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111 Sparks Street, Suite 500  
Ottawa, Ontario K1P 5B5  
613-233-8891, Fax 613-233-8250  
[csls@csls.ca](mailto:csls@csls.ca)

CENTRE FOR THE  
STUDY OF LIVING  
STANDARDS

THE RELATIONSHIP BETWEEN LABOUR PRODUCTIVITY  
AND REAL WAGE GROWTH IN CANADA AND OECD  
COUNTRIES

CSLS Research Report No. 2008-8  
Andrew Sharpe, Jean-François Arsenault, and Peter Harrison

# The Relationship between Labour Productivity and Real Wage Growth in Canada and OECD Countries

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## Abstract

The most direct mechanism by which labour productivity affects living standards is through real wages, that is, wages adjusted to reflect the cost of living. Between 1980 and 2005, the median real earnings of Canadians workers stagnated, while labour productivity rose 37 per cent. This report analyzes the reasons for this situation. It identifies four factors of roughly equal importance: rising earning inequalities; falling terms of trade for labour; a decrease in labour's share of GDP; and measurement issues. This report also explores the relationship between labour productivity and real wages by province and by sector, as well as in the United States and in other high-income countries.

## Résumé

La productivité du travail affecte les niveaux de vie directement à travers son impact sur les salaires réels, c'est-à-dire les salaires ajustés pour tenir compte de l'inflation sur le pouvoir d'achat. Entre 1980 et 2005, les travailleurs Canadiens ont vu leurs gains médians réels stagnés, alors que la productivité du travail augmentait de 37 pourcent. Ce rapport de recherche analyse les raisons sous-tendant cette situation. Quatre facteurs d'importance à peu près équivalente sont identifiés : la croissance des inégalités salariales; une diminution des termes de l'échange des travailleurs; une diminution de la part du PIB allant à la rémunération des travailleurs; et l'utilisation de mesures inadéquates. Ce rapport de recherche explore aussi le lien entre la productivité du travail et les salaires réels par province et par industrie, ainsi qu'aux États-Unis et dans un nombre pays à revenu élevé.

**Summary:** Between 1980 and 2005, the median real earnings of Canadians workers stagnated, while labour productivity rose 37 per cent. This article analyzes the reasons for this situation and identifies four factors of roughly equal importance for this development: rising earning inequalities; falling terms of trade for labour; a decrease in labour's share of GDP; and measurement issues.

**Keywords:** wages, productivity, inequality, measurement, price indexes, labour unions, capital, profitability.

# The Relationship between Labour Productivity and Real Wage Growth in Canada and OECD Countries

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# The Relationship between Labour Productivity and Real Wages Growth in Canada and OECD Countries

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## Executive Summary

In the long run, the most direct mechanism by which labour productivity affects living standards is through real wages, that is, wages adjusted for changes in the cost of living. Economic theory holds that at the aggregate level the growth of real wages are determined by labour productivity growth, a relationship mediated by the labour's share of output and labour's terms of trade (the price of output relative to the price of goods that workers consume). Neither increases in the labour share nor labour's terms of trade are likely to be a sustainable way of raising real wages because they fluctuate within fairly narrow bands. Only labour productivity growth can raise living standards in the long run. If short- and medium-term changes in the labour share or labour's terms of trade mean that Canadians are not benefitting from higher labour productivity in the form of higher real wages, then why should they support policies to increase labour productivity growth?

The release of data from the 2006 Census has sparked debate over the causes and consequences of the finding that median earnings of individuals working full time on a full-year basis barely increased between 1980 and 2005. Adjusting for inflation, annual earnings increased from \$41,348 to \$41,401 (in 2005 constant dollars), a mere \$53 over 25 years. Over the same time period, labour productivity in Canada rose 37.4 per cent. If median real earnings had grown at the same rate as labour productivity, the median Canadian full-time full-year worker would have earned \$56,826 in 2005, considerably more than the actual \$41,401. These facts do raise an interesting and important question that this report seeks to answer: what accounts for the divergence between the growth of labour productivity and the growth of real wages?

