

The Evolving

Comparative Competitiveness of Canadian and American Industries

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About the Centre for Productivity and Prosperity – Walter J. Somers Foundation

The Centre for Productivity and Prosperity – Walter J. Somers Foundation has a twofold mission. First of all, it is devoted to research on productivity and prosperity, mainly in Quebec. The Centre then shares its research findings through knowledge transfer and educational activities.

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The Somers family established the Walter J. Somers Foundation in tribute to the founder of Walter Surface Technologies. Through different donations, the Foundation pursues the family heritage of commitment to the community and contributes to the prosperity of Quebec society, firstly by helping to improve its productivity but also by supporting excellence in youth education.

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MESSAGE FROM THE DIRECTOR

In a context where the difficult negotiations surrounding the renewal of the North American Free Trade Agreement (NAFTA) are giving rise to serious concerns on this side of the border, we have to wonder about Canada's ability to compete. Is the Canadian economy so fragile that new trade barriers would threaten the survival of some industries? Doesn't the relative weakness of the Canadian dollar give them a sufficient trade advantage to offset the impact of such new barriers? In an effort to better understand the issues underlying the NAFTA negotiations, the Centre for Productivity and Prosperity – Walter J. Somers Foundation set out to evaluate the evolving competitiveness of Canadian industries in comparison with their American counterparts.

Using an innovative approach based on the relative evolution of productivity and production costs in Canada and the United States, this report examines the relative competitiveness of the 34 main industrial groups making up the Canadian economy. This allows us to evaluate whether Canadian industries' ability to withstand competition has improved or deteriorated, to identify the factors underlying this performance, and to assess how changes in the exchange rate affected their competitiveness between 2000 and 2014.

Generally speaking, the results show that productivity gains overall were too small for industries here to remain competitive when the Canadian dollar began rising. Whole sectors had not invested enough and were actually hurt by the stronger loonie. Many industries now appear vulnerable to new trade barriers, even though the relative weakness of the Canadian dollar currently gives them a significant trade advantage once again.

The conclusion is clear: to ensure their competitiveness, Canadian firms absolutely must focus on productivity, one of the few levers at their disposal to improve their ability to cope with factors that are beyond their control.

Robert Gagné

Director, Centre for Productivity and Prosperity – Walter J. Somers Foundation



TABLE OF CONTENTS

MESSAGE FROM THE DIRECTOR	3
INTRODUCTION	5
PART I - CONTEXT	7
What is competitiveness?	8
Available measurements	9
Why specifically target the United States?	12
Exchange rate advantages and disadvantages	14
PART 2 - USING PRICES TO MEASURE COMPETITIVENESS	18
Unit labour costs	19
Relative unit production costs	21
PART 3 - CANADA'S RELATIVE COMPETITIVENESS: RESULTS	28
Results by industry	30
Overview of the results	65
Discussion	67
CONCLUSION	70
BIBLIOGRAPHY	71
METHODOLOGICAL APPENDIX	72
SOURCES OF DATA	78

INTRODUCTION

The renegotiation of the North American Free Trade Agreement (NAFTA) has been in the headlines for months now, and has highlighted some substantial disagreements regarding trade among the three parties. But a closer look shows that the concerns expressed on this side of the border may actually overshadow a much more important economic issue: the competitiveness of the Canadian economy.

NAFTA initially helped to boost trade with our southern neighbour. Barely seven years after the Agreement came into effect, the actual value of exports to the United States had doubled, for all practical purposes, and over 85% of Canadian exports were headed for the US market alone.

Canadian exports to the US benefited not only from the lower trade barriers, but also from a particularly favourable exchange rate. Remember that in the early 2000s, one US dollar was worth as much as \$1.57 Canadian, a situation that artificially boosted the competitiveness of Canadian goods and services by reducing their effective prices to US customers. With this huge advantage, Canadian producers saw their exports skyrocket, without really having to worry about their productivity or whether they were in fact competitive.

The winds changed, however, in 2002, when the Canadian dollar began strengthening. Industries here, relying on the loonie's historic weakness, have postponed the necessary investments and gradually lost more and more ground in terms of productivity to US industries. Their ability to absorb a trade or monetary shock has also declined. As a result, many of them now find themselves vulnerable to potential new trade barriers, even though the exchange rate is once again giving them a significant trade advantage.

This report looks at the question in precisely this context. Using an empirical approach, the analysis sheds new light on the competitiveness of the Canadian economy, offering a detailed analysis of the situation in 34 major industrial groups. In the end, our analysis should make it possible to better grasp the deep-seated issues underlying the renegotiation of NAFTA.

COMPETITIVENESS

At first glance, the concept of competitiveness may seem fairly simple. General dictionaries define competitiveness as “the ability to withstand competition.” A firm will be considered competitive if it succeeds in profitably selling its goods or services in a competitive market, or if it manages to succeed despite its higher prices by relying on innovative production methods or higher quality. In short, competitiveness is determined in the end by a combination of price, quality and efficiency.

When we analyze the economic literature on the topic of competitiveness, however, things are more nuanced, and it seems impossible to arrive at a universal definition of the concept. At best, we can say that the main definitions revolve around two themes. On the one hand, competitiveness is frequently defined in terms similar to its semantic definition, i.e. the ability to withstand competition¹. On the other hand, competitiveness is often associated with the concept of productivity, since according to certain economists the two ideas are closely linked, if not equivalent².

1 Adamkiewicz-Drwiłło (2002) defines firms' competitiveness as their ability to adapt their products to market requirements. Fajnzylber (1988), for his part, sees competitiveness as a country's ability to maintain or increase its share of external markets and simultaneously improve the living standards of its population. Altomonte and co-authors (2012) specify the concept by defining international competitiveness as the ability to exchange the goods and services in which a country is abundant for goods and services that it lacks. Porter and his co-authors (2008) also refer to competitiveness in terms of a country's share of world markets for its products. This makes competitiveness a zero-sum game, because one country's gain inevitably comes at the expense of others.

2 Porter (1990) defines competitiveness as a nation's ability to produce a rising standard of living for its citizens and a high employment level; in his view, productivity is the only meaningful concept of competitiveness at the national level. Krugman (1990, 1994) agrees, estimating that competitiveness is just a way of measuring productivity. The Competitiveness Advisory Group (1995) also ties competitiveness to productivity by specifying that competitiveness is not a target, but a powerful means to increase social welfare.

While there is no universally accepted definition of the concept, there nonetheless seems to be a consensus regarding the economic role of competitiveness. An economy's ability to remain competitive determines the growth of its revenue, which ultimately enables it to maintain the quality of life of its citizens. In other words, competitiveness is deemed to be a powerful lever for economic and social development.

Competitiveness then becomes a crucial economic issue, especially for a country like Canada. Following the skyrocketing growth in international trade since the early 1990s, and given its relatively small economy, Canada is heavily exposed to international competition. Its producers must compete with imported goods and services on the domestic market, while at the same time competing with foreign producers when they export a large proportion of their production. The competitiveness of the Canadian economy becomes an essential factor since any loss of competitiveness will harm the country's ability to produce revenue.

A PROBLEM OF MEASUREMENT

For individual firms, competitiveness is fairly easy to measure. It can be based on an accounting approach, assuming that a firm that makes a profit in a competitive market must therefore be competitive. Things get more complicated, however, when we try to measure it in terms of more than one business. The simple fact of trying to measure competitiveness across an entire industry means combining a vast range of goods and services with different prices and quality. Furthermore, we are comparing a wide range of sizes of businesses, meaning that the influence of the economic environment on their competitiveness will vary within the industry³. Lastly, there are so many factors to be considered in order to properly evaluate competitiveness within an industry that it is difficult to develop concrete measurements. The result is that existing measurements are incomplete at best.

To remedy these shortcomings, the Centre for Productivity and Prosperity – Walter J. Somers Foundation (CPP) suggests an alternative approach based on unit input costs, allowing us to measure the final impact of the economic environment on competitiveness, rather than roughly estimating its influence by using a number of indicators that target the differences among countries. In other words, the approach evaluates competitiveness downstream of production processes rather than upstream, as is done with existing measurements. This should provide a more precise measurement of Canadian industries' true ability to withstand foreign competition.

This report, the first in a series of three, analyzes Canada's competitiveness in comparison with that of the United States. The report is divided into three parts. The first lays the groundwork for the analysis, by looking more closely at the concept of competitiveness. The second explains the process used to assess Canada's relative competitiveness. Lastly, the third part discusses the results obtained and presents all the results for the 34 industries analyzed. Two similar reports will follow, first of all to broaden the number of countries covered and then to assess competitiveness at the provincial level.

3 For instance, small businesses are not taxed at the same rate as larger ones, and do not have access to the same tax relief measures.

Part I

Context



WHAT IS COMPETITIVENESS?

At first glance, competitiveness appears to be a relatively simple concept. Leading dictionaries combine the definitions of competitiveness and competitive, defining it as “the ability to provide products and services as or more effectively and efficiently than the relevant competitors⁴” or, according to the Larousse dictionary, the ability to supply goods and services at a price that allows the firm to cope with the competition of similar products in a given market⁵. So competitiveness is defined by a firm’s ability to withstand competition by offering prices and/or quality allowing it to maintain its position on a market.

In economic theory, the ability to face competition is determined in two ways. As its name suggests, **price competitiveness** is the ability to compete on the basis of price. This kind of competitiveness comes from lower production costs, higher productivity, lower profit margins, an advantageous exchange rate, and so on. **Structural competitiveness**, on the other hand, is the ability to compete thanks to quality, innovation, reputation, etc. This is also referred to as non-price competitiveness, and allows a firm to remain competitive despite higher prices.

This definition of the concept, while it seems simple at first, quickly becomes more complex when we try to measure competitiveness in terms of more than one firm.

First of all, structural competitiveness becomes intangible. While we can say, for example, that a firm like Ray Ban manages to sell its sunglasses at higher prices than its competitors by relying on its brand image, this distinction no longer applies for all practical purposes when we are looking at the competitiveness of an entire sector or even an economy. In that case we have to consider a vast range of disparate goods and services in terms of price and quality, all at the same time, making the task of measuring competitiveness immensely more complicated.

More important still, this vision of competitiveness implies that any factor, policy, program, measure or institution that affects production costs or the ability to innovate then becomes a potential determinant of competitiveness. In this context, every government intervention can influence its economy’s competitiveness. Whether it is through economic development policies, monetary policy (controlling inflation and interest rates), trade policies (openness to international trade) or labour market and education policies, a government shapes its firms’ competitiveness by influencing their production costs and their ability to stand out through innovation.

It is largely for this reason that it is difficult to concretely measure competitiveness beyond individual firms: not only must we consider hundreds of disparate goods and services in terms of price and quality, but also keep in mind that the influence of the economic environment on their production varies widely. For instance, a small business is not taxed at the same rate as a much larger competing business, meaning that their respective competitiveness will not be affected in the same way by the tax system. Similarly, the presence or absence of different economic players and institutions will have different impacts on the competitiveness of apparently similar businesses. For instance, the presence of a union may stimulate competitiveness in one sector by encouraging a more skilled workforce, while it may harm another by resisting technological change. In short, there are so many factors to be considered in measuring competitiveness over time and among jurisdictions that it is difficult to measure the concept as it applies to anything more than an individual firm. The result is that the theme of competitiveness is rarely discussed and data on this topic are at best piecemeal.

.....
4 Oxford Dictionary

5 Larousse Dictionary

AVAILABLE MEASUREMENTS

Measurements by the World Economic Forum (WEF) and the Institute for Management Development (IMD) are the only available indicators of international competitiveness. In both cases, competitiveness is assessed indirectly, i.e. determined on the basis of different institutional, political, social, economic and cultural indicators, since these indicators are theoretically linked to national competitiveness. With an adjustment to take account of different nations' development, it is possible to compare Canada with the United States, but also with Qatar or Botswana.

THE WORLD ECONOMIC FORUM INDEX

The WEF Global Competitiveness Index is based on 114 indicators organized into 12 “pillars” representing specific areas considered important determinants of competitiveness. These pillars are then grouped into three subindexes that are then weighted to reflect different countries' stages of development and provide a global competitiveness indicator. Approximately 70% of the WEF indicators are obtained through surveys, meaning that the Index is founded mostly on perceptions of competitiveness.

Subindex 1: basic requirements

The indicators for the four pillars making up this subindex evaluate to what extent the economic environment is conducive to competitiveness. This subindex is more heavily weighted for emerging economies.

The *Institutions* pillar measures the advancement of public and private institutions, the *Infrastructure* pillar measures the quality of physical and technological infrastructure, the *Macroeconomic environment* pillar is more oriented toward statistical indicators and assesses the “quality” of the macroeconomic environment, and the *Health and education* pillar measures the prevalence and economic impact of malaria, tuberculosis and AIDS, infant mortality, life expectancy and primary school attendance and quality, among other factors.

Subindex 2: efficiency enhancers

The indicators for the six pillars of this subindex assess to what extent a country has the resources and mechanisms necessary for efficiency. The *Higher education and training* pillar measures the quality of the education and training system, the *Goods market efficiency* pillar measures market competition constraints, the *Labour market efficiency* pillar assesses the general condition of the labour market, the *Financial market development* pillar measures the development of markets, the *Technological readiness* pillar evaluates the availability and use of technology, and the *Market size* pillar compares the sizes of the domestic and foreign markets.

Subindex 3: innovation and sophistication factors

The indicators in the two pillars making up this subindex measure an economy's readiness to innovate. The *Business sophistication* pillar indicators compare countries' business environments (quantity and quality of local suppliers, nature of comparative advantages, control and sophistication of production, readiness to delegate, ability to stand out through a marketing approach, etc.) while indicators in the *Innovation* pillar measure its readiness to innovate.

THE IMD WORLD COMPETITIVENESS INDICATOR

The IMD ranking is based on 255 indicators and covers 63 countries. It looks at 137 statistical indicators, which could be defined as measured competitiveness, and 118 indicators obtained through surveys, which could be defined as perceived competitiveness. Given the weighting used, the statistical indicators make up two-thirds of the overall ranking.

The indicators are grouped into four separate factors, which in turn contain a number of criteria.

The **Economic performance** factor ranks countries based on macroeconomic factors, reflecting the size of their economies, their openness to trade, and different aspects of investment, employment and prices.

The **Government efficiency** factor assesses to what extent the state and its institutions encourage competitiveness. Countries are ranked according to the soundness of their public finances, their fiscal and monetary policies and different aspects of their business legislation (labour, immigration, justice, administration) and societal framework (gender and income equality).

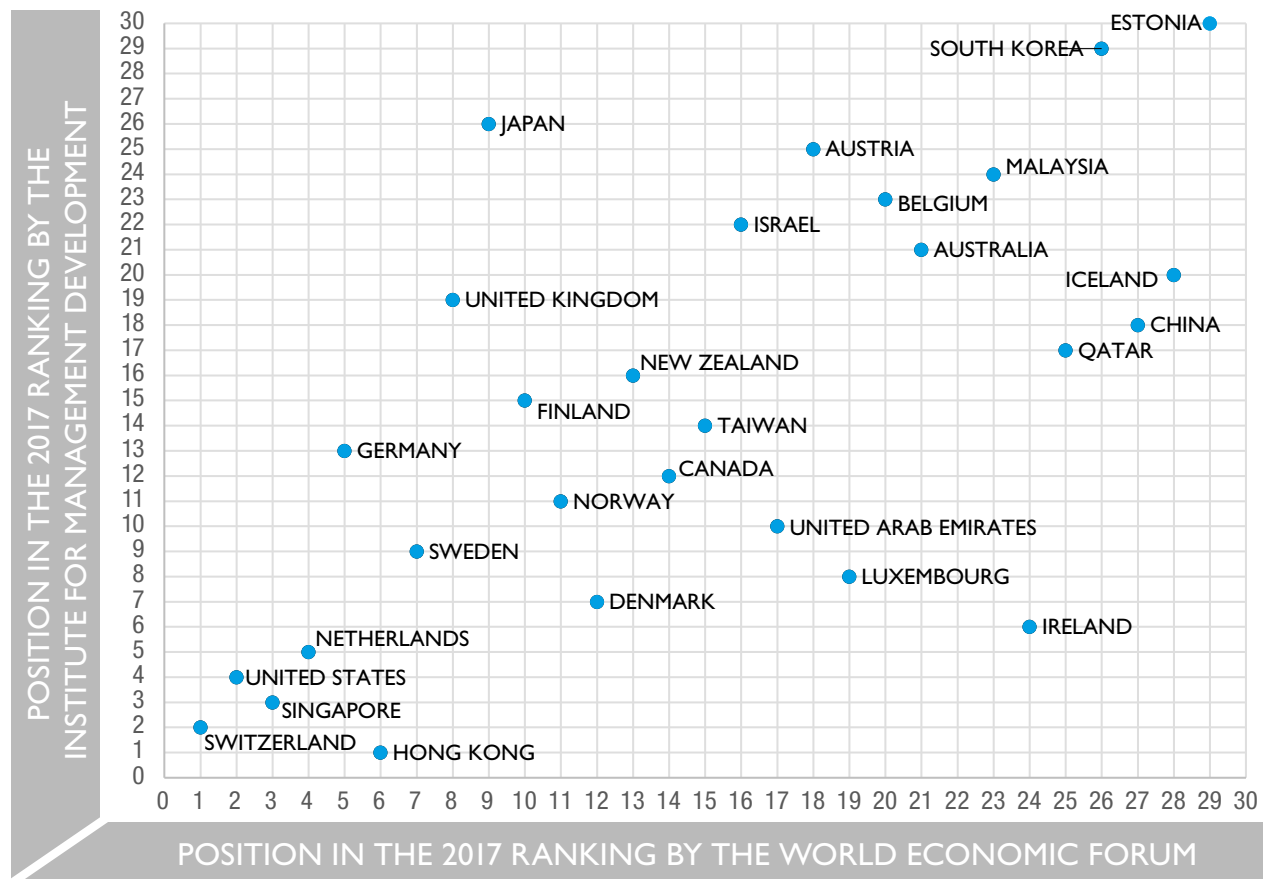
The **Business efficiency** factor assesses to what extent the economic environment encourages innovation by businesses. Countries are ranked on the basis of their productivity, labour market efficiency (labour costs, labour relations, availability of skilled labour), the efficiency of financial markets, and a number of qualitative indicators for management practices and general social attitudes and values.

The **Infrastructure** factor assesses to what extent resources and infrastructure respond to businesses' needs. Countries are ranked according to basic indicators (transportation systems, energy, population), technological infrastructure (mobile phone dissemination, internet users, computer users, technological environment, etc.), scientific infrastructure (R&D expenditure, university science graduates, number of patents, etc.) and the state of the education system, the healthcare system and the environment.

CONSISTENT RESULTS

Generally speaking, the WEF and IMD rankings seem consistent (Graph 1, next page). In 2017–2018, the same countries held 28 of the top 30 positions in the two rankings and, with a few exceptions, the final rankings were much the same in both cases. The top positions were held by Switzerland, the United States, Singapore and the Netherlands and, with the exception of Ireland and Japan, where there were considerable differences between the two rankings, much the same countries were in the subsequent positions.

GRAPH I
WEF AND IMD COUNTRY RANKINGS



... BUT LIMITED SCOPE

Despite the interest in this type of measurement and the consistency of the two rankings, it must be remembered that these approaches have substantial limitations. First of all, they include a number of indicators with no impact on the competitiveness of a country like Canada: health indicators measuring the prevalence of AIDS and malaria, for example, which are obstacles to competitiveness mainly in developing countries, or an indicator such as primary school attendance, given that all children in the industrialized world have this level of education.

The preponderance of perceived competitiveness indicators also limits the quality of these indexes. Inasmuch as there are no specific statistics on corruption, transparency, quality of regulation, the effectiveness of the justice system and so on, the WEF and the IMD have relied on surveys asking members of the executive to give their opinions on the quality of certain institutions. Without casting doubt on the respondents' good faith, it must be acknowledged that their answers are likely to be shaped by their immediate environment.

More important still is the fact that these approaches tend to evade the issue of prices, although this is the only true empirical measurement of competitiveness, i.e. a country's ability to face competition. By concentrating instead on factors influencing competitiveness, these rankings end up becoming sources of interesting information on countries' trading potential, whereas in fact the links with competitiveness remain tenuous and we know very little about their respective comparative advantages. A country like Ireland drops from sixth in one ranking to twenty-fourth in the other, with no explanation of why its competitiveness has fluctuated so widely.

TOWARD A MEASUREMENT OF COMPETITIVENESS

Given the shortcomings of the existing measurements, it seems that two criteria must be met if we are to more adequately assess countries' competitiveness. Any such assessment must:

- 1) be based on prices rather than on factors that influence competitiveness.
- 2) be measured by industry instead of by country.

Unlike existing indexes, the price approach measures competitiveness downstream of production processes rather than upstream. We consider the final impact of the economic environment on production costs and productivity, rather than attempting to estimate its influence by observing the differences among countries in different areas. By adopting a sector-based approach, we can arrive at a more precise evaluation of competitiveness by limiting the influence of the economic environment to a single sector⁶. In the end, the combined price-sector approach should make it possible to identify each country's comparative advantages by distinguishing between competitive and non-competitive sectors – which after all is the intrinsic goal of measuring competitiveness.

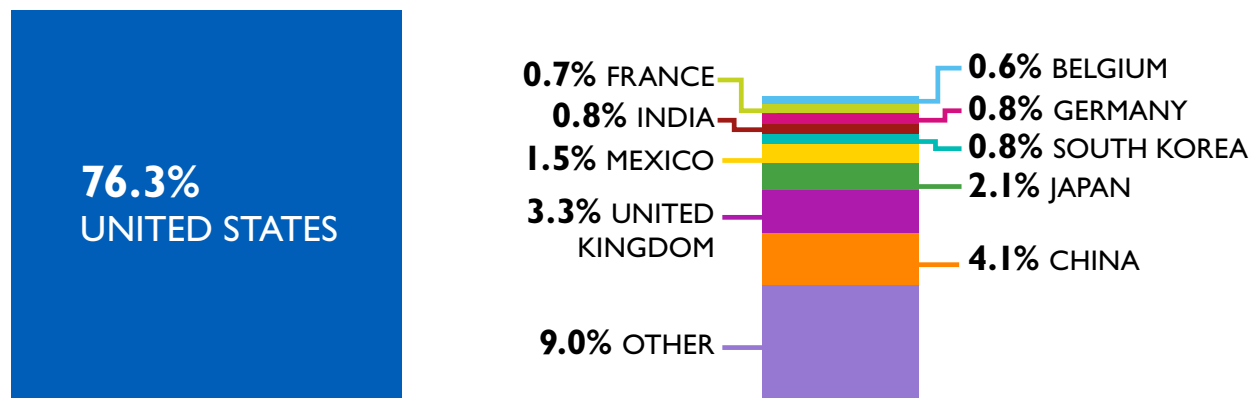
WHY SPECIFICALLY TARGET THE UNITED STATES?

Insofar as an industry's competitiveness is defined by its ability to cope with competition by offering prices allowing it to maintain its market position, it is only logical to focus our measurement on the markets in which the industry is active. It is essentially for this reason that the first step in our analysis specifically targets the United States.

Even though Canada trades with over 200 different countries, most of its trade is with its southern neighbour. In 2016, 76.3% of Canadian exports were headed for the US market (Graph 2, next page). Canada exported 18 times as much to the United States as it did to China, even though the latter was the second-largest export market, accounting for an estimated 4.1% of Canadian exports.

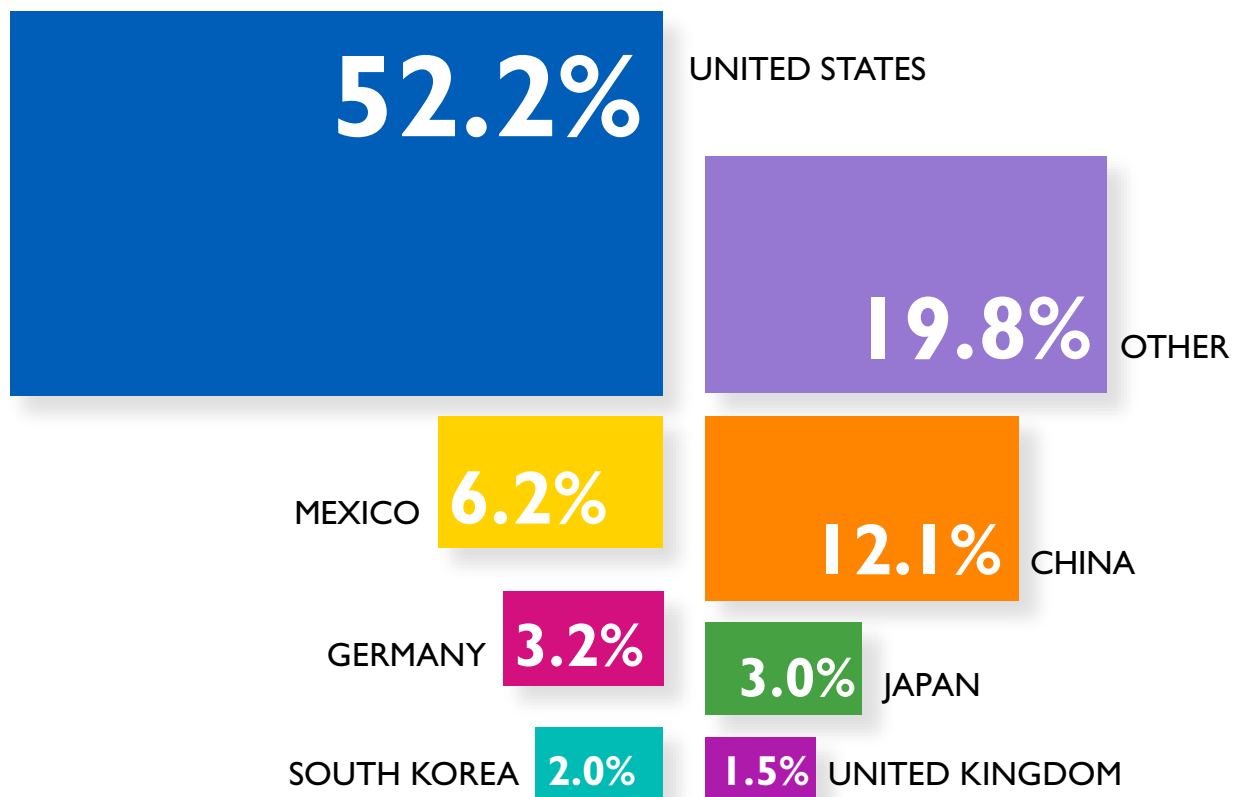
6 We need only think of the impact of the contribution to the Health Services Fund, in Quebec, on labour costs. It will vary considerably depending on whether we are looking at primary industries or the service sector.

GRAPH 2
CANADIAN EXPORTS BY DESTINATION, 2016



The situation is much the same when it comes to imports, although to a lesser extent (Graph 3). In 2016, 52.2% of imported goods and services were from the United States, four times as much as imports from China, although the latter is Canada's second-largest trading partner.

GRAPH 3
CANADIAN IMPORTS BY SOURCE, 2016

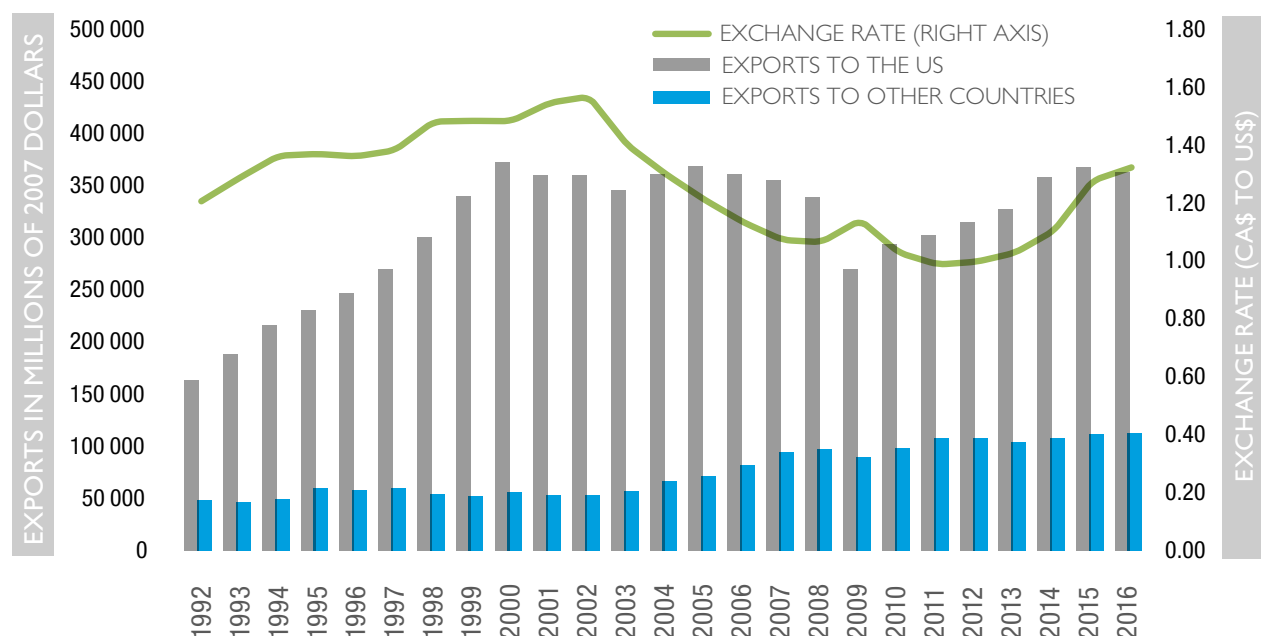


EXCHANGE RATE ADVANTAGES AND DISADVANTAGES

In addition to the advantage of the United States' close proximity, the strong trading ties between Canada and the United States have long been influenced by the effects of the exchange rate. In 2000, when the actual value of Canadian exports peaked (Graph 4), US\$1.00 was worth approximately CA\$1.50. A product that went for CA\$100 in Montréal would have cost an American buyer just US\$67. This boosted Canadian exports by artificially improving the competitiveness of Canadian goods and services.

Canada's trading advantage withered in the 2000s, however. Reduced at first by the bursting of the tech bubble, our real exports to the US were dragged further down when the Canadian dollar began gaining strength against the greenback. The decline worsened in the late 2000s, as the US was struck hard by the 2008 recession. At the nadir, in 2009, the real value of exports to the United States had fallen by 27% in comparison with 2000. Once the crisis was over, American demand picked up again and southbound exports started growing once more. This growth accelerated when the loonie lost ground to the US dollar. In 2016, the real value of Canadian exports was up by 35% from 2009.

GRAPH 4
TRENDS IN THE ACTUAL VALUE OF CANADIAN EXPORTS AND THE EXCHANGE RATE⁷



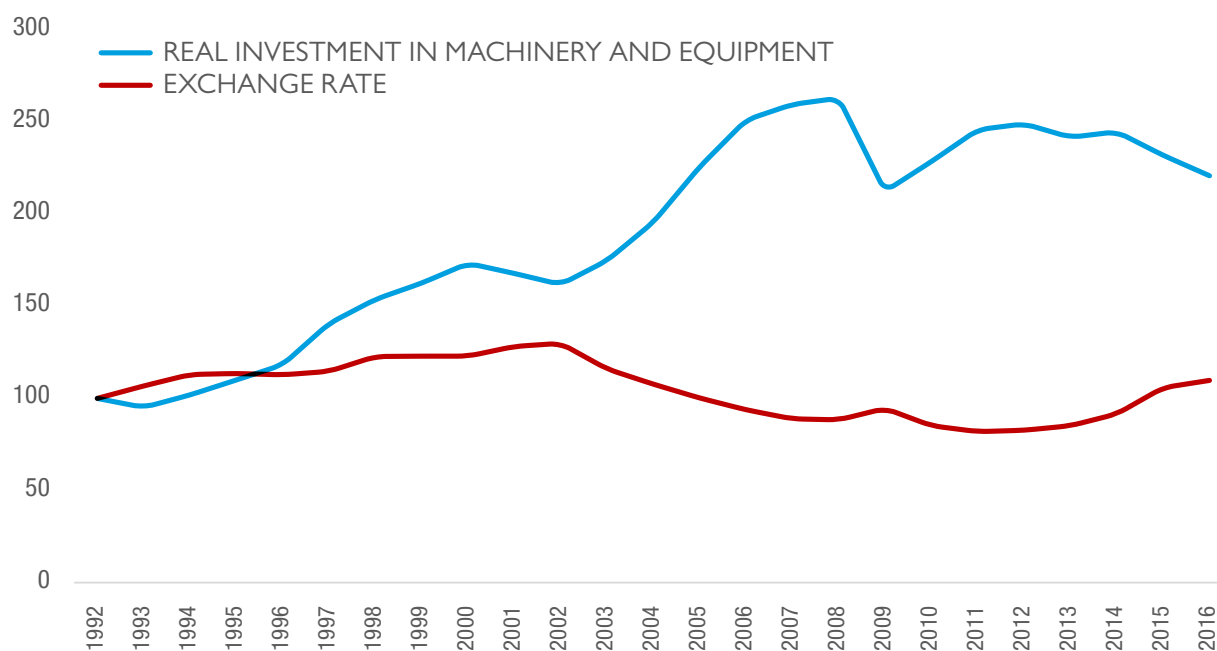
Given that most of Canada's trade is with the United States and the exchange rate has a strong influence on the volume of this trade, it might be tempting to downplay the importance of competitiveness in Canada. It might initially seem that Canadian producers simply have to clench their teeth during those brief periods when the Canadian and US dollars are at par, since the rest of the time their competitiveness is enhanced by the loonie's relative weakness.

⁷ The graph starts in 1992 so as to take account of the North American Free Trade Agreement (NAFTA), which came into effect in 1994. NAFTA was signed in 1992 and replaced the Canada-US free trade agreement, which had been in force since the late 1980s.

But the impact of that weakness is not always positive. Since the Canadian economy is relatively small, a significant proportion of intermediate goods, equipment and production materials is imported⁸. In the short term, the relative weakness of the Canadian dollar disadvantages Canadian producers by artificially increasing the cost of their foreign purchases. In the longer term, the relative weakness tends to undermine Canada's economic productivity. Producers, faced with prices driven up by an unfavourable exchange rate and having little incentive to invest, tend to put off investments. A relatively weak Canadian dollar over a long period slows private investment, which eventually impedes productivity growth by limiting the efficiency gains derived from more intensive use of machinery and equipment. In the end, this loss of efficiency has repercussions on the producers' competitiveness.

This is what appears to have happened in Canada. After the first free trade agreement with the United States was signed in the late 1980s, and helped along by an advantageous exchange rate, Canadian exports skyrocketed without producers really having to worry about their productivity or competitiveness. In return for the sizeable trade advantage that inflated their profits, however, Canadian producers had to pay more for their imports. And since there was very little incentive to invest, growth in investments in machinery and equipment inevitably slowed (Graph 5).

