Productivity in Residential Care Facilities in Canada, 1984-2009

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ABSTRACT

This article examines the productivity performance of the residential care sector in Canada. The output of that sector is currently measured by inputs in the current national accounts and therefore cannot be compared with inputs to provide a meaningful indicator of productivity for the sector. In contrast, the output measure in this article is a direct output measure that can be used to estimate the productivity performance of the sector. We find that labour productivity was virtually unchanged in the sector in Canada over the 1984-2009 period, with a large variation in labour productivity growth across the provinces. The level of labour productivity in residential care facilities also differs significantly across the provinces, reflecting differences in the ownership structure (private vs. public) and the size of residential care facilities.

THE ARTICLE CONSTRUCTS AN experimental measure of output and labour productivity of residential care facilities (RCF) in Canada. Residential care facilities mostly provide care for the aged, but they also provide care for persons with physical disabilities and persons who are developmentally delayed.[2] In Canada, those facilities are funded and licensed or approved by provincial/territorial departments of health and/or social services.

Total expenditures on health care as a share of gross domestic product (GDP) increased from 7.0 per cent to 10.9 per cent in Canada over the 1975-2014 period (CIHI, 2015). A measure of direct output and productivity for the health care sector is essential for understanding the sources of this large increase in health care expenditures and for the efficient allocation of resources (Sharpe *et al.*, 2007). Such a measure allows for a decomposition of changes in health care output into a part due to changes in the costs of labour, drugs, and capital and a part due to changes in health services. When health care sector productivity increases, the same level of resources can be used to provide more and better health care services, contributing to the sustainability of the health care system.

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2   In 2009, persons 65 years or older accounted for about three quarters of all residents in residential care facilities in Canada excluding Quebec. Persons who are developmentally delayed are the second largest group accounting for 9 per cent of all residents in 2009. Other residents include persons with psychiatric disabilities, persons with alcohol and drug problems, emotionally disturbed children, transients, and young offenders. For Quebec, the information on types of residents is not available.

But there are no measures of direct output and productivity performance for the health care sector (which includes hospitals, residential care facilities, and primary care) in the national accounts in Canada and in many other countries. Output in the sector is measured by inputs in the current national accounts and therefore cannot be compared with inputs to provide a meaningful indicator of productivity. This lack of a direct output measure and hence a meaningful productivity measure for the residential care facilities sector and other health care sectors is due to numerous statistical challenges.

Fortunately, over the last 10 years, substantial progress has been made in Canada, the United States, and other developed countries in addressing this data gap. In 2015, the U.S. Bureau of Economic Analysis released a health care satellite account that provides an improved measure of the price index of health care spending (Dunne *et al.*, 2015). Furthermore, Statistics Canada has constructed an experimental measure of direct output and productivity for the hospital sector (Gu and Morin, 2014). Also, a large number of European countries have constructed direct output measures for their health care sectors (Schreyer, 2010).

This article has a number of objectives. First, it develops a direct output measure for the residential care sector and then compares output and labour productivity growth in the sector by province for the 1984-2009 period.[3] Second, it compares the level of labour productivity in residential care facilities across Canadian provinces and examines potential contributing factors to that difference. Those factors include the scale of the facilities and ownership type (public vs. private).

This article continues our previous research on the development of output and productivity measures for the health care sector in Canada.

Gu and Morin (2014) constructed a measure of output and productivity in the hospital sector, and found that labour productivity growth in hospitals was higher than that in the business sector due to technical advances.

Residential care facilities are heavily labour intensive. They require a high level of personal contact between staff and residents for the provision of services. The sector is often cited as one of the industries where Baumol's cost disease is prevalent, with little or nonexistent productivity growth as there is little scope for standardization and automation (Baumol and Bowen, 1966). The estimates in this article will allow us to assess the prevalence of Baumol's cost disease in the residential care facilities sector.

This article makes a number of contributions to the measurement of output and productivity in the residential care sector, and in the health care sector in general. First, output is adjusted for changes in the quality of health care over time. The residential care sector is a service sector that provides care to its residents. The output of the sector is measured by the number of residents (Schreyer, 2010). To take into account the changes in the mix of the products or the levels of care provided, resident days are weighted across level of care to derive a cost-weighted output index.

A challenge that has emerged from previous empirical work in Canada and other countries relates to the adjustment of output for quality changes or changes in health outcomes associated with the care. The rationale for such adjustment is that changes in unit costs or values arising from the change in the quality of the output or health outcomes should be counted as an increase in the volume of the output measure. The health outcomes or quality of care for residential care facilities can be divided into three

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3   As the Survey of Residential Care Facilities that was used for the article was terminated in 2010 for reference year 2009, the data collected for reference year 2009 is the most recent year for which data are available.

main domains: physical function, quality of life, and resident safety (CIHI, 2013). Unfortunately, those indicators were not available from the data that we used to construct our estimates of direct output.

In this article, we take into account quality changes in the output of residential care facilities by using the quality of labour input. The level of nursing and services is found to be associated with improved care in a large number of empirical studies (McGregor and Ronald, 2011 and Murphy, 2006). In this article, the share of personnel that provide direct care to residents in total personnel will be used as an indicator for the quality of the care to residents.[4] This is similar to the use of that the quality and experience of teachers to adjust the output of the education sector (Schreyer, 2012). The personnel that provide direct care include registered nurses, registered nursing assistants, physiotherapists, and occupational therapists. Over the 1984-2009 period, the share of direct care personnel in the total hours increased from 65 per cent to 75 per cent. The increase in the share of direct care personnel is a result of rapid growth in direct care personnel, with much slower growth in non-direct care personnel. In particular, during this period, the hours of direct care personnel increased by 2.4 per cent year, while the hours of other personnel increased at 0.6 per cent per year.

The second contribution of the article is to overcome a common challenge in the literature. In particular, total expenditures need to be allocated among different products or different levels of care for firms or facilities that provide multiple products, when only total expenditures are available. To construct the cost-weighted output index aggregated across level of care, we need to estimate unit costs or costs per resident day by level of care. Residential care facilities often provide more than one level of care. But expenditures are only available at the facility level. The total expenditures must be broken down into the expenditures by level of care to derive unit costs by level of care. The article explores alternative methods to generate a breakdown of total expenditures by level of care and examines the effect of alternative methods on the estimate of unit costs and output measures of residential care facilities.

The article is organized as follows. Section 1 provides an overview of the residential care facilities sector using data from the national accounts. Section 2 presents the methodology for constructing the direct output and productivity measure of residential care facilities. Section 3 discusses the annual Survey of Residential Care Facilities (the RCF survey) of Statistics Canada that is used for empirical analysis in this article. Section 4 presents estimates of output and productivity in residential care facilities at the national level. Section 5 compares productivity growth and productivity levels of the residential care sector across the provinces. Section 6 concludes.

An Overview of the Residential Care Facilities in the National Accounts

Residential care facilities are establishments primarily engaged in providing residential care combined with either nursing, supervisory, or other types of care. In this sector, the care provided is a mix of health and social services, with the health component being largely nursing services.