## Framework and Measurement

Economic theory offers a useful toolkit for analyzing the relationship between labour productivity and real wages. In a simple economic model, the relationship between labour productivity growth and the growth of product wages (labour compensation per hour worked, deflated with an output price deflator) is mediated by changes in the share of national income going to labour. If the labour share remains constant, growth in labour productivity should be reflected proportionally in growth in product wages. The relationship between labour productivity growth and the growth of consumption wages (wages deflated with the consumer price index) is mediated not only by changes in the labour share, but also by changes in the relative prices of output and consumption goods, that is, labour's terms of trade.

Yet, the relationship between labour productivity and real wages is fraught with conceptual, definitional and measurement issues. The theoretical relationship between real

wages and labour productivity is a relationship between the total compensation paid to labour and labour productivity. Therefore, when comparing the growth of real wages and labour productivity, it is important that the measure of wages be exhaustive, which means it should particularly include supplementary labour income which encompasses employer contributions to pension plans (private or public), supplementary health benefits, employment insurance (EI) and worker's compensation. Since 1961, supplementary labour income has become increasingly important for Canadian workers, rising from 5 per cent of labour income in 1961 to 13 per cent in 2007.

Since growth in both labour productivity and real wages are real, that is, inflation-adjusted concepts, how current-dollar or nominal estimates of labour compensation are converted into constant-dollar or real values is a significant issue. The growth of consumption wages (nominal wages deflated by the CPI or another consumption deflator) is more directly relevant to living standards than the growth of product wages (nominal wages deflated by the GDP deflator, but is less directly linked to labour productivity growth because of the effects of the terms of trade for labour, that is, the differences between the prices for the goods that workers produce (overall GDP) and the goods that they consume (the basket used to construct the CPI).

### **Trends in Labour Productivity and Real Wages**

Our review of trends in the aggregate relationship between labour productivity and real wages reveals the following key findings:

- In Canada, over the period 1961 to 2007, growth in both product (or producer) wages (1.56 per cent per year) and consumption (or consumer) wages (1.67 per cent), has generally been slightly slower than labour productivity growth (1.73 per cent).
- By definition, the gap between the product wage growth and labour productivity growth reflects trends in the labour share. The labour share thus fell 0.17 per cent per year between 1961 and 2007, from 57.5 per cent of GDP to 53.1 per cent. The fall in the labour share was almost entirely due to developments between 1992 and 1996, when the labour share fell from 57.7 per cent to 54.0 per cent. Over that five-year period, labour productivity increased 1.26 per cent per year while product wages decreased 0.11 per cent per year.
- The gap between the growth in product wages and consumption wages reflects changes in labour's terms of trade, the price of output relative to price of consumption goods. From 1961 to 2007 labour's terms of trade improved slightly, helping to offset the effect of the fall in labour share on the growth in consumption wages. Labour's terms of trade experienced major swings over the period. They improved from 1961 to 1976; declined from 1976 to 2002; then rose from 2002 to 2007.

- In the presence of competitive labour and product markets, there should be no direct relationship between labour productivity growth and growth in real consumption wages at the sector level. Wages are determined at the level of the total economy labour market. Above average labour productivity gains in one sector are reflected in falling relative output prices rather than in higher relative wages. Lower output prices benefit all workers rather than only workers in the sector experiencing above average labour productivity growth.
- In the United States, over the period 1961 to 2007, labour productivity and product wages grew at similar average annual rates, 1.82 per cent and 1.73 per cent respectively. The difference in growth rates resulted from a decline in the labour share of 0.09 per cent per year, from 64.1 per cent of GDP in 1961 to 61.5 per cent of GDP in 2007. Consumption wages, which grew by 1.74 per cent per year between 1961 and 2007, followed product wages very closely, reflecting very little change in labour's terms of trade.
- Between 1970 and 2006, the trend among other high-income countries has been for labour productivity and product wages to grow at almost the same rate. Only three out of 18 countries grew at a rate more than one percentage point different from the unweighted average growth rate of all countries. In the 18 high-income countries examined in this report, labour productivity grew at an unweighted average annual rate of 2.33 per cent, while product wages grew by 2.28 per cent per year, and consumption wages grew by 2.22 per cent per year, albeit for a somewhat smaller set of countries.