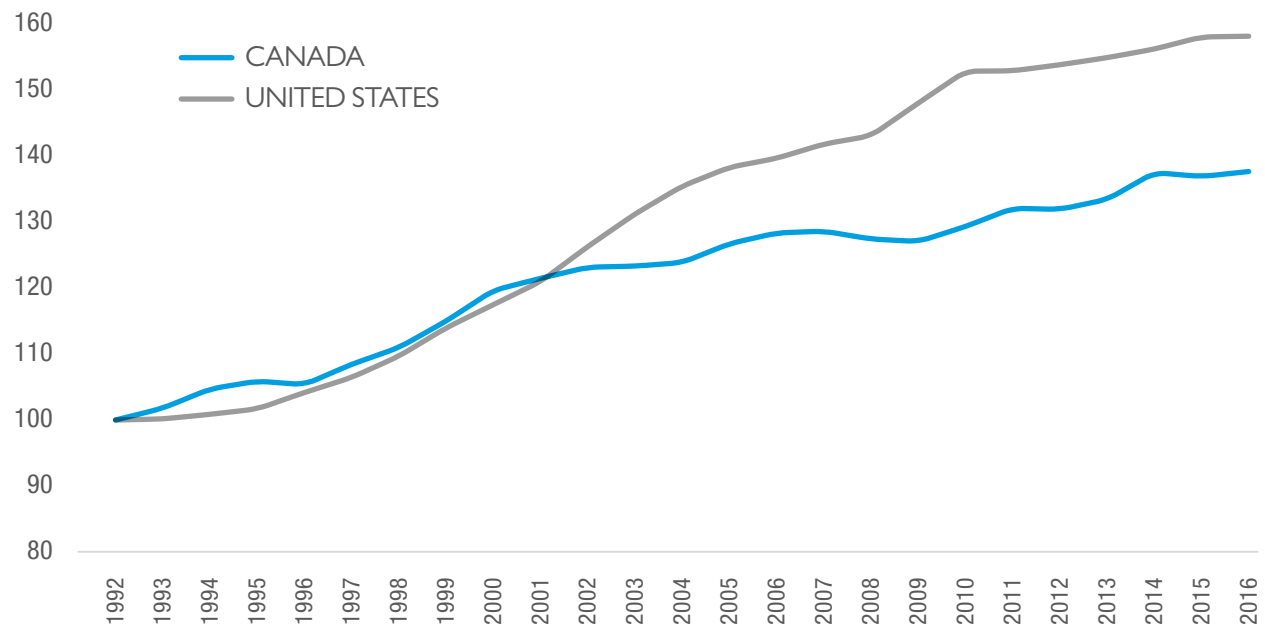
GRAPH 5
TRENDS IN REAL INVESTMENT IN MACHINERY AND EQUIPMENT AND
THE EXCHANGE RATE (CA\$ TO US\$)
(1992=100)



When the Canadian dollar began appreciating in 2002, investments picked up. But it was too little, too late. The stronger loonie slowed Canadian exports, eating away at Canadian producers' market share and reducing economies of scale, thereby increasing pressure on Canadian firms' productivity. As Graph 6 shows (next page), labour productivity in Canada rose more slowly after 2002. After moving at roughly the same pace as US labour productivity in the 90s, it gradually fell farther behind through the 2000s and the gap did not stop growing until 2012.

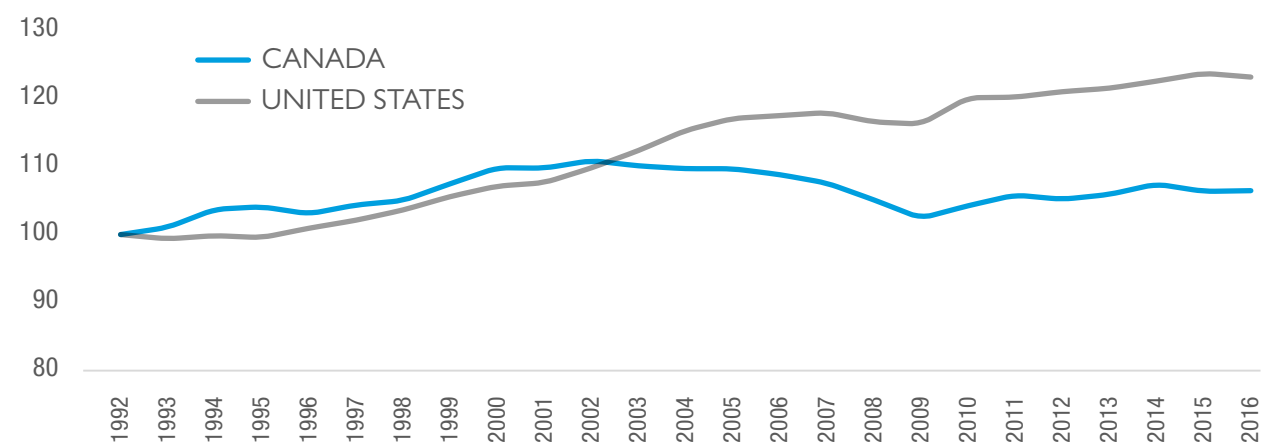
⁸ Depending on the estimate, it seems that at least half of final demand is for imported machinery and equipment.

GRAPH 6
TRENDS IN LABOUR PRODUCTIVITY
(1992=100)



The same applies when it comes to multifactor productivity (MFP – see the box on the next page for a definition). After climbing at essentially the same pace from 1992 to 2002 (Graph 7), Canadian MFP reversed course and declined until 2009.

GRAPH 7
TRENDS IN MULTIFACTOR PRODUCTIVITY
(1992=100)



Clearly, at this point Canadian producers were ill equipped to cope with the exchange shock. When the Canadian dollar rose, the trade advantage they had enjoyed for many years evaporated and, having failed to invest sufficiently, firms were unable to absorb the shock by means of efficiency gains.

In these circumstances, threats surrounding the renegotiation of NAFTA become more serious. Canadian firms failed to invest sufficiently, and now lag far behind in terms of productivity. Their ability to absorb a shock in trade or in the exchange rate has inevitably shrunk. Canada is now in a precarious position. Although the recent depreciation of the Canadian dollar has given the Canadian economy a renewed trading advantage and reduced the effective cost of trade barriers, the imposition of new barriers could be particularly harmful for certain industries if nothing is done to properly stimulate private investment and the productivity of Canadian firms.

MULTIFACTOR PRODUCTIVITY

Multifactor productivity (MFP) is a measurement of efficiency, determining the portion of the increase in production not explained by more intensive use of production factors. In this way, productivity gains are measured by considering the combined use of production factors, rather than their individual contributions in terms of their respective productivity, as is done with labour productivity, for example.

Part 2

Using prices to measure competitiveness



Inspired by the work of Jorgenson and Nishimizu (1978), the approach developed to assess the relative competitiveness of Canadian industries simultaneously considers the price and productivity dimensions, the two theoretical foundations of the concept of competitiveness. Similar to the measurement of unit labour costs (ULCs), the approach considers the final cost of the inputs used in production, making it possible to determine the overall influence of the economic environment on companies' competitiveness without having to consider the differences in institutional and economic policies that distinguish Canada from the United States.

Before explaining the approach developed, hereinafter referred to as the relative unit production costs (RUPC) method, we will briefly review how ULCs are measured, to illustrate its basic operation.

UNIT LABOUR COSTS

ULCs basically measure the cost of the labour required to produce one unit. For a firm that makes bathtubs, for example, the ULC is the ratio between the firm's payroll and the number of bathtubs it produces. If the firm makes ten bathtubs in ten hours, with the help of an employee earning \$10/hour, the ULC will be \$10 per unit.

By itself, this information is not terribly useful. What can we conclude, really, from the fact that a company spends \$10 on wages for each bathtub it produces? On the other hand, measuring the ULC provides valuable information on production costs and efficiency when it is evaluated over time or when different firms are compared. The ULC would then make it possible to assess, at least partially, the firms' competitiveness.

Let's look at the above example again, assuming that in the following period wages rise to \$15/hour, and the number of units produced also rises, to 12. In this case, the firm's ULC will increase to \$12.50 per unit. The firm will be less competitive, since the inflationary pressure of wages will exceed productivity gains.

	Period 1	Period 2A	Period 2B
Payroll	100	150	180
Hourly wage	10	15	18
Hours	10	10	10
Units produced	10	12	20
ULC	10	12.5	9

Now suppose that wages rise to \$18/hour, but that the firm manages to double its output. In this case, the ULC would fall to \$9 per unit, since productivity gains would exceed wage growth. The firm has become more competitive.

If the same logic applies when we try to compare one firm with another, the question of units quickly becomes an issue. How do we distinguish between the value of one bathtub and the value of one sink?

To get around this problem, we measure units in terms of real GDP⁹. Considered as a measurement of volume, real GDP neutralizes annual increases in prices, making it possible to standardize the units produced by considering only changes in the quantity of goods and services produced. ULCs are then obtained with the following equation:

$$ULC = \left(\frac{\text{Total employee compensation}}{\text{Real GDP}} \right)$$

By introducing hours worked into this equation, we can define the unit labour cost as a price effect – workers' hourly wages – and an efficiency effect – labour productivity. Changes in ULCs are then determined in terms of growth in wages and labour productivity¹⁰: when growth in total hourly wages exceeds productivity gains, ULCs increase, because the pressure of wages on production costs exceeds productivity gains. Inversely, ULCs decrease when productivity gains outstrip wage increases.

$$ULC = \left(\frac{\text{Total employee compensation}}{\text{Hours worked}} \right) \times \left(\frac{\text{Hours worked}}{\text{Real GDP}} \right)$$

$$ULC = \left(\frac{\text{Total employee compensation}}{\text{Hours worked}} \right) \div \left(\frac{\text{Real GDP}}{\text{Hours worked}} \right)$$

$$ULC = (\text{Hourly compensation}) \div (\text{Labour productivity})$$

$$\Delta\% \text{ of ULC} = \Delta\% \text{ of hourly compensation} - \Delta\% \text{ of labour productivity}$$

Once the unit effect is neutralized, changes in competitiveness can be measured on a larger scale – for instance, as they apply to an entire industry.

THE LIMITATIONS OF ULCS

Considering how simple it is to calculate ULCs, it is tempting to use only this indicator to measure competitiveness. However, the ease of calculation comes with limitations that considerably reduce its scope when comparing the competitiveness of sectors with different production processes.

Suppose, for instance, that two competing firms produce bathtubs. Thanks to major investments, company A has automated its assembly line and manages to produce 10 bathtubs a day with just one employee. Company B, on the other hand, employs 10 people to produce the same number of bathtubs by hand. Thus company A will have a ULC ten times less than company B, and will be considered more competitive, even though its total unit production cost is slightly higher than that of company B.

⁹ Nominal GDP represents the value added of an output, which is itself determined by the sales price and quantity of goods and services sold. Thus changes in the nominal GDP depends on changes in the sales price and quantity of goods and services sold. Real GDP neutralizes the price effect. Starting from a base year, where real GDP corresponds to nominal GDP, the portion of the growth in nominal GDP explained by changes in prices is removed, to give real GDP. In terms of growth, real GDP retains only changes in the quantities of goods and services sold. Note that since products are not the same, the method takes account of changes in the price structure of an industry, for instance.

¹⁰ Using logarithmic properties.

	Company A	Company B
Payroll	100	1,000
Hourly wage	10	10
Hours	10	100
Annual cost of machinery	1,000	0
Total production costs	1,100	1,000
Units produced	10	10
ULC	10	100
Total unit production cost	110	100

This example shows how considering a single production factor in isolation when assessing an industry's competitiveness can lead to false conclusions. This is why it is important to use an approach that encompasses all production processes so as to properly evaluate the influence of all inputs on production costs.

RELATIVE UNIT PRODUCTION COSTS

The RUPC approach is more inclusive and encompasses all the factors used in production processes. In addition to labour, it covers capital, i.e. the profits and tangible assets required for production (buildings, machinery, tools, equipment, inventory) and intermediate expenses, i.e. goods and services purchased from third parties for production purposes. In economic terms, the total cost of these three inputs corresponds to gross output, a measurement upstream of the concept of gross domestic product (GDP) and which is more or less synonymous with the firm's sales.

Generally speaking, this approach essentially applies the same logic as that underpinning ULCs, in that changes in competitiveness over time are determined by the difference between growth in production costs and improved efficiency.

Rather than assessing efficiency gains from each factor through its respective productivity in isolation, we use MFP to evaluate the aggregate efficiency gains. In the end, the process remains the same, i.e. gains in MFP compensate for the pressure from increased production factor costs. A sector becomes more competitive over time if gains in productivity offset increased production costs; inversely, its competitiveness will decline if productivity gains are not enough to cover the increase in production costs.

By measuring unit production costs in relative terms, i.e. by evaluating the unit cost of each production factor in Canada in comparison with its equivalent in the United States, we can define an industry's competitiveness threshold: a ratio greater than zero means that Canada holds a competitive advantage over the United States thanks to a lower unit cost, and a ratio of less than zero means that it is the United States that hold an advantage over Canada. This gives¹¹:

$$\ln RP_i = \bar{s}_K \ln RP_i^K + \bar{s}_L \ln RP_i^L + \bar{s}_M \ln RP_i^M - \ln G_i^{MFP} - \ln e$$

where for each industry i , RP_i is the relative output price, RP_i^K , RP_i^L , RP_i^M are the relative prices of capital, labour and intermediate inputs, G_i^{MFP} is the multifactor productivity gap between Canada and the United States, and $\bar{s}_j = \frac{1}{2} [s_j^{CA} + s_j^{US}]$ is the average compensation proportion of input j in Canada and the United States. The equation uses logarithmic properties ($\ln$) to estimate Canada's relative competitiveness in comparison with that of the United States. The relative competitiveness of an industry at a given period is determined by the weighted sum of the relative cost of the three main production factors; the productivity gap is then deducted from this sum.

Once measured over time, this equation makes it possible to determine whether the competitiveness of a Canadian industry has improved or deteriorated in comparison with its American counterpart. The competitive gains or losses are then determined by taking the weighted difference in growth:

- ▶ of the unit labour price, i.e. the growth in the value of payments, benefits, contributions and other labour-related payments per unit of labour¹²;
- ▶ of the unit capital price, i.e. the growth in the utilization value of tangible assets – buildings, machinery, tools, equipment, inventory, etc. – and profit per unit of capital¹³;
- ▶ of the unit price of intermediate purchases, i.e. the growth in the value of intermediate purchases per unit of goods and services¹⁴;
- ▶ of multifactor productivity, i.e. gains in overall productivity of production factors¹⁵.

Thus a Canadian industry becomes more competitive if its production costs rise more slowly than its counterpart in the United States and/or if its productivity grows faster. On the other hand, its competitiveness will fall if its production costs rise faster than its counterpart south of the border and/or if productivity gains are smaller or insufficient to cover the gap.

To understand the details underlying this calculation, we will consider the relative competitiveness of the entire Canadian economy, step by step.

11 The approach is inspired by the work of Jorgenson and Nishimizu (1978) and is based on a Cobb-Douglas function. Our analysis spans the years from 2000 to 2014 and covers all NAICS S-level industries (2 digits) as well as industries in the manufacturing sector at the NAICS M level (3 digits). See the appendix on methodology for detailed calculations.

12 Changes in labour units over time are determined by changes in hours worked, adjusted so as to consider the quality of labour, assuming that the service value of one hour of work is not homogenous throughout the economy.

13 In the same way that changes in hours worked are corrected to take account of changes in the quality of labour, changes in capital stock are corrected to take account of the service value of assets.

14 Everything else being equal, Canada's relative competitiveness will increase if growth in the unit cost of purchases of labour, capital and intermediate purchases is slower than in the United States, and vice versa.

15 In this case the effect is different from production factors. Everything else being equal, Canada's competitiveness will increase if MFP grows more quickly than in the United States, and will decline if MFP gains are smaller.

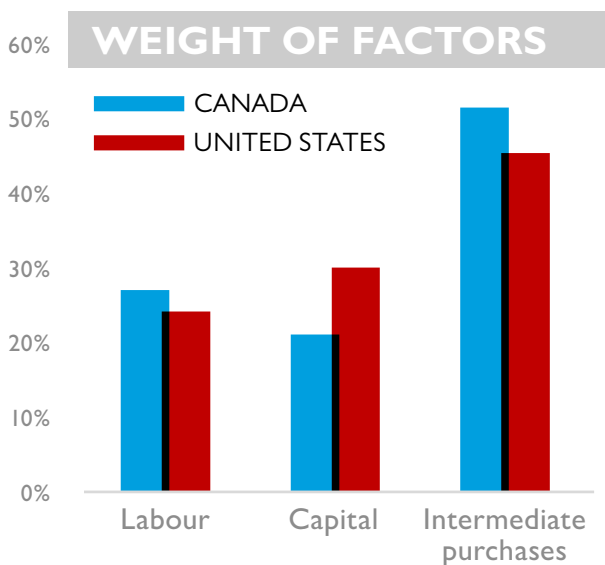
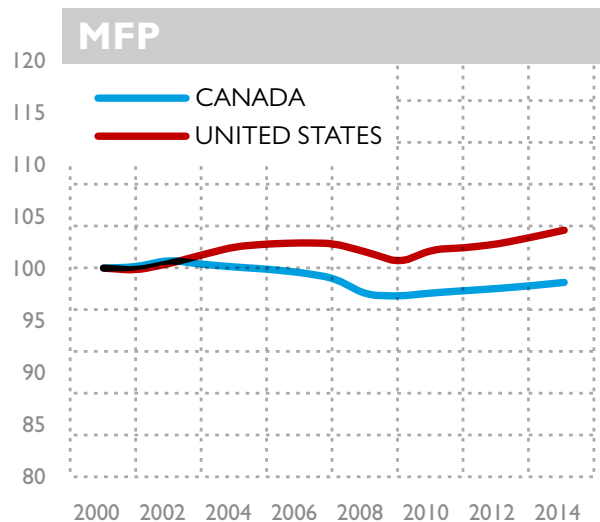
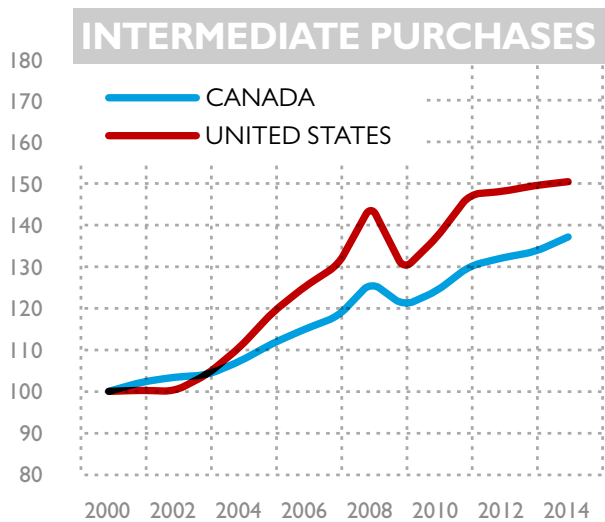
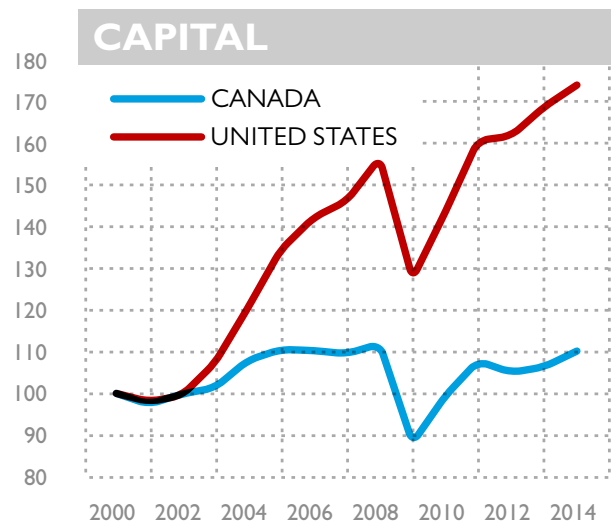
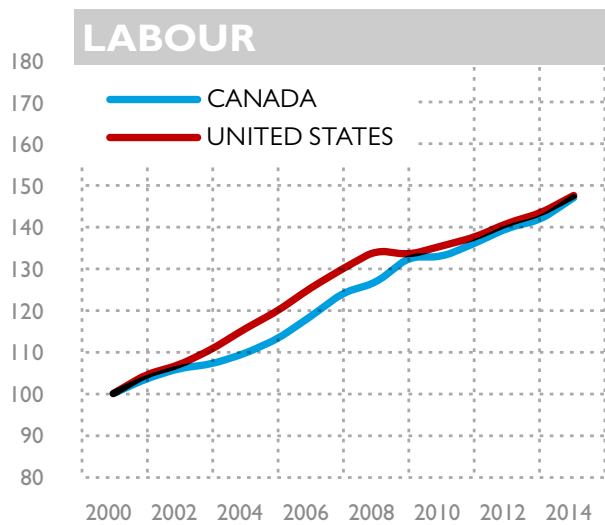
ALL INDUSTRIES, AS AN EXAMPLE

First of all, we can see that growth in the unit labour price in Canada has been essentially identical to that in the United States (Graph 8, next page). There was no gain in competitiveness due to labour costs between 2000 and 2014, as the relative cost of labour remained constant.

On the other hand, there were significant gains in terms of capital cost. In 2002, growth in the unit price of capital in the United States rose substantially, while it remained relatively weak in Canada. As a result, the cost of using tangible assets rose by 74% in the United States but only 10% in Canada. Everything else being equal, Canada should have become more competitive, since the pressure exerted by capital on firms' production costs was lower than in the United States.

The situation was much the same when it comes to intermediate purchases, although the difference in growth was less substantial. Starting in 2002, the unit price of goods and services purchased by American firms grew faster than in Canada, thus exerting more pressure on their production costs and so reducing their relative competitiveness. On the other hand, Canada's poor performance in terms of productivity reduced the gains in terms of capital and intermediate purchases. Between 2002 and 2008, the MFP of Canadian industries shrank slightly, while it rose in the United States. Canadian MFP then moved upward following the recession in 2008, but the gains were not enough to keep pace with growth in American MFP.

GRAPH 8
UNIT PRICE OF PRODUCTION FACTORS AND MULTIFACTOR PRODUCTIVITY FOR ALL INDUSTRIES

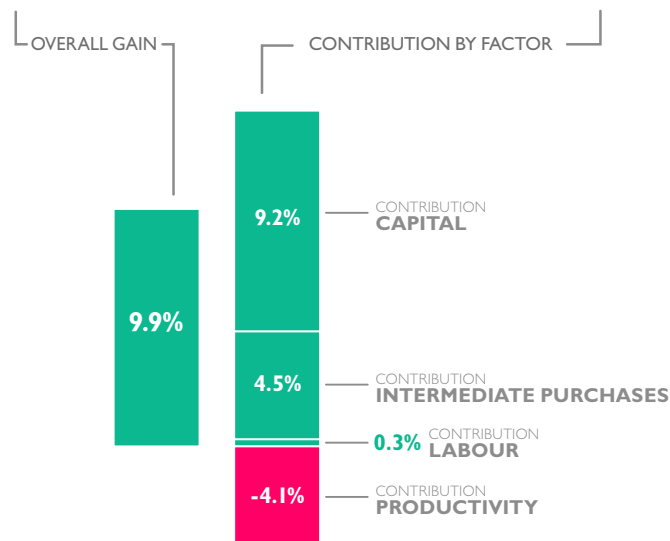


Now we need only consider the importance of each production input to determine how the relative competitiveness of Canada's economy evolved between 2000 and 2014. It can be seen that non-negligible gains were made during this period, since the pressure on production costs was less severe overall than in the United States (Graph 9). Although the weak growth of Canadian MFP reduced the country's relative competitiveness by 4.1 percentage points, these losses were largely offset by the gains in terms of capital (9.2%) and intermediate purchases (4.5%). Since the labour effect was nil, the relative competitiveness of the Canadian economy improved by 9.9%.

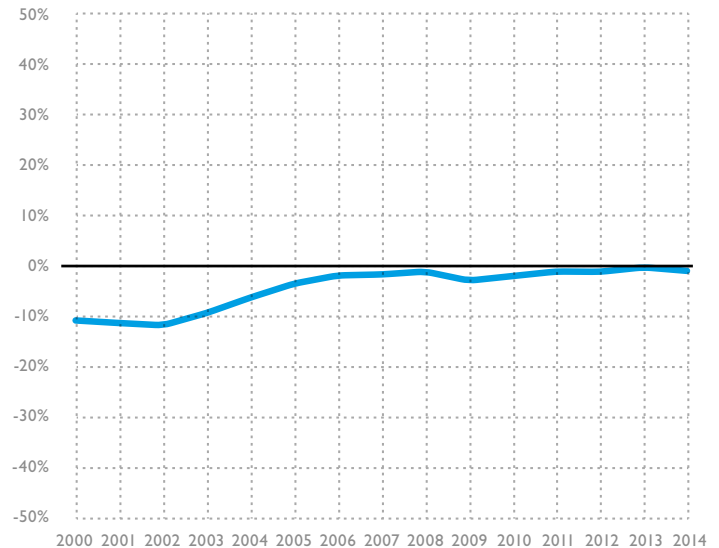
GRAPH 9

CONTRIBUTIONS AND OVERALL GAIN IN RELATIVE COMPETITIVENESS BETWEEN 2000 AND 2014

CHANGES IN NOMINAL COMPETITIVENESS



CHANGES IN NOMINAL COMPETITIVENESS



We can now determine whether the gains in competitiveness between 2000 and 2014 were due to a catch-up effect, by defining the initial level of unit production costs in Canada and the United States. The relative unit production costs in 2000 are determined by the weighted amount of the relative cost of the three inputs by unit of production¹⁶. This gives:

$$RUPC_{2000,i} = \frac{\text{Unit labour cost}_{Canada,2000,i}}{\text{Unit labour cost}_{US,2000,i}} \times \text{Weight of labour in gross output}_i + \frac{\text{Unit capital cost}_{Canada,2000,i}}{\text{Unit capital cost}_{US,2000,i}} \times \text{Weight of capital in gross output}_i + \frac{\text{Unit cost of intermediate purchases}_{Canada,2000,i}}{\text{Unit cost of intermediate purchases}_{US,2000,i}} \times \text{Weight of intermediate purchases in gross output}_i$$

As shown in the right-hand portion of Graph 9, the relative improvement in competitiveness of the Canadian economy is likely attributable mainly to a catch-up effect. In the early 2000s, unit production costs were approximately 10% higher in Canada, which reduced the relative competitiveness of the Canadian economy. With the gains made between 2000 and 2014, the gap gradually shrank and by 2014, the two economies almost reached parity in terms of competitiveness.

¹⁶ The productivity effect is implicitly included in the unit costs of the three inputs, which allows the growth productivity to be measured for subsequent periods.

It can be seen, in fact, that most of the competitiveness gains occurred between 2002 and 2008, at a time when the Canadian dollar had mostly finished its rise – confirming that the gains were cyclical, not structural. Over time, the rising exchange rate eased the pressure on production costs in Canada by reducing the effective costs of inputs exposed to fluctuating exchange rates. The costs of tangible capital assets and intermediate purchases from abroad declined, and so the economy became more competitive even though it gained less in productivity than did the US economy.

THE EXCHANGE RATE EFFECT

Thus far the impact of the exchange rate has been viewed indirectly, in terms of its effect on the costs of certain inputs. However, it also has a direct effect on the competitiveness of Canadian firms, by modifying the effective value of their production.

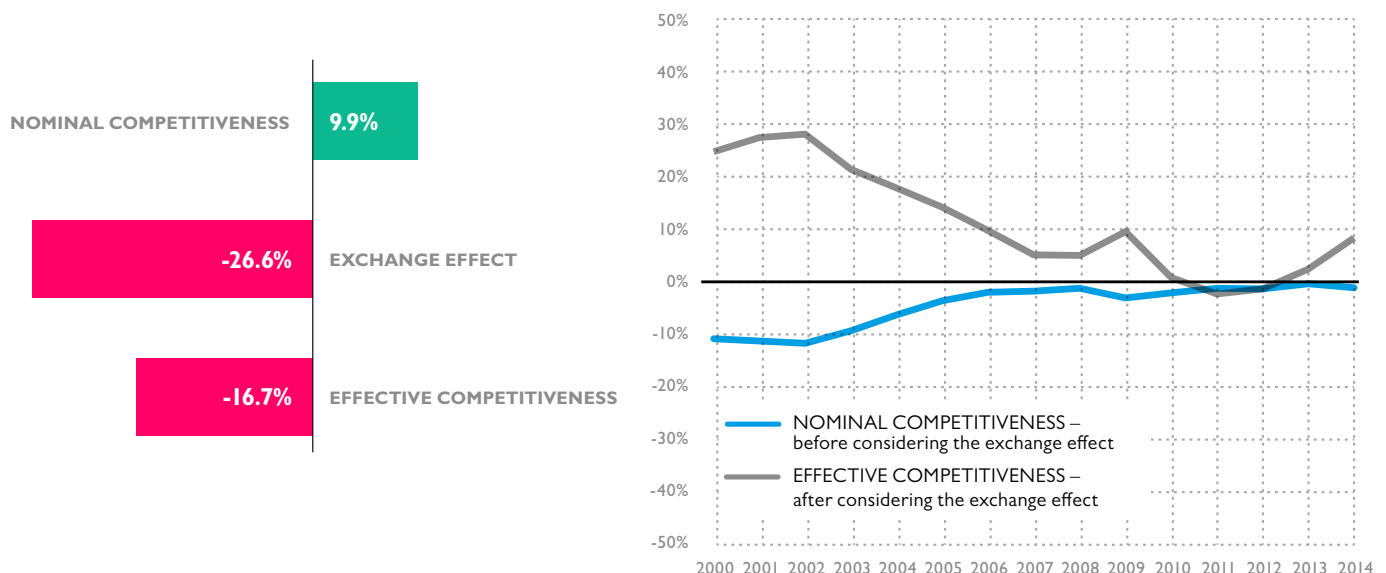
Consequently, we must adjust production costs to reflect the exchange rate so as to take account of changes in the relative value of the Canadian dollar. It can be seen that exchange rate fluctuations have had a significant impact on the effective competitiveness of the Canadian economy (Graph 10).

In the early 2000s, the exchange rate enhanced the competitiveness of Canadian producers by artificially reducing the relative value of their unit production costs. Despite a slight delay, Canada's effective competitiveness was 25% higher, at the time, than that of the United States. In other words, Canadian producers – and, in particular, exporters – enjoyed a significant trade advantage.

This advantage crumbled, however, once the loonie began appreciating in 2002. Because Canadian firms had not improved their productivity enough, the nominal gains from the costs of capital and intermediate purchases were insufficient to offset the exchange effect and the effective competitiveness of the Canadian economy plunged. In the end, Canada's effective competitiveness fell by 16.7% between 2000 and 2014, as the gain of 9.9% in nominal competitiveness was overwhelmed by the exchange effect.

GRAPH 10

NOMINAL AND EFFECTIVE COMPETITIVENESS OF THE CANADIAN ECONOMY



From this point on, we have all the information required to assess the evolution of the relative competitiveness of the Canadian economy. On the one hand, nominal measurement identifies the determinants of the performance of each industry by assessing the relative gains and losses resulting from changes in efficiency and production costs. Measured downstream of the production process, nominal competitiveness is determined largely by factors over which firms have a hold. On the other hand, effective measurement assesses the competitiveness of industries in the markets by adjusting the value of production to account for the impact of the exchange rate. Ultimately, we can measure the true ability of industries to compete.

Part 3

Canada's relative
competitiveness:

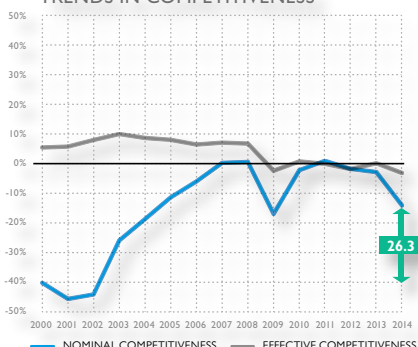
Results



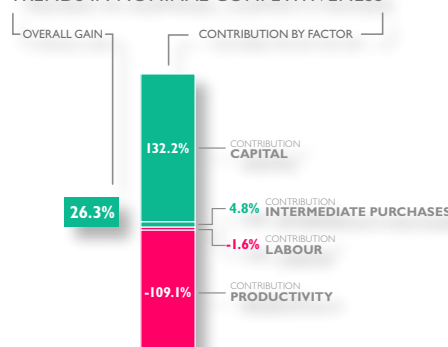
The rest of this study will present the main findings for 34 major industrial groups¹⁷, i.e. the two-digit industries of the North American Industry Classification System, along with detailed data concerning three-digit manufacturing industries. The results by industry will be presented, with one page per industry (see the example below). The first graph in the left-hand section shows trends in the industry's nominal and effective competitiveness and gains in nominal competitiveness between 2000 and 2014. The second graph breaks down the growth in nominal competitiveness so as to identify the contribution of inputs and MFP. Beneath these two graphs, growth in nominal competitiveness is linked to the exchange effect so as to evaluate the growth in the industry's effective competitiveness. Lastly, the right-hand portion shows contextual statistics on the industry, i.e. the respective weight of inputs in the industry's gross output and levels and growth in labour productivity, hourly wages and capital intensity, as defined by capital compensation per hour worked.

OIL AND GAS EXTRACTION

TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

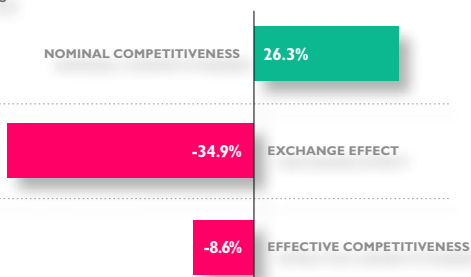


CONTRIBUTION TO EFFECTIVE COMPETITIVENESS

Growth in **NOMINAL COMPETITIVENESS** measures the relative changes in production costs before considering the exchange rate. When growth is positive, Canada has gained in competitiveness, i.e. the pressure on production costs was less than in the United States, and vice versa.

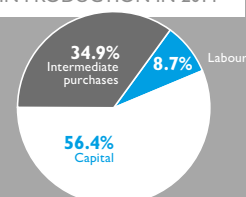
The **EXCHANGE EFFECT** considers the final impact of changes in the exchange rate on production costs, on the assumption that the appreciation of the dollar between 2000 and 2014 increased the effective value of production costs in Canada.

EFFECTIVE COMPETITIVENESS measures relative changes in production costs, taking the exchange rate into account. It is obtained by adding the exchange effect to the growth in nominal competitiveness.

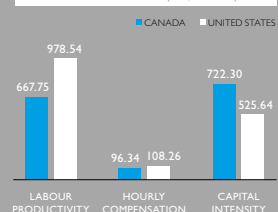


ECONOMIC CONTEXT

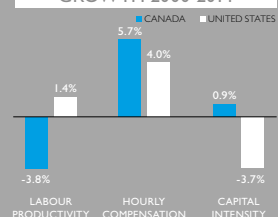
WEIGHT OF FACTORS IN PRODUCTION IN 2014



2014 LEVELS (C\$ / HOUR)



AVERAGE ANNUAL GROWTH 2000-2014



¹⁷ The analysis does not include the healthcare and education industries, since the considerable public/private distinction makes it impossible to compare Canada and the United States.

