

Income Gap Decomposition for the Canadian Provinces,
1966 to 2007

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Abstract

In this paper we decompose the income gap of the Canadian Provinces in four factors: the output per worker, the employment rate, the participation rate and the working age population. For the period studied, 1966-2007, we find that: the main factor of the income gap was the output per worker, and the provinces that reduced their income gap the most were the Atlantic Provinces.

Sommaire

Dans cette étude nous décomposons l'écart de revenu pour les provinces canadiennes en : la productivité du travail, le taux emploi-population active, le taux d'emploi, et le taux de population en âge de travailler. Entre les années 1966 et 2007, nous avons trouvé que le facteur principal de l'écart de revenu était la production par travailleur. En outre, pour les mêmes années, les provinces qui diminuaient plus leur écart de revenu étaient les Provinces de l'Atlantique.

1 Introduction

The real income for Canada increased from 1966 to 2007 and its divergence among provinces reduced, but relatively there were differences among regions. To analyze this difference the method we perform is a decomposition of the income gap into several factors for each region relative to Canada.

Baldwin et al. (2004) found that the main source of growth of output for the Canadian provinces for most on the nineties was the increase in the labour productivity. As Baldwin we decompose the output per capita, but to enlarge the time period analysis we measure labour productivity as output per worker instead of -the standard approach- output per hour. In addition to that paper, we analyze the provinces relative to Canada.

A few conclusions of our paper are that the provincial gap of income per capita came primarily by the output per worker, followed by the participation rate. The employment rate and the working age did not explain the income gap that much. As for the provinces, the ones that improved their income gap the most in relation with Canada were the Maritime Provinces. In the last years, Alberta and Newfoundland were the regions that over-perform and the factors that explain this change were mostly the gains in output per worker.

The paper is organized as follows: in the second section we decompose the income gap into different factors, on the following section we analyze the sources of income gap for each province, and the last section concludes.

2 Decomposition

We can decompose the income per capita for province “i” and time “t” (years) as follows:

$$\left(\frac{Y}{N}\right)_{it} = \left(\frac{Y}{E}\right)_{it} * \left(\frac{E}{L}\right)_{it} * \left(\frac{L}{WA}\right)_{it} * \left(\frac{WA}{N}\right)_{it}$$

Where,

Y: Nominal Gross Domestic Product (GDP)

E: Employment, measured by number of people employed

L: Labour force, measured as people +15 years old, unemployed plus employed

WA: Working age population (people of 15 years and older), labour market participants plus non-participants

N: Total population

This identity is a decomposition of income per capita (Y/N) into average worker productivity (Y/E), the employment rate (E/L), the participation rate (L/WA) and the working age to total population ratio (WA/N). It is worth to notice that this equation is an identity and does not necessary mean there is causality or a drive.

We define income per capita as total production (GDP) divided by total population. The income per capita between 1966 and 2007 had a positive trend with the exceptions of the recessions of early-1980s and early-1990s. On average the GDP per capita grew annually in real terms 1.89% during the period. In addition to this growth, there was a convergence between provinces from 1961 and 1991 (Coulombe and Lee, 1995). So Canada got richer and more equal.

The first factor is labour productivity, defined as output per worker. Depending on the model it will change -among other things- by the amount of physical capital, the quantity of human capital, and technology. From 1966 to 2000 the output per worker grew annually 1.05% in real

terms. Secondly, the employment rate is defined as employment to labour force. It is equal to one minus the unemployment rate, so if there is full employment then the employment rate is 1. If there is a recession -in general- the unemployment rate will increase and the employment rate will decrease; so high employment rates reflect working opportunities in an economy. The rate is function of technology (measured by the TFP), taxes, working benefits, labour protection, and the bargaining coordination (Alho et al., 2008).

As for the third factor, the participation rate is the share of people actively in the labour force aged 15 years and older, relative to the total population aged 15 years and older. This factor increases if men and/or women enter the job market, if there are less students, and if the demand for labour increases. Nation-wide the participation rate has changed significantly, from close to 58% in late 1960s increasing to 68% in 2007; this change came from the increase in women participation in the labour market.

The last factor, the working age ratio is the share of people that have the age to work in relation to the total population¹. Larger the working age population higher will be the share of people that can enter the labour force, produce and save money. It reflects demographic changes since a baby-boom or a decline in births rates can directly make this ratio change.