The residential care sector generated current dollar value added of $17.3 billion in 2012, representing 1.0 per cent of GDP in Canada, up

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4   An alternative indicator could be the absolute level of direct care staff. The level of direct care staff should be less related to the quality of care than the share of direct care staff in total employment as the increase in the absolute level of direct care may reflect the increase in the number of residents in the facilities. The ratio of direct care staff to residents may be a better indicator for quality of care, but was not used in this article.

from 0.8 per cent in 1997 (CANSIM Table 479-0029). The residential care sector is classified as 623 at the 3-digit level of the North American Industry Classification System (NAICS) and is part of the two-digit health care and social asssitance industry (NAICS 62). It comprises establishments in both the business sector and non-business sector. The residential care facilities operating for profit are included in the business sector, while the residential care facilities owned by religious, municipal, regional health authority, lay (not for profit), and provincial governments are included in the non-business sector. In 2011, the share of the residential care facilities operating for profit accounted for about 30 per cent of gross output in all residential care facilities. This share was virtually unchanged over the 1997-2011 period.[5]

The share of for-profit facilities in total output differs across provinces.[6] The data from the Survey of Residential Care Facilities conducted by Statistics Canada show that the share of for-profit facilities in 2009 was higher in Ontario and Western Canada than in the Atlantic provinces (Chart 1). Saskatchewan had the highest for-profit share at 57 per cent, while New Brunswick had the lowest at 12 per cent. Ontario had the second highest share at 46 per cent, followed by British Columbia (45 per cent) and Manitoba and Alberta (both 43 per cent). Nova Scotia was at 40 per cent, Prince Edward Island was at 29 per cent, and Newfoundland and Labrador was at 13 per cent.

Chart 1

Share of For-Profit Facilities in Output of Residential Care Facilities in Canadian Provinces, 2009

(per cent)
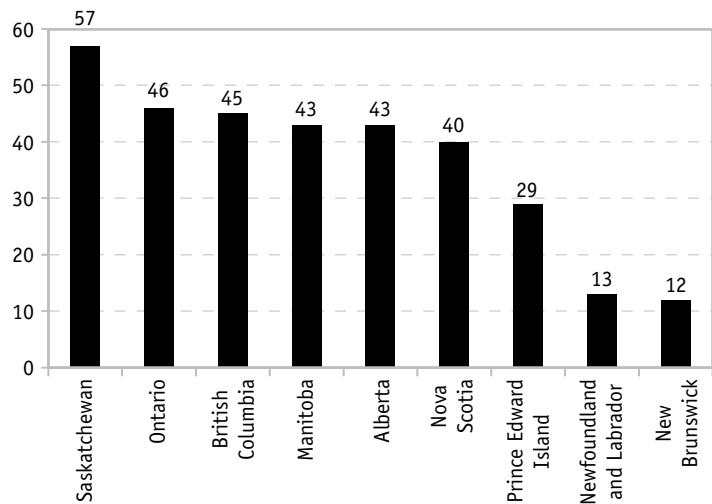
Source: Authors' calculations using data from the RCF survey, Statistics Canada.

Chart 2 presents the cost shares of capital, labour, and intermediate inputs in residential care facilities for both the business (for-profit) and non-business (not-for-profit) sector in 2011. The input cost share experienced little change over the 1997-2011 period. The sector is heavily labour intensive with labour costs accounting for 74 per cent of total costs in the non-business sector and 64 per cent of total costs in the business sector. Intermediate inputs are the second important component of total costs accounting for a little over 20 per cent of total costs for both the business and

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5   There are seven types of ownership: lay (i.e. not-for-profit), religious, municipal, provincial, proprietary, regional health authority, and not classified elsewhere. In 1984, there were 1,490 residential care facilities were not for profit, 316 were religious, 302 were municipal, 238 were provincial, 1,806 were proprietary, 0 were regional health authorities, and 3 were not classified elsewhere, for a total of 4,155 facilities. In 2009, there were 1,740 residential care facilities were not-for-profit, 253 were religious, 144 were municipal, 116 were provincial, 1,793 were proprietary, 310 were regional health authorities, and 15 were not classified elsewhere, for a total of 4,371 facilities. The for-profit share fell from 3.5 per cent of all facilities in 1984 to 41.0 per cent in 2009.

6   The share of for-profit residential care facilities in total expenditures outside of Quebec from the RCF survey is higher than that in the national accounts, which shows that the share of for-profit facilities in total expenditures in all Canadian provinces is about 30 per cent. The difference could be due to the fact that Quebec may have a lower share of RCP output produced by for-profit facilities.

Chart 2
Input Costs Shares in GDP of Residential Care Facilities in Canada, 2011
(per cent)
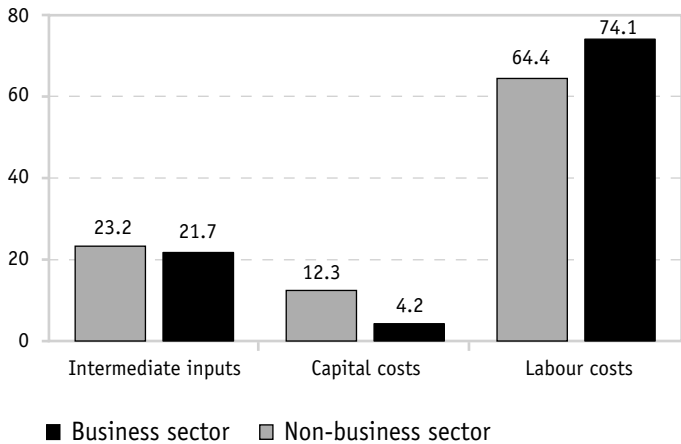
Source: National Accounts, Statistics Canada.

non-business sectors. Capital costs (which include the consumption of capital for the non-business sector and the consumption of capital plus profit for the business sector) is the smallest component of total costs.

Methodology

The construction of direct output for residential care facilities starts with the choice of unit of output and measurement of health services that can be used to take into account the changes in the quality of the residential care.

For the measurement of output of the hospital sector, the complete treatment of a disease represents the unit of output (Eurostat, 2001; Schreyer, 2010). But for residential care facilities, that concept is not very meaningful. Some of these facilities are maintained for chronically ill or disabled people who reside there more or less permanently. This is in contrast to a hospital where patients are accommodated on the basis of medical need.

For residential care facilities, resident days will be used as the unit of output. To take into account the differences in care provided, the number of resident days is classified by the level of care. There are seven levels of care in the Survey of Residential Care Facilities that will be used for the article. Those levels are:

- self-sufficient – room and board only;
- self-sufficient – room and board with guidance/counselling with respect to social, employment, and addiction problems, or parental guidance with skilled counselling (i.e. child care homes);
- self-sufficient – room and board with custodial care and/or special school, or sheltered workshops, etc.;
- type I – supervision and/or assistance with daily living and meeting psycho-social needs;
- type II – medical and professional nursing supervision, etc.;
- type III- medical management, skilled nursing care, etc.; and
- higher type of care.

Those various types of resident days represent different type of services and need to be weighted to derive a measure of output for the RCF sector. The weights can be based on expenditures per resident day to derive a cost-weighted output index. An alternative measure is the value-weighted output index that uses the value of the output as weights.[7] Often those value weights are not available. Therefore, the cost-weighted output index represents a practical approach for the measurement of the direct output measure for the non-market sectors (Aktinson, 2005, Eurostat 2001, Schreyer 2010). In this article, costs will be used to aggregate different types of output into a cost-weighted output index.

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7   Gu and Wong (2010) constructed a value-weighted output index of the output of the education sector where the value of education is estimated as an increase in the present discounted value of the lifetime income arising from education.