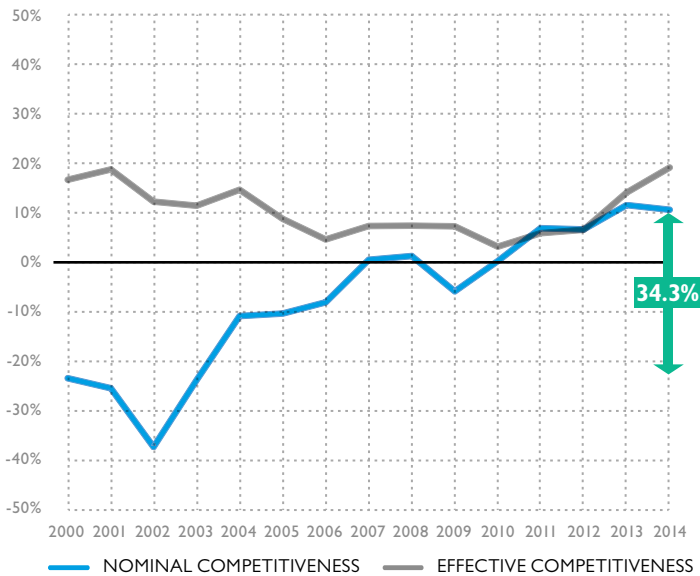
RESULTS BY INDUSTRY

TABLE 4
LIST OF INDUSTRIES ANALYZED

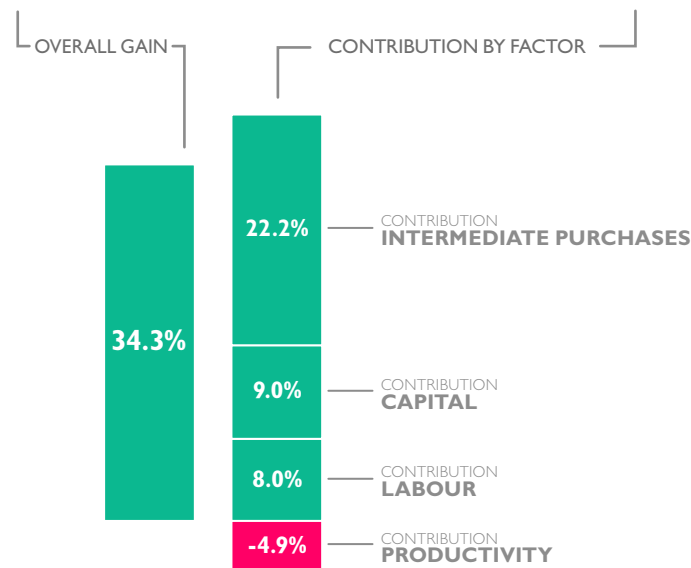
Agriculture, forestry, fishing and hunting [11]	Page 31
Oil and gas extraction [211]	Page 32
Mining, except oil and gas [212]	Page 33
Support activities for mining and oil and gas extraction [213]	Page 34
Utilities [22]	Page 35
Construction [23]	Page 36
Food, beverage and tobacco manufacturing [311 - 312]	Page 37
Textile and textile product mills [313 - 314]	Page 38
Clothing, leather and allied product manufacturing [315 - 316]	Page 39
Wood product manufacturing [321]	Page 40
Paper manufacturing [322]	Page 41
Printing and related support activities [323]	Page 42
Petroleum and coal product manufacturing [324]	Page 43
Chemical manufacturing [325]	Page 44
Plastic and rubber products manufacturing [326]	Page 45
Non-metallic mineral product manufacturing [327]	Page 46
Primary metal manufacturing [331]	Page 47
Fabricated metal product manufacturing [332]	Page 48
Machinery manufacturing [333]	Page 49
Computer and electronic product manufacturing [334]	Page 50
Electrical equipment, appliance and component manufacturing [335]	Page 51
Transportation equipment manufacturing [336]	Page 52
Furniture and related product manufacturing [337]	Page 53
Miscellaneous manufacturing [339]	Page 54
Wholesale trade [41]	Page 55
Retail trade [44 - 45]	Page 56
Transportation and warehousing [48 - 49]	Page 57
Information and cultural industries [51]	Page 58
Finance, insurance, real estate and renting and leasing [52 - 53]	Page 59
Professional, scientific and technical services [54]	Page 60
Administrative and support, waste management and remediation services [56]	Page 61
Arts, entertainment and recreation [71]	Page 62
Accommodation and food services [72]	Page 63
Other services, except public administration [81]	Page 64

AGRICULTURE, FORESTRY, FISHING AND HUNTING

TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



CONTRIBUTION TO EFFECTIVE COMPETITIVENESS

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NOMINAL COMPETITIVENESS

34.3%

-31.9%

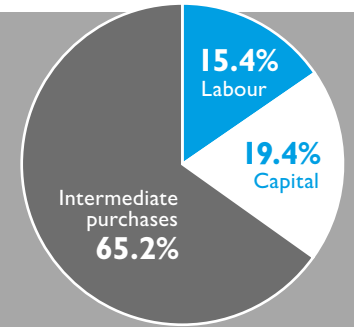
EXCHANGE EFFECT

EFFECTIVE COMPETITIVENESS

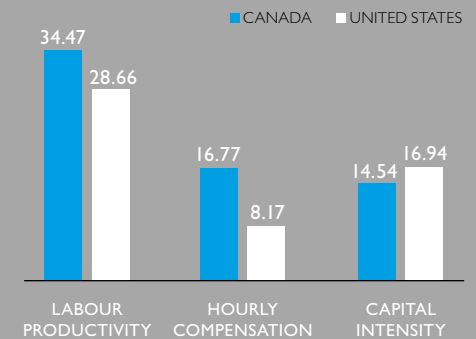
2.5%

ECONOMIC CONTEXT

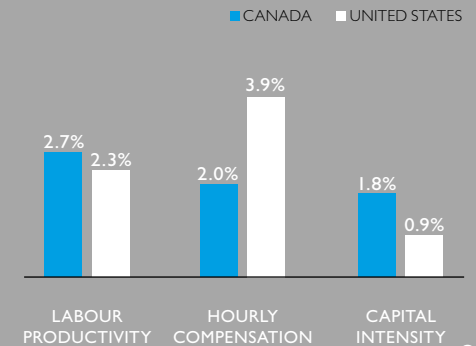
WEIGHT OF FACTORS IN PRODUCTION IN 2014



2014 LEVELS (CA\$ / HOUR)



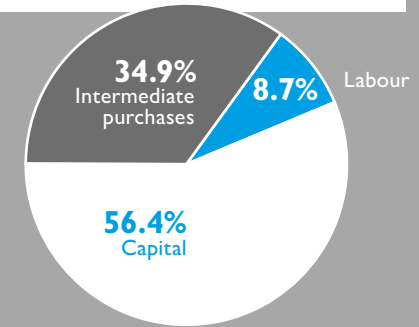
AVERAGE ANNUAL GROWTH 2000-2014



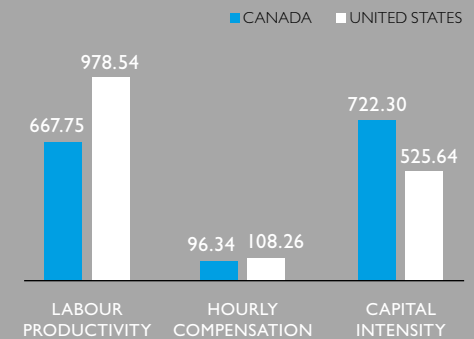
OIL AND GAS EXTRACTION

ECONOMIC CONTEXT

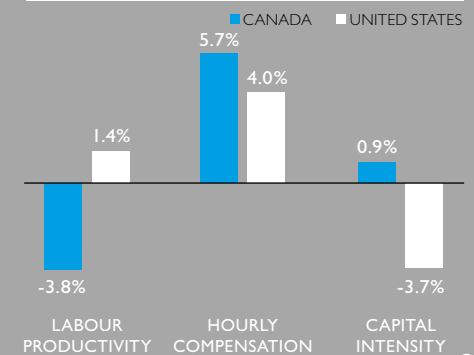
WEIGHT OF FACTORS IN PRODUCTION IN 2014



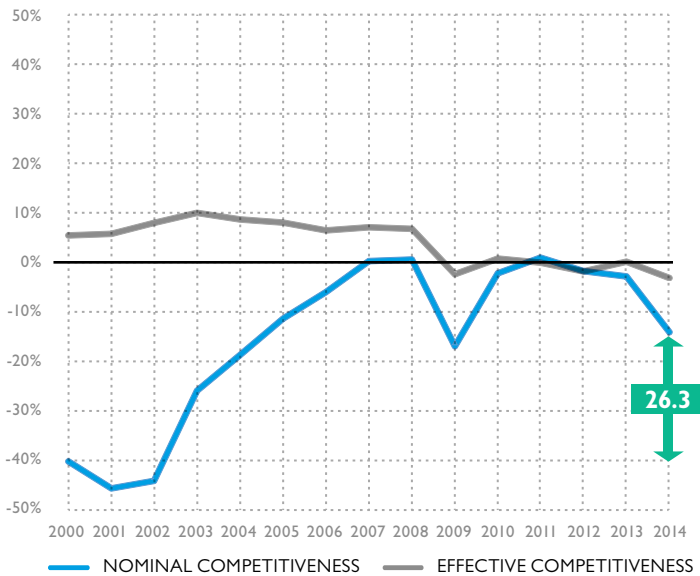
2014 LEVELS (CA\$ / HOUR)



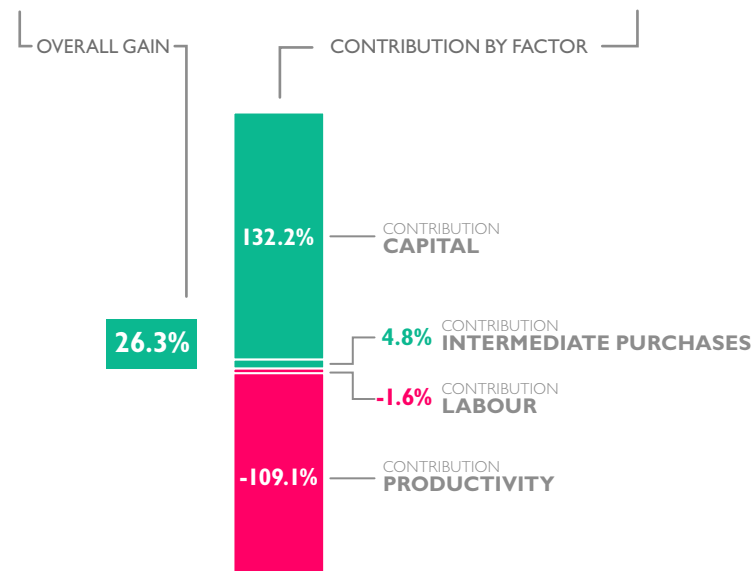
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



CONTRIBUTION TO EFFECTIVE COMPETITIVENESS

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NOMINAL COMPETITIVENESS

26.3%

-34.9%

EXCHANGE EFFECT

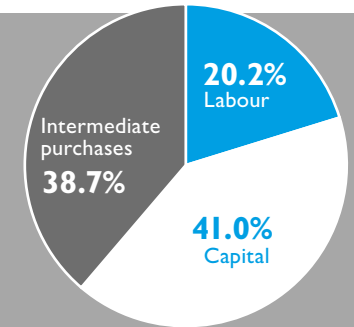
-8.6%

EFFECTIVE COMPETITIVENESS

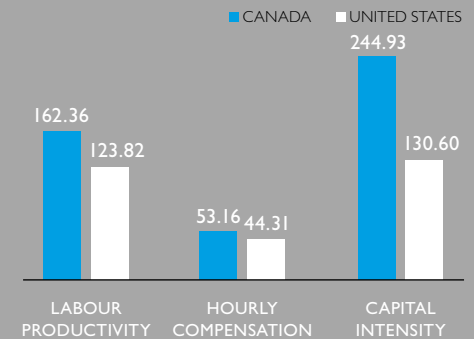
MINING, EXCEPT OIL AND GAS

ECONOMIC CONTEXT

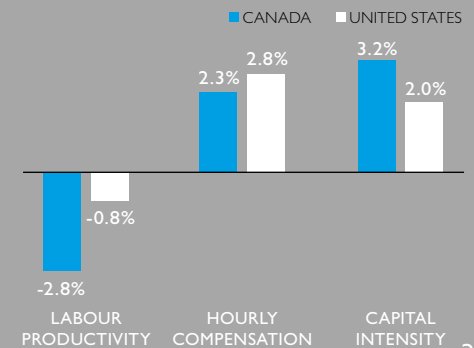
WEIGHT OF FACTORS IN PRODUCTION IN 2014



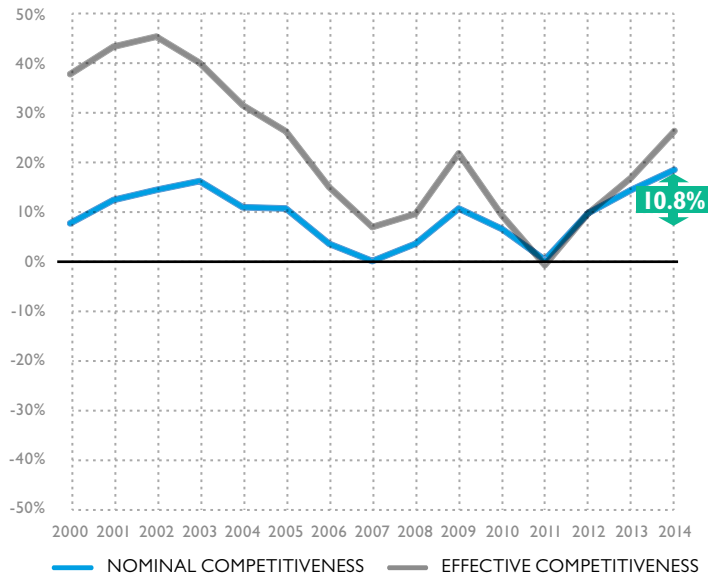
2014 LEVELS (CA\$ / HOUR)



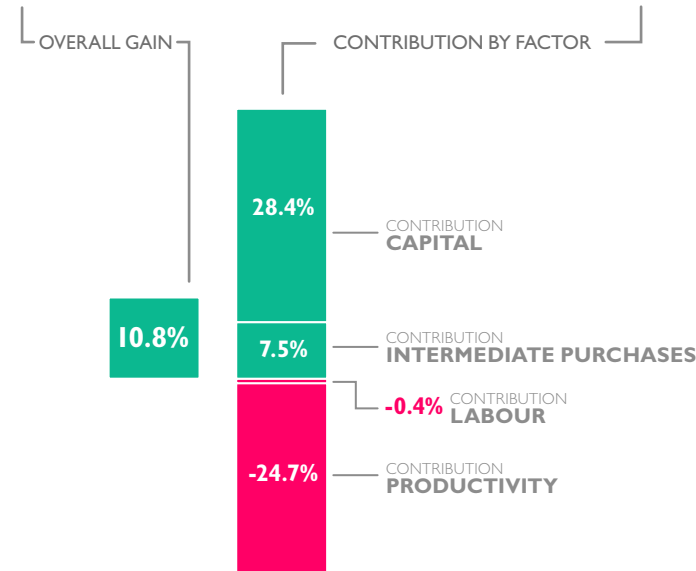
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

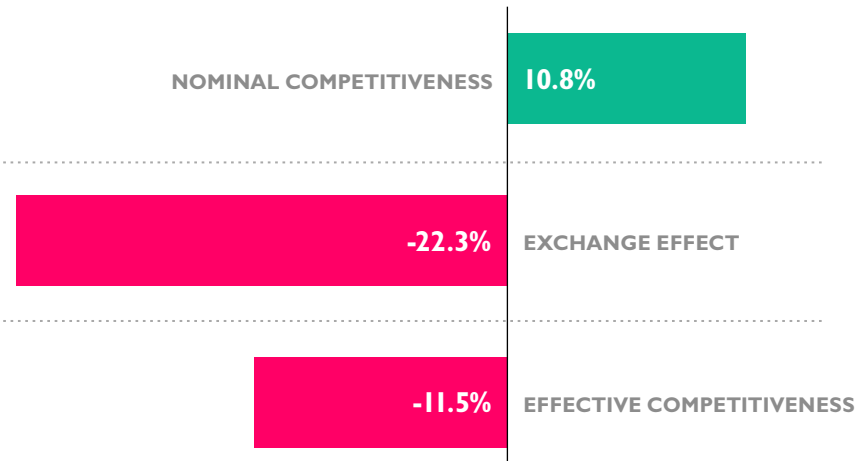


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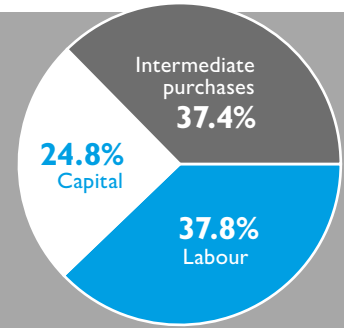
EFFECTIVE COMPETITIVENESS measures relative changes in production costs, taking the exchange rate into account. It is obtained by adding the exchange effect to the growth in nominal competitiveness.



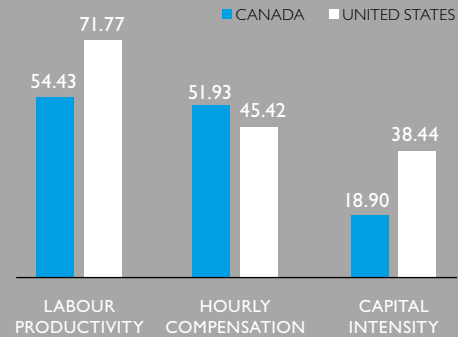
SUPPORT ACTIVITIES FOR MINING AND OIL AND GAS EXTRACTION

ECONOMIC CONTEXT

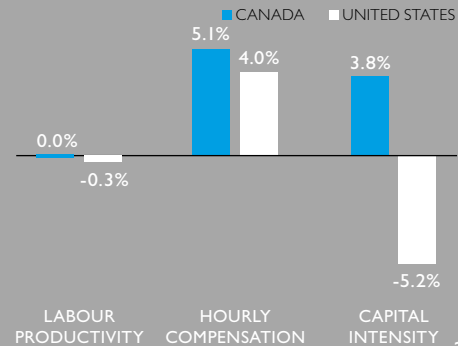
WEIGHT OF FACTORS IN PRODUCTION IN 2014



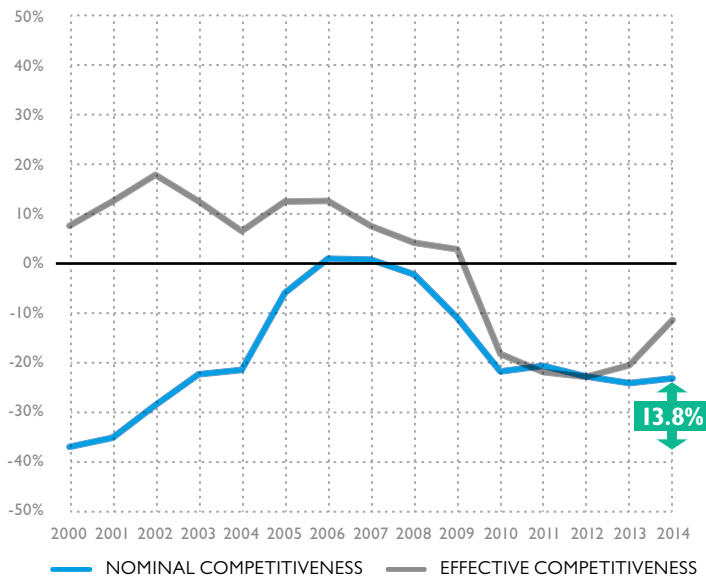
2014 LEVELS (CA\$ / HOUR)



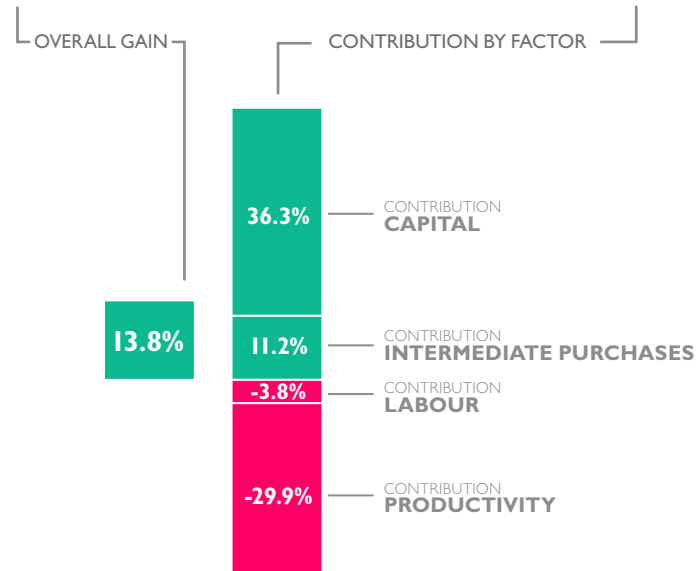
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

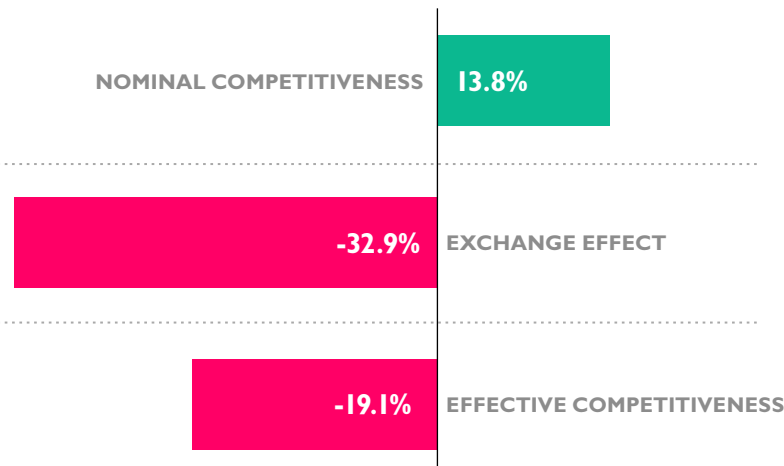


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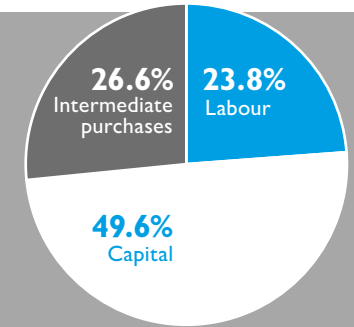
EFFECTIVE COMPETITIVENESS measures relative changes in production costs, taking the exchange rate into account. It is obtained by adding the exchange effect to the growth in nominal competitiveness.



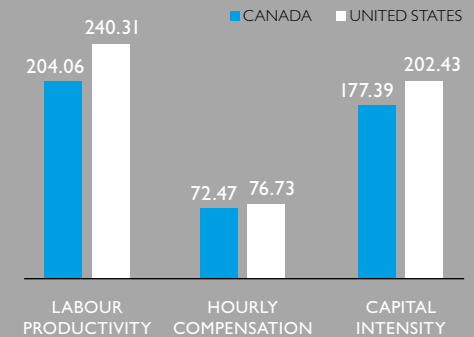
UTILITIES

ECONOMIC CONTEXT

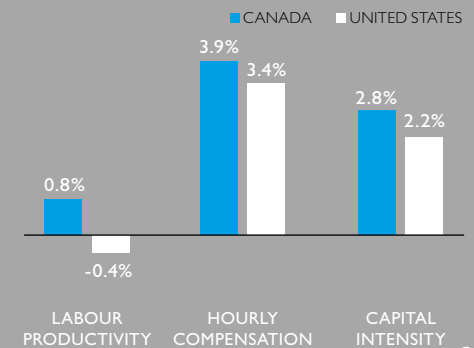
WEIGHT OF FACTORS IN PRODUCTION IN 2014



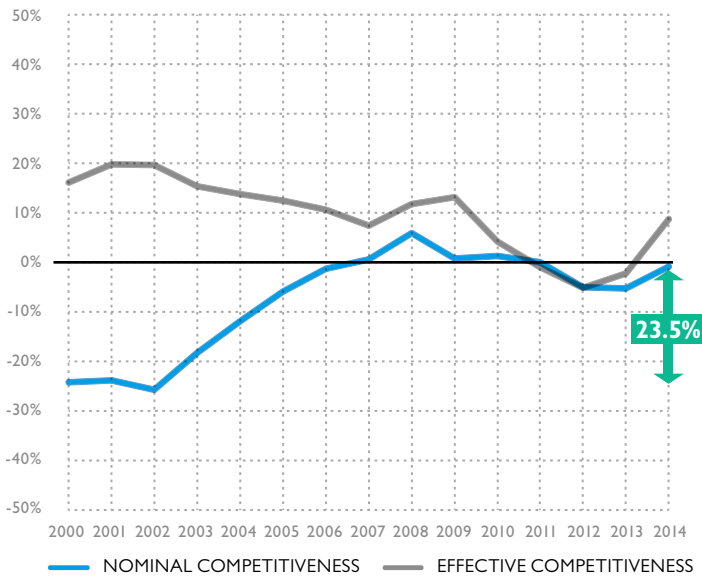
2014 LEVELS (CA\$ / HOUR)



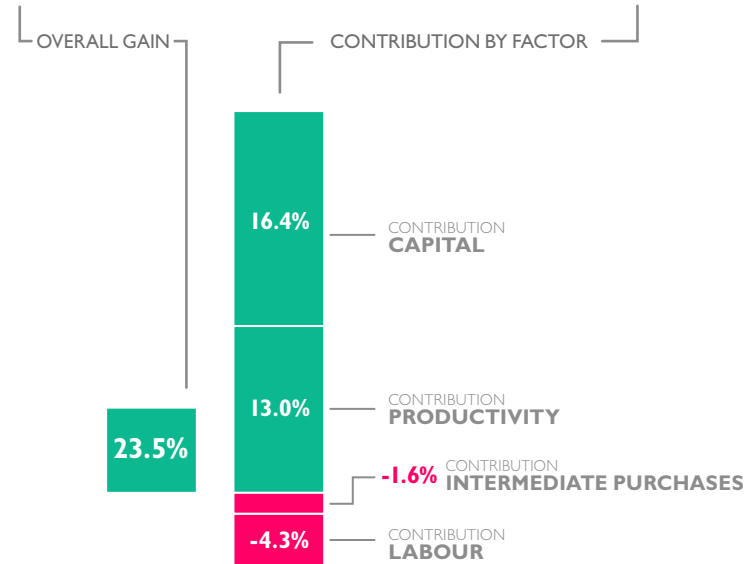
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



CONTRIBUTION TO EFFECTIVE COMPETITIVENESS

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NOMINAL COMPETITIVENESS

23.5%

-30.9%

EXCHANGE EFFECT

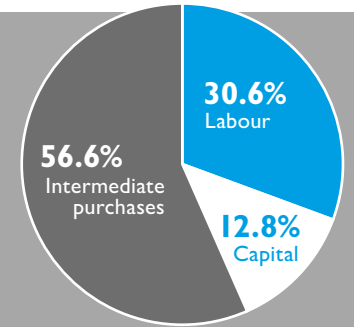
-7.4%

EFFECTIVE COMPETITIVENESS

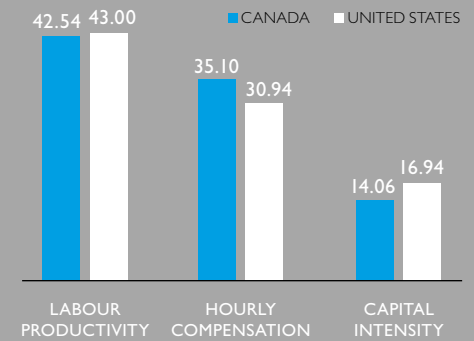
CONSTRUCTION

ECONOMIC CONTEXT

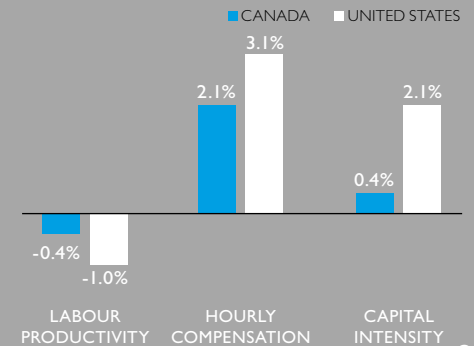
WEIGHT OF FACTORS IN PRODUCTION IN 2014



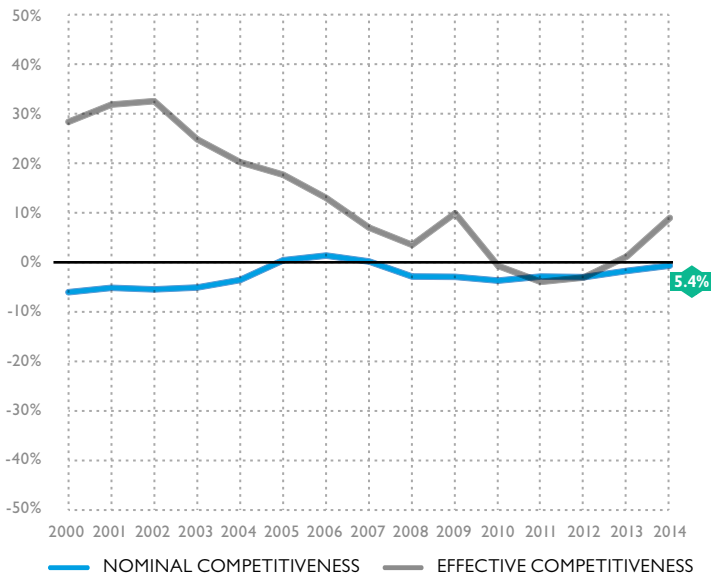
2014 LEVELS (CA\$ / HOUR)



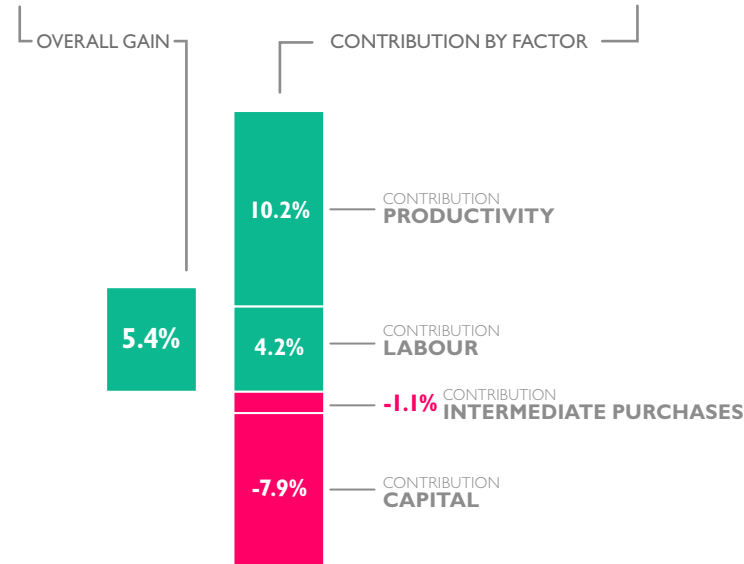
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

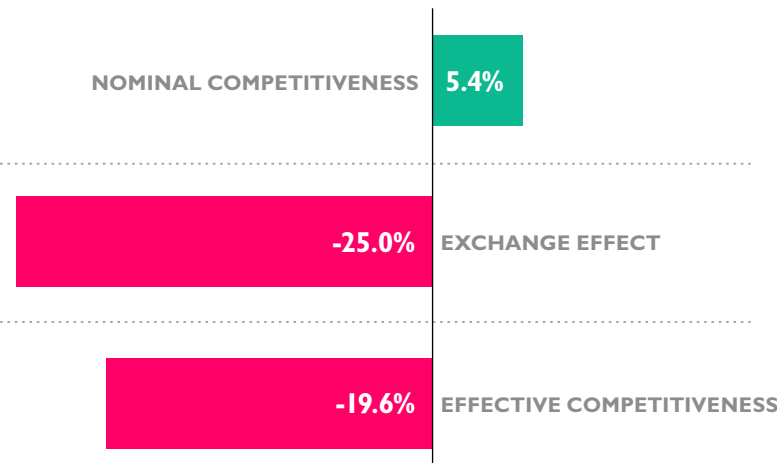


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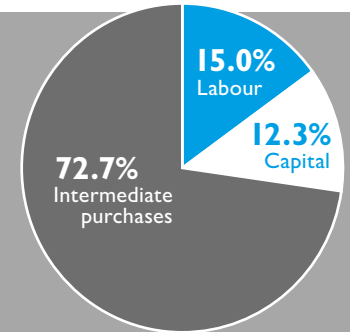
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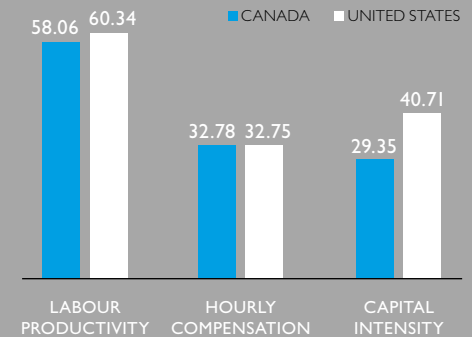
FOOD, BEVERAGE AND TOBACCO MANUFACTURING

ECONOMIC CONTEXT

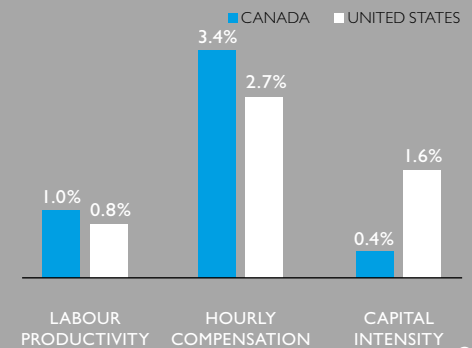
WEIGHT OF FACTORS IN PRODUCTION IN 2014



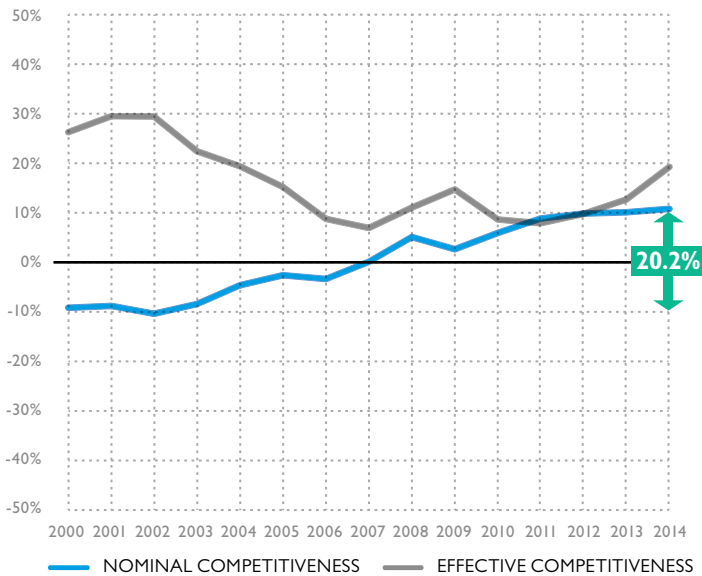
2014 LEVELS (CA\$ / HOUR)