Dividing the two sides of the provincial decomposition by the national factors we obtain the provincial income per capita relative to the national performance:

$$\frac{\left(\frac{Y}{N}\right)_{it}}{\left(\frac{Y}{N}\right)_{CANt}} = \frac{\left(\frac{Y}{E}\right)_{it}}{\left(\frac{Y}{E}\right)_{CANt}} * \frac{\left(\frac{E}{L}\right)_{it}}{\left(\frac{E}{L}\right)_{CANt}} * \frac{\left(\frac{L}{WA}\right)_{it}}{\left(\frac{L}{WA}\right)_{CANt}} * \frac{\left(\frac{WA}{N}\right)_{it}}{\left(\frac{WA}{N}\right)_{CANt}}$$

1 This is not the same than the dependency ratio, that is equal to the ratio dependent–not dependent population

We make the following substitutions:

$$\frac{Y}{N}=y, \quad \frac{Y}{E}=p, \quad \frac{E}{L}=e, \quad \frac{L}{WA}=l, \quad \frac{WA}{N}=w$$

Finally, we express the decomposition of the income gap by taking the natural logarithm on both sides of the identity:

$$\ln y_{it} - \ln y_{CANt} = (\ln p_{it} - \ln p_{CANt}) + (\ln e_{it} - \ln e_{CANt}) + (\ln l_{it} - \ln l_{CANt}) + (\ln w_{it} - \ln w_{CANt})$$

The income gap definition that we use: is the difference between the outputs per capita of a province versus the output per capita of Canada. For a certain year, this income gap would be equal to the sum of the factors gaps of the province with Canada; so the interaction of gaps would imply different levels of income gap.

We construct the series entirely with data obtained from Statistics Canada (for more details see Appendix A). For this paper, we do not consider the territories so “Canada” is the aggregation of the ten provinces for every variable.

3 Provincial Income Gap

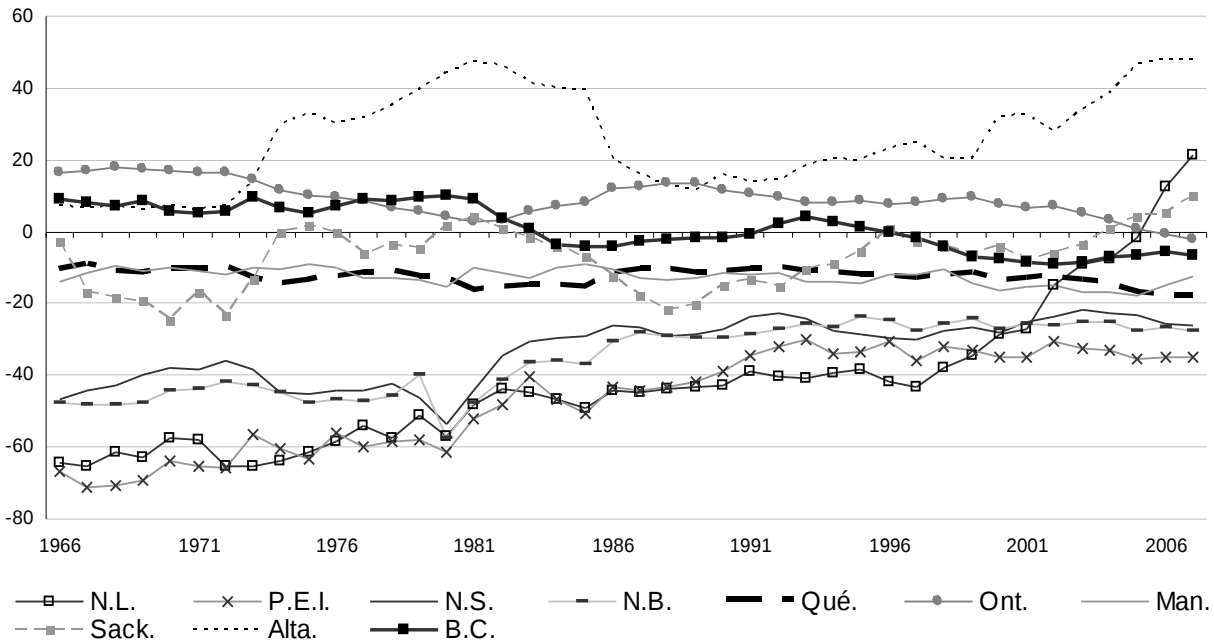
In this section, we analyze the decomposition of the income gap for every province individually in relation with Canada. First, as to facilitate the analysis we group the provinces by their performance in income per capita -by plotting the left term of the decomposition².

The provinces that changed positively in relation with the others are the Atlantic Provinces (Figure 1). As a group, these provinces started (close to) 50% poorer than Canada and ended with an income per capita around -20%. The regions that were -almost- always relatively richer than the rest, Alberta and Ontario: started close to +10% richer and closed around +30%. The

² Income gap of province in relation to Canada, $\ln y_{it} - \ln y_{CANt}$

provinces that did not change much during the period -the stagnant- are Québec and Manitoba, staying 10 to 20% less rich than the rest. Finally, there were a couple of provinces that had ups and downs around Canada: Saskatchewan and British Columbia.

Figure 1. Income gap in logs³



From now on, we include the factors gap of every province in relation with Canada (the right term of the decomposition⁴). So from Figure 2 we detail the factor's percentage difference of every province individually. The sum of all the factors will be equal to the income gap.