Table 1

Number of Residential Care Facilities by Dominant Level of Care in Canada excluding Quebec, 1984 and 2009

Level of Care	1984			2009		
	Number of Facilities	Share of Facilities	Share of Resident Days	Number of Facilities	Share of Facilities	Share of Resident Days
1. Room and board only	164	3.9	3.9	1	0	0.3
2. Room and board with guidance/counselling	1,111	26.5	9.1	724	16.5	6
3. Room and board with custodial care and/or special school, sheltered workshop, etc.	689	16.5	8.1	196	4.5	1.3
4. Type I - Supervision or assistance with daily living and meeting psycho-social needs	1,350	32.2	32.1	1,843	41.9	20
5. Type II - Medical and professional nursing supervision, etc.	690	16.5	34.8	946	21.5	38.9
6. Type III - Medical management, skilled nursing care, etc.	166	4	10.9	657	14.9	32
7. Higher type	17	0.4	1.1	30	0.7	1.5
Total	4,187	100	100	4,397	100	100

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

The volume index of the output of the RCF sector in year Q is constructed as a Tornqvist aggregation of resident days by level of care using the share of expenditure as weights:

$$(1)\ lnQ_1 - lnQ_{t-1} = \sum_i \bar{s}_i (lnq_{it} - lnq_{it-1})$$

where $\bar{s}_i = \dfrac{s_{it} + s_{it-1}}{2}$ and $s_{it} = \dfrac{c_{it}q_{it}}{\sum_i c_{it}q_{it}}$.

where q_{it} is the number of resident days for level of care i, c_{it} is costs per resident day or unit cost for level of care i, and s_{it} is the cost share of level of care i in total costs which sum to one across levels of care.

The nominal value of output of the RCF sector is estimate as total costs of inputs including capital, labour, and intermediate inputs. The costs of capital input include the cost of depreciation for the non-business sector of the RCF sector and include the cost of depreciation plus a return on capital for the business sector.[8]

The implicit price index for the output of the RCF sector is the ratio of the nominal value of output to the volume index of the output of the RCF sector estimated from equation (1). Labour productivity in the RCF sector is the ratio of the volume index of the output to hours. It increases when output increases faster than hours.

The output measure needs to be adjusted to take into account the effect of the care on health outcomes. Health outcomes can be divided into three main domains: physical function (e.g. provision of walking assistance, incontinence), quality of life

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8   This is because there should be no profits for the not-for-profit residential care facilities or the non-business sector. This is also the practice followed in the national accounts. For the non-business sector, the value of output for the non-business sector is estimated as the sum of labour costs, intermediate inputs and the depreciation of fixed capital.

Table 2

Residential Care Facilities by Number of Levels of Care Provided in Canada excluding Quebec, 1984 and 2009

Number of Levels of Care Provided	1984			2009		
	Share of Number of Facilities (%)	Share of Residents (%)	Average Number of Residents	Share of Number of Facilities (%)	Share of Residents (%)	Average Number of Residents
1	46.0	23.6	21	72.5	59.4	39
2	20.4	17.8	36	13.6	15.1	52
3	15.1	17.9	49	5.8	7.2	59
4	11.8	20.7	73	5.3	10.2	91
5	4.1	9.7	97	2.3	4.4	92
6	1.8	6.7	153	0.4	1.6	180
7	0.7	3.7	215	0.1	2.1	715

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

(e.g. depression, pain, satisfaction), and resident safety (e.g. frequency of falls, pressure ulcers). CIHI (2013) developed a list of quality indicators that were used to compare the quality of residential care facilities. Those indicators are not available in the data that we used for this article.

For this article, we will use the quality of labour input as a quality indicator of the care to the residents. The quality of labour input is estimated as the share of personnel providing direct care in total labour input. Those personnel include registered nurses, physiotherapists, and occupational therapists. A previous study found that the share of registered nurses and other health professionals was linked to the quality of care (McGregor and Ronald, 2011 and Murphy, 2006). The implicit prices associated with the quality of labour input are estimated from a hedonic regression that related the price of residential care to the quality of labour input. The change in the price of residential care output associated with changes in the quality of labour input is counted as the change in the quality-adjusted volume index of output of the residential care sector.

The Residential Care Facilities Survey

The data for estimating direct output and labour input are derived from the Annual Survey of Residential Care Facilities (RCF survey) of Statistics Canada. The RCF survey is a census of residential care facilities for all provinces except Quebec. Consequently, all estimates for the RCF sector in this article are for Canada excluding Quebec. Generally, only facilities which have four beds or more are surveyed.

The residents are classified into one of the seven levels of care that they receive at the end of a fiscal year in the RCF survey.[9]

Facilities providing self-sufficient, minimal or Type I care with less than ten beds receive a short or abbreviated form. These facilities represent about half of residential care facilities. They report totals for personnel and expenses and do not provide a breakdown of personnel and expenses between direct care services and general services. The remainder of facilities - those providing Type I care with ten beds or more and those providing Type II care or higher - receive the long or standard form. These facilities report

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9   In the RCF survey, the facilities are assigned to a level of care that represents the level of care that most of the residents receive in the facilities (called dominant level of care).

totals and detailed breakdowns for personnel (direct care services and general services) and expenses (direct care services, general services, and other expenses).

For facilities sent short forms and some facilities sent long forms, total hours and total expenses were reported without a detailed breakdown. They are then imputed.[10]

The annual RCF survey used for this article covers the fiscal years from 1984/1985 to the 2009/2010. The fiscal year starts from April 1 and continues to March 31 of the following year. The survey was cancelled in 1994/1995 and was terminated in 2010/2011 fiscal year. In this article, we will refer to 1984/1985 as 1984, and 2009/2010 as 2009.

At the end of 2009, there were about 4,600 residential care facilities in Canada excluding Quebec serving about a quarter of a million residents.[11] Overall, those facilities generated $17.1 billion in revenue, and $17.0 billion in expenses (Statistics Canada, 2011).

To estimate the direct output of the RCF sector, time-series data on resident days and unit costs by levels of care first need to be constructed. As shown in Table 2, 27.5 per cent of residential care facilities provide more than one level of care in 2009 and those facilities account for about 40 per cent of total residents in the RCF sector.

The share of facilities with a single level of care increased over time. It increased from 46.0 per cent in 1984 to 72.5 per cent in 2009. This perhaps reflects a trend towards specialization in residential care facilities.

The facilities that provide multiple levels of care tend to be larger than those facilities with a single level of care. The facilities that provide all seven levels of care to the residents are the largest. Those had an average of 715 residents in 2009.

Estimation of Resident Days by Level of Care

As the RCF survey only collects information on total expenditures and total resident days without a breakdown by level of care, this information must be estimated for those facilities that provide more than one level of care.

The variables used to estimate resident days by level of care are total number of resident days during the fiscal year and the number of residents in the facilities by level of care on the last day of the fiscal year.

To estimate the number of resident days by level of care in a facility, the total number of resident days during a fiscal year is allocated using the mix of residents by level of care in the facility at the end of the fiscal year. The number of resident days by level of care is then aggregated across all facilities to obtain the number of resident days by level of care in a province. This will be called "resident-level estimation method".