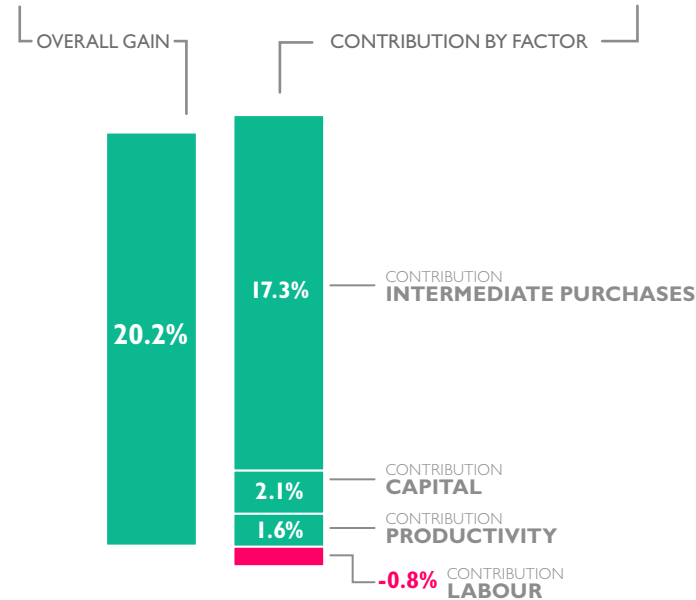
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



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NOMINAL COMPETITIVENESS

20.2%

-27.2%

EXCHANGE EFFECT

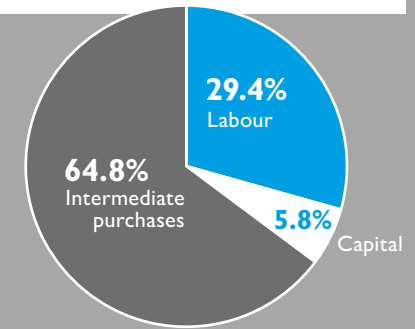
-7.0%

EFFECTIVE COMPETITIVENESS

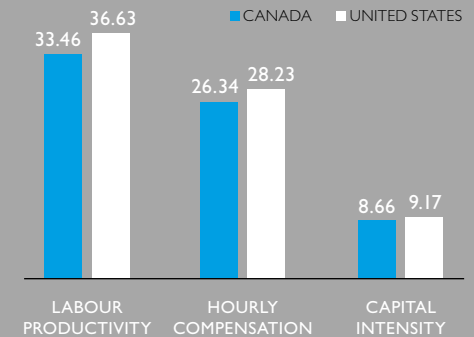
TEXTILE AND TEXTILE PRODUCT MILLS

ECONOMIC CONTEXT

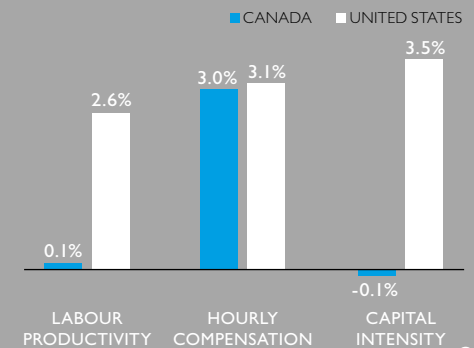
WEIGHT OF FACTORS IN PRODUCTION IN 2014



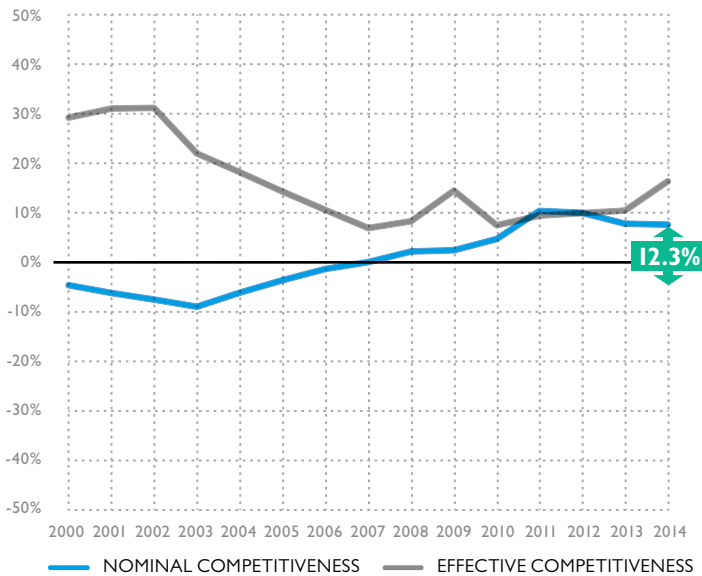
2014 LEVELS (CA\$ / HOUR)



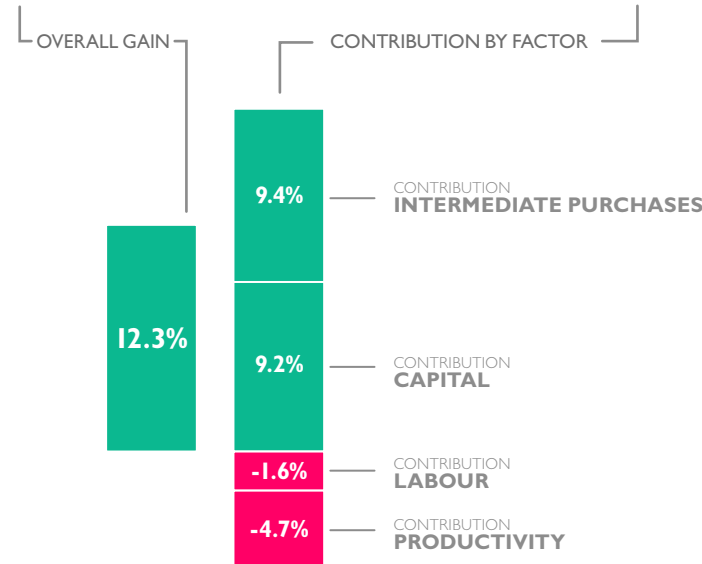
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



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NOMINAL COMPETITIVENESS

12.3%

-25.3%

EXCHANGE EFFECT

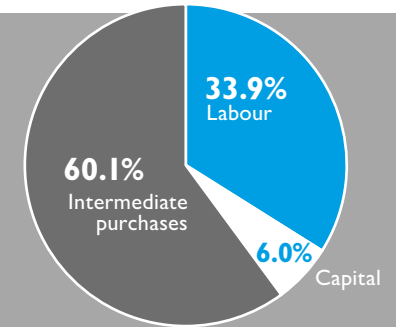
-13.0%

EFFECTIVE COMPETITIVENESS

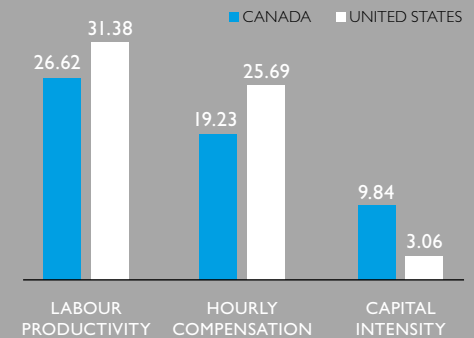
CLOTHING, LEATHER AND ALLIED PRODUCT MANUFACTURING

ECONOMIC CONTEXT

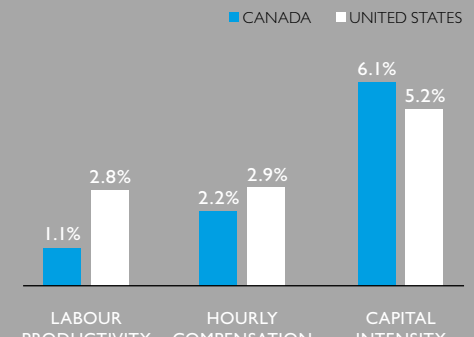
WEIGHT OF FACTORS IN PRODUCTION IN 2014



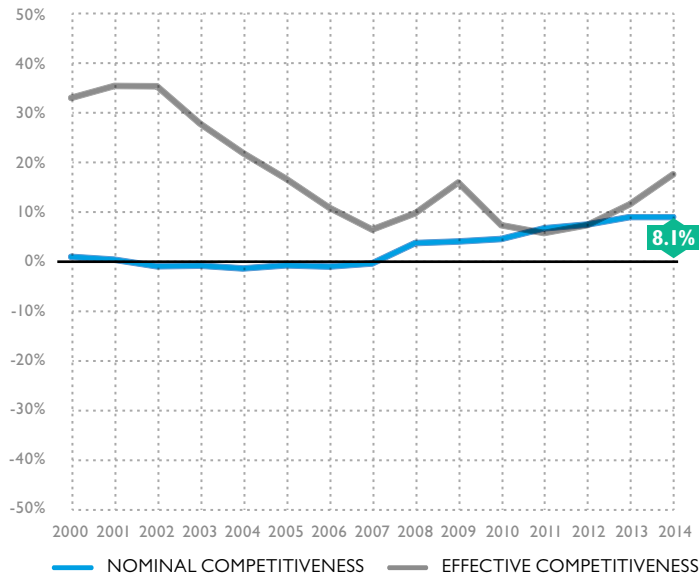
2014 LEVELS (CA\$ / HOUR)



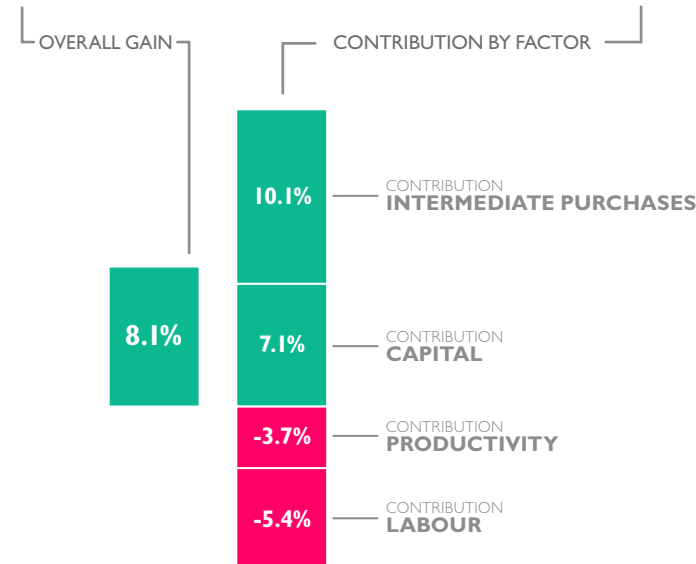
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

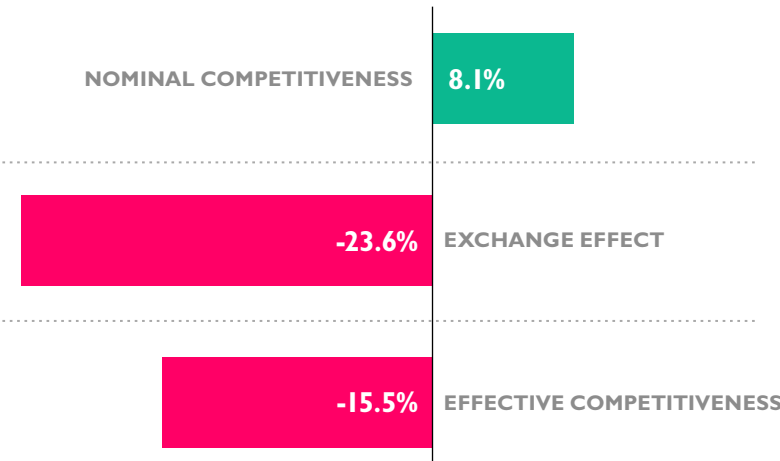


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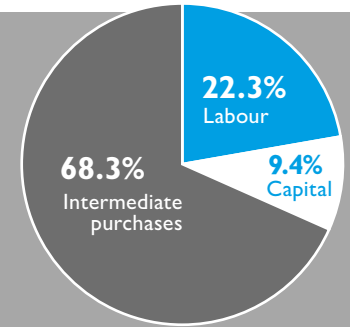
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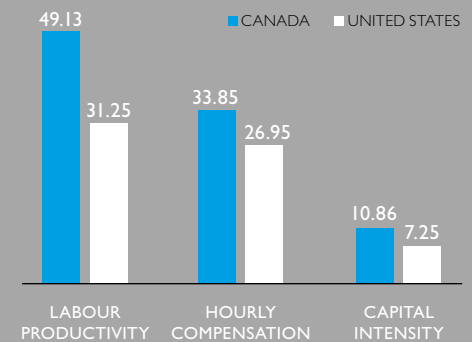
WOOD PRODUCT MANUFACTURING

ECONOMIC CONTEXT

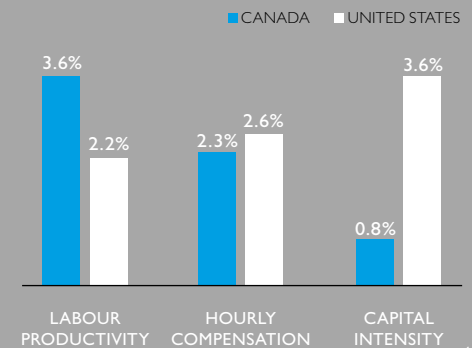
WEIGHT OF FACTORS IN PRODUCTION IN 2014



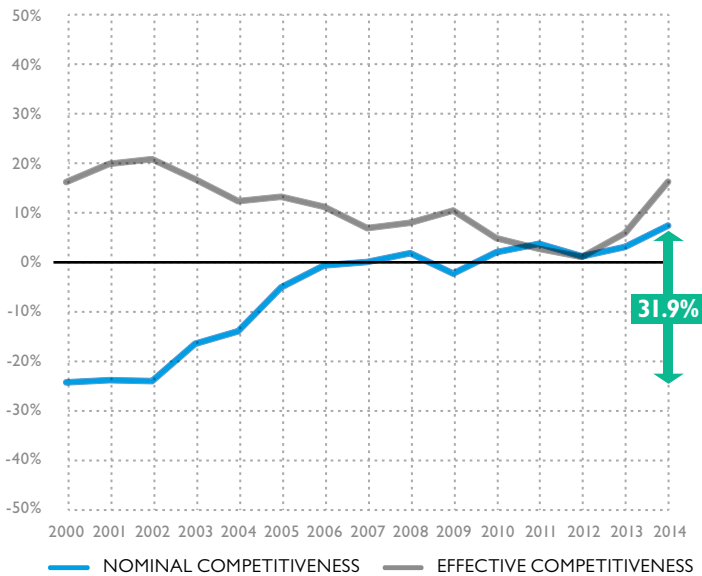
2014 LEVELS (CA\$ / HOUR)



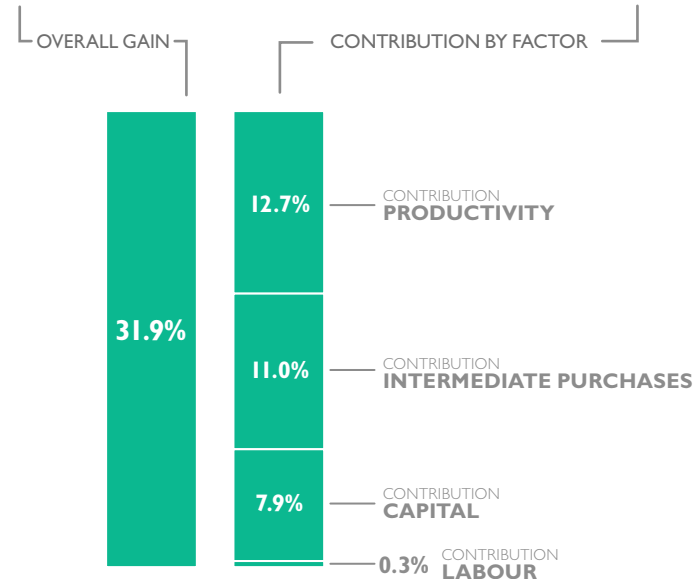
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



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NOMINAL COMPETITIVENESS

31.9%

-31.9%

EXCHANGE EFFECT

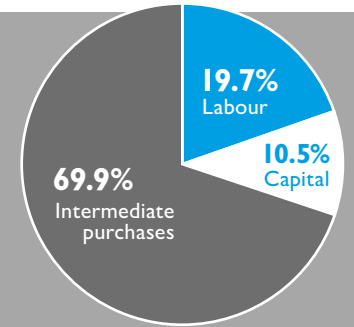
EFFECTIVE COMPETITIVENESS

0.0%

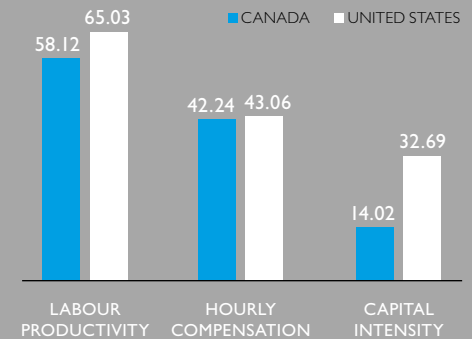
PAPER MANUFACTURING

ECONOMIC CONTEXT

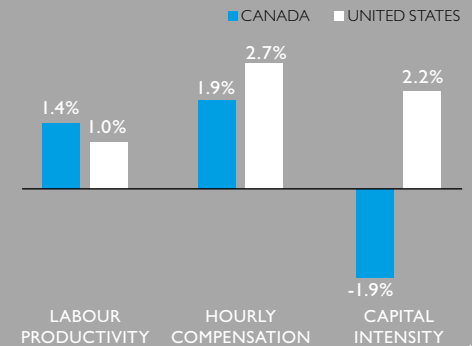
WEIGHT OF FACTORS IN PRODUCTION IN 2014



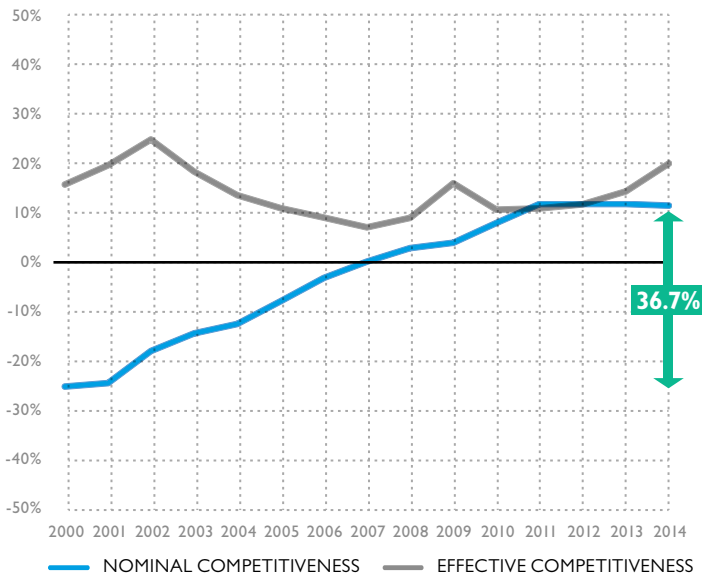
2014 LEVELS (CA\$ / HOUR)



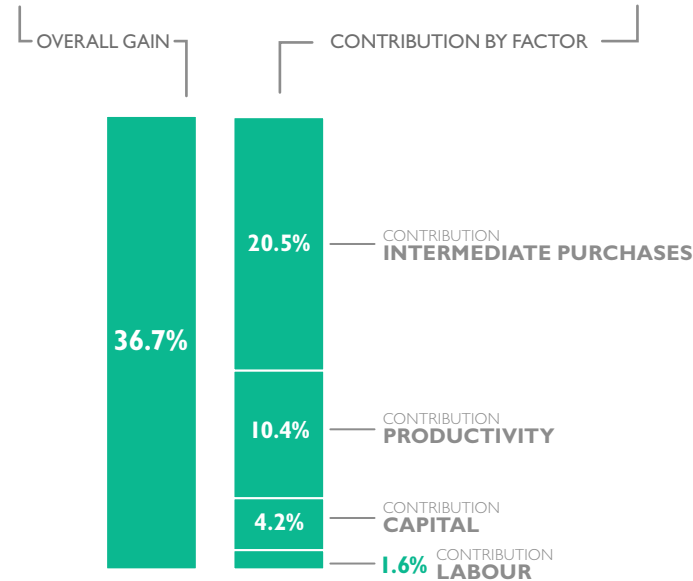
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



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NOMINAL COMPETITIVENESS

36.7%

-32.5%

EXCHANGE EFFECT

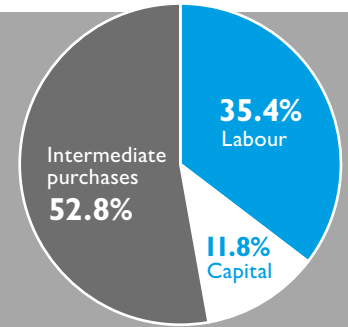
EFFECTIVE COMPETITIVENESS

4.2%

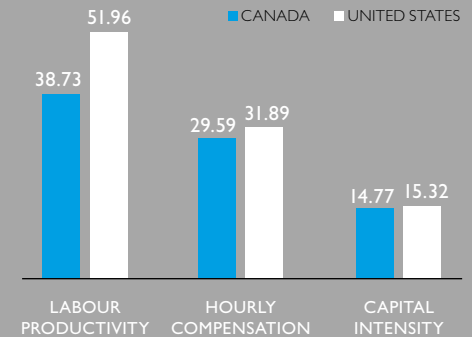
PRINTING AND RELATED SUPPORT ACTIVITIES

ECONOMIC CONTEXT

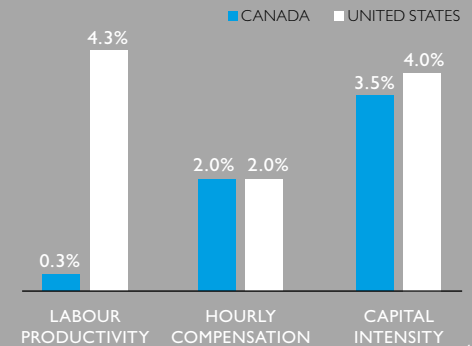
WEIGHT OF FACTORS IN PRODUCTION IN 2014



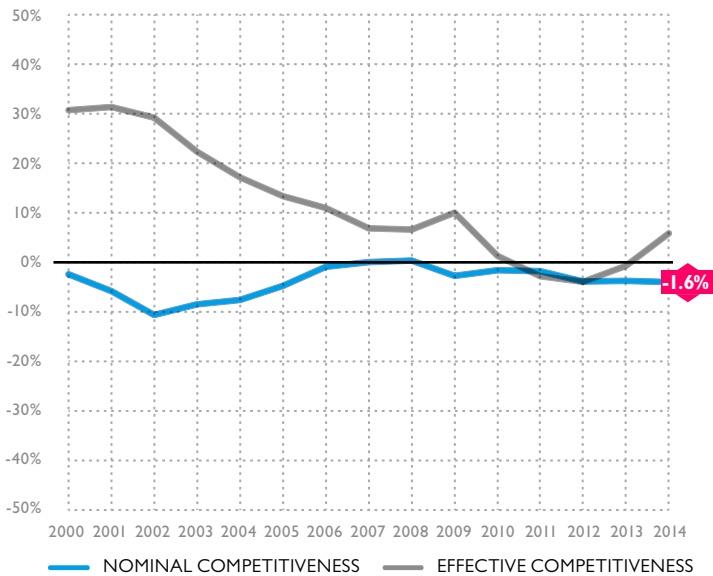
2014 LEVELS (CA\$ / HOUR)



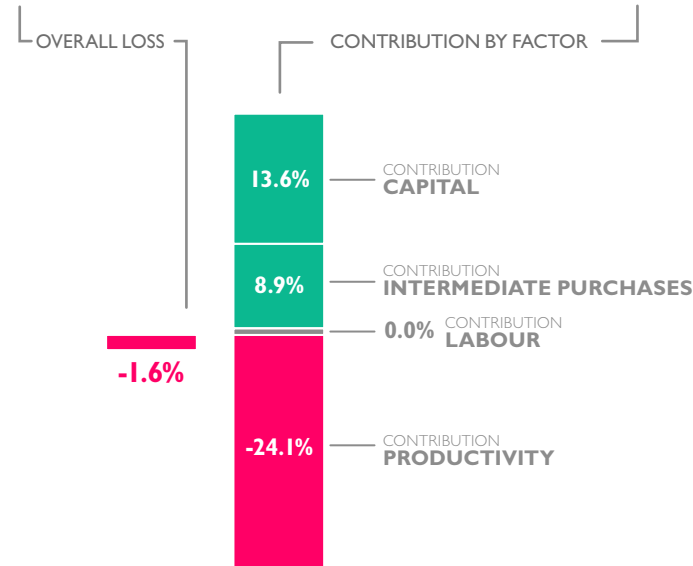
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

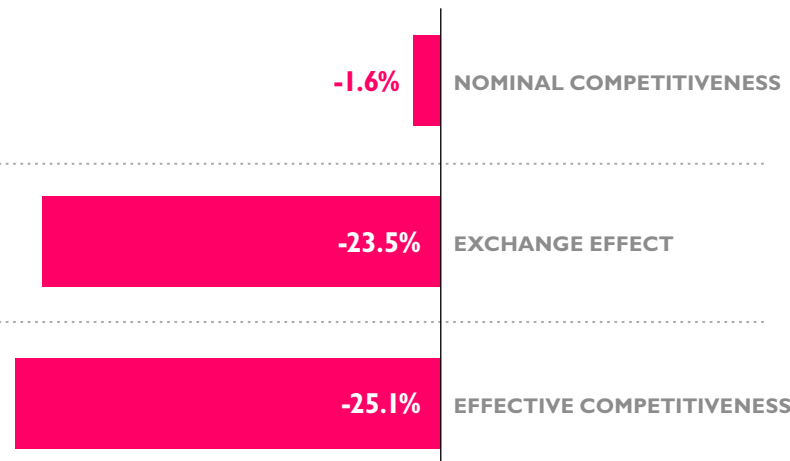


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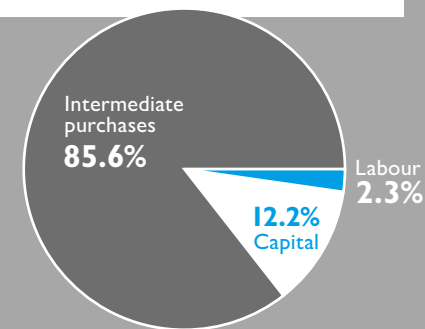
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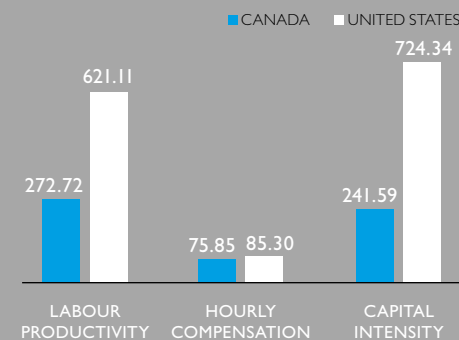
PETROLEUM AND COAL PRODUCT MANUFACTURING

ECONOMIC CONTEXT

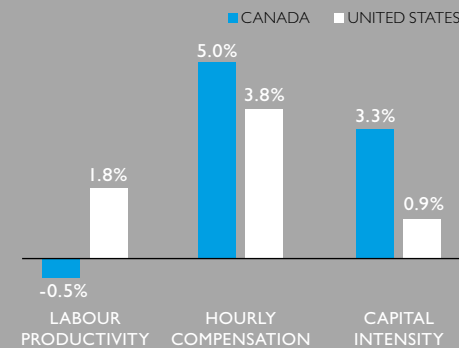
WEIGHT OF FACTORS IN PRODUCTION IN 2014



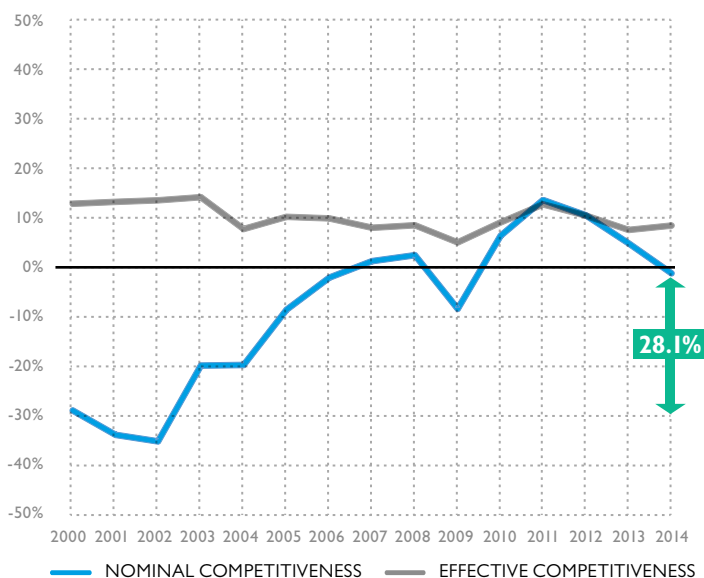
2014 LEVELS (CA\$ / HOUR)



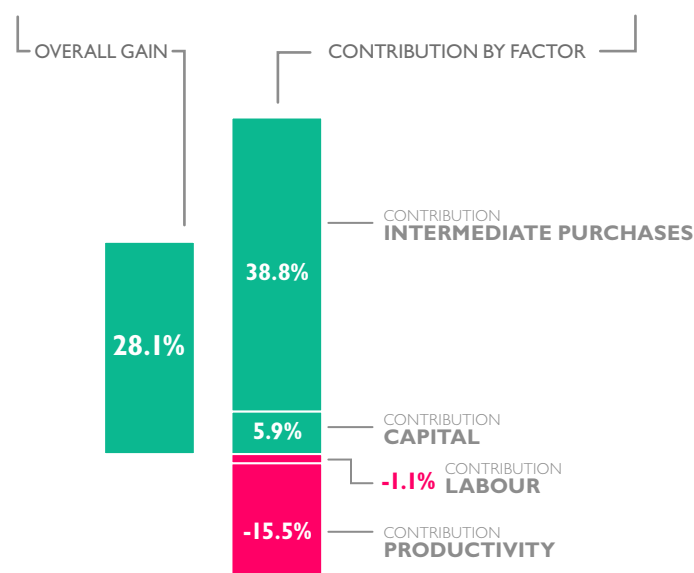
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

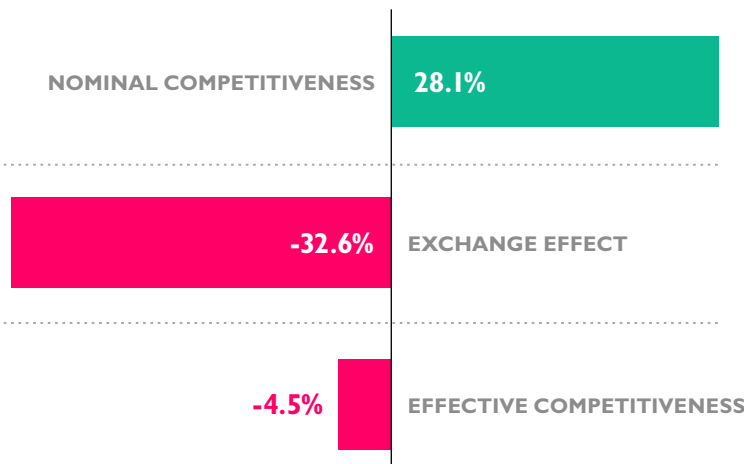


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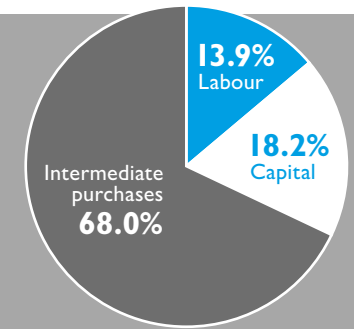
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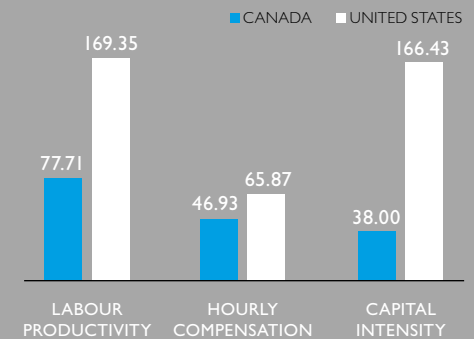
CHEMICAL MANUFACTURING

ECONOMIC CONTEXT

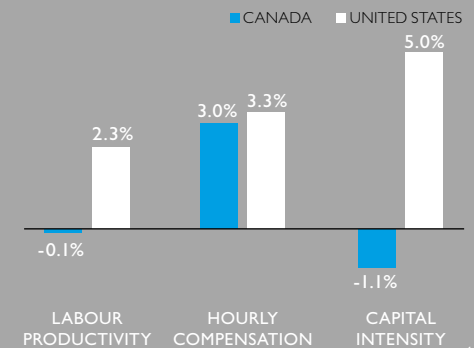
WEIGHT OF FACTORS IN PRODUCTION IN 2014



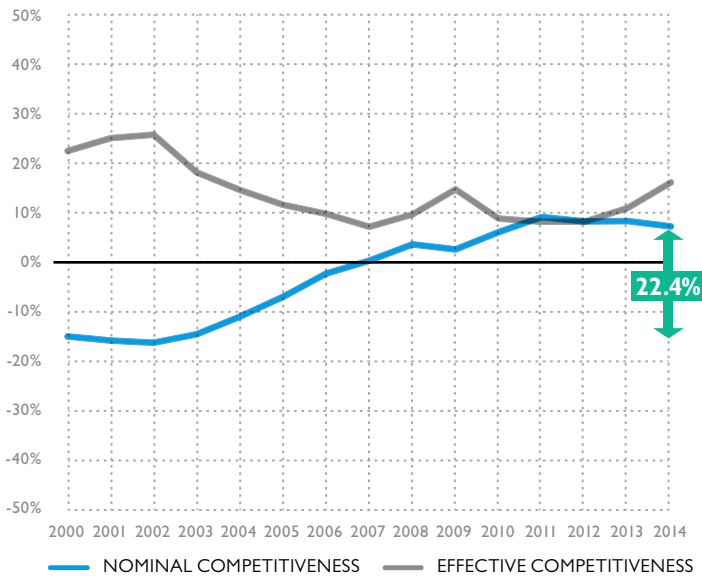
2014 LEVELS (CA\$ / HOUR)



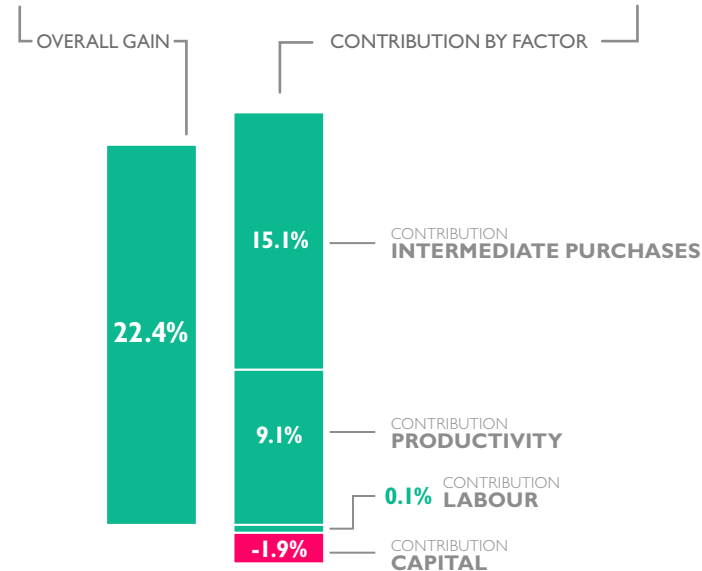
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

