineating Functional Areas in All Territories*, OECD Territorial Reviews, Paris: OECD Publishing.

Ornstein, M. (1986). "Regionalism and Canadian Political Ideology", in Brym, R. (Eds). *Regionalism in Canada*, Toronto: Irwin.

Quah, D. (2011). The Global Economy's Shifting Centre of Gravity, *Global Policy*, 2(1): 3-9.

Reid, A. (2019). "On the Future of Western Canada", The Angus Reid Institute's New West Project (see https://angusreid.org/the-new-west-economy-identity-politics-and-the-future-of-canada/, last accessed on 8 August 2023).

Savoie, D. J. (2019). *Democracy in Canada: The Disintegration of Our Institutions*. McGill-Queen's University Press.

Saunders, R., & Maxwell, J. (2003). Changing Labour Markets: Key Challenges Facing Canada, Canadian Policy Research Networks Incorporated.

Scott, A. J. (2012). *A World in Emergence – Cities and Regions in the 21st century*, Cheltenham, UK: Edward Elgar.

Statistics Canada (2023a). Energy statistics, March 2023, released as part of *The Daily* on June 6th, Ottawa: ON.

Statistics Canada (2023b). Quarterly Capital Spending: Oil and Gas Industries, second quarter 2023, released as part of *The Daily*, September 1st, Ottawa: ON.

Statistics Canada (2021). *Dictionary, Census of Population*, Ottawa: ON.

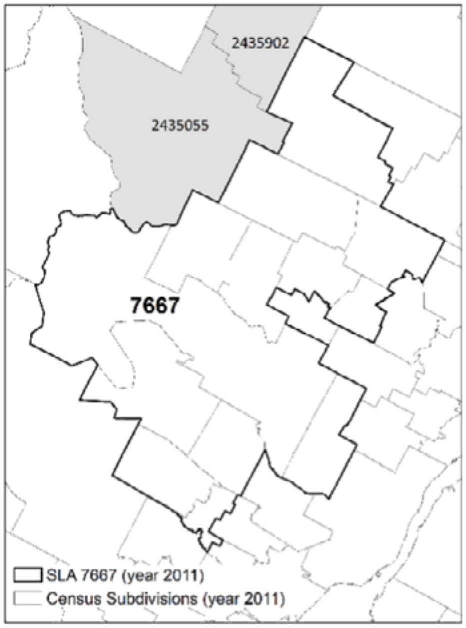
Statistics Canada (2008). *Data quality and Confidentiality Standards and Guidelines (public)*, Ottawa: ON.

Storper, M. (1997). *The Regional World – Territorial Development in a Global Economy*, New York, NY: The Guilford Press.

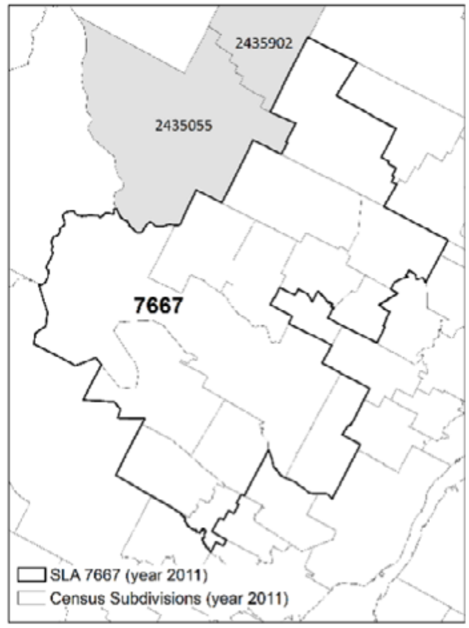
APPENDIX 1
AN EXAMPLE OF HOW THE RULES TO CONSTRUCT CONSISTENT SLA BOUNDARIES ACROSS TIME ARE APPLIED

(i) Minor boundary changes (i.e., where less than 15% of the SLA boundary does not correspond to its previous delineation)

Statistics Canada's 2011 definition



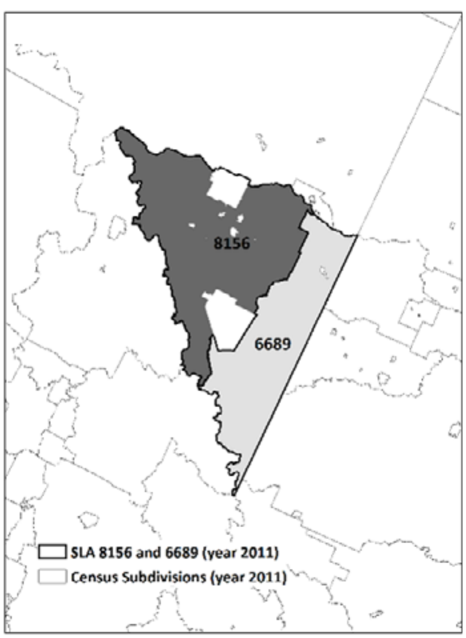
Boundary for SLA 7667 in year 1996



The 2011 boundaries for CSDs 2434055 and 2435902 are not the same as in 1996, which also means that the boundary for SLA 7667 is slightly different in 2011 compared to 1996. As these boundary changes are less than 15% of Statistics Canada's 2011 SLA boundary, we keep the boundary for SLA 7667 in 1996 as it is.

(ii) Major boundary changes requiring the combinations of SLAs into one aggregate region (i.e., where more than 15% of the SLA boundary does not correspond to its previous delineation)

Statistics Canada's 2011 definition



Consistent SLA boundary

The Census Subdivisions constituting SLAs 8156 and 6689 in 2011 consisted of simply one large census subdivision before the year 2001. In this case, when we spatially join the census subdivisions of earlier years to those of the 2011 SLA boundary, more than 15% of the SLA boundary no longer corresponds to its previous delineation. Accordingly, we combine SLAs 8156 and 6689 together and create it as SLA 81562.

APPENDIX 2
CANADA'S ECONOMIC CENTRE OF GRAVITY, BASED ON PROVINCES, 1986 TO 2019