### **Explaining the Median Wage Growth/Labour Productivity Growth Gap**

The median real earnings of Canadians barely increased between 1980 and 2005; over the same period, labour productivity rose by 37.4 per cent. This divergence can be explained by four factors: measurement issues, an increase in earnings inequality, a decline in labour's terms of trade, and a decline in labour's share of national income.

The most important measurement issue is the definition of real wages. The labour compensation series from the Canadian Productivity Accounts covers the broadest definition of labour compensation and covers the widest definition of worker. It is therefore used as the measure of real wages in this report. Moving from earnings of full-time full-year workers to labour compensation per hour explains about one-fifth of the real wages and labour productivity growth gap over the 1980-2005 period. This difference is fully explained by the more rapid growth of non-wage labour income including pension benefits, relative to earnings.

Rising earnings inequality, as captured by the difference in average and median real earnings growth, accounts for about one-quarter of the gap. The sources of the significant increase in earnings inequality in Canada since the late 1970s are still under investigation, but any convincing explanation will have to focus on the increasing concentration of income among top earners.

Labour's terms of trade deteriorated significantly from 1980 to 2005, and accounted for 33.3 per cent of the gap between the growth in real median earnings and labour productivity. Three-quarters of this deterioration was the result of the quality-adjusted prices of investment goods rising much more slowly than the Consumer Price Index.

The fall in labour's share of GDP explained the last fifth of the gap between the growth of real median earnings and the growth of labour productivity over the 1980-2005 period. A substantial fall in the labour share occurred during the recession and prolonged stagnation of the first half of the 1990s. The relationship stabilized after 1996, with real wages growing at roughly the same pace as labour productivity. Yet, the ground lost was never made up.

Workers were unable to recover the same share of income they had enjoyed earlier for three key reasons. First, bargaining power was weakened by declining unionization, deregulation, and increased competition from low-wage countries. Second, a boom in commodity prices led to an increased profit share, particularly in resource-related industries. Finally, the structural shift to short-lived assets such as ICT investment goods increased the share of CCA in GDP.

In some sense, this report raises more questions than answers. Further research is required to understand more fully what has driven changes in earnings inequality, labour's terms of trade, and labour's share. Labour productivity growth is the only way to raise living standards in the long run, and real wages are the most direct mechanism to transfer the benefits of productivity growth to Canadians. It is worrying, therefore, that real median earnings failed to increase from 1980 to 2005, while labour productivity grew 37.4 per cent. If most Canadians are not seeing the benefits of labour productivity growth in the form of higher real wages, why should they support policies favouring productivity growth?



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# The Relationship between Labour Productivity and Real Wages Growth in Canada and OECD Countries<sup>1</sup>

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## I. Introduction

### A. Motivation

In the long run, the most direct route by which labour productivity affects living standards is through real wages, that is, wages adjusted for the cost of living. Economic theory holds that at the aggregate level the growth of real wages is determined by labour productivity growth, a relationship mediated by the labour's share of output and labour's terms of trade (the price of output produced by workers relative to the cost of living). Neither a rising labour share nor an improvement in labour's terms of trade are likely to provide a sustainable way of increasing real wages because they fluctuate within fairly narrow bands. Only labour productivity growth can raise living standards in the long run. If changes in the labour share or labour's terms of trade mean that Canadians are not benefitting from higher labour productivity in the form of higher real wages, then why should they support policies to increase labour productivity growth?