Alternatively, each facility can be assigned a level of care that most of its residents receive (the dominant level of care). Total number of resident days in a facility is allocated to the level of care that is assigned to that facility. The number of resident days is then aggregated across all facilities to obtain the number of resident days by level of care in a province. This will be called the "facility-level estimation method".

Estimation of Unit Costs by Level of Care

The RCF survey collects data on total expenditures during a fiscal year. But it does not collect data on total expenditures broken down by level of care.

Total expenditures need to be allocated among different levels of care for the facilities that provide more than one level of care. This is similar

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10 For the facilities that did not report total hours or expenses, total hours and total expenditures are also imputed.

11 This figure is actually from March 31, 2010 because of the nature of the survey (i.e. fiscal years).

Table 3
Average Unit Costs of Residential Care Facilities by Level of Care
(Dollars per Resident Day)

Level of Care	Data-based Estimates ($)	Hedonic Regression Estimates ($)
1	47.6	19.2
2	115.9	99.2
3	118.9	71.3
4	94.7	76.2
5	106.3	101.9
6	123.3	134.4
7	173.6	152.3

Note: The absolute value for the regression coefficient is the hedonic regression value minus the value of the constant (19.2).

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

to the task that empirical researchers face when allocating total expenditures on patients (who often have multiple diseases) across different diseases to derive health care costs by type of disease (Hall and Highfill, 2013).

In this article, we have experimented with alternative methods for allocating total expenditures among level of care to examine the robustness of estimates. A simple method for estimating expenditures by level of care is used when the facility-level estimation method is used to estimate resident days by level of care. For this method, we assign all facilities the dominant level of care that the facility provides. Total resident days and total expenditures are aggregated across the facilities to obtain time-series data on resident days and total expenditures by dominant level of care in a province. Unit costs are estimated by dividing total expenditures by total number of resident days by the dominant level of care. This method will be called Method A.

In another method, Method B, the number of resident days is derived from estimating resident days by level of care in a facility with multiple

levels of care and then aggregating resident days by level of care across facilities. Since Method A and Method B yield a similar shift in the composition of resident days by level of care, the output indices from the two methods have almost identical growth rates.

More complex methods can be used to allocate total expenditures among levels of care for facilities with multiple levels of care when the resident-level estimation method is used to estimate resident days by level of care. This is done using either unit cost estimates from Method A or unit costs estimates from a hedonic regression. For the former, we use unit costs by dominant level of care from Method A as a proxy for relative unit costs for a level of care. For the latter, we estimate an equation that relates average unit costs at the facility level to shares of residents by various levels of care. The equation is essentially a hedonic regression that relates unit costs of facilities to the characteristics of facilities as represented by the share of residents by level of care. The sample for estimation consists of all facilities.

In sum, we experiment with three alternative methods for estimating time series data on resident days, expenditures and unit costs by level of care in a province:
- Method A: Facility-level estimation of resident days, total expenditures and unit costs by level of care;
- Method B: Resident-level estimation of resident days and facility-level estimation of unit costs by level of care; and
- Method C: Resident-level estimation of resident days and hedonic regression estimation of unit costs.

Output and Productivity of Residential Care Facilities at the National Level

This section presents the estimates of output and labour productivity in residential care facilities in Canadian provinces excluding Quebec.

The section begins with a discussion of the trends in the composition of residents over time in residential care facilities. It then presents the growth in output and productivity of the RCF sector at the national level.

Table 1 presents changes in the composition of care over time in the RCF sector. In 2009, 91 per cent of resident days were in the fourth, fifth, and sixth level of care (Types I, II, and III), up from 78 per cent in 1984.

Type II care is the most prevalent form of care. It accounted for 38.9 per cent of all resident days in residential care facilities in 2009. Those residents are senior residents with chronicle illness that require on-going medical attention. Type III care is the next important form of care (32.0 per cent of resident days), followed by Type I care (20.0 per cent of resident days).

Over time, there has been a shift in the composition of level of care away from Type I care towards Type II and Type III care, which tend to be more expensive. The share of residents with Type III care increased the most, from 10.9 per cent to 32.0 per cent for the 1984-2009 period, while the share of residents with Type II care increased from 34.8 per cent to 38.9 per cent during that period. The share of residents with Type I care declined from 32.1 per cent to 20.0 per cent over that period.

The share of residents with only room and board declined over time. By 2009, the residents with only room and board accounted for only 7.6 per cent in total, down from 21.1 per cent in 1984.

The share of residents with the highest level of care (level 7) was small and did not change much over time. It accounted for about 1.5 per cent of all residents in 2009.

Table 3 presents two alternative estimates of unit costs of residential care by level of care averaged over the 1984-2009 period. The first set of estimates (data-based) presents unit cost estimates that were derived by assigning a level of care to facilities according to the dominant level of care in a facility and then aggregating total resident days and total expenditures by this dominant level of care across all facilities. The unit costs for a level of care are calculated by dividing total expenditure for each level of care by the number of residents in that level of care.

The second set of estimates were obtained from a hedonic regression of average unit costs on the share of the residents by level of care in a facility. More specifically, we estimate the following regression.

$$(2) \quad unit\ cost_{it} = \alpha_0 + \sum_{j=1}^{7} \alpha_j share(j)_{it} + \varepsilon_{it}$$

where the variable $unit\ cost$ is the ratio of total expenditures to total number of resident days in facility i in year t, $share(j)$ is the share of residents with level of care j in the total number of residents in facility i in year t.

The coefficient estimate α_0 represents the average unit cost for level of care 1. The average unit costs for level of care $j = 2$ to 7 are estimated as $\alpha_0 + \alpha_j$.
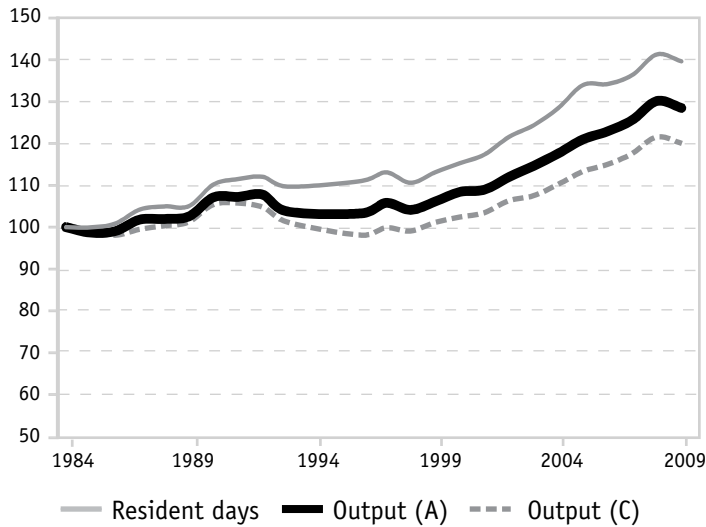
The regression can be modified to allow for the changes in unit costs over time by introducing interaction terms between the variables for the share of a level of care and the year dummy variables. This is not done here for this article. Rather, we use average unit costs estimated from equation 2 to aggregate resident days across the level of care.

Overall, the two estimates of unit costs provide a similar ranking of relative unit costs among the levels of care. Unsurprisingly, level of care 1 with only room and board is the least expensive while the level of care 7 is the most expensive.