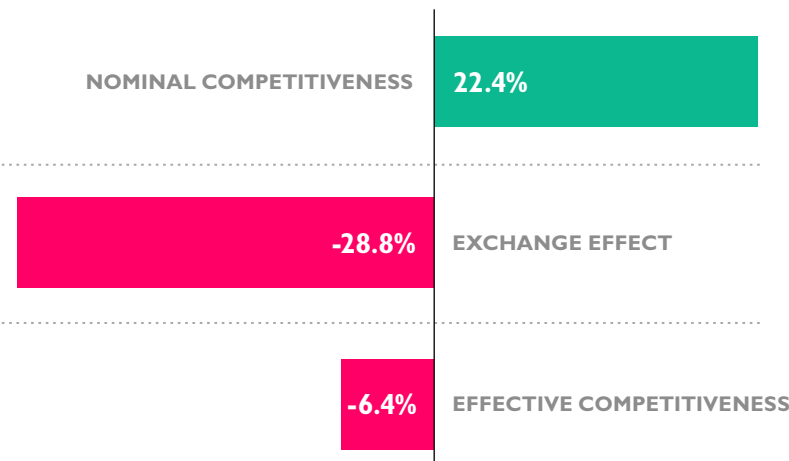


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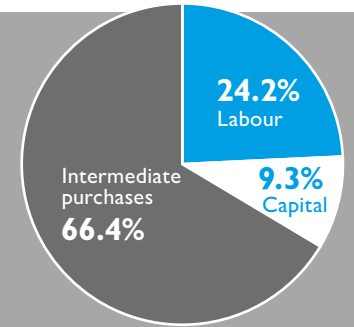
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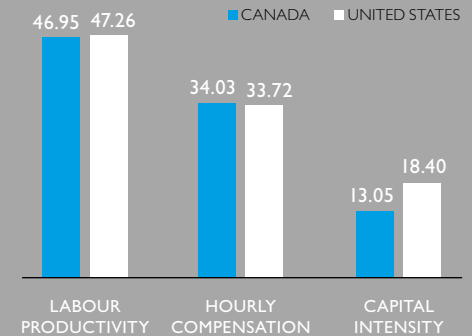
PLASTIC AND RUBBER PRODUCTS MANUFACTURING

ECONOMIC CONTEXT

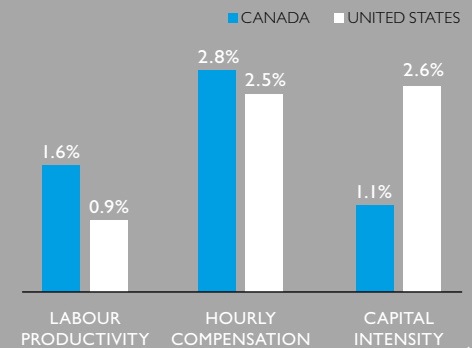
WEIGHT OF FACTORS IN PRODUCTION IN 2014



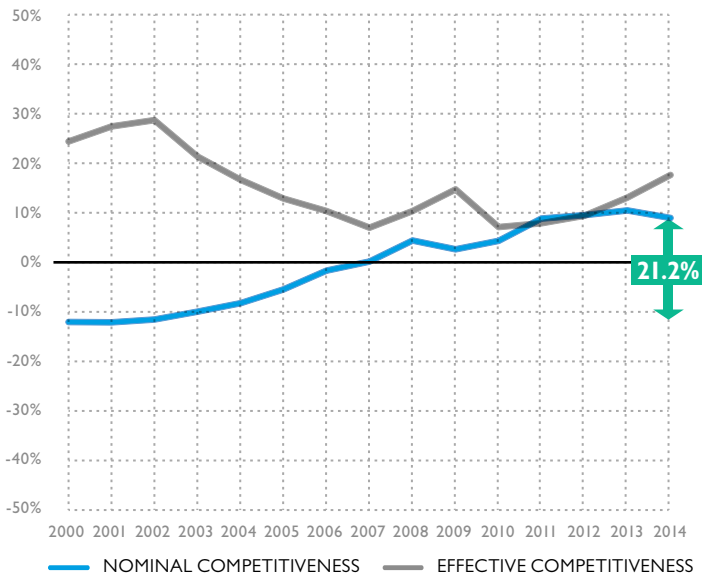
2014 LEVELS (CA\$ / HOUR)



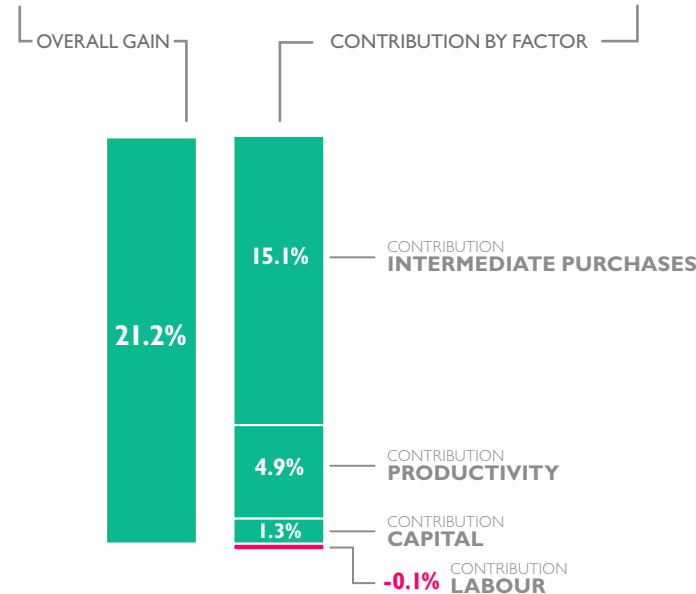
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

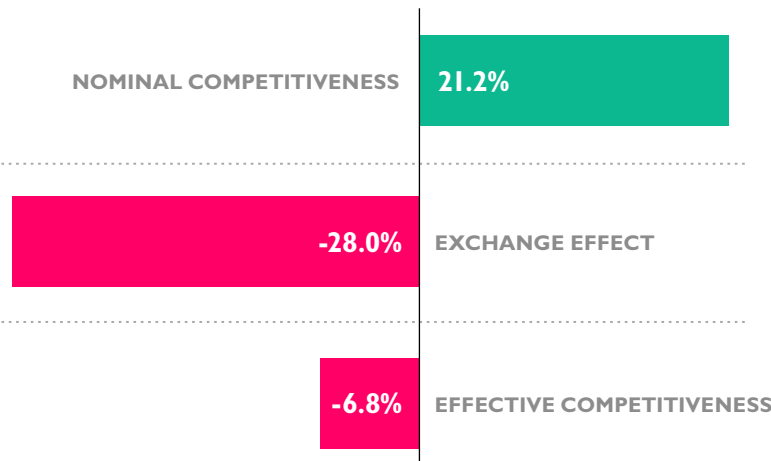


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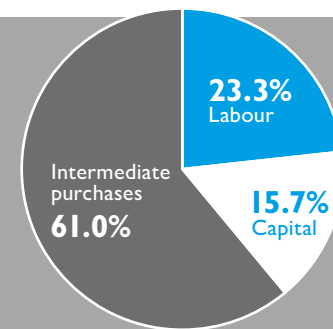
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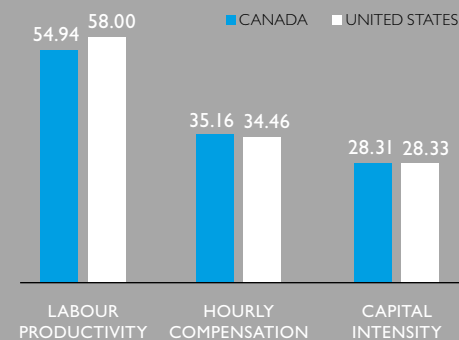
NON-METALLIC MINERAL PRODUCT MANUFACTURING

ECONOMIC CONTEXT

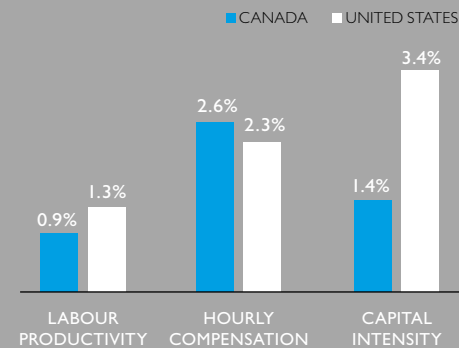
WEIGHT OF FACTORS IN PRODUCTION IN 2014



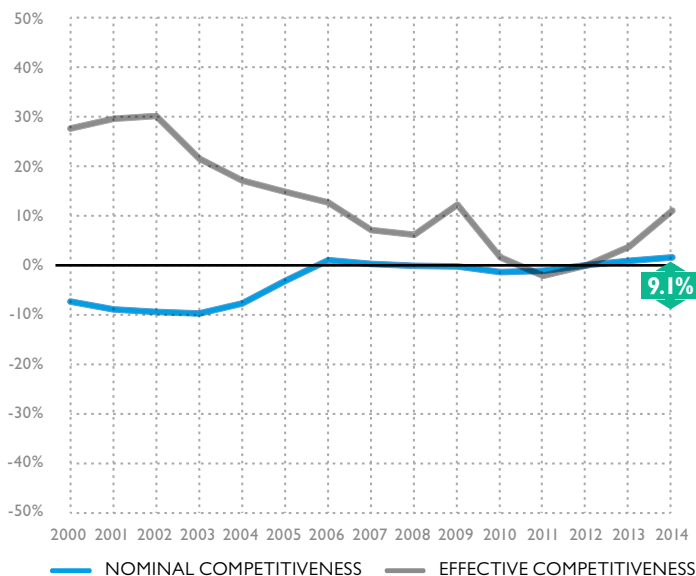
2014 LEVELS (CA\$ / HOUR)



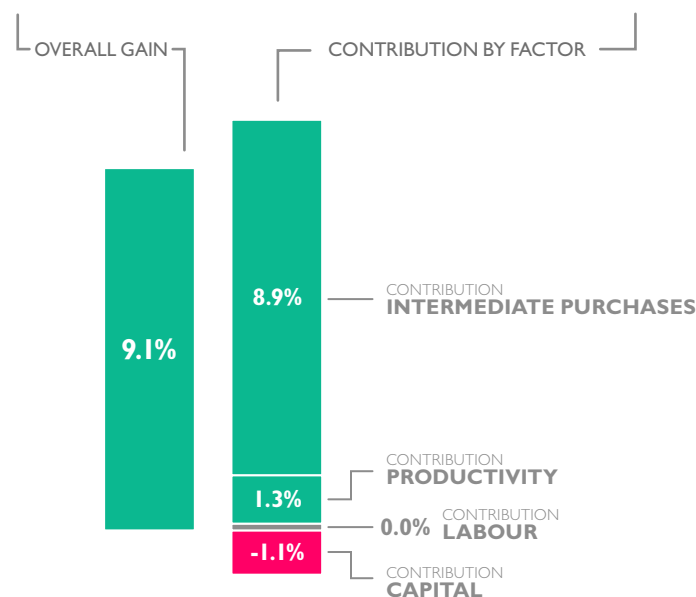
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

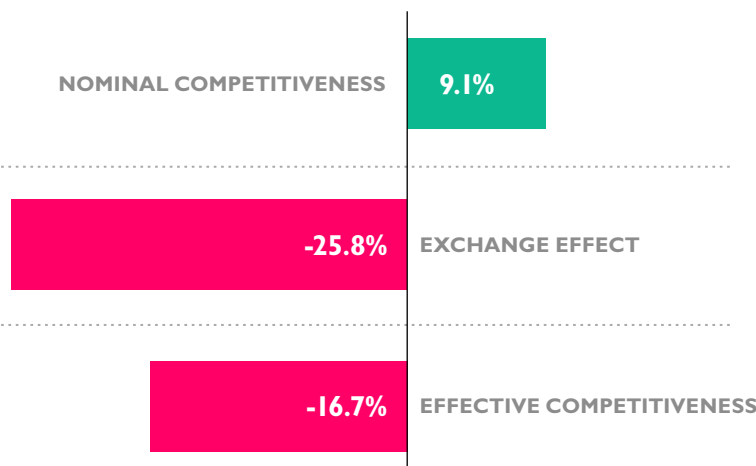


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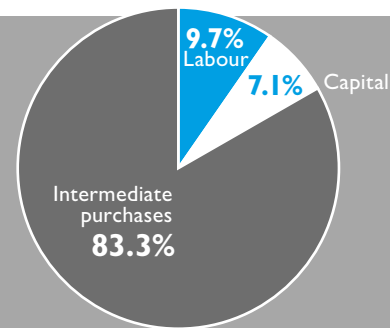
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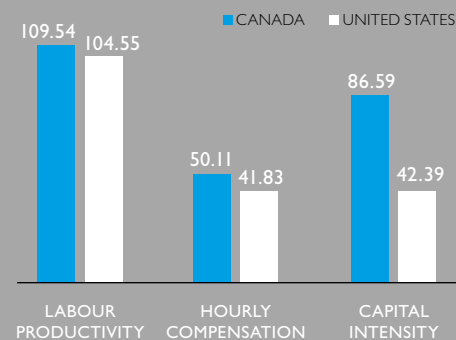
PRIMARY METAL MANUFACTURING

ECONOMIC CONTEXT

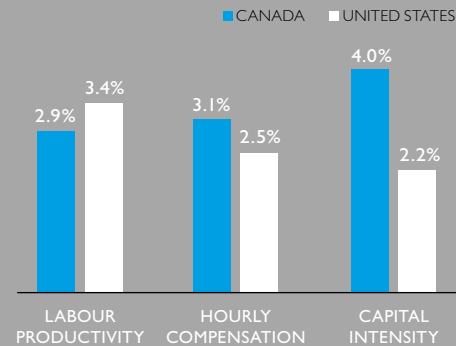
WEIGHT OF FACTORS IN PRODUCTION IN 2014



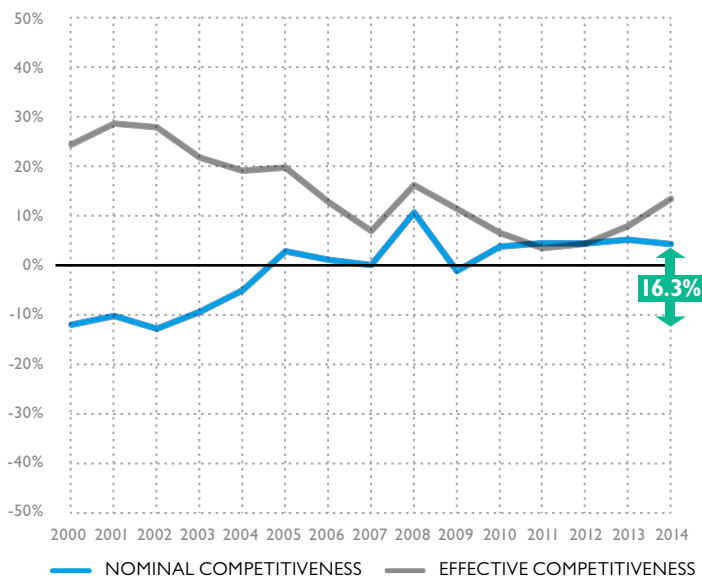
2014 LEVELS (CA\$ / HOUR)



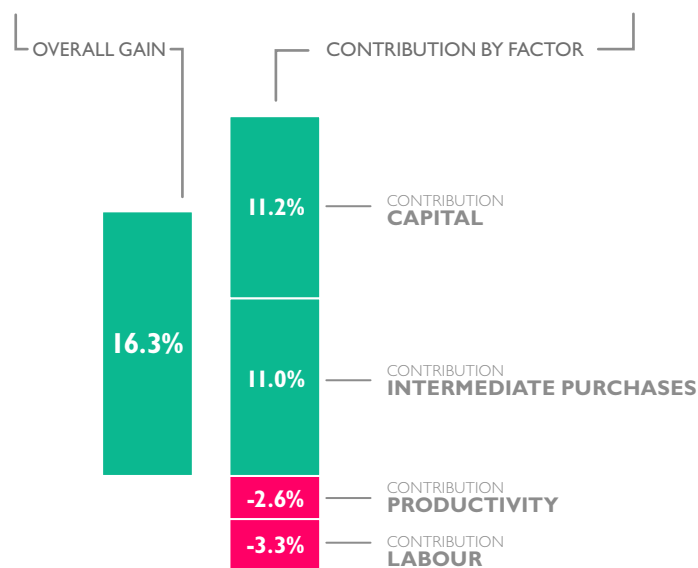
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

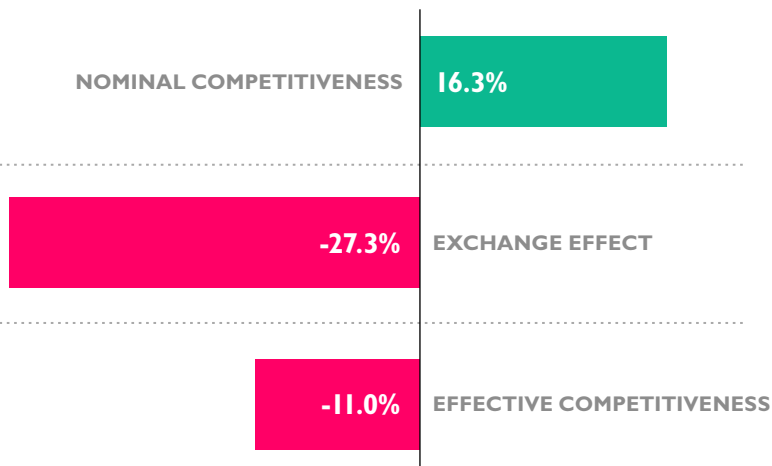


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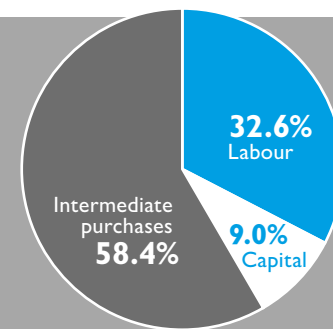
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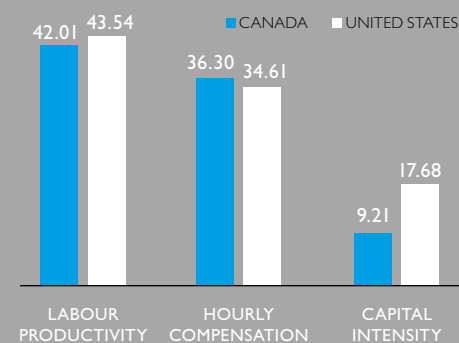
FABRICATED METAL PRODUCT MANUFACTURING

ECONOMIC CONTEXT

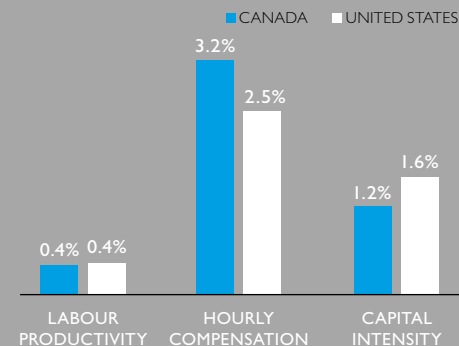
WEIGHT OF FACTORS IN PRODUCTION IN 2014



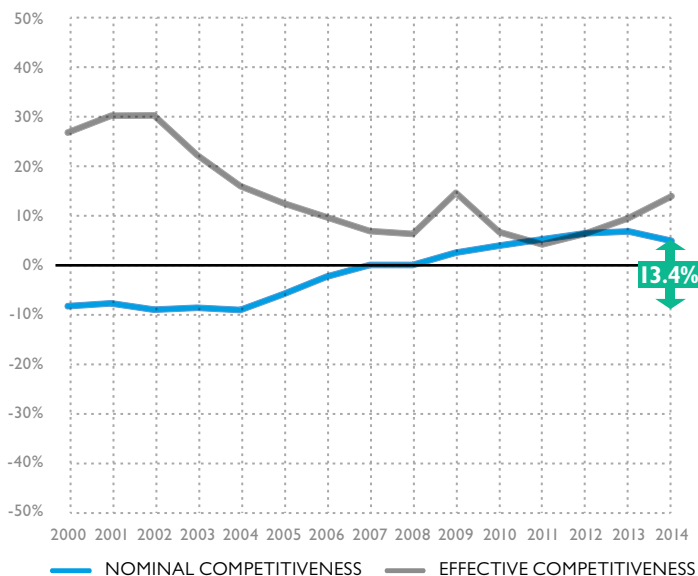
2014 LEVELS (CA\$ / HOUR)



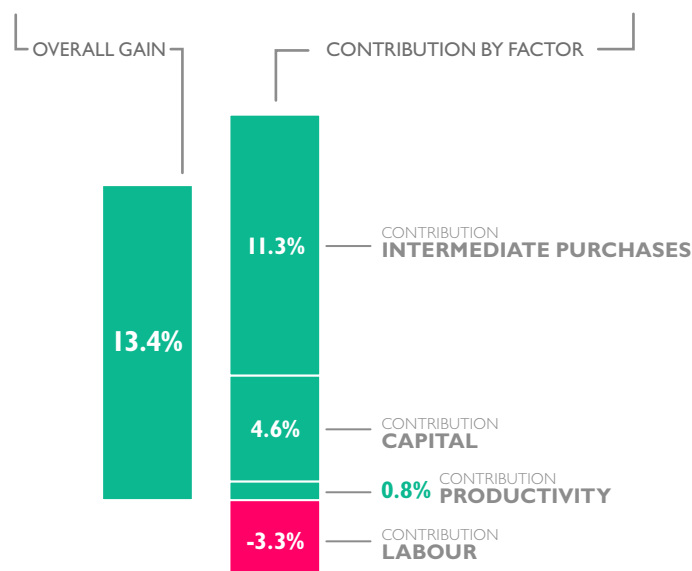
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



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NOMINAL COMPETITIVENESS

13.4%

-26.4%

EXCHANGE EFFECT

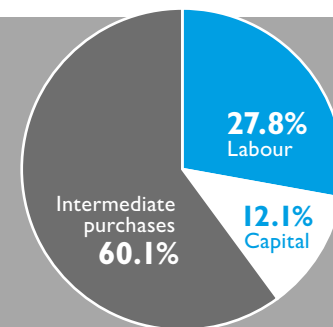
-13.0%

EFFECTIVE COMPETITIVENESS

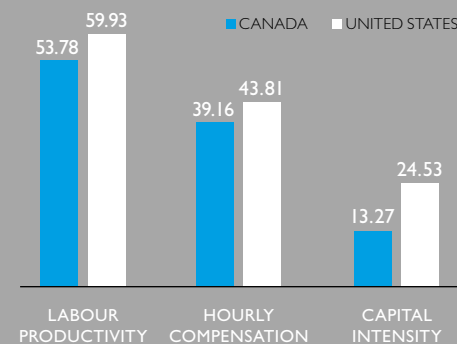
MACHINERY MANUFACTURING

ECONOMIC CONTEXT

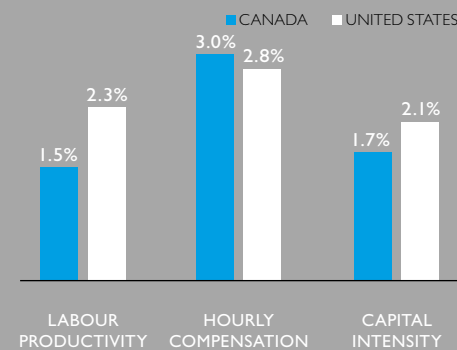
WEIGHT OF FACTORS IN PRODUCTION IN 2014



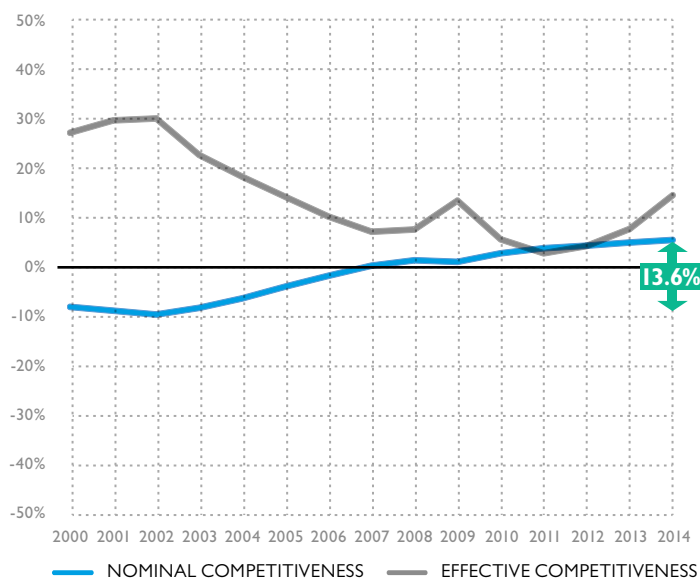
2014 LEVELS (CA\$ / HOUR)



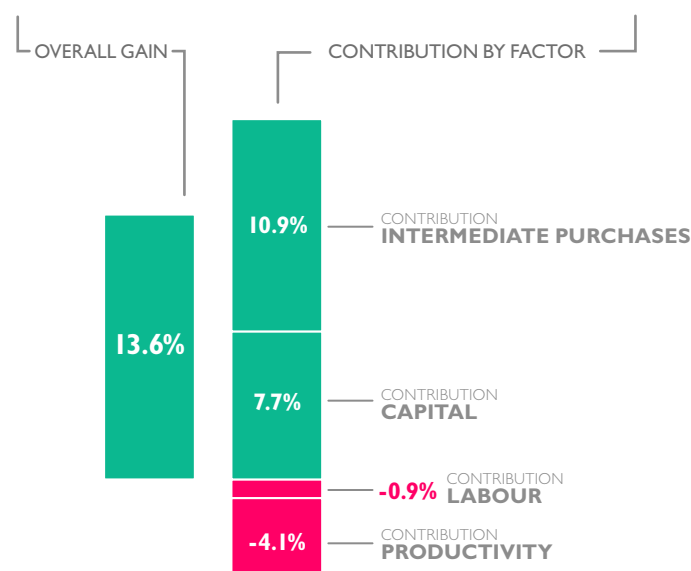
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

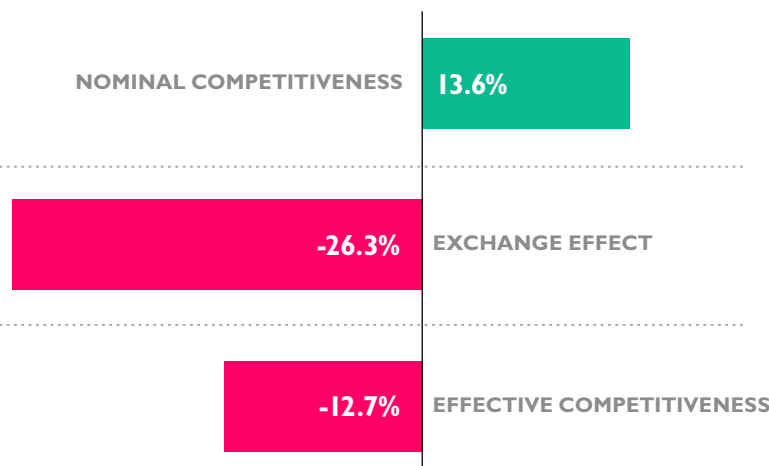


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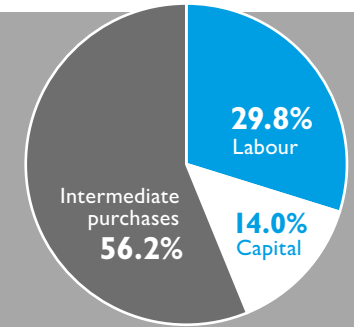
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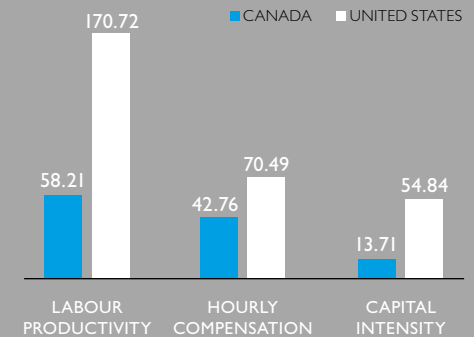
COMPUTER AND ELECTRONIC PRODUCT MANUFACTURING

ECONOMIC CONTEXT

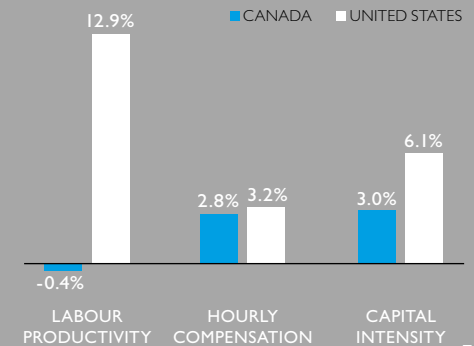
WEIGHT OF FACTORS IN PRODUCTION IN 2014



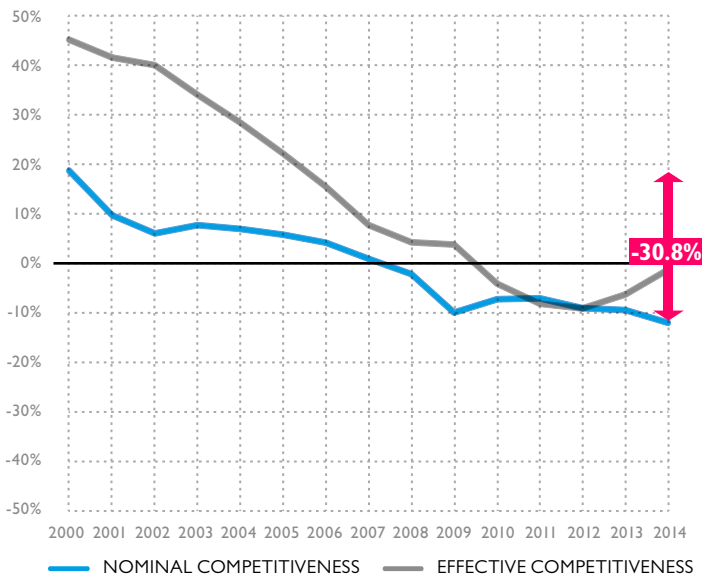
2014 LEVELS (CA\$ / HOUR)



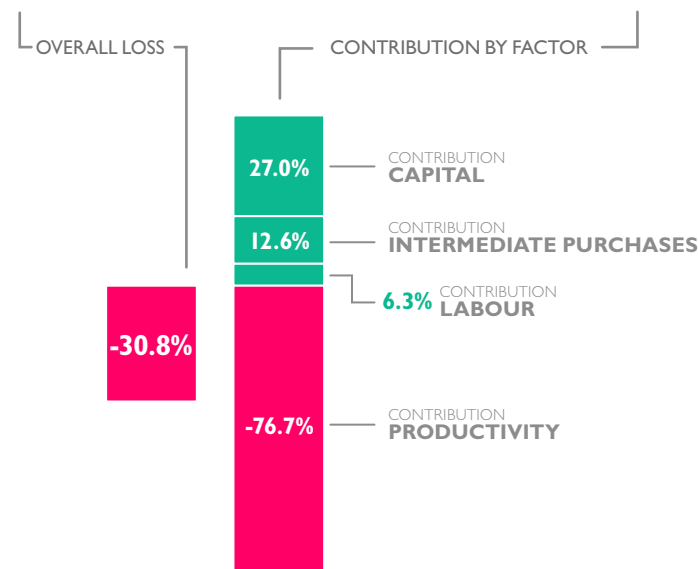
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

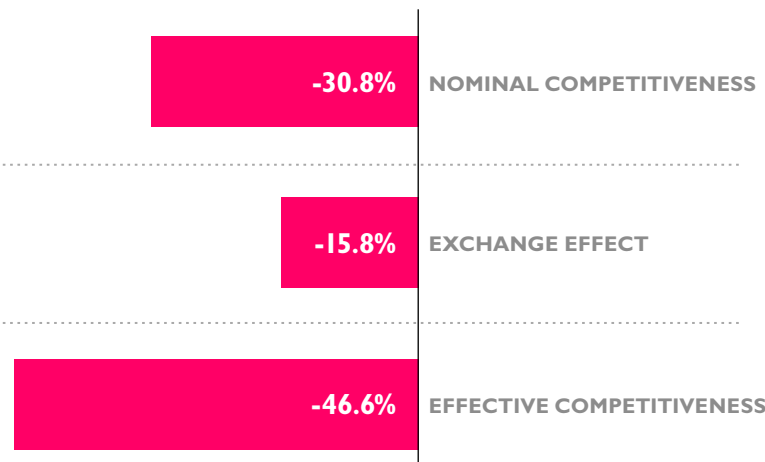


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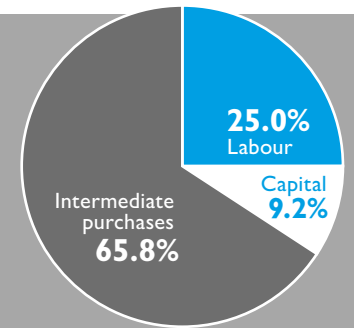
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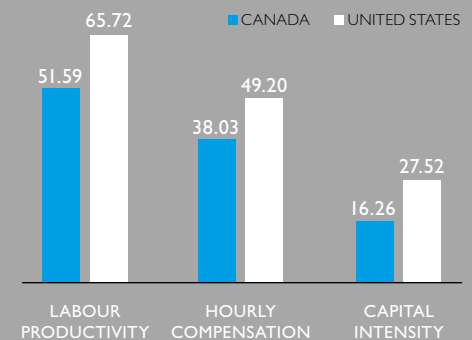
ELECTRICAL EQUIPMENT, APPLIANCE AND COMPONENT MANUFACTURING

ECONOMIC CONTEXT

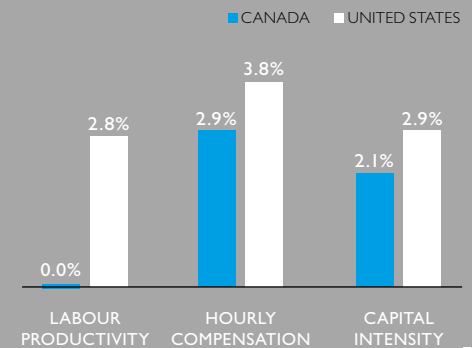
WEIGHT OF FACTORS IN PRODUCTION IN 2014



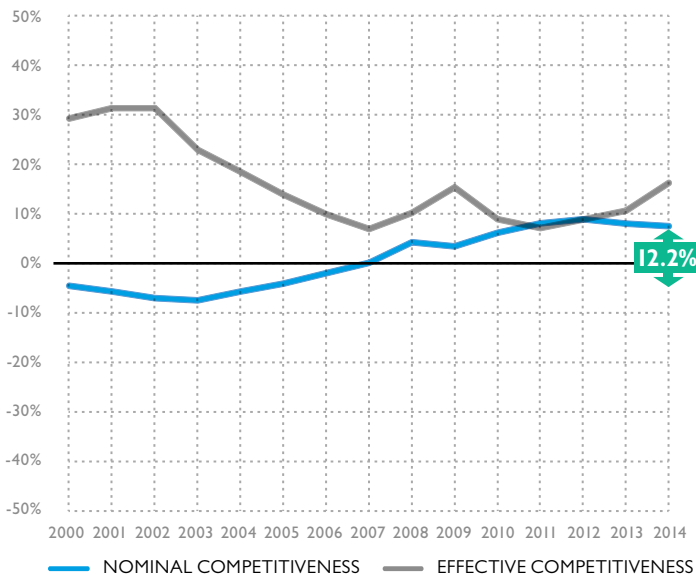
2014 LEVELS (CA\$ / HOUR)