To further complicate matters both measurement issues related to wages and income inequality can affect Canadians perceptions of the relationship between labour productivity and real wages. For example, the recent release of data from the 2006 Census has sparked debate over the causes and consequences of the finding that median earnings of individuals working full time on a full-year basis barely increased between 1980 and 2005 (Statistics Canada, 2008a: 6). Adjusting for inflation, annual earnings increased from \$41,348 to \$41,401 (in 2005 constant dollars), a mere \$55 over 25 years. Over the same time period, labour productivity in Canada has risen 37.4 per cent. If median real earnings had grown at the same rate as labour productivity, the median Canadian full-time full-year worker would have earned \$56,826 in 2005, considerably more than the actual \$41,401(2005 dollars).

### B. Organization of the Report

Including this introduction, this report is divided into eight major parts. The second part reviews the literature on the relationship between real wages and a labour productivity. The third part sets out a theoretical framework for analyzing the relationship between labour productivity and real wages. The framework of economic theory offers a useful toolkit for analyzing the relationship between labour productivity and real wages. In a

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<sup>1</sup>Andrew Sharpe is Executive Director of the Centre for the Study of Living Standards (CSLS). Jean-François Arsenault and Peter Harrison are economists at the CSLS. This is the unabridged version of Sharpe, Arsenault and Harrison (2008) and was prepared for Human Resources and Social Development Canada (HRSDC). The authors would like to thank a number of HRSDC officials who provided comments and Cynthia Haggard-Guenette of Statistics Canada for assistance with data. E-mails: andrew.sharpe@csls.ca; jf.arsenault@csls.ca; peter.harrison@csls.ca.

simple economic model, labour productivity is directly related to product wages (labour compensation per hour worked, deflated with an output price deflator) and labour's share of output. The growth of consumption wages (labour compensation deflated with a consumption price deflator like the Consumer Price Index (CPI)) is more directly relevant to living standards, but is less directly linked to labour productivity growth because of the effects of labour's terms of trade, that is, the differences between the prices for the goods that workers produce (as measured by the GDP deflator) and the goods that they consume (as measured by the CPI).

The fourth part deals with the conceptual, definitional, and measurement issues related to wages. This report devotes significant attention to cataloguing these factors and analyzing how they impact the relationship between labour productivity and real wages. While in economic theory wages are a simple concept, reconciling economic theory with the data available is more complex. There are numerous sources of data on labour compensation in Canada and the choice of which series to use has a significant impact on the relationship between labour productivity and real wages.

The fifth part situates the relationship between labour productivity and real wages in the Canadian, provincial, industrial, and international context. For a comprehensive analysis of the relationship between aggregate labour productivity and real wages, it is interesting to examine not only Canada as a whole, but also the relationship at the provincial and industry levels. To gain perspective on how the relationship between labour productivity and real wages has evolved in Canada, it is useful to look outside of Canada. The relationship has evolved differently in different countries. The United States as well as selected member countries of the Organisation for Economic Cooperation and Development (OECD) are examined in this report.

In its sixth part, this report will consider possible explanations for changes in the relationship between labour productivity and median real earnings, one measure of real wages. It begins by reconciling the census finding that the real median earnings of full-time full-year workers have not moved in the past 25 years with the finding in this report that the growth in real wages has generally tracked the growth in labour productivity in Canada. The part then goes on to discuss how labour's terms of trade have evolved. Finally, possible explanations for why real wage growth diverged from labour productivity growth in the 1990s are set out. Once cyclical factors are addressed, structural and long-term factors are discussed. These include commodity prices, the institutional setting for wage bargaining, market competition, technological change, demographic developments and immigration, and inflation and inflation expectations.

The seventh part offers policy implications of the report. The eighth and final part concludes.

## II. Literature Review

The finding that real median earnings in Canada have barely moved in 25 years is only the most recent news in a long-running debate over the relationship between labour productivity and real wages. In Canada, a number of analysts have explored the relationship between labour productivity and real wages. Fisher and Hostland (2002) found that while the relationship was stable over the period 1956 to 2001, labour productivity growth had significantly outpaced real wage growth from 1994 to 2001. These recent developments could potentially call into question the stability of the relationship going forward. They concluded that the divergence in recent years was little cause for concern since labour and non-labour income shares tend to revert to their respective means over the long term. With the benefit of several more years of data, part five of this report largely confirms the findings of Fisher and Hostland and offers possible explanations for the observed divergence between labour productivity and real wages (part six).