Output of the Residential Care Facilities Sector

Chart 3 presents the trend in the number of resident days and the weighted sum of the resi-

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

growth over time.[12] The unit costs used to aggregate resident days across levels of care are the same for Method A and B. The difference between the two methods is in the difference in the estimation of resident days by level of care.

The cost-weighted output index from Method C has the highest growth rate. The main difference between Method C and Methods A and B is in the estimation of unit costs. As noted earlier, the unit costs for each level of care in Method C are estimated from running a hedonic regression (equation 2) that relates average unit costs to the share of residents by level of care. The unit costs from hedonic regression for Method C, as shown in Table 3, are relatively high for level of care 6 (Type III) compared with the estimates used for Methods A and B. As the number of resident days receiving Type III care increased the most over time, estimates from Method C that assign relatively high unit costs to Type III care increased the fastest compared with estimates from Methods A and B.

The rest of the article will focus on estimates from Method C, the hedonic regression method, as this is the most common method that is used to allocate total heath care expenditures among the treatment of various diseases (Hall and Highhill, 2013). In our case, the hedonic method is used to allocate total expenditures among multiple levels of care.

Quality-Adjusted Output of the RCF Sector

The volume index of output in the RCF sector presented above does not take into account changes in the quality of care in residential care facilities. In this section, we take into account quality changes in the estimates of the output of the RCF sector.

We use the quality of labour input to adjust for the quality of output. Our assumption is that the share of hours that is spent on direct

dent days across the level of care using cost shares as weights. The weighted sum of resident days across the levels of care is used to measure the output of the RCF sector. As discussed above, we have experimented with three alternative estimates of the output of the RCF sector.

The number of resident days showed little change before 2000. After 2000, it increased at a much faster rate reflecting the more than 50 per cent faster growth in the share of the population aged 80 years and over in the 2000-2009 period relative to the 1984-2000 period. The rapid increase in resident days is likely to continue as a result of the aging of the Canadian population.

All three estimates of the output index increased faster than the number resident days. This reflects the compositional shift towards the levels of care (Type II and Type III) that are more expensive.

The cost-weighted output indices that are estimated from Methods A and B show similar

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12   We have not included Method B results in Chart 3 as they are virtually identical to those of Method A.

Table 4

Coefficient Estimates from the Regression of Output Price on the Characteristics of Residential Care Facilities

Variables	Equation 1		Equation 2	
	Coefficient	t-statistics	Coefficent	t-statistics
Share of direct care	1.88*	2.15	1.93*	2.06
Log of hourly wages of direct care personnel	0.98*	4.16	0.98*	3.84
Gross output deflator	..	..	0.04	0.18
Constant	0.01	0.70	0.01	0.56

* indicates statistical significance at the 5 per cent level.

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

care to residents in the total number of hours is associated with improvements in the quality of residential care. A similar approach has been used to adjust for quality improvement in the output of the education sector, where the experience and quality of teachers is used as an indicator for the quality of education output (Schreyer, 2012).

The RCF survey collects hours by type of personnel in residential care facilities. Employees in the RCF survey are classified into 11 types. The first six types of employees provide direct care to residents while the remaining 5 types provide general service to the residents.[13]

Chart 4 presents the share of employees that provide direct care to residents in the total number of hours, which increased from 65 per cent in 1984 to 75 per cent in 2009.[14]

The increase in the share of direct care in the number of hours is used as an indicator for the improvement in the quality of care to residents, but it could also be due to an increase in the number of older and sicker patients in the RCF (namely, a change in the level of care). In both

Chart 4

Share of Direct Care in Total Hours in Residential Care Facilities in Canada excluding Quebec, 1984-2009
(per cent)
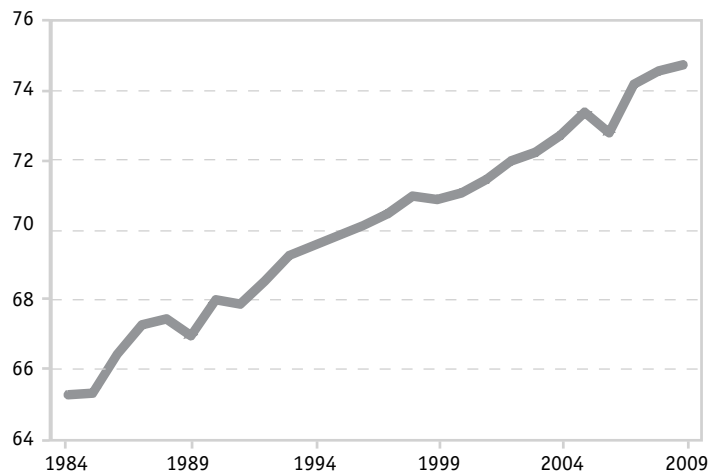
Source: Authors' calculations using data from the RCF survey, Statistics Canada.

cases, the increase represents an increase in the output of the RCF sector.

When the increase in the share of personnel that provides direct care to residents is associ-

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13 The six types of employees whose time is mainly spent on direct care to residents are: registered nurses; registered qualified nursing assistants/licensed practical nurses; physiotherapists/occupational therapists; other therapists, activity/recreation staff; and other direct care staff not included above.

14 To the extent that the change in the share of direct support personnel is due to the change in the composition of care towards more expensive care that may require a higher share of direct support personnel, one may worry that this adjustment for the quality of care could overlap with the adjustment for composition changes on the level of care. However, this is not a concern as the increase in the share of direct support staff is all due to the increase with each level of care, not due to the changes in composition of care with different shares of direct support personnel.

Chart 5

Chart 5

Labour Productivity in the RCF Sector with Quality-Adjustment of Output in Canada excluding Quebec, 1984-2009

(1984=100)
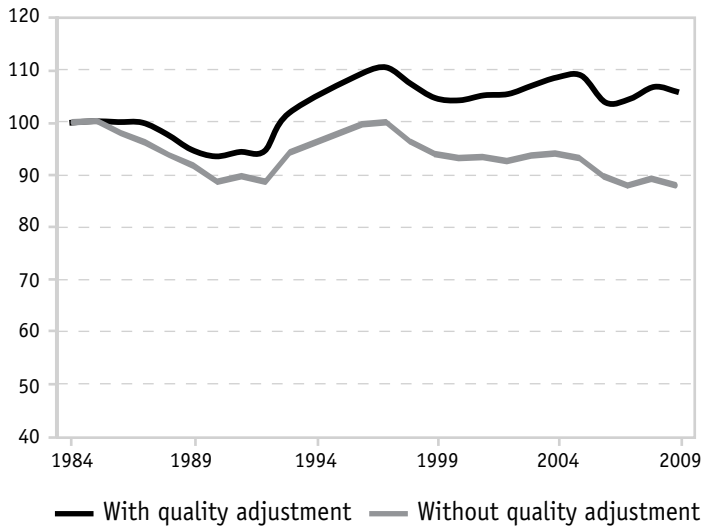
Source: Authors' calculations using data from the RCF survey, Statistics Canada.

ated with the increase in the quality of care to residents, changes in the price of the output of residentail care faclities associated with the increase in the share of direct care personnel should be counted as an increase in the volume of output. That association can be estimated from a regression that relates the price of output of residential care facilities to the change in the share of direct care personnel and other factors that affect the price of the output:

$$(3) \; \Delta ln P_t^{RCF} \; = \; \alpha_0 + \Delta \alpha_1 (share \; of \; direct \; care_t) \\ + \Delta \alpha_2 \, ln(wage_t) + \Delta \alpha_3 \, ln P_t^V + \varepsilon_t$$

The deflator for the output of the RCF sector is expressed as a function of the share of direct care in total hours, the average wages of employees that provide direct care, and a general inflation

term that represents the increase in the price of other expenditures related to residential care facilities, including drugs, the depreciation of capital, and wages for general service personnel.