The Provinces with Positive Changes

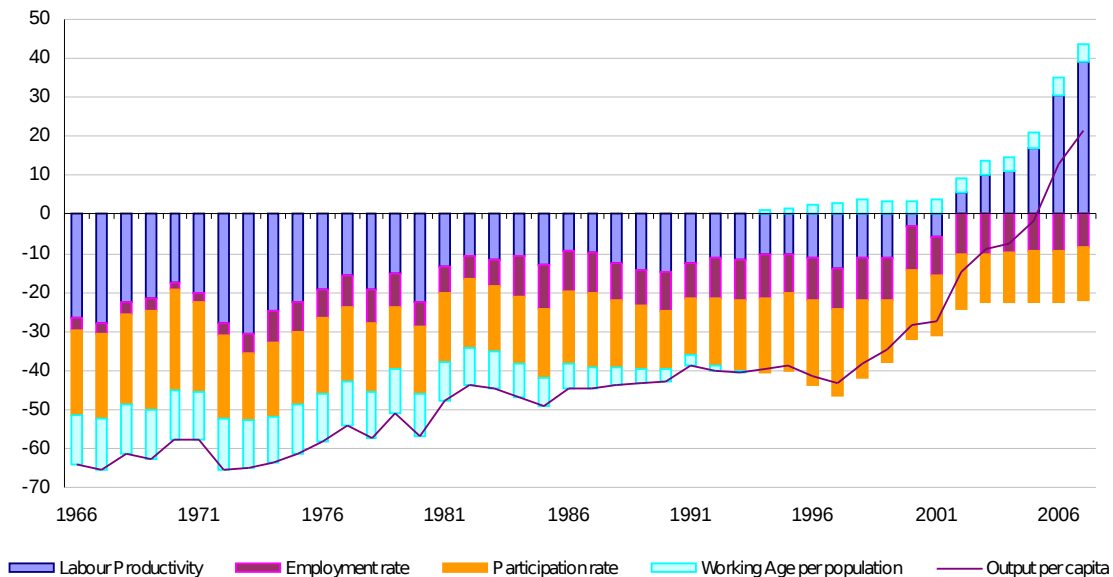
Newfoundland (Figure 2) was one of the provinces that in relative terms changed positively the most during the period '66-'07. It can be observe that the production per capita started very low (-64%) but surpassed Canada in 2002. The factor output per worker was important in this change: from -27% to +39%, thanks to the growth in the mining and oil and gas extraction sector (Sharpe

³ This figure is on a 100 log scale as to be interpreted as percentages differences

⁴ $(\ln p_{it} - \ln p_{CANt}) + (\ln e_{it} - \ln e_{CANt}) + (\ln l_{it} - \ln l_{CANt}) + (\ln w_{it} - \ln w_{CANt})$

and Arsenault, 2009). The working age ratio was slightly higher to Canada since 1991. For the employment and participation rates, the province was never on advantage.

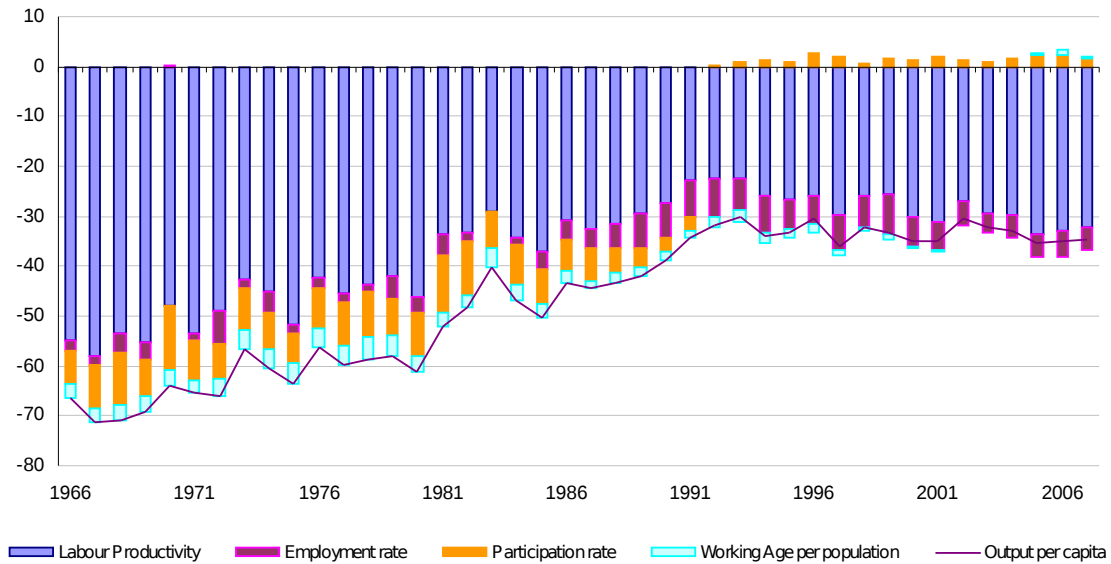
Figure 2. Newfoundland income decomposition in logs⁵



For the province of Prince Edward Island (Figure 3), the income per capita was the lowest of all but closing the gap since the year 1970. The relative low output per worker that was converging (from -55% in 1966 to -32% in 2007) can help explain the level of income and its tendency; probably this is due to its low accumulation in physical capital (Robson and Goldfarb, 2004). The employment rates as the working age ratio were a bit lower than Canada (values from -8% to 0%), and the participation rates are higher since 1993.