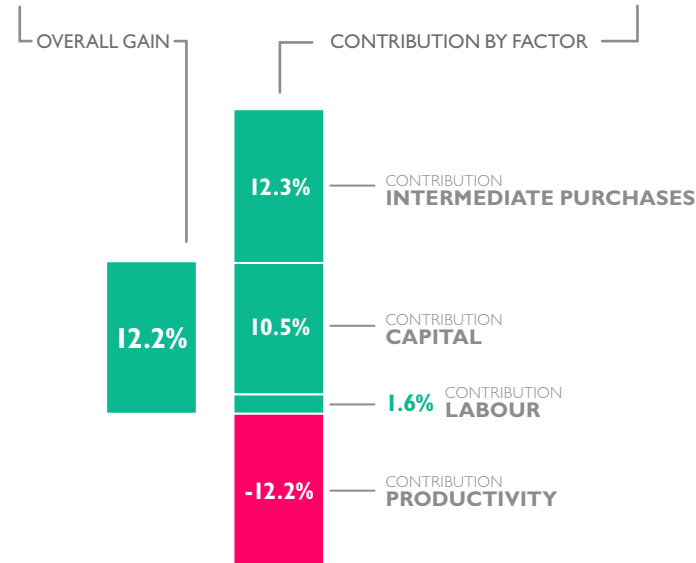
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

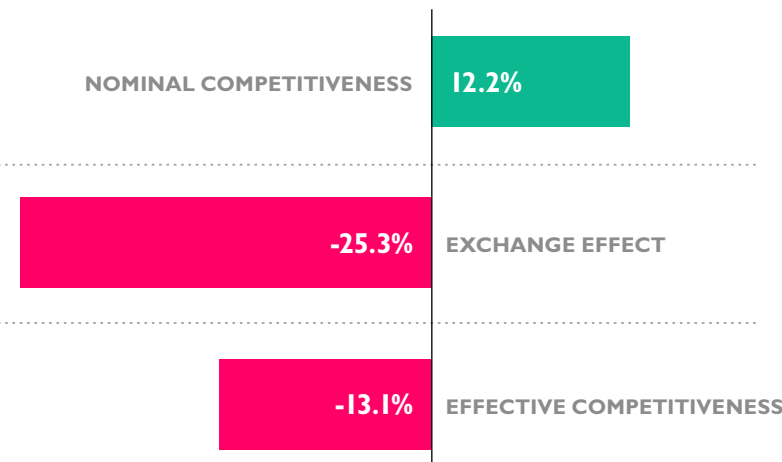


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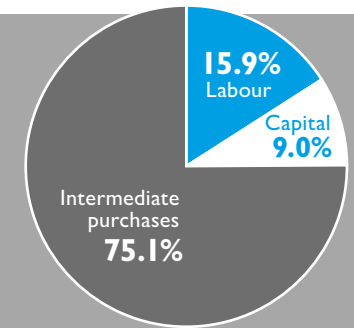
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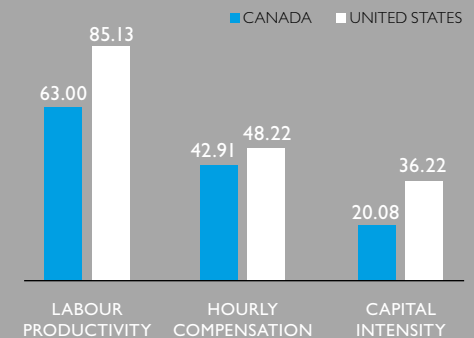
TRANSPORTATION EQUIPMENT MANUFACTURING

ECONOMIC CONTEXT

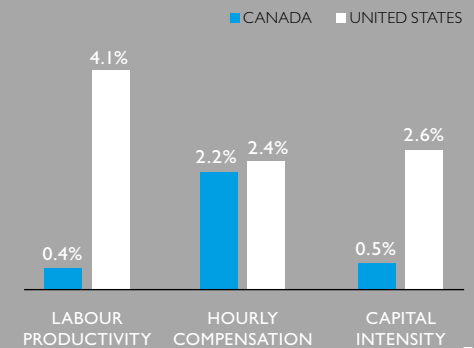
WEIGHT OF FACTORS IN PRODUCTION IN 2014



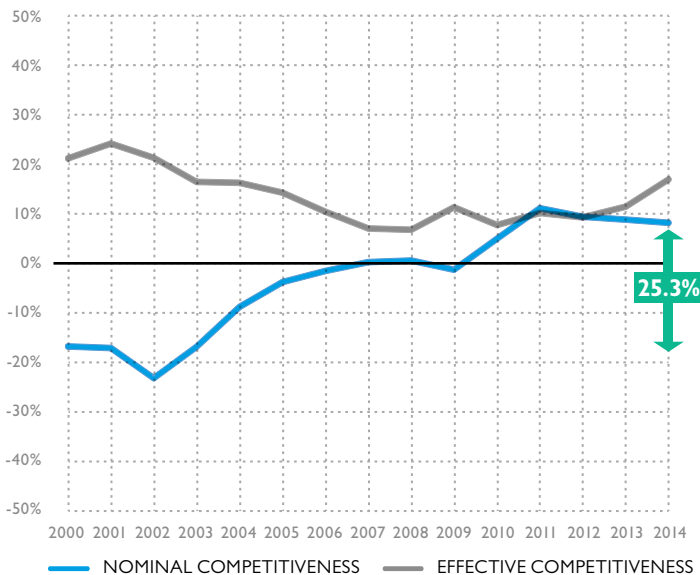
2014 LEVELS (CA\$ / HOUR)



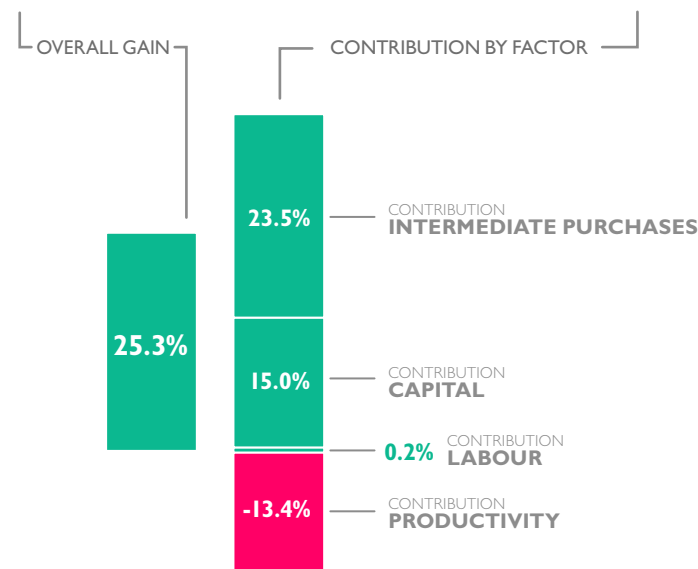
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

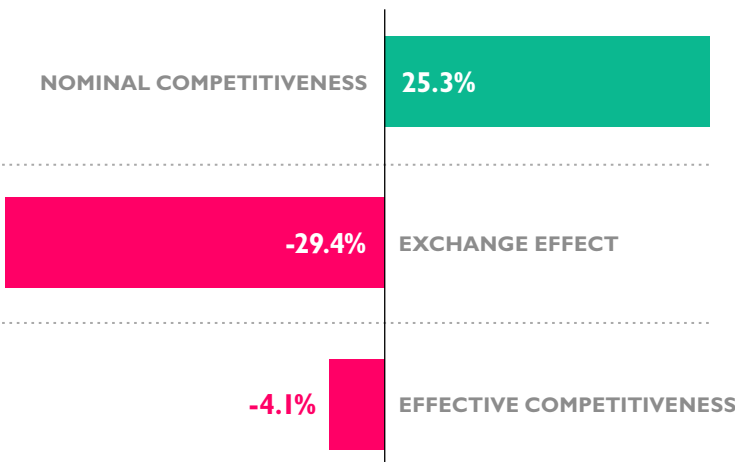


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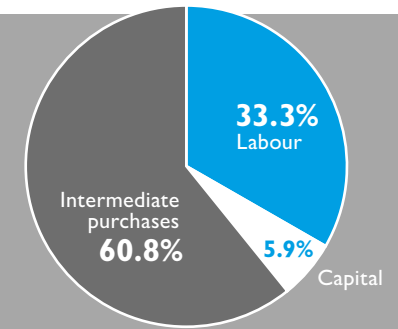
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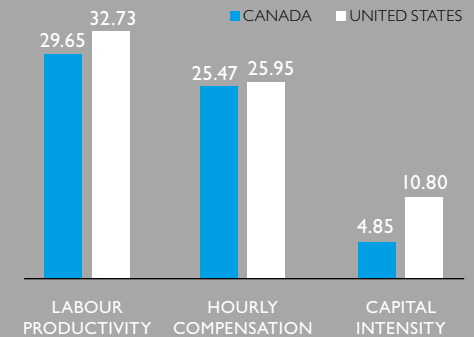
FURNITURE AND RELATED PRODUCT MANUFACTURING

ECONOMIC CONTEXT

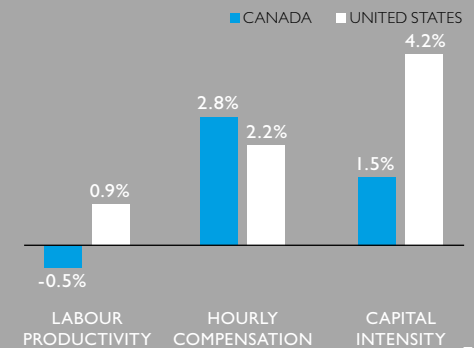
WEIGHT OF FACTORS IN PRODUCTION IN 2014



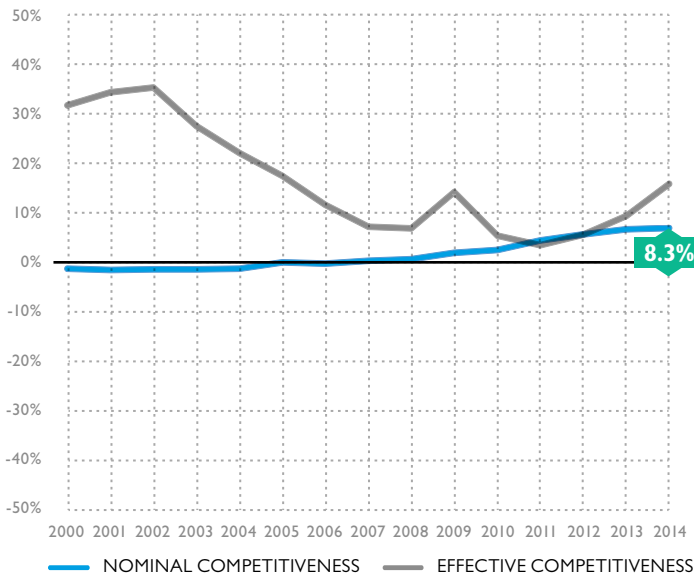
2014 LEVELS (CA\$ / HOUR)



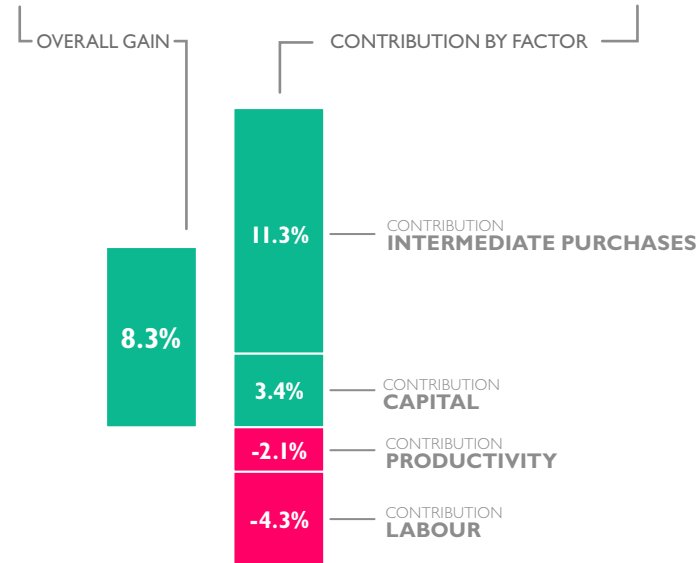
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

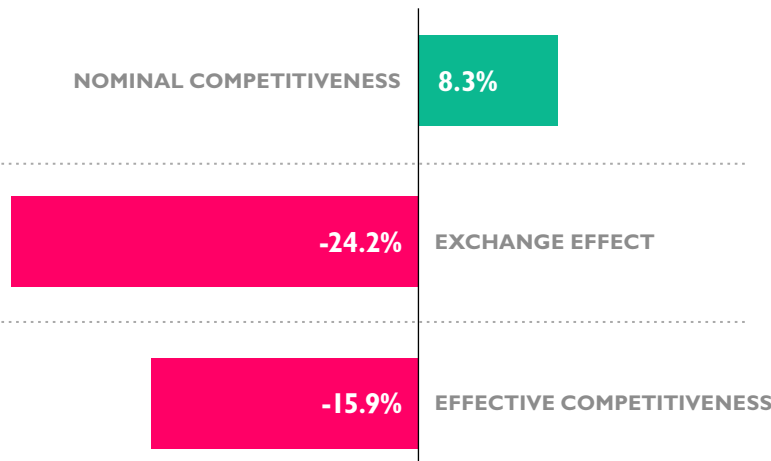


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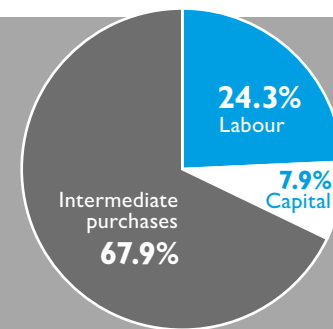
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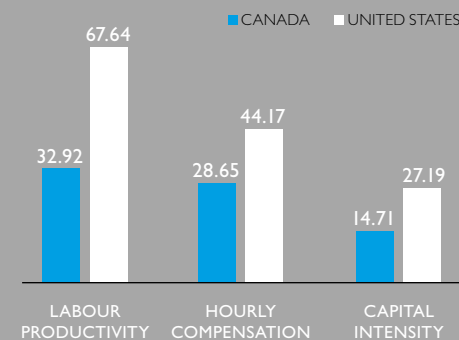
MISCELLANEOUS MANUFACTURING

ECONOMIC CONTEXT

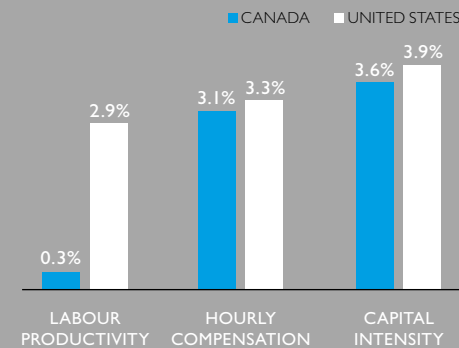
WEIGHT OF FACTORS IN PRODUCTION IN 2014



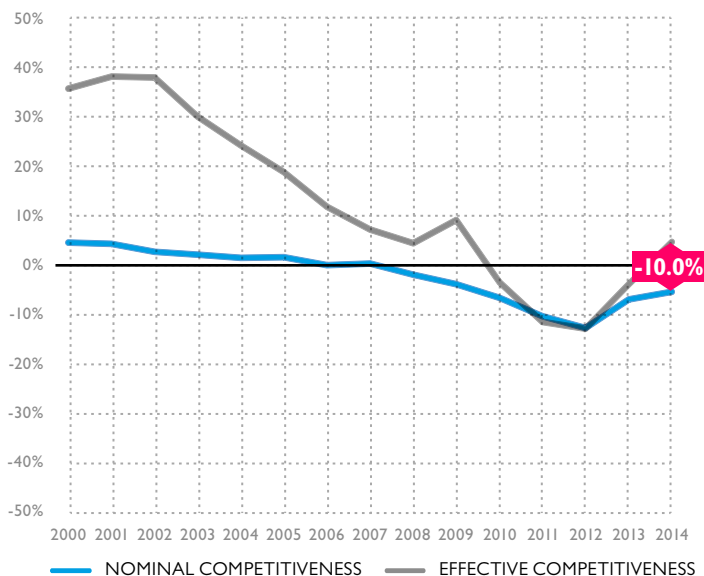
2014 LEVELS (CA\$ / HOUR)



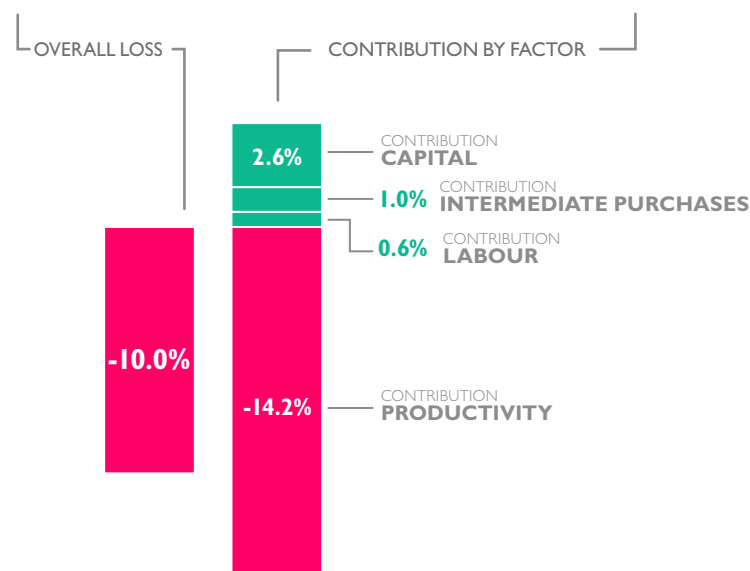
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

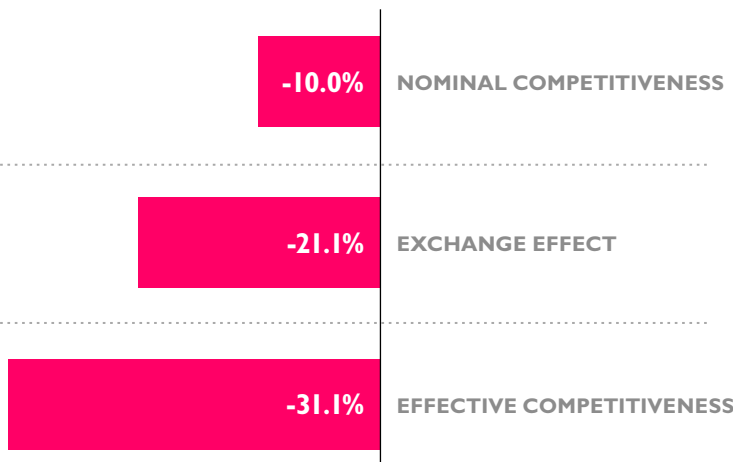


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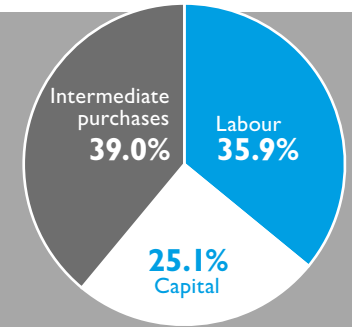
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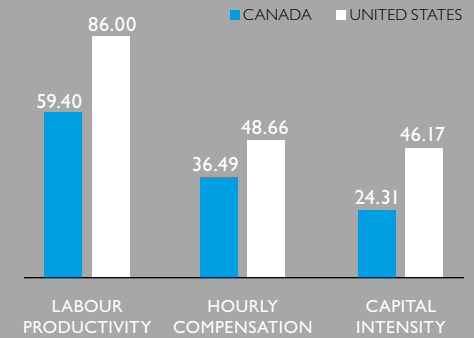
WHOLESALE TRADE

ECONOMIC CONTEXT

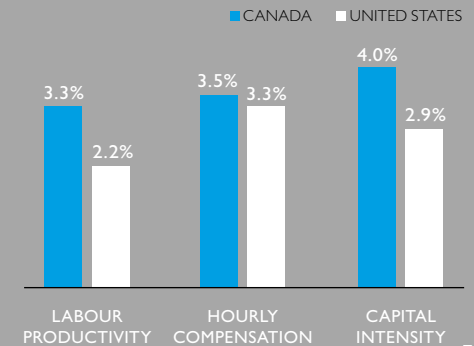
WEIGHT OF FACTORS IN PRODUCTION IN 2014



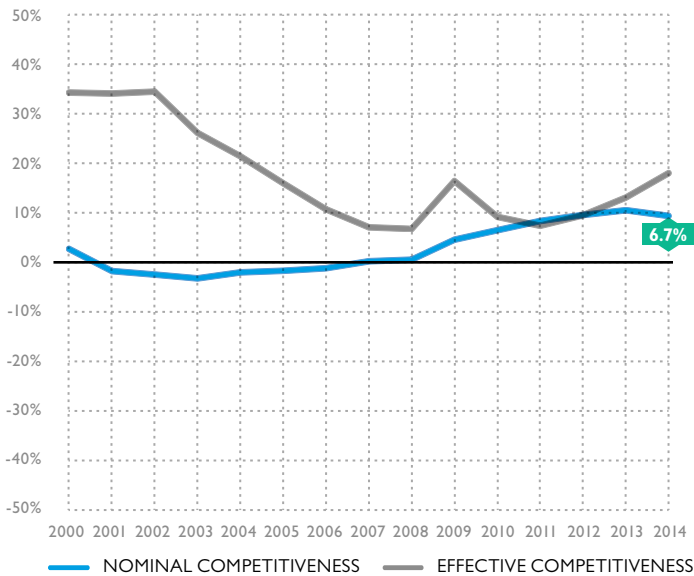
2014 LEVELS (CA\$ / HOUR)



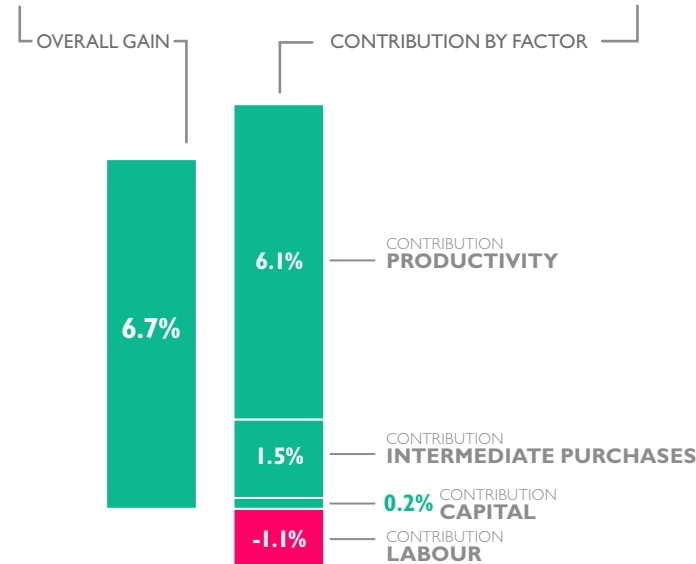
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



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NOMINAL COMPETITIVENESS

6.7%

-23.1%

EXCHANGE EFFECT

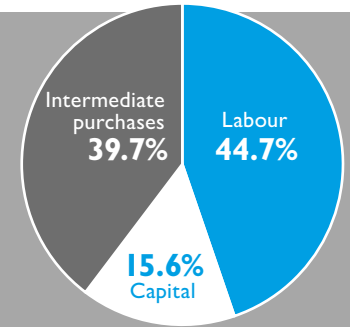
-16.4%

EFFECTIVE COMPETITIVENESS

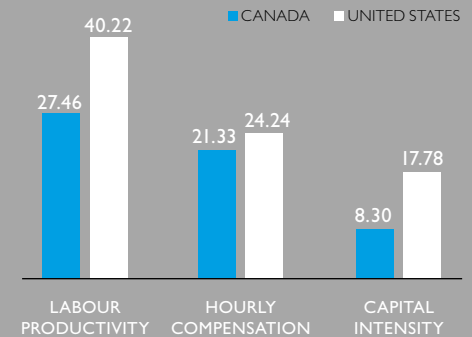
RETAIL TRADE

ECONOMIC CONTEXT

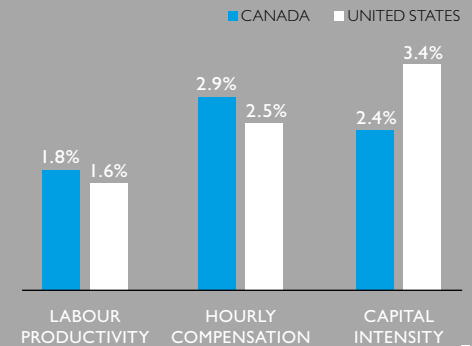
WEIGHT OF FACTORS IN PRODUCTION IN 2014



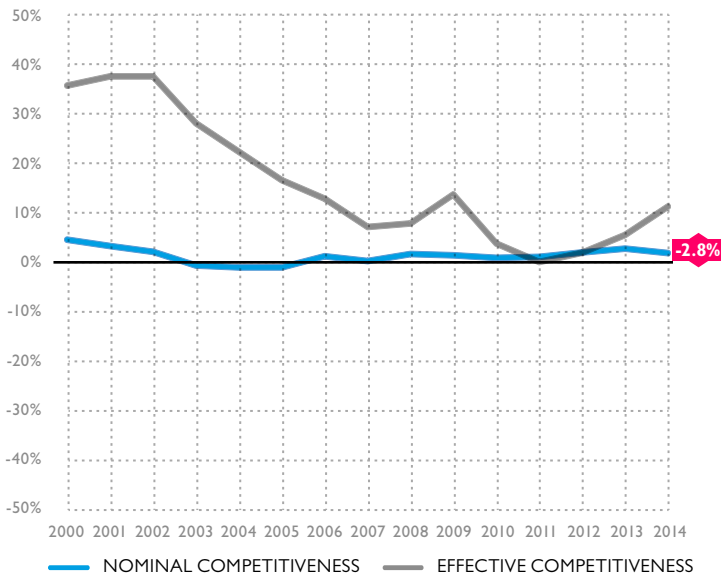
2014 LEVELS (CA\$ / HOUR)



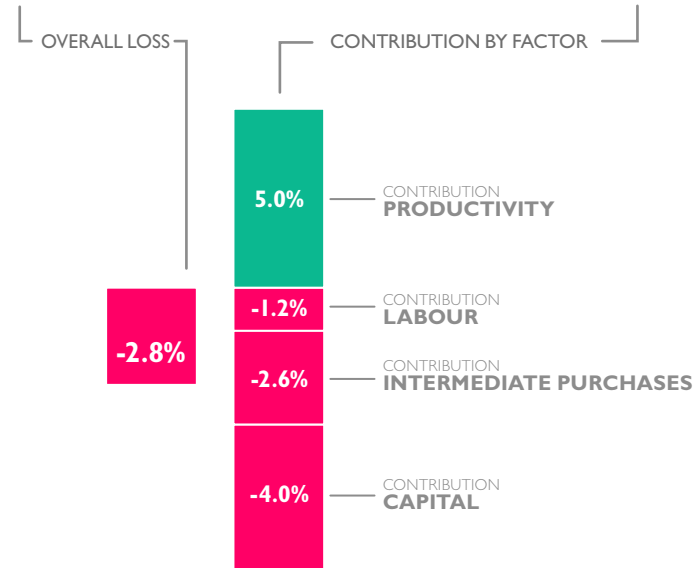
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

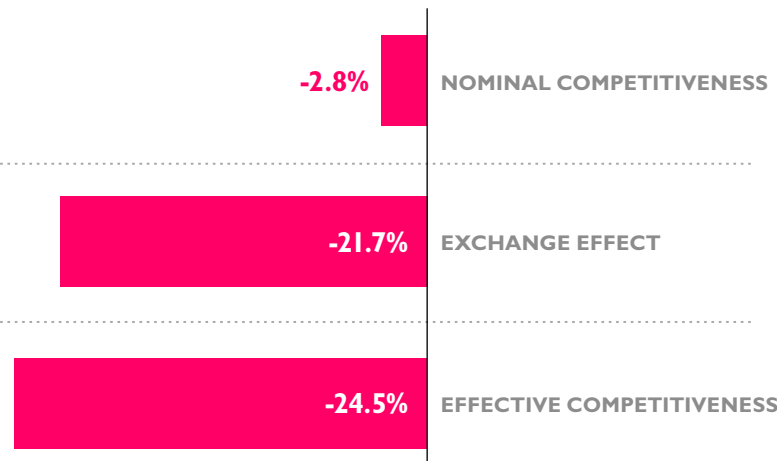


CONTRIBUTION TO EFFECTIVE COMPETITIVENESS

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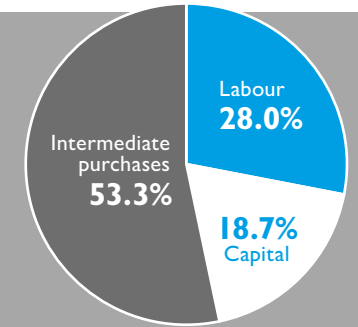
EFFECTIVE COMPETITIVENESS measures relative changes in production costs, taking the exchange rate into account. It is obtained by adding the exchange effect to the growth in nominal competitiveness.



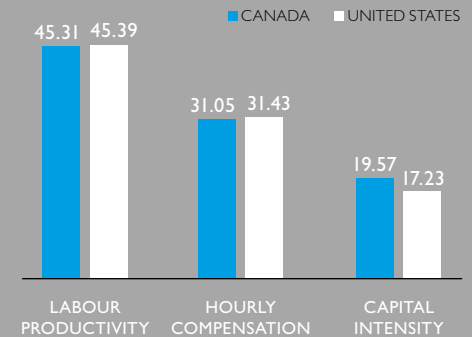
TRANSPORTATION AND WAREHOUSING

ECONOMIC CONTEXT

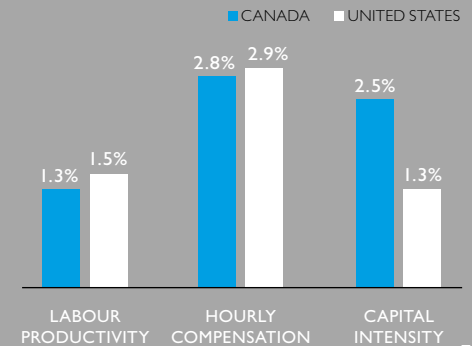
WEIGHT OF FACTORS IN PRODUCTION IN 2014



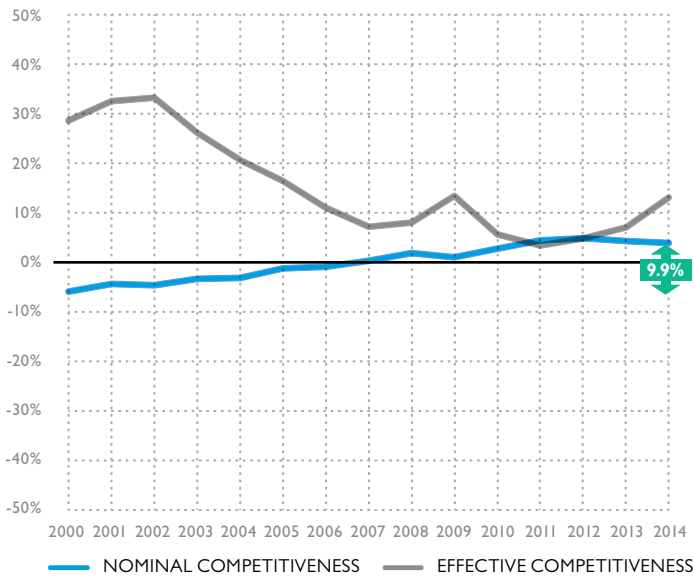
2014 LEVELS (CA\$ / HOUR)



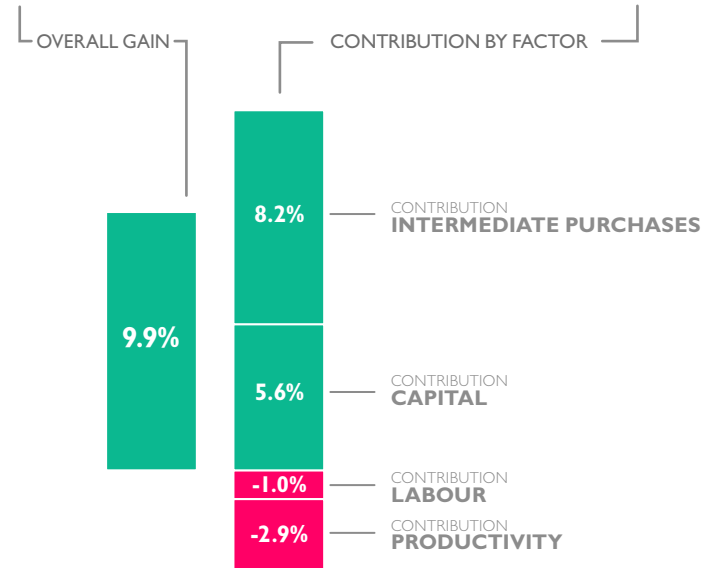
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS



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NOMINAL COMPETITIVENESS

9.9%

-25.5%

EXCHANGE EFFECT

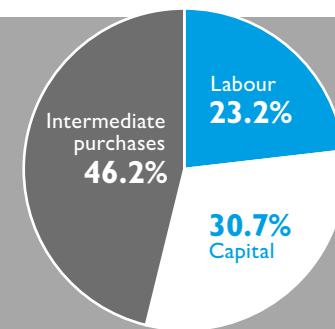
-15.6%

EFFECTIVE COMPETITIVENESS

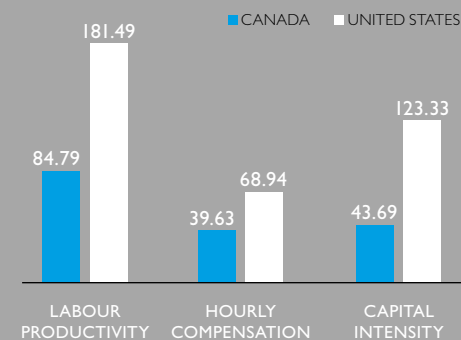
INFORMATION AND CULTURAL INDUSTRIES

ECONOMIC CONTEXT

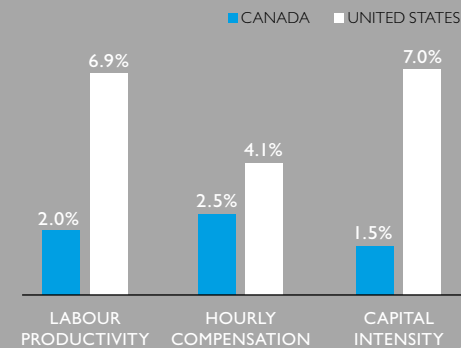
WEIGHT OF FACTORS IN PRODUCTION IN 2014



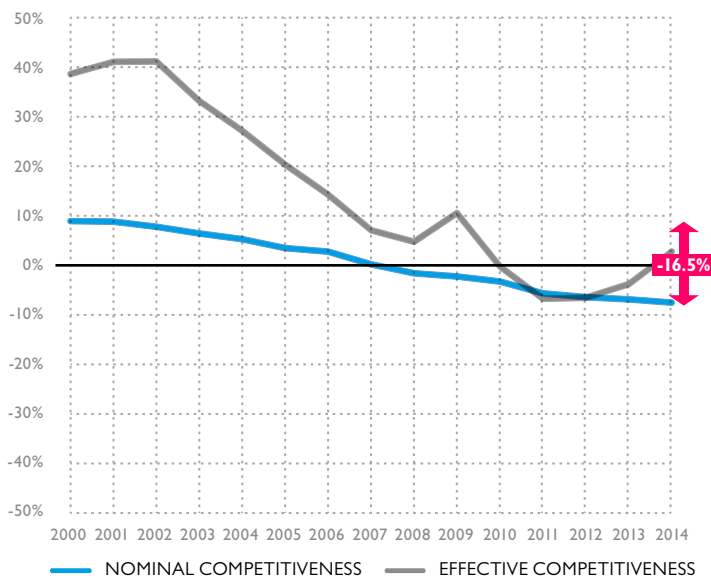
2014 LEVELS (CA\$ / HOUR)



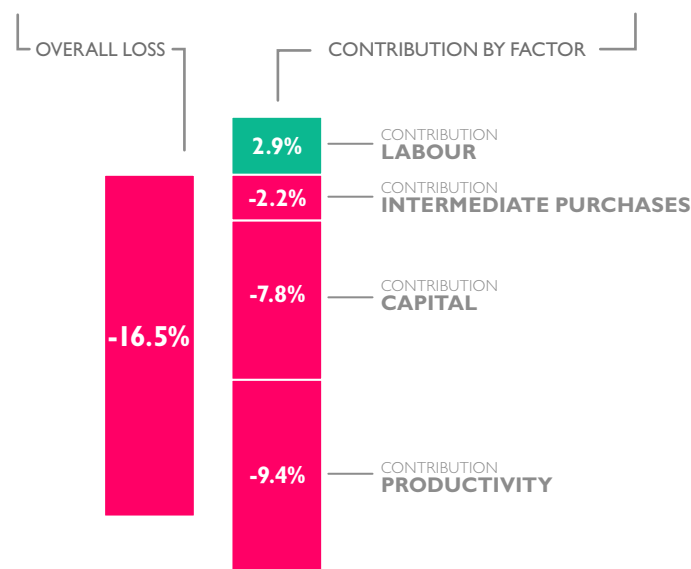
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

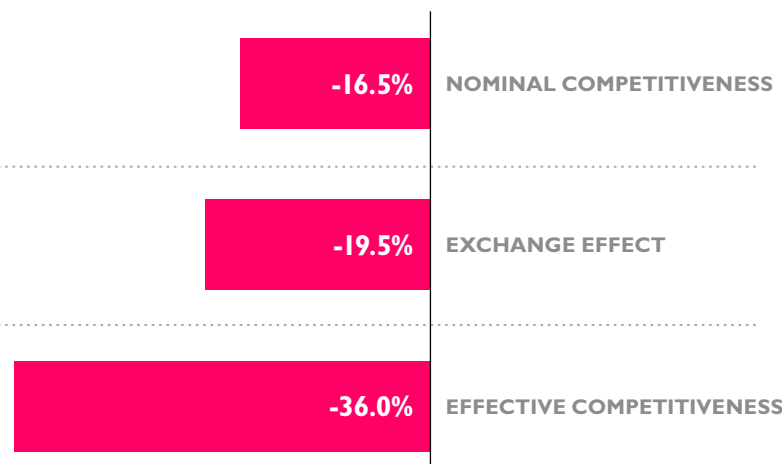


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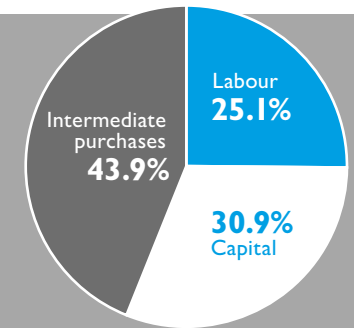
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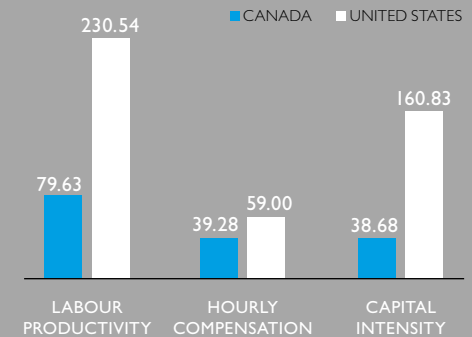
FINANCE, INSURANCE, REAL ESTATE AND RENTING AND LEASING

ECONOMIC CONTEXT

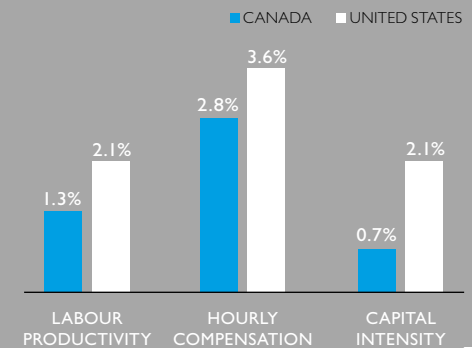
WEIGHT OF FACTORS IN PRODUCTION IN 2014



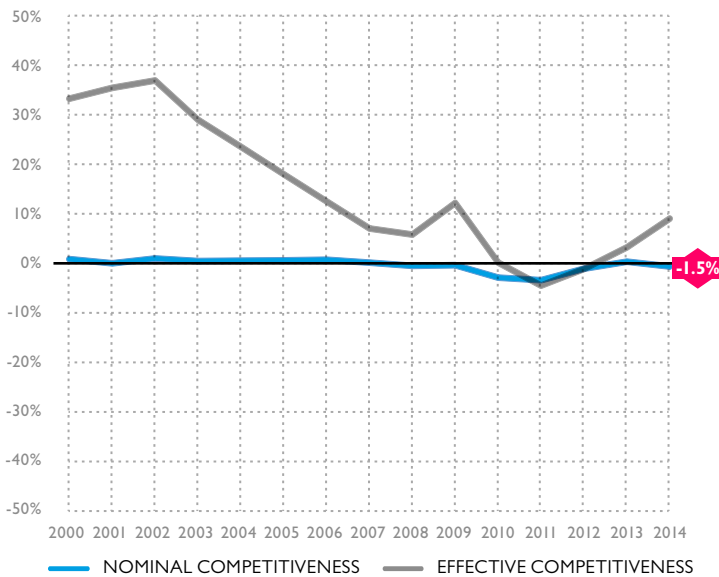
2014 LEVELS (CA\$ / HOUR)



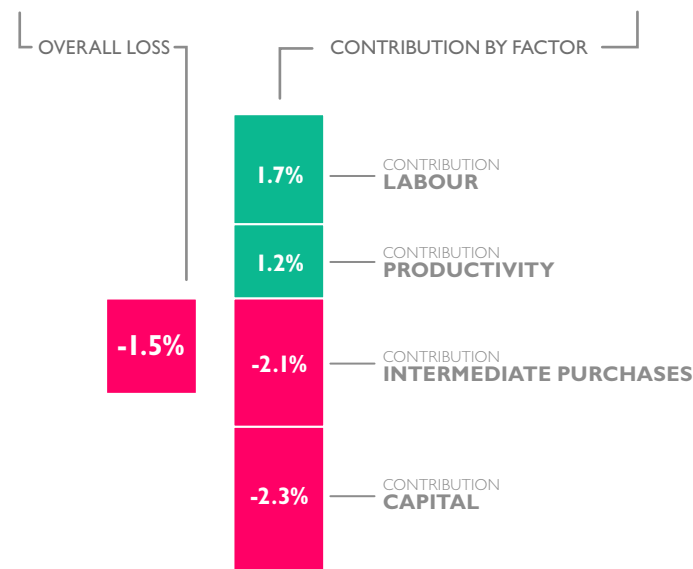
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

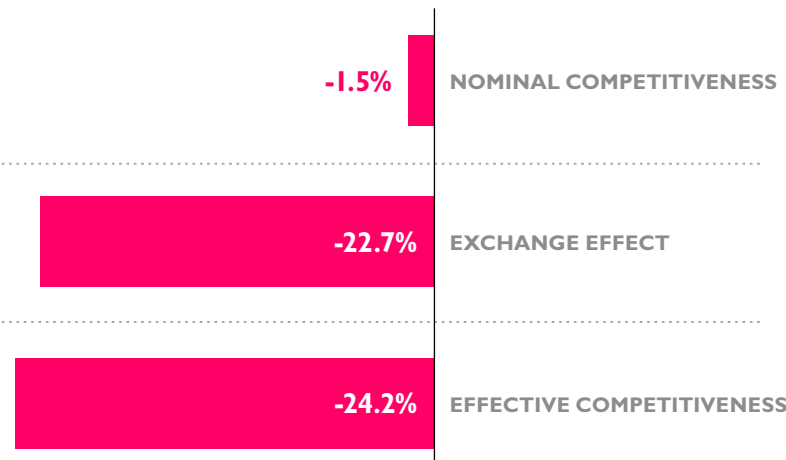


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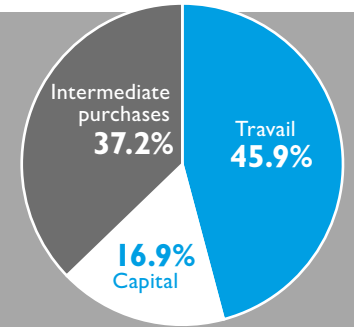
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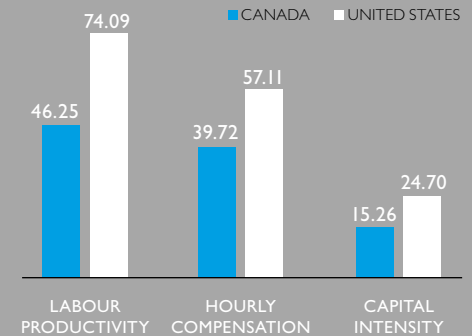
PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES

ECONOMIC CONTEXT

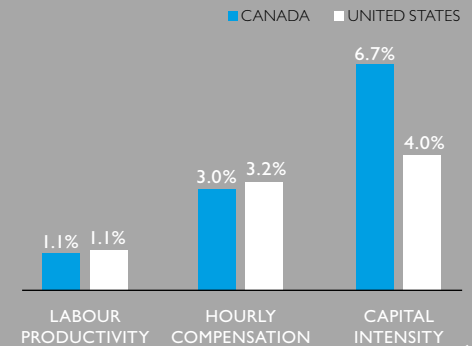
WEIGHT OF FACTORS IN PRODUCTION IN 2014



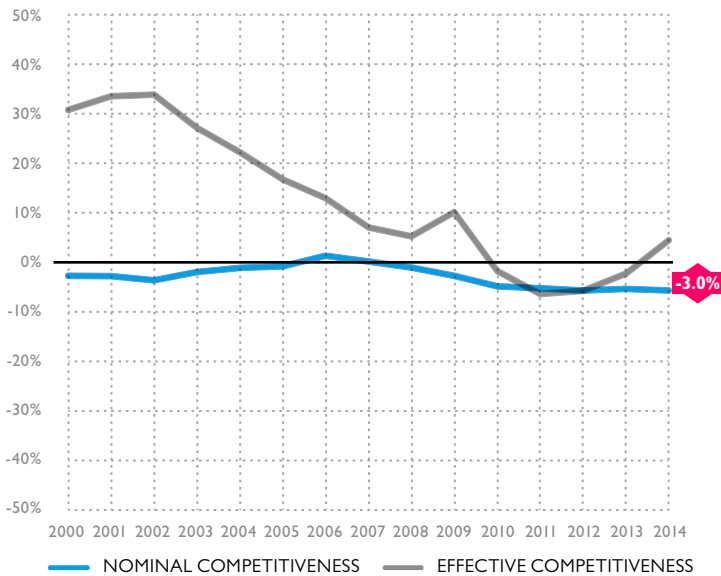
2014 LEVELS (CA\$ / HOUR)



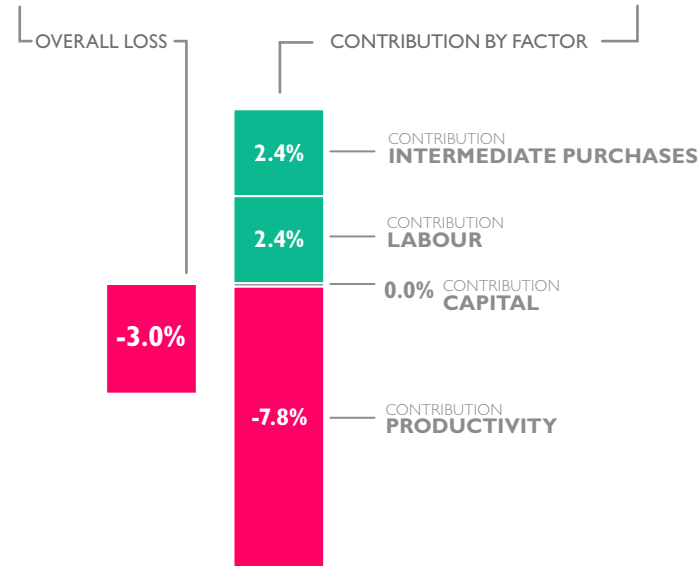
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

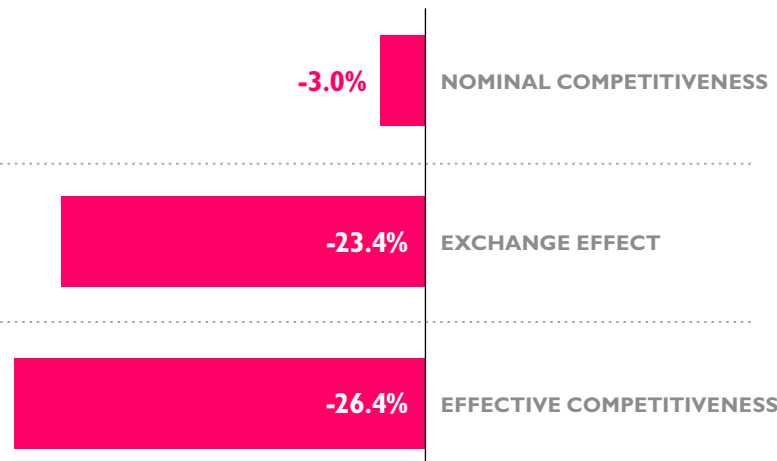


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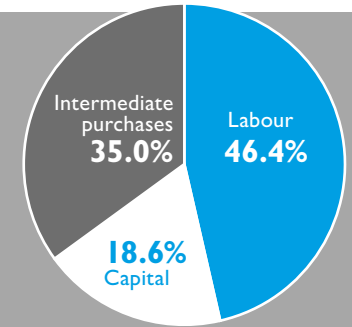
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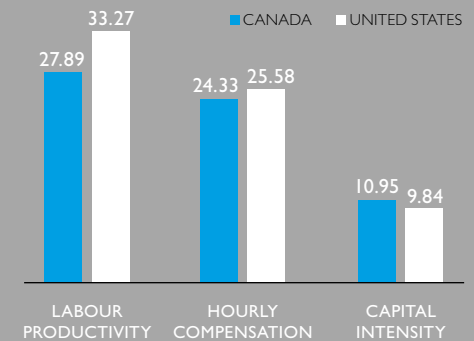
ADMINISTRATIVE AND SUPPORT, WASTE MANAGEMENT AND REMEDIATION SERVICES

ECONOMIC CONTEXT

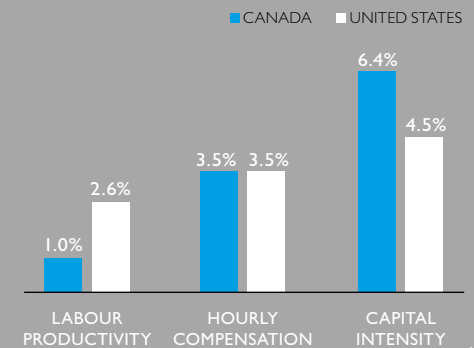
WEIGHT OF FACTORS IN PRODUCTION IN 2014



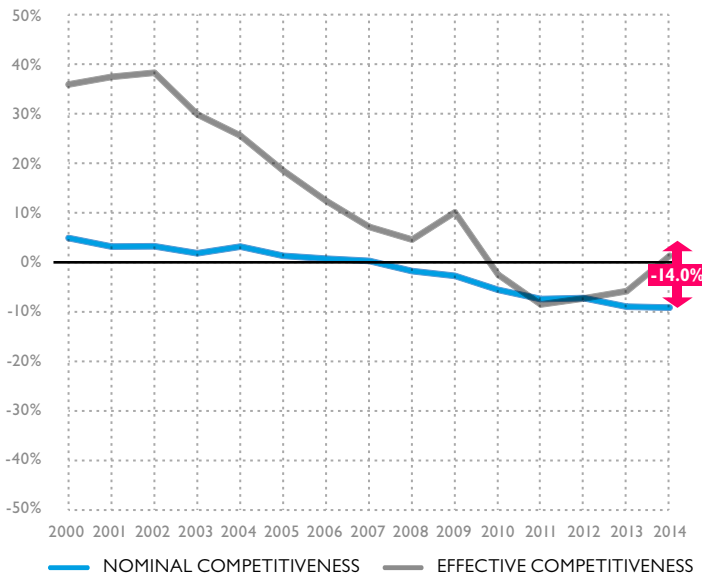
2014 LEVELS (CA\$ / HOUR)



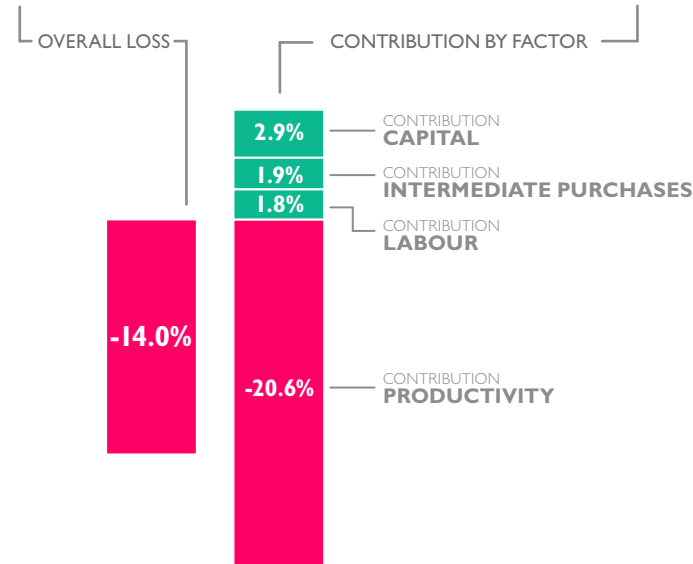
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

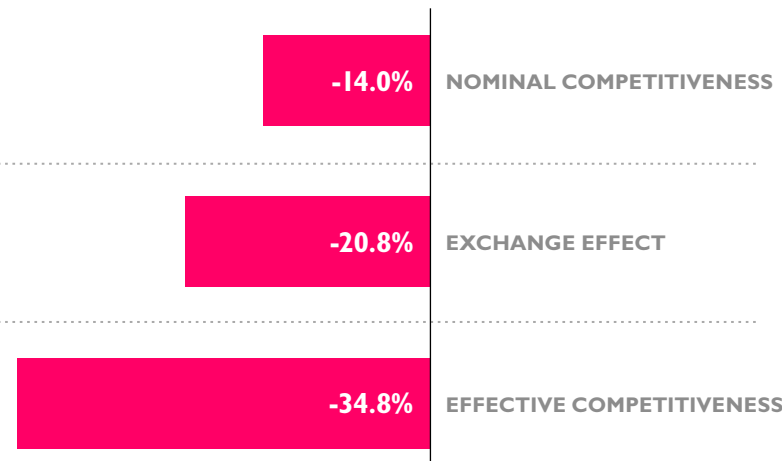


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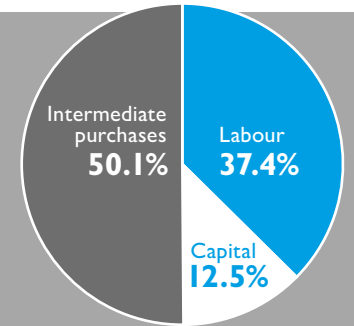
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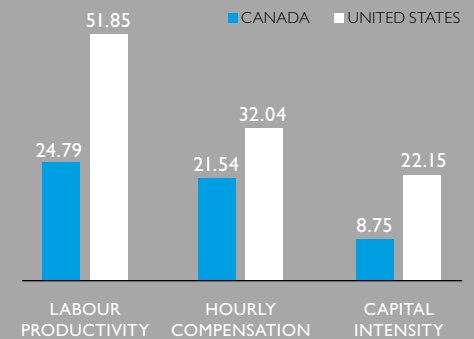
ARTS, ENTERTAINMENT AND RECREATION

ECONOMIC CONTEXT

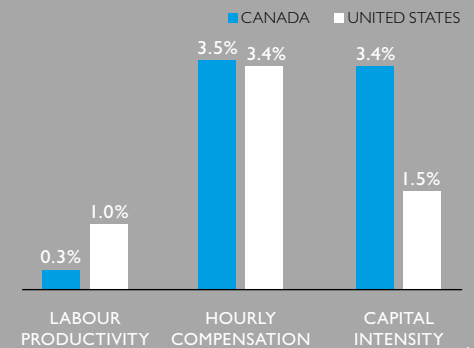
WEIGHT OF FACTORS IN PRODUCTION IN 2014



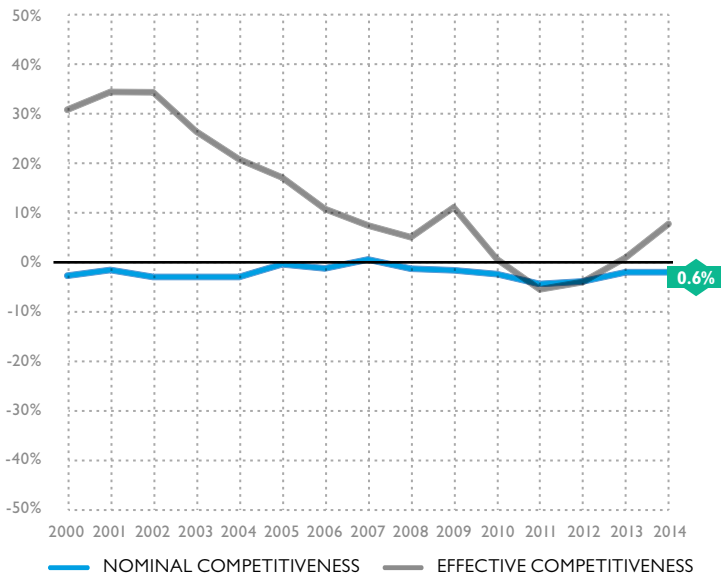
2014 LEVELS (CA\$ / HOUR)



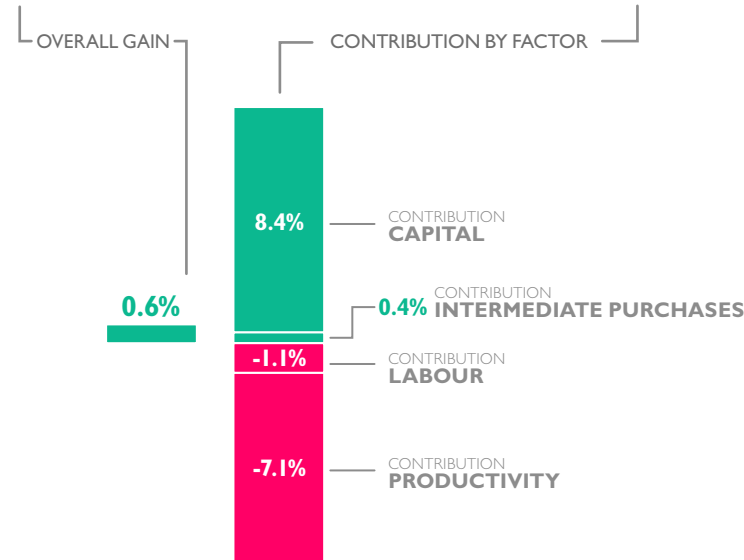
AVERAGE ANNUAL GROWTH 2000-2014



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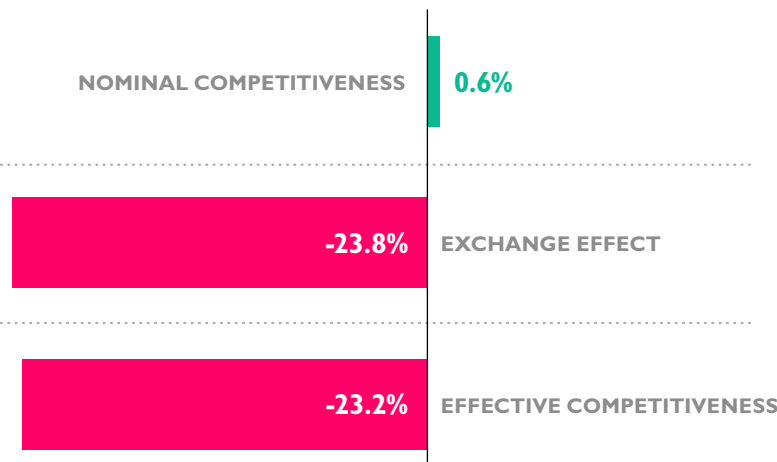


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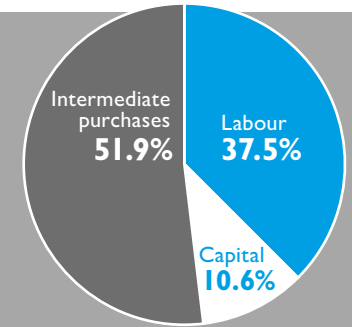
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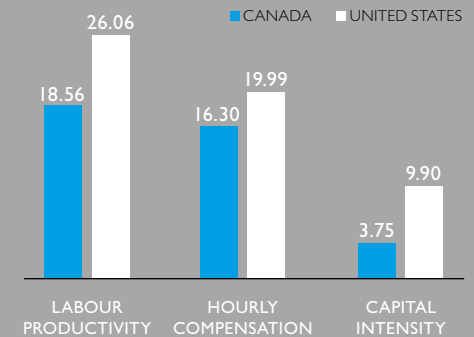
ACCOMMODATION AND FOOD SERVICES

ECONOMIC CONTEXT

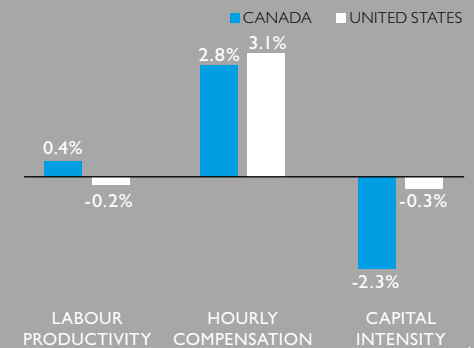
WEIGHT OF FACTORS IN PRODUCTION IN 2014



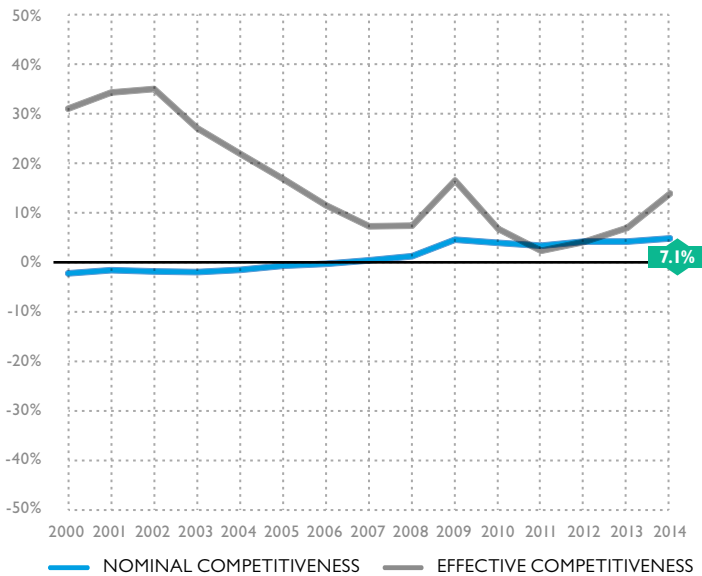
2014 LEVELS (CA\$ / HOUR)



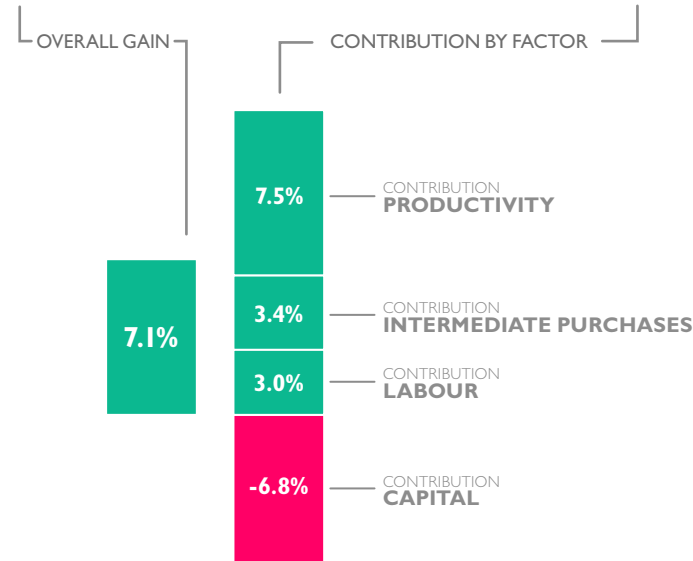
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

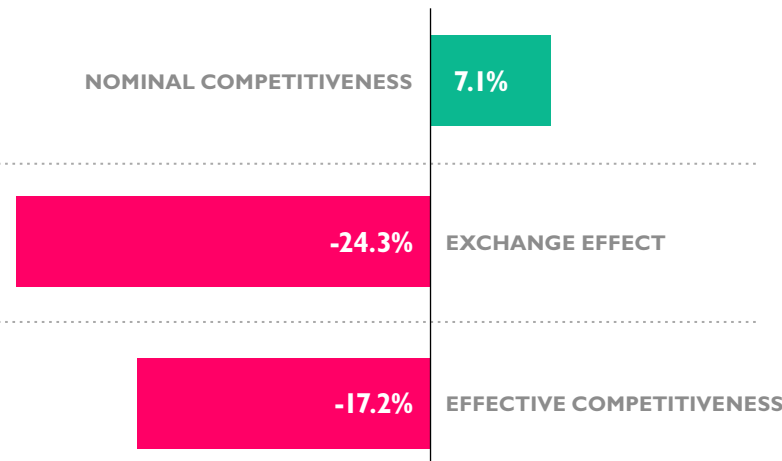


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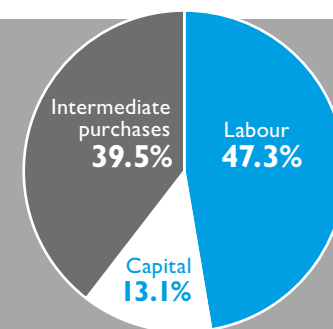
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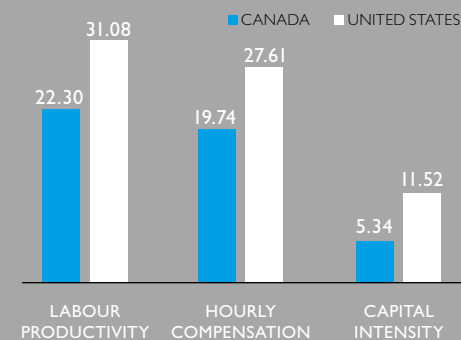
OTHER SERVICES, EXCEPT PUBLIC ADMINISTRATION

ECONOMIC CONTEXT

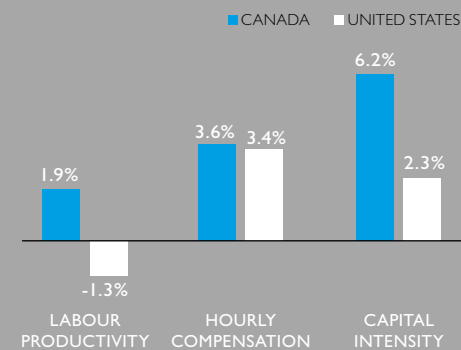
WEIGHT OF FACTORS IN PRODUCTION IN 2014



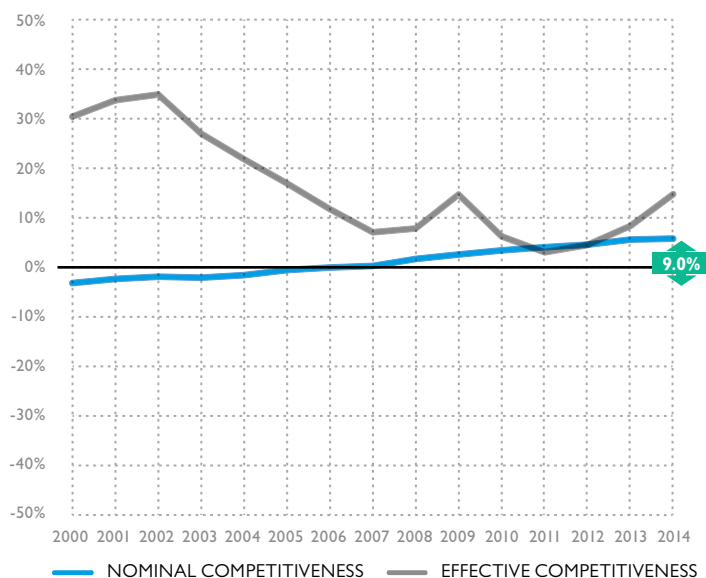
2014 LEVELS (CA\$ / HOUR)



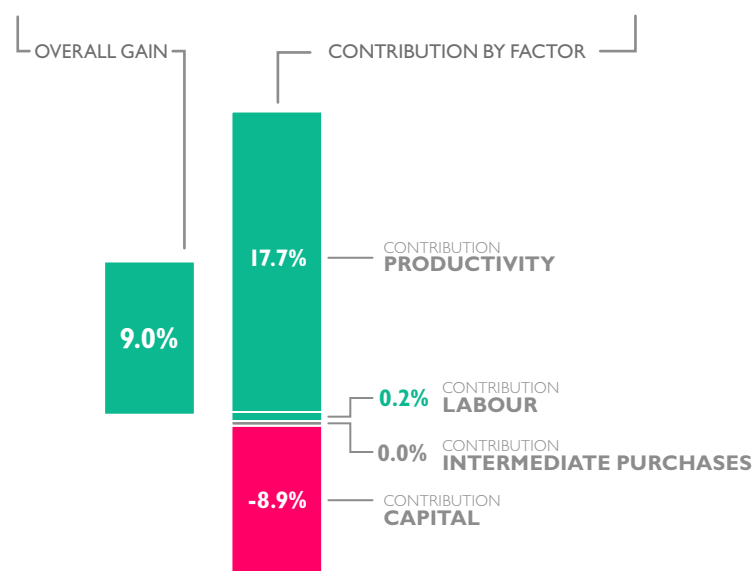
AVERAGE ANNUAL GROWTH 2000-2014



TRENDS IN COMPETITIVENESS



TRENDS IN NOMINAL COMPETITIVENESS

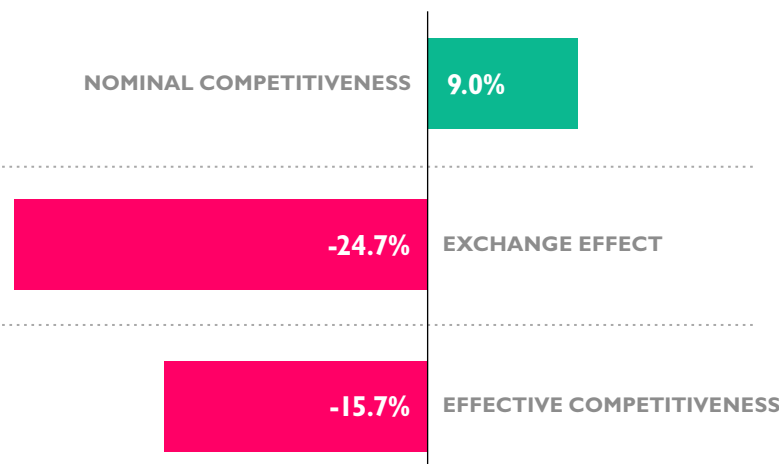


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OVERVIEW OF THE RESULTS

Table 2 (next page) gives an overview of the results obtained, by industry. The left-hand columns show the contribution of inputs and MFP. A green arrow indicates a positive contribution to the industry's competitiveness, whereas a red arrow means a negative contribution. The other columns show to what extent the nominal and effective competitiveness of the industry improved between 2000 and 2014.