Wages and salaries accounted for the largest component of total expenditures. In 2009, labour costs accounted for 64 per cent of total expenditures. This share has remained relatively constant over the period.

The regression results are presented in Table 4. The share of direct care in hours is positively related with the change in the price of output of the RCF sector. A one percentage point increase in the share of direct care in total hours is associated with 2 per cent increase in the price of output of the RCF sector. This increase represents the increase in the output of the RCF sector arising from the increase in the quality of care.

The wages of direct care personnel are positively associated with the price of output of the RCF sector. A one per cent increase in the hourly wage rate of direct care personnel is associated with a 1 per cent increase in the output of the RCF sector. The coefficient on the wages of direct care (0.98) is much more than its share in nominal output, as the coefficient may capture the effect of changes in other costs.

Labour Productivity of the RCF Sector

Labour productivity is the ratio of the output index to labour input. Labour input is estimated as the number of hours paid during a fiscal year.[15]

Chart 5 presents the index of labour productivity in the RCF sector based on a different measure of output that takes into account the quality changes in output. Table 5 presents the

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15 While the appropriate concept of labour input for measurement of labour productivity is the total number of hours worked, the data on hours worked are not available from the RCF survey. Instead, the RCF survey collects data on hours paid. The trend in hours paid and hours worked have been found to be similar in previous studies.

annual growth of output and labour productivity in the RCF sector for the 1984-2009 period for Canada excluding Quebec. Nominal gross output is estimated as total expenditures from the RCF survey. Total expenses include the costs of labour, capital, and intermediate inputs. For a comparison, the table also presents the annual growth of output and labour productivity in the business sector.

The nominal value of gross output in the RCF sector increased faster than that in the business sector over the 1984-2009 period at 5.4 per cent per year, compared with 4.9 per cent per year.

Most of the increase in nominal output in the RCF sector was due to the increase in the price index of output in the RCF sector. The price index of the output of the RCF sector increased at 3.3 per cent per year for the 1984-2009 period, accounting for 60 per cent of the annual 5.4 percentage point growth in total expenditures in residential care. The growth in the price index of residential care output is much faster than the growth in the price index of output of the business sector (2.2 per cent per year).

Based on Method C output with quality adjustment, the volume index of output increased at 2.1

Table 5
Output and Labour Productivity in the RCF Sector in Canada excluding Quebec, 1984-2009
(average annual rate of change)

	RCF	Business sector
Nominal output	5.4	4.9
Price index of output	3.3	2.2
Volume index of output	2.1	2.6
Hours worked	1.8	1.5
Labour productivity	0.2	1.2

Note: The RCF output measure is adjusted for output quality. The business sector includes Quebec. In addition, output in the business sector is value added while output in the RCF is gross output. Hence, these estimates are not directly comparable.

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

per cent in the RCF sector for the 1984-2009 period, accounting for the remaining 40 per cent of the annual growth in total expenditures in residential care. The number of hours increased at 1.8 per cent per year. Consequently, the growth in labour productivity in the RCF sector, which is the difference between growth in output and growth in hours, was 0.2 per cent per year.

The growth in nominal output and real output constructed in this article can be com-

Table 6
Output and Labour Productivity in the RCF Sector by Province, 1984-2009
(average annual rate of change)

	Output	Hours	Labour Productivity
Newfoundland and Labrador	3.1	1.7	1.4
Prince Edward Island	1.4	2.0	-0.5
Nova Scotia	0.7	1.7	-1.0
New Brunswick	1.7	1.5	0.2
Ontario	2.1	1.5	0.6
Manitoba	0.6	1.9	-1.3
Saskatchewan	1.0	1.6	-0.5
Alberta	3.2	3.2	-0.1
British Columbia	2.9	2.2	0.8
Canada	2.1	1.8	0.2

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

Table 7
Regression Results for Labour Productivity Level of Residential Care Facilities in 2009

	No Scale Control		Scale Control	
	Coefficent	t-statistics	Coefficient	t-statistics
Indicators for province				
Newfoundland and Labrador	0.13*	2.62	0.17*	3.74
Prince Edward Island	0.25*	3.36	0.25*	3.63
Nova Scotia	-0.21*	-5.13	-0.13*	-3.61
New Brunswick	0.13*	4.19	0.25*	8.73
Manitoba	-0.11*	-2.91	-0.01	-0.30
Saskatchewan	-0.06	-1.65	0.06	1.65
Alberta	-0.12*	-4.34	-0.01	-0.51
British Columbia	-0.02	-0.68	0.12*	4.75
Indicators for level of care				
Level 2	-0.64	-1.16	-0.73	-1.43
Level 3	-0.58	-1.05	-0.66	-1.29
Level 4	-0.54	-0.98	-0.68	-1.34
Level 5	-0.57	-1.03	-1.02*	-1.99
Level 6	-0.62	-1.12	-1.13*	-2.21
Level 7	-0.45	-0.81	-1.02*	-1.98
Indicators for ownership				
Lay (i.e. not for profit)	-0.20	-1.41	-0.15	-1.14
Religious	0.20	1.35	0.10	0.70
Municipal	0.09	0.58	-0.06	-0.42
Provincial	-0.39*	-2.57	-0.31*	-2.19
Proprietary	0.47*	3.21	0.42*	3.10
Regional health authority	-0.08	-0.55	-0.09	-0.65
Size			0.22*	26.80
Constant	-1.11	-1.94	-1.57*	-2.97

Note: The estimates are obtained from an un-weighted robust regression. The omitted categories for the indicators are "Ontario" for the province indicators, "level of care 1" for the level indicators, and "ownership not classified elsewhere" for the ownership indicators. * indicates statistical significance at the 5 per cent level.

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

pared with their growth from the national accounts. Data for the residential care sector are available for the period from 1997 onward. The nominal output of the residential care sector (value added) from the national accounts increased at 6.8 per cent per year over the 1997-2009, compared to 6.0 per cent per year from the RCF survey.[16] The difference is mostly due to the difference in 2009 when the RCF survey was terminated. The price deflator for output for the health service sector (which includes RCF, dental offices, and physicians) in the national accounts increased at 3.2 per cent for the 1997-2009 period, while the price deflator constructed in this article for the RCF sector increased at 3.6 per cent per year. As there is little productivity growth in the RCF sector, it is not surprising that the deflator based on the input costs in the national accounts is similar to the output deflator constructed from the direct output measure in this article.

16 The nominal output of the RCF sector from the national accounts increased by 11.0 per cent in 2009, while the estimate from the RCF survey increased only 2.3 per cent for that year.

Productivity of Residential Care Facilities by Province

Table 6 presents the average annual growth of output, hours worked, and labour productivity in residential care facilities in Canadian provinces excluding Quebec over the 1984-2009 period. Output growth is estimated using Method C and unit costs by level of care are set equal to the national average as presented in Table 3. The quality adjustment for output is based on the share of direct care in total hours in a province.