5 The sum of the several factors should be equal to the production per capita logarithm. The figures are on a 100 log scale

Figure 3. Prince Edward Island income decomposition in logs



The production per capita of Nova Scotia (Figure 4) was lower than the rest of the provinces, and it should not be rare since mostly every factor was lower than Canada. The output per worker had a high volatility with an all-time low of -37% for the year 1980, and since 1982 with a small tendency to close the gap. The participation rates were also important in the identity -in a negative sense- while the employment rates contribution was marginal. The working age ratio was relatively positive since 1994, reaching a +3% advantage.

For New Brunswick (Figure 5), the changes and level of difference were quite similar to Nova Scotia, including a relatively high income for 1980 (-57%) and a working age advantage since the beginning of the 1990s. The production per capita was lower than the rest of the provinces, closing the gap since early 1980s, as well as the output per worker. The employment rates had a negative contribution to the income gap, especially at the end of the seventies, reaching -6% in 1977. The participation rates also had a negative contribution, but in a lesser degree. The working age compensated a little the low productivity since 1992.

Figure 4. Nova Scotia income decomposition in logs

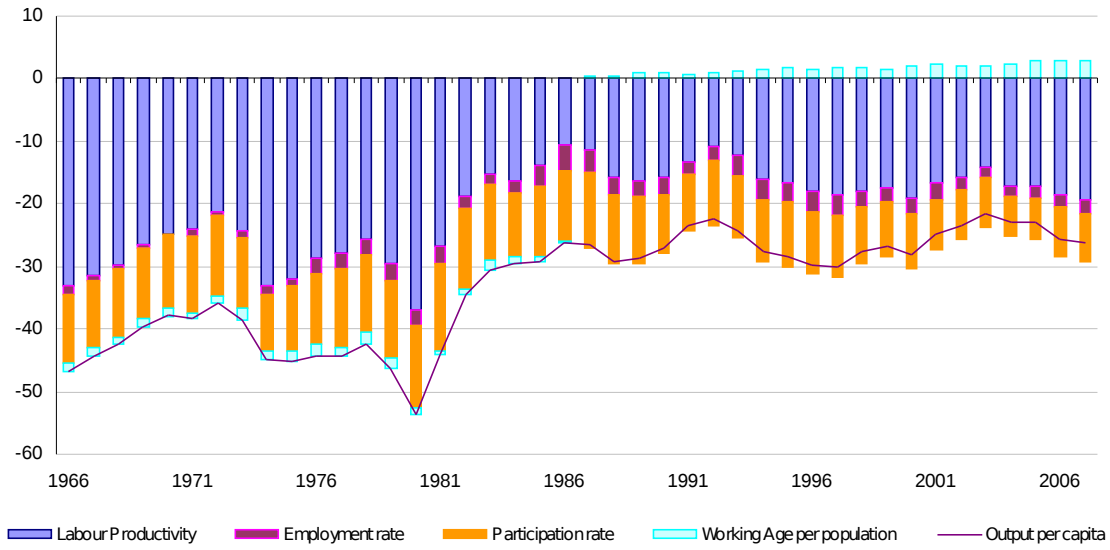
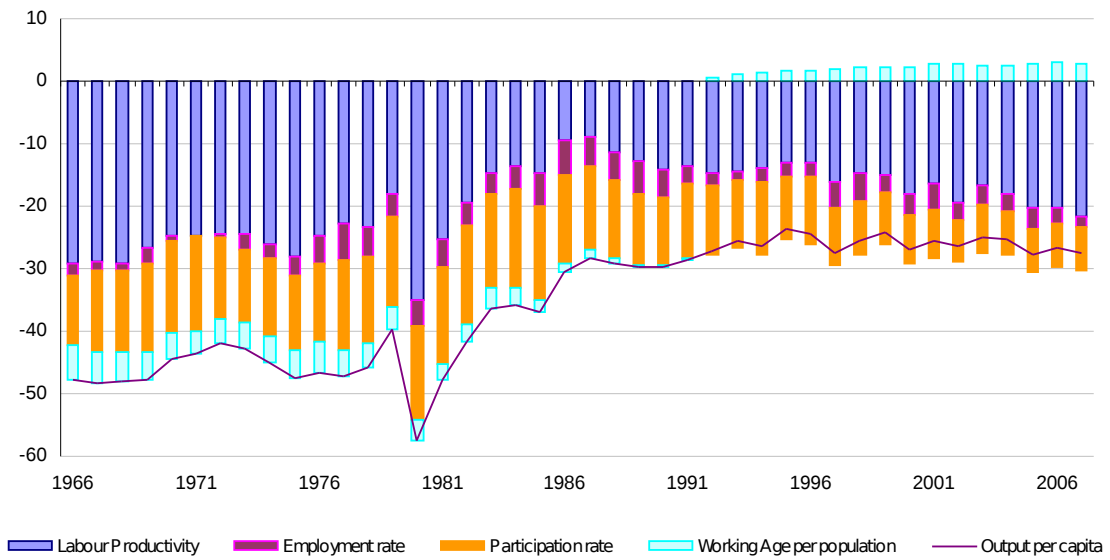