In contrast with Fisher and Hostland, Russell and Dufour (2007) argue that the growth of real wages has not kept up with the growth of labour productivity in the long-term, and that the divergence between labour productivity and real wages is thus a legitimate cause for concern. However, they use a narrow measure of labour compensation as a proxy for real wages. Part four of this report argues that such a narrow measure is an inappropriate proxy.

In a 2005 study, Harchaoui and Morissette undertook a similar examination to that attempted in this report, but used the business sector, not the total economy. They looked at the relationship between the changes in productivity, real wages, and income distribution over the period 1981 to 2004. First, they found that much of the difference between the growth rate of labour productivity and the growth rate of product wages occurred in the late 1990s. Second, they found that such a gap had occurred in all other OECD countries examined except the United States. Finally, they concluded that the decline in labour share of non-university educated workers and an increase in the labour share of university education workers in recent years had resulted from technological change.

The Centre for Spatial Economics (2007) explored some of the reasons behind labour's declining share of national income and the policy implications. This study reiterated the observation of Fisher and Hostland (2002) that labour productivity growth had outpaced the growth in real wages since the mid 1990s. The study noted that Canada was not alone in this divergence, but that countries like the United States and United Kingdom, with larger and fast growing information and communications technology sectors had seen larger and more persistent gaps between the growth in labour productivity and real wages. The authors concluded that the decline in Canada's labour share was highly cyclical and would likely be reversed in an economic slowdown. The policy recommendations were to increase competition in labour markets by improving regional and occupational mobility.

When using appropriate measures, studies on the relationship between labour productivity and real wages in Canada seems to concur that the divergence observed since the mid 1990s is cyclical and will be reversed over time. Apart from those studies noted here, there has not been a great deal of recent research on the relationship between labour productivity and real wages in Canada.

Unlike in Canada, the debate over the relationship between real wages and labour productivity in the United States has been vigorous, both among academics and in the mainstream media. Bosworth et al. (1994) noted that two popular measures of the growth in real wages had significantly lagged labour productivity growth, but found that measurement issues explained much of this divergence.<sup>2</sup> This report addresses the issues raised by Bosworth *et al.* and assesses their relevance in Canada (part IV). More recently, Feldstein (2008) re-iterated the importance of taking measurement issues into account. He noted that when correctly measured, real wage growth has kept up with labour productivity growth from 1970 to 2006. His findings are compared with those in this report in part V. There seems to be consensus in the US literature that growth in properly measured real wages has fairly closely followed growth in labour productivity.

This agreement notwithstanding, the debate continues with respect to how changes in income inequality are affecting the relationship between real wages and labour productivity. This relationship is important for living standards. The census findings, which relate to median, reflect the impact of the changing distribution of income in Canada and have implications for the sharing of labour productivity gains. While much research and debate on the relationship between real wages, labour productivity and the distribution of income is underway in the United States,<sup>3</sup> the lack of work in Canada likely offers a fruitful opportunity for further research. This report fills that gap by exploring the relationship between the growth in median earnings and labour productivity growth (part six).

Research on labour and product market deregulation has also tackled the relationship between labour productivity and real wages. Blanchard and Giavazzi (2003) proposed a stylised model where both the labour share and the unemployment rate are a function of firms' mark-up and worker's bargaining power. These latter two variables are in turn assumed to be the result of product and labour market regulations respectively. They show the effect of deregulation in the labour market, arguing that a decrease in worker's bargaining power should lead to a short-term decrease in the labour share and a short-term increase in unemployment. In the long-term, however, their model predicts a return of the labour share to its previous level, as well as a reduction of unemployment below the pre-deregulation level. The authors suggest that their theory is consistent with empirical evidence from European countries (Part V) and thus predict an increase in the labour share and a falling unemployment rate in the years to come.