HIGHLIGHTS:

- Most (26 out of 34) Canadian industries recorded relative gains in nominal competitiveness between 2000 and 2014. Only 8 industries saw their nominal competitiveness decline.
- Paper manufacturing, wood product manufacturing and agriculture were the only industries that recorded effective competitiveness gains. In other words, the nominal gains achieved by these industries were sufficient to offset the exchange effect.
- Slower growth in the cost of capital input generated competitiveness gains in 26 of the 34 industries analyzed.
- Slower growth in the cost of intermediate purchases led to competitiveness gains in 28 of the 34 industries analyzed. Manufacturing industries automatically benefit from relative changes in the cost of intermediate purchases.
- Only 12 industries achieved competitiveness gains based on relative productivity gains.
- Primary industries all showed competitiveness gains, but none of these gains was based on structural improvement in their competitiveness, in that the gains were never the result of improved productivity.
- Of the 18 industries that make up the manufacturing sector, only the computer and electronic product manufacturing industry recorded a significant decline in competitiveness.
- Paper and wood product manufacturing are the only industries where the contribution of productivity and inputs is consistently positive.
- Half the industries in the service sector reported a loss of competitiveness, while the other half reported small gains in relative competitiveness. The transportation and warehousing industry reported the largest gain, but ranked only 18th out of 34.

TABLE 2

**GROWTH IN CANADA'S COMPETITIVENESS BETWEEN 2000 AND 2014,
BY INDUSTRY AND CONTRIBUTION BY FACTORS**

	LABOUR	CAPITAL	INTERMEDIATE PURCHASES	PRODUCTIVITY	NOMINAL COMPETITIVENESS	EFFECTIVE COMPETITIVENESS
Paper manufacturing	▲	▲	▲	▲	36.7%	4.2%
Agriculture, forestry, fishing & hunting	▲	▲	▲	▼	34.3%	2.5%
Wood product manufacturing	▲	▲	▲	▲	31.9%	0.0%
Petroleum and coal product manufacturing	▼	▲	▲	▼	28.1%	-4.5%
Oil and gas extraction	▼	▲	▲	▼	26.3%	-8.6%
Transportation equipment manufacturing	▲	▲	▲	▼	25.3%	-4.1%
Utilities	▼	▲	▼	▲	23.5%	-7.4%
Chemical manufacturing	▲	▼	▲	▲	22.4%	-6.4%
Plastic and rubber products manufacturing	▼	▲	▲	▲	21.2%	-6.8%
Food, beverage and tobacco manufacturing	▼	▲	▲	▲	20.2%	-7.0%
Primary metal manufacturing	▼	▲	▲	▼	16.3%	-11.0%
Support activities for mining and oil and gas extraction	▼	▲	▲	▼	13.8%	-19.1%
Machinery manufacturing	▼	▲	▲	▼	13.6%	-12.7%
Fabricated metal product manufacturing	▼	▲	▲	▲	13.4%	-13.0%
Textile and textile product mills	▼	▲	▲	▼	12.3%	-13.0%
Electrical equipment, appliance and component manufacturing	▲	▲	▲	▼	12.2%	-13.1%
Mining, except oil and gas	▼	▲	▲	▼	10.8%	-11.5%
Transportation and warehousing	▼	▲	▲	▼	9.9%	-15.6%
Other services, except public administration	▲	▼	▼	▲	9.0%	-15.7%
Non-metallic mineral product manufacturing	■	▼	▲	▲	9.1%	-16.7%
Furniture and related product manufacturing	▼	▲	▲	▼	8.3%	-15.9%
Clothing, leather and allied product manufacturing	▼	▲	▲	▼	8.1%	-15.5%
Accommodation and food services	▲	▼	▲	▲	7.1%	-17.2%
Wholesale trade	▼	▲	▲	▲	6.7%	-16.4%
Construction	▲	▼	▼	▲	5.4%	-19.6%
Arts, entertainment and recreation	▼	▲	▲	▼	0.6%	-23.2%
Finance, insurance, real estate and renting and leasing	▲	▼	▼	▲	-1.5%	-24.2%
Printing and related support activities	■	▲	▲	▼	-1.6%	-25.1%
Retail trade	▼	▼	▼	▲	-2.8%	-24.5%
Professional, scientific and technical services	▲	▲	▲	▼	-3.0%	-26.4%
Miscellaneous manufacturing	▲	▲	▲	▼	-10.0%	-31.1%
Administrative and support, waste management and remediation services	▲	▲	▲	▼	-14.0%	-34.8%
Information and cultural industries	▲	▼	▼	▼	-16.5%	-36.0%
Computer and electronic product manufacturing	▲	▲	▲	▼	-30.8%	-46.6%

DISCUSSION

Generally speaking, the results suggest that the evolution of the exchange rate between 2000 and 2014 had two opposing effects. By gradually bringing production costs to their effective value, the rising Canadian dollar had a direct impact on all Canadian firms, by reducing their **effective competitiveness**. On the other hand, the stronger loonie improved the **nominal competitiveness** of many producers, by reducing the effective cost of inputs purchased abroad¹⁸. While the first effect generally overrode the second, the industries that import more inputs seemingly enjoyed an advantage from the stronger Canadian dollar¹⁹.

This is partly what explains why goods-producing industries and, in particular, those in the manufacturing sector made such a large contribution (Table 3). In that they use more equipment and machinery than industries in the service sector, and require more intermediate purchases for their production, these industries were generally disadvantaged by the value of the Canadian dollar in the early 2000s and hence fell far behind their American counterparts in terms of competitiveness. Once the dollar began rising, the pressure on their production costs eased considerably, and they made substantial gains in nominal competitiveness.

As a result, these industries managed to close the nominal competitiveness gap with the United States even though their relative productivity did not improve. In other words, there was likely a catch-up effect and in fact these industries' competitiveness apparently remains fragile, even though they are responsible for almost all the gains in competitiveness recorded between 2000 and 2014.

On the other hand, industries that required fewer intermediate purchases and where capital was less important were not subject to the same pressures, so their nominal competitiveness was generally higher. This is what we see in most of the service sector industries, but also in some goods-producing industries where the labour input has the largest role²⁰. In the end, their contribution to improving Canada's overall competitiveness was low or even negative – not because they underperformed but because their initial performance was better and their nominal competitiveness was not affected by movements in the exchange rate.

TABLE 3
CONTRIBUTIONS TO GROWTH IN CANADA'S NOMINAL COMPETITIVENESS
BETWEEN 2000 AND 2014, BY SECTOR

	Contribution	Weight
Goods-producing industries	10.1 p.p.	50.5 %
Primary sector	2.4 p.p.	11.7 %
Low-tech manufacturing*	2.5 p.p.	7.3 %
Medium-low-tech manufacturing **	1.8 p.p.	8.3 %
Medium-high-tech and high-tech manufacturing ***	2.4 p.p.	8.7 %
Utilities	0.6 p.p.	1.9 %
Construction	0.4 p.p.	12.6 %
Service sector	-0.2 p.p.	49.5 %
TOTAL	9.9 %	100.0 %

* **Low-tech:** Food, beverages, tobacco, clothing, leather goods, textiles, wood products, paper, furniture and printing.

** **Medium-low-tech:** Petroleum products, plastic and rubber products, non-metallic and metallic mineral products and metals processing.

*** **Medium-high technology and high technology:** Chemical products, machines, electronics, transportation equipment; computers and electronics, pharmaceuticals and drugs, aerospace products.

¹⁸ Based on data from the input-output accounts, it is estimated that at least half of all investments in machinery and equipment were imported.

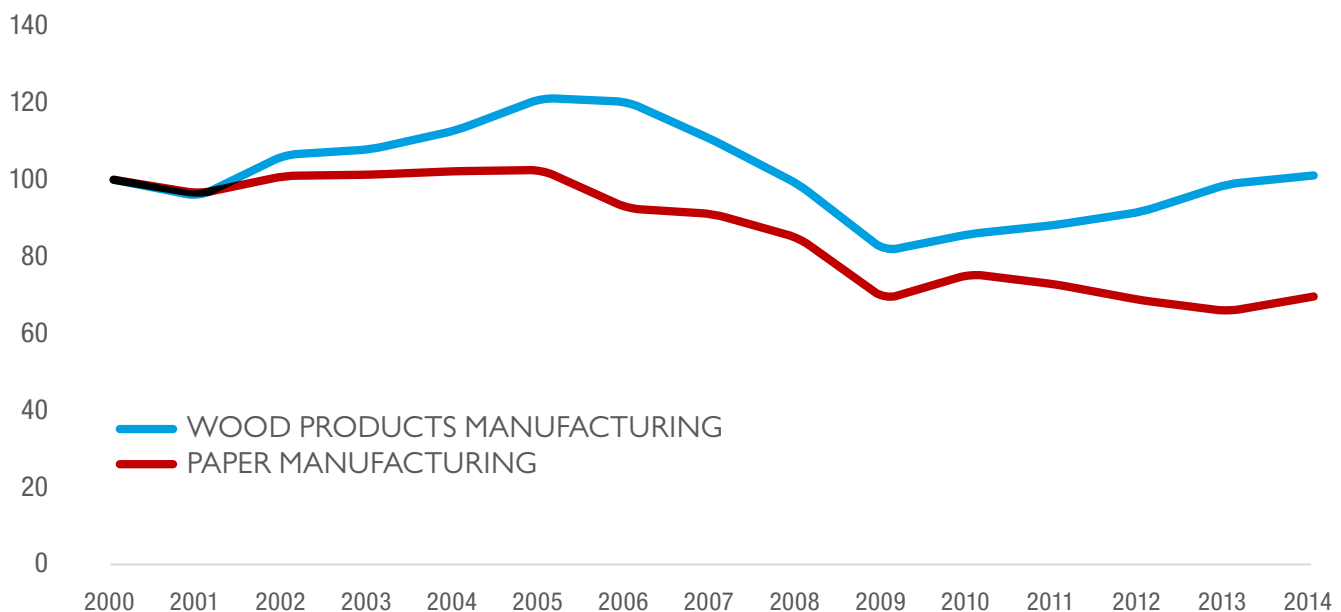
¹⁹ Suppose, for instance, that a Canadian firm must import a tonne of raw materials from the United States, and that the price of the materials remained constant at US\$100 between 2000 and 2014. Considering the changes in the exchange rate, the effective price of this tonne in Canada would have dropped from CA\$154 to CA\$100 between 2000 and 2011. The firm's production costs would have been reduced by the exchange rate, and its nominal competitiveness would have greatly improved

²⁰ This is the case in particular for the clothing manufacturing industry

Looking at the results by sector gives some interesting insights. For instance, gains in competitiveness in the oil and gas extraction industry reflect the close ties between the Canadian dollar and oil prices. When the loonie began rising in 2002, the industry's competitiveness – initially much lower than in the United States – began increasing as well. As the price of oil climbed, the dollar did too, and extraction activities picked up. The unit cost of capital in the industry then fell rapidly, and a significant catch-up began.

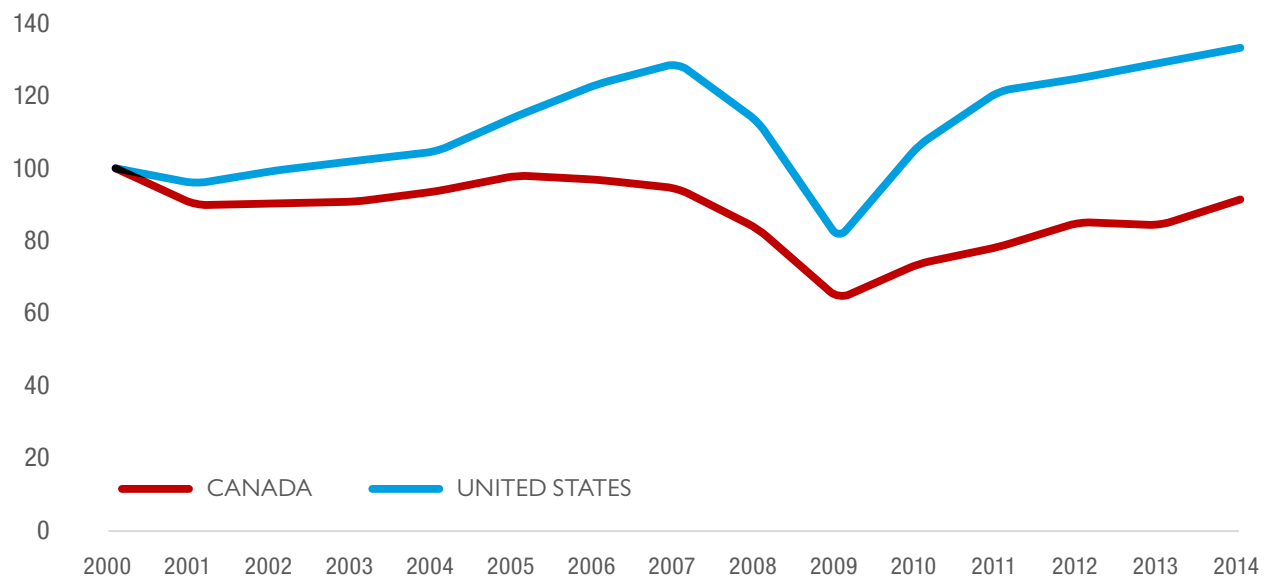
Other results illustrate the changes observed in certain sectors. This is the case for paper and wood product manufacturing, where major gains were made. In both cases, the nominal gains apparently reflect a “skimming off” effect, in that the drop in economic activity (Graph II) apparently led to the removal of less-efficient players. For wood products, 40% of the gains come from faster productivity growth in the industry. Much the same applies for paper manufacturing, where over one-quarter of the gains were generated by improved productivity in the industry.

GRAPH II
EVOLUTION OF REAL GDP IN THE WOOD PRODUCTS AND
PAPER MANUFACTURING INDUSTRIES, 2000-2014
(2000=100)

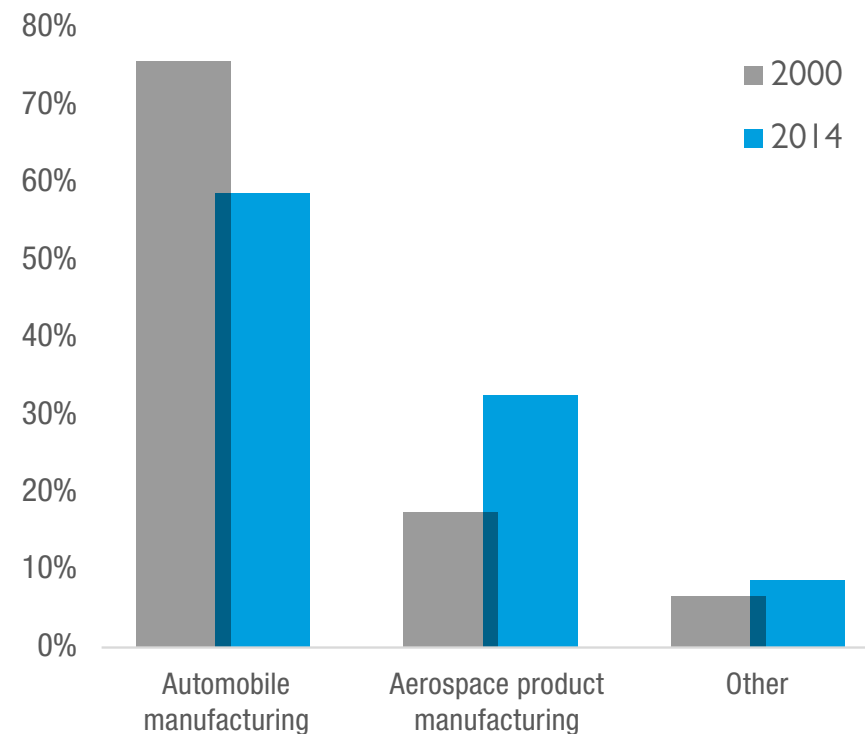


Improved competitiveness in the transportation equipment manufacturing industry also reflects changes in economic activity in this sector. Between 2000 and 2014, the sector's real output decreased slightly in Canada because of a decline in activity in the automobile sector, whereas it grew south of the border (Graph 12). The aeronautics industry then became more important in Canada (Graph 13), which may have helped the sector's overall competitiveness.

GRAPH 12
EVOLUTION OF REAL GDP IN THE TRANSPORTATION EQUIPMENT MANUFACTURING INDUSTRY, 2000-2014
(2000=100)



GRAPH 13
DISTRIBUTION OF GDP IN THE
TRANSPORTATION EQUIPMENT MANUFACTURING INDUSTRY, 2000 AND 2014



CONCLUSION

In the end, the results obtained show that Canadian industries' lack of initiative has considerably undermined their ability to compete on the American market. Having enjoyed a highly advantageous exchange rate for many years and received very little incentive to invest in improving their efficiency, Canadian firms built up a considerable productivity lag in comparison with the United States and their ability to absorb a trade or monetary shock has declined. As a result, many industries are now vulnerable to the threats from Canada's main trading partner, even if the exchange rate once again gives them a significant advantage.

The situation is all the more worrisome in that governments have injected huge sums in the meantime to support economic development. Since these programs did not target productivity in particular, the billions in public funds have been insufficient to prompt firms to prepare themselves for an eventual rise in the value of the Canadian dollar, by improving their efficiency. Little by little, vast parts of the economy have become more fragile, to the point that certain sectors have not been able to cope with the emergence of international competition. This is apparently what happened in the manufacturing sector. Although almost all manufacturing industries recorded large gains in competitiveness between 2000 and 2014, these gains were essentially cyclical and the result of catching up, or skimming off inefficient firms in some cases.

In this context, it is essential that Canadian firms not rely on the weakness of the Canadian dollar once again to stimulate their production. Since the resilience of many industries is dubious, the Canadian economy could be hard hit if the loonie rises again. To improve the competitiveness of their production, Canadian firms must instead aim for greater productivity, one of the few levers at their disposal to improve their ability to withstand factors that are beyond their control.

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METHODOLOGICAL APPENDIX

THEORETICAL FRAMEWORK

The theoretical framework of this report is based on a methodology developed by Jorgenson and Nishimizu (1978), used to explain the relative gaps in production between two countries (Canada and the United States) through the differences observed in production factors and multifactor productivity. These authors assume that production is achieved thanks to a translog function whose main arguments are primary inputs (capital and labour), intermediate inputs and a technology index represented by time²¹.

If we assume that production is characterized by constant returns to scale, we obtain a specific case of the translog function mentioned above, which is none other than the Cobb-Douglas function. If we take an economy consisting of several sectors or industries, the production function for each industry may be represented as follows:

$$\ln Y_i = s_K \ln K_i + s_L \ln L_i + s_M \ln M_i + MFP_i \quad (1)$$

where Y_i is the gross output of industry i , $\{K_i, L_i, M_i\}$ represent respectively the capital input, the labour input and the intermediate inputs in industry i , MFP_i is the multifactor productivity of industry i and lastly $\{s_K, s_L, s_M\}$ are the shares of capital, labour and intermediate goods in the industry's gross output, with

$$s_K + s_L + s_M = 1$$

For a given industry, the average growth rate of production between two consecutive periods may be expressed as a weighted average of the growth rates of production factors and multifactor productivity:

$$\ln Y_{it} - \ln Y_{it-1} = \hat{s}_K [\ln K_{it} - \ln K_{it-1}] + \hat{s}_L [\ln L_{it} - \ln L_{it-1}] + \hat{s}_M [\ln M_{it} - \ln M_{it-1}] + \widehat{MFP}_{it} \quad (2)$$

where $\{\hat{s}_K, \hat{s}_L, \hat{s}_M\}$ are the average shares of capital, labour and intermediate goods in the gross output of industry i between periods t and $t-1$ and $\widehat{MFP}_{it}$ is the average growth rate of multifactor productivity between periods t and $t-1$.

Now, rather than conducting an analysis over two consecutive periods, let us consider instead two economies, i.e. those of Canada and the United States, at a given time t . The difference in logarithmic form of the outputs of each industry may be expressed as a weighted average of the differences observed in inputs (primary and intermediate) and multifactor productivity, using the average compensation proportions of the different inputs in Canada (CA) and in the United States (US) as weighting factors.

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21 The translog production function was conceptualized by Christensen, Jorgenson and Lau (1971, 1973)

More specifically, this gives the following equation:

$$\ln Y_i^{CA} - \ln Y_i^{US} = \bar{s}_K [\ln K_i^{CA} - \ln K_i^{US}] + \bar{s}_L [\ln L_i^{CA} - \ln L_i^{US}] + \bar{s}_M [\ln M_i^{CA} - \ln M_i^{US}] + \overline{MFP} \quad (3)$$

where

$$\bar{s}_K = \frac{1}{2} [s_K^{CA} + s_K^{US}]$$

$$\bar{s}_L = \frac{1}{2} [s_L^{CA} + s_L^{US}]$$

$$\bar{s}_M = \frac{1}{2} [s_M^{CA} + s_M^{US}]$$

$\overline{MFP}$ is the average multifactor productivity gap between Canada and the United States.

If we assume constant returns to scale, one of the conditions necessary to solve the problem of the firm is that both output and input prices must maintain the equality between the nominal value of production and the total expenditures made to acquire these inputs or production factors. If we assume competitive market conditions, it is possible to derive a relative price function from Equation 3, so that we can link the production price of each industry to the prices of its inputs and the multifactor productivity gaps between Canada and the United States.

In order to take account of the effects of the exchange rate on competitiveness, the relative prices of production have been divided by the exchange rate (e) expressed in CA\$ per US\$.

This report introduces two measurements of competitiveness. Differences in effective competitiveness are calculated in keeping with Jorgenson and Nishimizu (1978) and Jorgenson and Kuroda (1995), as follows:

$$\ln RP_i = \bar{s}_K \ln RP_i^K + \bar{s}_L \ln RP_i^L + \bar{s}_M \ln RP_i^M - \ln G_i^{MFP} - \ln e \quad (4)$$

where for each industry i , RP_i is the relative production price, RP_i^K , RP_i^L , RP_i^M are the relative prices of capital, labour and intermediate inputs, G_i^{MFP} is the multifactor productivity gap and $\bar{s}_j = \frac{1}{2} [s_j^{CA} + s_j^{US}]$ is the average compensation proportion of input j in Canada and the United States.

Logically, and unlike the volume of production, increased productivity (e.g. greater production using the same quantities of inputs) will lead to lower prices.

The second measurement named nominal competitiveness ignores the exchange rate effects and is calculated as follows :

$$\ln RP_i = \bar{s}_K \ln RP_i^K + \bar{s}_L \ln RP_i^L + \bar{s}_M \ln RP_i^M - \ln G_i^{MFP} \quad (5)$$

DERIVING THE DIFFERENT SERIES

Equations (4) and (5) give a theoretical framework one can use to measure the effective and nominal competitiveness, respectively, of two economies' industries. Before applying them, however, we must derive price series for industries in each country and the multifactor productivity gap.

I- Deriving relative price series

Before we can compare prices expressed in two different currencies, we must make a conversion and express them in Purchasing Power Parity (PPA) terms. More specifically, this means calculating the relative prices of labour in PPA between Canada and the United States, for example, i.e. the price in CA\$ of a unit of labour that would cost US\$1.00 in the United States. Authors such as Jorgenson and Kuroda (1995) or Kuroda and Nomura (1999) had data at their disposal on the relative prices in PPA of primary and intermediate inputs by industry for the base year, and used them to derive relative prices for other years. Since such data were unfortunately not available, the CPP developed a new approach allowing us to link Canadian price series with those of the United States, using the Relative Unit Costs (RUCs) of inputs.

It is important to note that the data collected cover 34 Canadian and American industries and concern the following variables: nominal series expressed in the currency of the country concerned, such as nominal gross output; labour compensation, cost of capital and the cost of intermediate factors, as well as quantity indices for the real gross output, the labour factor, the capital factor and the intermediate factors. The labour factor is an aggregate measurement of hours worked and an index of workforce composition that measures its quality, i.e. levels of education and professional experience of the workforce. The capital factor, for its part, is an aggregate measurement of the services derived from inventory, land and renewable assets such as equipment and structures. Intermediate factors are an aggregation of energy, materials and services, which enter into the production process of final goods and services.

The Canadian series come from the CANSIM 383-0032 table issued by Statistics Canada, while the American data are from the Bureau of Economic Analysis (BEA) and the Bureau of Labor Statistics (BLS). More specifically, the American data on gross output (nominal and as a quantity index), compensation for production factors (labour, capital and intermediate inputs) and the quantity index for intermediate factors are from the BEA while the quantity indices for the capital and labour factors are from the BLS.

First of all, we must calculate the price series obtained by dividing a nominal variable by a real variable. For each of the Canadian and American industries, the nominal price series were calculated by dividing the compensation of inputs by their quantity indices, as follows:

$$Q_t^j = \frac{\text{Compensation of input } j}{\text{Factor } j}$$

where Q_t^j is the nominal price series for input j , i.e. $\{K, L, M\}$ and $\text{Factor } j$ is the quantity index for input j .

The use of these price series is limited, however, since their levels are not comparable; consequently, only their trends in Canada and the United States can be used. They could be normalized in the form of indices, with 2000 as the base year, using the following equation:

$$P_t^j = \frac{Q_t^j}{Q_{2000}^j}$$

If we proceed in this way, however, the prices of factors in Canada and the United States would be equal in the base year – a strong assumption. To get around this problem, we assume that in 2000 the input prices of each industry in Canada are equal to the RUCs of these inputs. This gives the following equation:

$$P_{2000}^j (CA) = RUC_{2000}^j = \frac{UC_{2000}^j (CA)}{UC_{2000}^j (US)}$$

where $P_{2000}^j (CA)$ is the price of input j (K, L or M) in Canada,

$UC_{2000}^j (CA) = \frac{\text{Compensation of input } j \text{ in 2000 (CA)}}{\text{Gross output in 2000 in 2007 dollars (CA)}}$ is the unit cost of input j in Canada and

$UC_{2000}^j (US) = \frac{\text{Compensation of input } j \text{ in 2000 (US)}}{\text{Gross output in 2000 in 2007 dollars (US)}}$ is the unit cost of input j in the United States.

In the base year, the relative prices of production factors can be expressed as follows:

$$RP_{2000}^j = \frac{RUC_{2000}^j}{P_{2000}^j (US)}$$

For subsequent years, the relative price series can be estimated from the relative price in the base year and the above-mentioned indices of Canadian and American prices. This gives the following equation:

$$RP_t^j = \frac{RP_{2000}^j * P_t^j (CA)}{P_t^j (US)} \quad (6)$$

2- Deriving multifactor productivity

Simply rewriting equation (3) allows us to derive relative multifactor productivity. More specifically, this gives the following equation:

$$\ln G_i^{MFP} = \ln \left(\frac{Y_i^{CA}}{Y_i^{US}} \right) - \bar{s}_K \ln \left(\frac{K_i^{CA}}{K_i^{US}} \right) - \bar{s}_L \ln \left(\frac{L_i^{CA}}{L_i^{US}} \right) - \bar{s}_M \ln \left(\frac{M_i^{CA}}{M_i^{US}} \right) \quad (7)$$

where variables $\{Y, K, L \text{ and } M\}$ represent quantity indices for real gross output, the labour factor, the capital factor and intermediate factors.

AGGREGATION METHODOLOGY

How can we measure the overall competitiveness of one economy in comparison with another? The purpose of this section is to answer this question, which is entirely legitimate and justified when we analyze the competitiveness of industries from different angles. Measurements of competitiveness by industry can be aggregated in two ways to obtain a measurement of the competitiveness of all industries: aggregation by factors, and aggregation through industries.

1- Aggregation by factors

This method consists of first aggregating the measurements of competitiveness of primary and intermediate inputs and those concerning productivity gaps, before calculating the weighted average of the results obtained by applying an equation similar to equations (4) and (5) (except that this equation will apply to all industries or the whole economy). More specifically, this gives the following equation:

$$\ln RP_{economy} = \bar{\alpha}_K \ln RP_{economy}^K + \bar{\alpha}_L \ln RP_{economy}^L + \bar{\alpha}_M \ln RP_{economy}^M - \ln G_{economy}^{MFP} - \ln e \quad (8)$$

where $\bar{\alpha}_j = \frac{1}{2}[\alpha_j^{CA} + \alpha_j^{US}]$ is the average share of the compensation of input j in the aggregate gross output of Canada and the United States; $RP_{economy}^j = \sum_{i=1}^{34} w_i RP_i^j$ is the weighted sum of the relative prices of input j using the weights of Canadian industries in the gross output as weighting factors²² (w_i); and $G_{economy}^{MFP} = \sum_{i=1}^{34} w_i G_i^{MFP}$ is the weighted sum of the multifactor productivity gaps.

2- Aggregation through industries

The second method consists of aggregating measurements of competitiveness through industries, using the weights of Canadian industries as weighting factors. This gives the following equation:

$$RP_{aggregate} = \sum_{i=1}^{34} w_i RP_i$$

where RP_i is the relative production price of industry i . Note that the two aggregation methods lead to comparable results.

22 By using the weight of Canadian industries, we assume that the US economy has the same industrial structure as Canada's. While this assumption simplifies our analysis, it does not qualitatively change the main conclusions of this report, since the two countries have essentially the same level of development. It would be better, however, to use average weights if the competitiveness analysis concerned two countries with very different levels of development, such as a developed and developing country.

CONTRIBUTIONS TO GROWTH METHOD

I- Decomposition by factors method

This method is based on the growth of relative production prices as estimated by the difference in the natural logarithm of relative production prices. We have already expressed the equation for relative production prices as a natural logarithm (Equation 5), so its simple difference between 2000 and 2014 shows the contribution of each factor (labour, capital, intermediate purchases, multifactor productivity) to changes in competitiveness.

$$\begin{aligned} \ln RP_{2014} - \ln RP_{2000} \\ = (\bar{s}_{K_{2014}} \ln RP_{2014}^K - \bar{s}_{K_{2000}} \ln RP_{2000}^K) + (\bar{s}_{L_{2014}} \ln RP_{2014}^L - \bar{s}_{L_{2000}} \ln RP_{2000}^L) \\ + (\bar{s}_{M_{2014}} \ln RP_{2014}^M - \bar{s}_{M_{2000}} \ln RP_{2000}^M) - (\ln G_{2014}^{MFP} - \ln G_{2000}^{MFP}) \end{aligned}$$

Once the contributions have been identified, they are applied to our measurement of changes in competitiveness²³. Thus the contributions by labour, capital and intermediate purchases depend on changes in their relative prices and their average weight in gross output. The contribution of multifactor productivity depends only on changes in the MFP gap.

2- Decomposition by industries method

This method is based on measuring the Canadian economy's competitiveness, expressed as the weighted sum of industries' competitiveness²⁴. The variation in this measurement between 2000 and 2014 shows the contribution of each industry to changes in Canadian competitiveness, using the following equation.

$$\begin{aligned} \Delta \text{Canadian competitiveness gap}_{2014-2000} \\ = \sum_{i=1}^{34} (S_{i,2014} * \text{Competitiveness gap}_{i,2014} - S_{i,2010} * \text{Competitiveness gap}_{i,2000}) \end{aligned}$$

Once the contributions have been identified, they are applied to our measurement of changes in competitiveness. Thus the contribution by industries to changes in Canadian competitiveness depend on changes in their own competitiveness, but also on changes in the industrial structure of the Canadian economy.

23 In this report, competitiveness is shown as the percentage difference between the production price in the United States and the production price in Canada, and is calculated as $1 - \text{relative production price}$. Thus a negative difference means that prices are higher in Canada than in the United States, and hence that the Canadian economy is less competitive.

24 This method uses the competitiveness of industries expressed as the percentage difference between the production price in the United States and the production price in Canada, calculated as $1 - \text{relative production price}$.

SOURCES OF DATA

All the Canadian data come from Statistics Canada, while the American data are from the BEA and BLS. As mentioned earlier, the American data on gross output, compensation for labour, capital and intermediate inputs and the quantity index for intermediate consumption are from the BEA. However, the American series on the quantity indices of capital services and the labour factor come from the BLS.

In considering the measurements of primary factors, for example, i.e. capital and labour, it is important to note that Statistics Canada has made certain improvements to ensure better comparability with American data. Statistics Canada initially measured the capital factor (and capital stock) by simply adding up assets, and aggregated total hours worked to measure the labour factor. But in 2002, Statistics Canada adopted the quality index developed by Jorgenson and Griliches (1967), which makes it possible to take account of the effects of variations in the quality of labour and capital on the growth of multifactor productivity²⁵. The assets used to measure the capital factor now include land and inventory as well as renewable assets, and new depreciation rates take account of the declining value of assets after they are acquired. Thanks to these revisions, the methods used by Statistics Canada to measure these production factors now correspond to those used by the BLS in the United States.

Nonetheless, despite efforts to harmonize data building methods, some differences remain and researchers must consider them in their economic studies and analyses. For instance, in the United States, the BEA evaluates gross output by industry at market prices, while Statistics Canada measures it at basic prices. The difference between these two measurements corresponds to the taxes and subsidies on production factors.

²⁵ See Baldwin and Gu (2013) for more details.