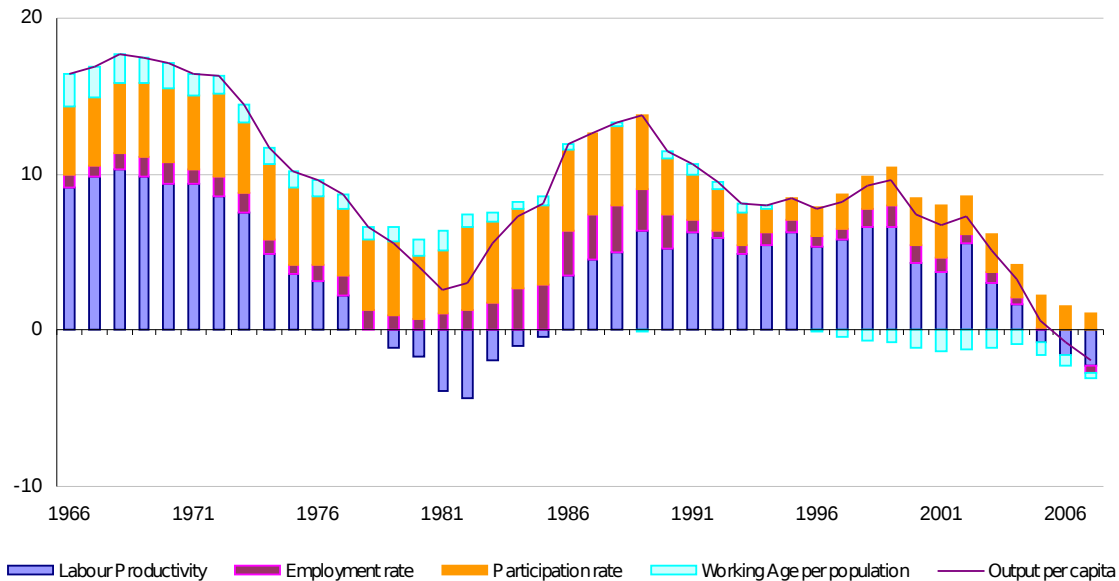
Figure 5. New Brunswick income decomposition in logs



The Relatively Rich

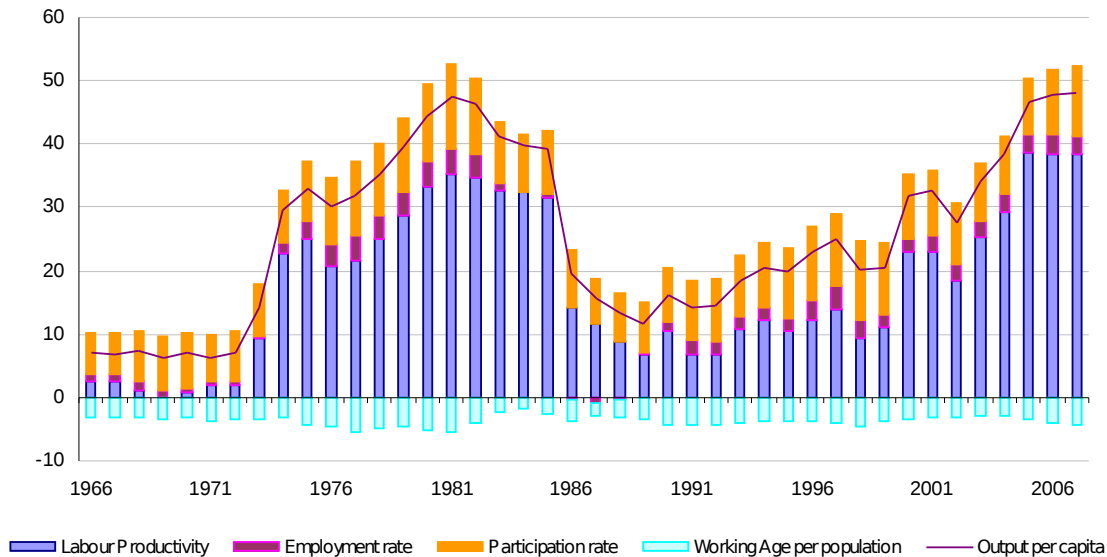
The output per capita of Ontario (Figure 6) was the highest in 1966 (+16%), but reduced the gap during the following years and closed poorer than Canada in 2007. This is due to a convergence of every factor. There was a relative downward trend of the output per worker during the 1970s – that falls to -4% in 1982-. The participation rates compensated this effect with values around +4%, therefore the income gap is positive for those years. There was no major event that explains the two relative falls in production (during the 1970s and the 2000s decade), simply others provinces had higher growths rates as Gellatly (2007) explains for the 1997-2005 period.