There is a large variation in labour productivity growth across Canadian provinces. Labour productivity growth in the RCF sector between 1984 and 2009 was positive in four provinces (Newfoundland and Labrador, New Brunswick, Ontario, and British Columbia), and was negative in the five other provinces (PEI, Nova Scotia, Manitoba, Saskatchewan, and Alberta).

Newfoundland and Labrador had the fastest labour productivity growth at 1.4 per cent per year for the 1984-2009 period. Manitoba had the worst productivity performance with output per hour falling 1.3 per cent per year.

To compare the level of labour productivity of residential care facilities across Canadian provinces, we use a parametric approach and estimate a regression that expresses the level of labour productivity in logarithmic form in a facility as a function of dummy variables for the provinces and a number of control variables.[17] Those control variables include binary variables for seven dominant levels of care, a variable for scale, and binary variables for ownership. Labour productivity in a facility is defined as the number of resident days divided by the number of hours. The scale is defined as total number of residents at the end of a fiscal year. The estimates are obtained from an un-weighted regression and thus provide a comparison of the productivity levels of average residential care facilities.

Table 7 presents the results using data for 2009. The first two columns present the estimation results that do not control for the effect of scale. The third and fourth columns present the estimates that control for the effect of scale. The two specifications in the table all control for the effect of ownership. We have also estimated two alternative specifications that do not control for the effect of ownership (Table 8).

The coefficient estimates on the province dummies represent the log difference in the labour productivity between that province and Ontario in 2009 (Table 7). The level of labour productivity in a province relative to that of Ontario can be calculated from those coefficients and is presented in Table 8.

We will focus on the results that control for the effect of scale and level of care, but do not control for the effect of ownership. We are essentially comparing the labour productivity level of facilities with the same size and same level of care in 2009.

The regression results in Table 7 also show that facilities that are proprietary are the most productive. Those facilities are private corporations operating for a profit. Residential care facilities that are owned by religious organizations have the second highest labour productivity level. The facilities that are owned by the provincial governments are the least productive. The full ranking of ownership in labour productivity levels from high to low in 2009 is: proprietary, religious, municipal, regional health authority, lay (not for profit), and provincial.

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17 Alternatively, a non-parametric or index number approach for estimating the level of labour productivity across provinces could be used. The relative price level of residential care by province is constructed first. Those relative prices are then used to deflate the relative level of the nominal output of the province to derive the relative level of the volume of output of the RCF sector. Relative labour productivity is the ratio of relative output to relative hours worked (Schreyer, 2010).

Table 8

Relative Level of Labour Productivity in Canadian Provinces, 2009

(Ontario = 100)

	Without ownership control		With ownership control	
	No scale control	**Scale control**	**No scale control**	**Scale control**
Newfoundland and Labrador	133.7	135.6	113.8	118.7
Prince Edward Island	127.8	127.2	129.0	128.8
Nova Scotia	74.8	81.7	81.3	87.4
New Brunswick	128.2	143.8	113.3	127.8
Ontario	100.0	100.0	100.0	100.0
Manitoba	75.6	86.4	89.7	99.0
Saskatchewan	74.9	88.9	93.7	106.3
Alberta	79.3	91.2	88.5	98.7
British Columbia	91.7	108.3	98.2	112.2

Source: Authors' calculations using data from the RCF survey, Statistics Canada.

Chart 6

Level of Labour Productivity in Residential Care Facilities in Canadian Provinces

(Ontario = 100)

■ Average facility productivity   ▨ Aggregate sector productivity
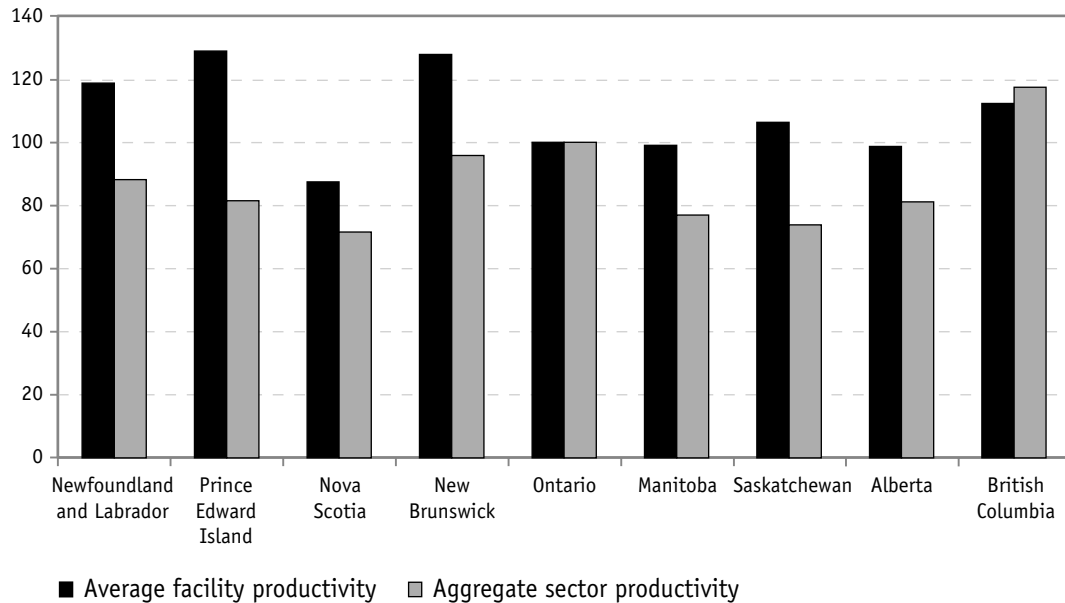
Note: The average facility productivity estimate is based on both the scale and ownership control.
Source: Authors' calculations using data from the RCF survey, Statistics Canada.

The finding that for-profit residential care facilities tend to have higher productivity levels than not-for-profit facilities in Canada is consistent with evidence from studies in other countries (for a survey, see Australian Produc-tivity Commission, 2008). This may be the result of a stronger incentive mechanism for innovation and efficiency improvement associated with commercial operation. It may also reflect the lower quality of care that is often

found to be associated with for-profit residential care facilities.

Residential care facilities in three Atlantic provinces (Newfoundland and Labrador, PEI, and New Brunswick) have higher levels of labour productivity than those in Ontario for all four specifications (Table 8). All other provinces generally have lower labour productivity levels than Ontario.

Controlling for scale, but with no ownership control, New Brunswick has the highest labour productivity level in 2009, followed by Newfoundland and Labrador, and Prince Edward Island. In 2009, residential care facilities in New Brunswick were about 44 per cent more productive than those in Ontario. Nova Scotia has the lowest labour productivity level at 81.7 per cent of the Ontario average.

Some of the differences in labour productivity levels of average facilities across provinces are due to the effect of differences in ownership. This effect can be assessed from a comparison of relative productivity levels across provinces with and without control for ownership structure of the facilities. When we control for the effect of ownership, three Atlantic provinces and British Columbia still have higher labour productivity levels than Ontario. But the three Prairies provinces no longer have significantly lower productivity levels than Ontario.