Figure 6. Ontario income decomposition in log



The province of Alberta (Figure 7) was always richer than the rest but since 1973 the difference is wider because the OPEC embargo increased the demand for Alberta's oil; the province ended with a +48% advantage for 2007. Almost every factor for the '66-'07 period contributed to the income gap, but the output per worker had a major role with the slowdown of 1986-1999. The advantage of the employment rate is small, and the participation rate helped increasing the gap. The high nativity among the Albertans -reflected on the working age ratio with values around -4%- diminished the income gap with Canada.

Figure 7. Alberta income decomposition in logs



The Stagnant

The income of Québec (Figure 8) was relatively inferior to the rest of the provinces –near -12% on average- and with a tendency to widening the gap. The output per worker was lower than some provinces due to its industry mix (Campbell, 2002) and since 1999 falls behind, though in a lesser degree than other provinces. The participation rates did not help with the convergence –especially during the 1970s- neither did the employment rates from 1977 to 1997. The working age compensated a little the others variables since 1972 -on average +1.6% to Canada.

The Figure 9 shows that the production per capita of Manitoba was under the standard for '66-'07 (on average -12%), probably by the low output per worker from the low investments in capital (FCPP, 2003). The employment rates were always higher than Canada, on the contrary to the participation rate that was almost always lower. Since 1982 the working age had a negative effect on the relative output of the province (that ends at -3%), as a result of its high births rates (Figure 9a).

Figure 8. Québec income decomposition in logs

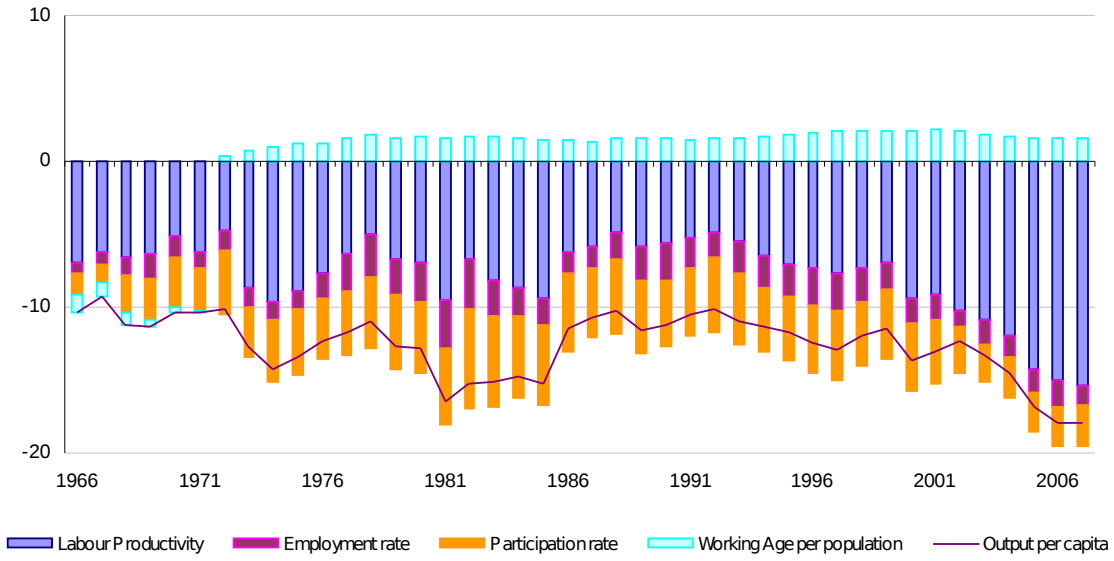
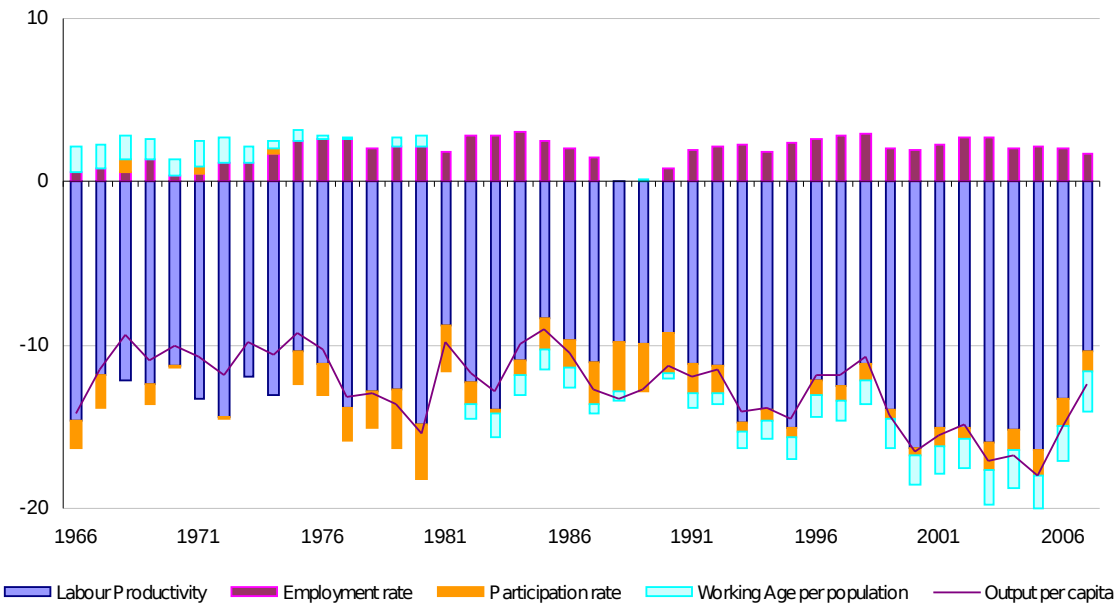


Figure 9. Manitoba income decomposition in logs



With Ups and Downs

The income of Saskatchewan (Figure 10) -that attained a +10% advantage in 2007- had a lot of volatility with most of the years under Canada –with the exception of 1975, 1981 and since 2004. Although it is often compared with Manitoba, its productivity was slightly higher because of the high productivity of the natural resources sector (Baldwin, 2001). The employment rates were always above Canada (with values close to +3%), contrarily to the participation rates that were always below. The proportion of working age persons was a disadvantage, mainly by its important number of childbirths.

The income per capita of British Columbia (Figure 11) experienced -in relative terms- a lot of ups and downs. The output per worker had a negative tendency because of the declining capital intensity (Sharpe and Arsenault, 2008). The employment rates did not help with the convergence in the mid-eighties (-5% in 1985), on the contrary to the positive relation of the participation rate in the beginning of the nineties (+4% in 1994). The working age ratio had a mixed behavior, but reduced the income gap -in general.

Figure 10. Saskatchewan income decomposition in logs

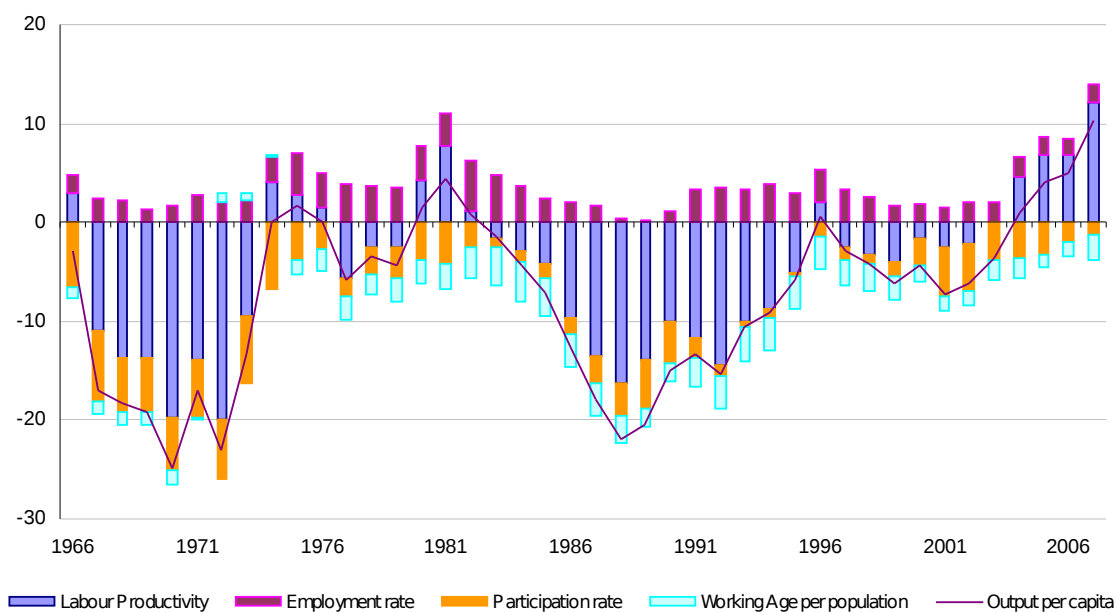
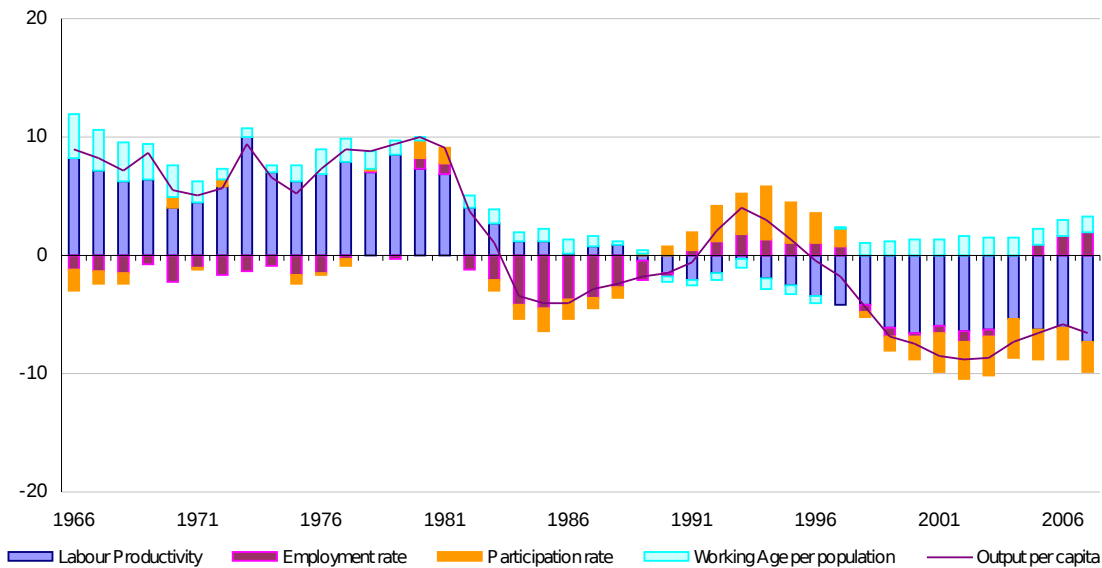