The relatively higher labour productivity levels of residential care facilities in the three Atlantic provinces (Newfoundland and Labrador, Prince Edward Island, and New Brunswick) are in contrast to the relatively lower productivity levels of the business sectors in those provinces (de Avillez and Ross, 2011). A key to understanding this apparent contradiction is to recognize that the estimates above represent the relative productivity levels of average facilities in a province. The aggregate productivity level of the residential care facilities is a weighted sum of the average labour productivity across facilities. While the average facilities in those three Atlantic provinces have a higher relative labour productivity, the aggregate productivity level that reflects both the productivity level of average facilities and the composition of facilities across size and ownership structure could be lower as those provinces have a larger share of facilities with a smaller size or public ownership. As shown in Chart 6, that is indeed the case. The aggregate productivity level of the RCF sector in those Atlantic provinces is lower compared with other provinces.

To compare the productivity level of the aggregate residential care facility sector, we estimate the regression that expresses the level of labour productivity in logarithmic form in a facility as a function of dummy variables for the provinces and the dominant level of care using the weighted regression, where weights are total expenditures. The results for the relative level of productivity in the aggregate residential care sector in 2009 are presented in Chart 6. For a comparison, the chart also presents the relative level of productivity of the average facility with the similar size, same ownership, and same level of care as shown in Table 8. While the productivity level of the average facility is relatively high in three Atlantic provinces, the productivity level in the aggregate sector is relatively low in those provinces due to their lower share of for-profit facilities and the smaller scale of their facilities. For the aggregate RCF sector, British Columbia, Ontario and New Brunswick have the highest level of productivity in 2009.

Conclusion

This article has examined the productivity performance of residential care facilities in Canada excluding Quebec. For that purpose, a direct output measure is constructed as a cost-

weighted output index by aggregating resident days by level of care and adjusting for the quality of care, as reflected by costs.

The nominal value of gross output in residential care facilities or total expenditures on residential care increased faster than that in the business sector over the 1984-2009 period. About 60 per cent of the increase in total expenditures in residential care was due to the increase in the price of the output of residential care facilities. The remaining 40 per cent of the increase was due to the increase in the amount of care provided to the residents and in the number of residents, reflecting both an increase in the number of residents, weighted by the level of care, and the quality of output, weighted by the relative share of direct care personnel.

Labour productivity increased at 0.2 per cent per year in residential care facilities over the 1984-2009 period, much more slowly than in the business sector (1.2 per cent).

There is a large variation in labour productivity growth in residential care facilities across Canadian provinces. Newfoundland and Labrador had the fastest labour productivity growth at 1.4 per cent per year over the 1984-2009 period. Manitoba had the slowest labour productivity growth during that period at negative 1.3 per cent per year.

There is also a large variation in the level of labour productivity in residential care facilities across the provinces. Three Atlantic provinces (Newfoundland and Labrador, Prince Edward Island, and New Brunswick) had the highest labour productivity level in 2009. Labour productivity in these provinces was much higher than that in Ontario. Some of the differences in labour productivity levels across provinces can be attributed to the cross-province differences in ownership, scale of residential care facilities, and quality of care.

The residential care facilities sector is heavily labour intensive and is often seen as one of the industries where Baumol's cost disease is prevalent. This article concludes that Baumol's cost disease is not prevalent in the residential care facilities as there is a large variation in productivity growth across provinces. Innovation and productivity growth are possible in the residential care facilities sector.

Future research should focus on understanding the sources of the difference in labour productivity across Canadian provicnes and across residential care facilities. While few studies exist on the factors contributing to productivity growth in the RCF sector, much has been learned about the factors contributing to productivity growth in the business sector (Baldwin, 1995; Baldwin and Hanel, 2003). The factors contributing to productivity growth in the business sector include competition, innovation, entrepreneurship, and scale economies. The effect of these factors on productivity growth in the health care sector should be a topic of future research.

References

Atkinson, A. B (2005) *Atkinson Review Final Report: Measurement of Government Output and Productivity for the National Accounts*. Palgrave Macmillan.

Australian Productivity Commision (2008) "Trends in Aged Care Services: Some Implication," Commission Research Paper, Canberra.

Baldwin, J.R. (1995) *The Dynamics of Industrial Competition*. (Cambridge: Cambridge University Press).

Baldwin, J.R. and P. Hanel (2003) *Innovation and Knowledge Creation in an Open Economy*. (Cambridge: Cambridge University Press).

Baumol, W., and W. Bowen (1966) *Performing Arts, The Economic Dilemma: A Study of Problems common to Theater, Opera, Music and Dance*. (New York: The Twentieth Century Fund).

Canadian Institute for Health Information (CIHI) (2006) "Facility-based Continuing Care in Canada, 2004-2005," Ottawa, Canada

Canadian Institute for Health Information (CIHI) (2013) "When a Nursing Home is Home: How Do Canadian Nursing Homes Measure up on Quality?" Ottawa, Canada.

Canadian Institute for Health Information (CIHI) (2015) "National Health Expenditure Trend, 1975 to 2015," Ottawa, Canada.

Dawson, D. *et al*. (2005) "Developing New Approaches to Measuring NHS Outputs and Productivity," Final Report to the Department of Health, Centre for Health Economics (York) and National Institute of Economic and Social Research.

De Avillez, R. and C. Ross (2011) "A Portrait of the Productivity Performance of the Canadian Provinces," *International Productivity Monitor*, Number 21, Spring, pp. 48-69.

Diewert, E. (2008) "The Measurement of Nonmarket Sector Outputs and Inputs Using Cost Weights," Vancouver: Department of Economics, University of British Columbia. Discussion Paper 08-03.

Dunne, A. L. Rittmueller and B. Whitmire (2015) "Introducing the New BEA Health Care Satellite Account," Survey of Current Business, BEA.

Eurostat (2001) *Handbook on Price and Volume Measures in National Accounts* (Luxembourg, Germany, European Communities).

Gu, W. and S. Morin (2014) "Experimental Measures of Output and Productivity in the Canadian Hospital Sector, 2002 to 2010," in *Measuring Economic Sustainability and Progress*, D. Jorgenson, S. Landerfield, and P. Schreyer (eds.). NBER/CRIW. (Chicago: University of Chicago Press).

Gu, W. and A. Wong (2015) "Productivity and Economic Output of the Education Sector," *Journal of Productivity Analysis*, Vol. 32, pp. 165-182.

Hall A. and T. Highhill (2013) "Calculating Disease-based Medical care Expenditure Indices of Medicare Beneficiaries: A Comparison of Method and Data Choices," Bureau of Economic Analysis.

McGregor, M.J. and L.A. Ronald (2011) "Residential Long-term Care for Canadian Elders: Nonprofit, For-Profit or Does it Matter?" No. 14, Institute for Research on Public Policy.

Murphy, J.M. (2006) "Residential Care Quality: A Review of the Literature on Nurse and Personal Care Staffing and Quality of Care," paper prepared for Nursing Directorate, British Columbia Ministry of Health.

Schreyer, P. (2010) "Towards Measuring the Volume Output of Education and Health Services: A Handbook," OECD Statistics Directorate, Working Paper No. 31, OECD.

Schreyer, P. (2012) "Output, Outcome, and Quality Adjustment in Measuring Education and Health Services," *Review of Income and Wealth*, Vol. 58, pp. 257-278.

Sharpe A., C. Bradley, and H. Messinger (2007) "The Measurement of Output and Productivity in the Health Care Sector in Canad: An Overview," CSLS Research Report 2007-06, Ottawa. Canada

Statistics Canada (2011) "Residential Care Facilties," Catalogue No. 83-237.