Figure 11. British Columbia income decomposition in logs



4 Discussion and Conclusions

This paper has some limitations: it does not take into account the differences of cost of living between provinces. A change in GDP can come from a change of productivity and/or inflation. It would be ideal to have a closer measure of productivity, hence deflate the effect of inflation for each province. For this, it is necessary to have a series of consumer price index starting from 1966 for every province. Statistics Canada has the series from 1979. It was sacrificed some reliability for a longer series.

For the decomposition of income of this paper, the differences in output per worker were the main factor of the income gap between the Canadian provinces, secondly, the participation rate. Individually, the employment rate and the working age to total population ratio did not explain much the level of difference of the output per capita.

By province, the variables moved quite similarly for the Maritime Provinces: the income gap is reduced due to a relative raise in productivity until approximately 1986, and after due to the participation and the working age rates. Newfoundland, as a result of its changes in demographics and output per worker of the last years, took some distance from the rest of the Atlantic Provinces and ended with a higher income than Canada.

The relatively rich, Alberta and Ontario, were so mainly due to the high output per worker and participation rates. The income gaps of Saskatchewan and British Columbia had ups and downs relative to Canada, mainly from the changes in productivity. For Saskatchewan, the participation rate, the employment rate and the working age stabilized the changes in the income gap; whereas for British Columbia those rates contributed to the income gap variation.

Manitoba and Québec did not change their relatively negative position. Québec's income gap is widened due to the production per capita, but not much since the working age compensated a little this effect. Manitoba did not change much its income gap for the period: the high employment rates compensated the low output per worker.

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Appendix A: Data Definitions and Sources

Variable	Definition	Source
$Y_{t,i}$	Gross Domestic Product at current prices	1966-1980 Statistics Canada Catalogue 13-213
		1981-2007 CANSIM using E-STAT (Table 384-0002)
$N_{t,i}$	Total population	1966-1970 CANSIM using E-STAT (Table 051-0026)
		1971-2007 CANSIM using E-STAT (Table 051-0001)
$E_{t,i}$	Employment 15 years and over	1966-1975 CANSIM using E-STAT (Table 384-0035)
		1976-2007 CANSIM using E-STAT (Table 282-0002)
$L_{t,i}$	Labour force 15 years and over	1966-1975 Statistics Canada Catalogue 71-201
		1976-2007 CANSIM using E-STAT (Table 282-002)
$WA_{t,i}$	Working Age population (15 and over)	1966-1971 CANSIM using E-STAT (Table 051-0026)
		1972-2007 CANSIM using E-STAT (Table 051-0001)
	Gross Domestic Product, factor cost in constant prices	1966-2000 CANSIM using E-STAT (Table 379-0004)
	Participation Rates	1976-2007 CANSIM using E-STAT (Table 282-0002)
	Total number of births	1966 – 1971 CANSIM using E-STAT (Table 051-0028)
		1972 – 2007 CANSIM using E-STAT (Table 051-0013)

Appendix B: Other Figures

Figure 9a. Birth rates for Manitoba and Canada (childbirths per 1000 people)