In the context of the relationship between labour productivity and real wages, the original contribution of this report is three-fold. First, this report offers a more

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<sup>2</sup> This point has been made by others over the years including Walsh (2004), Tatom (2006), and Anderson (2007).

<sup>3</sup> See, for example Dew-Becker and Gordon (2005), Bernstein and Mishel (2007), and Mishel et al (2007).



comprehensive assessment of the link between labour productivity and real wages. It goes beyond the simple relation between product wages and labour productivity to explore how changes in inequality and labour's terms of trade have impacted the relationship. Second, this report also digs below national aggregate data to analyze the relationship between labour productivity and real wages at the provincial and industry levels. Finally, the report discusses in some detail data sources and measurement issues related to studying the relationship labour productivity and real wages in Canada. The work done in these areas opens up an attractive research agenda, discussed in the conclusion.

### III. Frameworks for the Analysis of the Relationship between Labour Productivity and Income

Part III explains the theoretical framework that underpins the analysis of the relationship between labour productivity and real wages in this report. Real wages will be defined and discussed in detail. First, a simple economic model is constructed and theoretical links between labour productivity and real wages are illustrated. Second, labour productivity is linked to real gross domestic product (GDP) per capita, the most common measure of economic performance. Finally, the connection is made between labour productivity and personal income per capita.

#### A. Theoretical and Empirical Perspectives on Labour Productivity and Real Wage Trends

This section has two sub-sections. First, a simple model of the economy is constructed and the link between labour productivity and product wages is demonstrated.<sup>4</sup> The importance of the labour share in the relationship between labour productivity and real wages is highlighted. The second sub-section situates the consumption wage in relation to labour productivity and the product wage. The importance of labour's terms of trade (the GDP deflator relative to the Consumer Price Index) in the relationship between labour productivity and real wages is highlighted.

##### i. A Simple Model of the Relationship between Labour Productivity and Real Wages: the Importance of the Labour Share

In the economy, firms combine labour and capital inputs to produce output. Economists use a simple model to illustrate this process:

$$y = AK^\alpha L^{1-\alpha} \quad (1)$$

Where  $y$  is real output,  $A$  is technology,  $K$  is capital,  $L$  is labour,<sup>5</sup>  $1 - \alpha$  is the share of income (output) going to labour, and  $\alpha$  is the share of income (output) going to capital. This model is called a Cobb-Douglas production function. This functional form embodies a number of assumptions:

- Technological change ( $A$ ) is exogenous. That is, technological change is not determined in this model. The amount of labour or capital in the economy has no impact on technological change.

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<sup>4</sup> A real wage series constructed with a consumption deflator is often referred to as the *consumption wage* or *consumer wage*; a real wage series constructed with an output deflator is referred to as the *product wage* or *producer wage* (Bosworth *et al.*, 1994).

<sup>5</sup> In the analysis of productivity, labour is usually measured in hours worked, a more precise measure of labour than the number of workers, since the average number of hours worked per worker varies over time, among workers, and across countries, provinces, and industries.

- Constant returns to scale. Increasing both factors of production (labour and capital) in equal proportion (say 10 per cent) will result in an equivalent (10 per cent) increase in production. This assumption is satisfied as long as  $0 < \alpha < 1$ .
- Diminishing returns to each factor input. Increasing one factor of production, while holding the other constant will lead to a declining marginal product of the factor being increased. For example, one worker (labour) farms a small plot of land (capital). Adding an extra worker will not double production unless the size of the plot is doubled. At some point adding more workers will result in only a small amount of additional production, because there is only so much a worker can do to a piece of land to extract agricultural output.

Taking the derivative of Equation (1) with respect to labour illustrates this point.

$$\frac{\partial y}{\partial L} = \frac{AK^{\alpha(1-\alpha)}}{L^{\alpha}} \quad (2)$$

Since the numerator will be positive ( $\alpha < 1$ ) and labour is in the denominator of the fraction, increasing the quantity of labour decreases labour's marginal product.

- Perfect competition. Labour and capital can compete freely, and the costs of transactions are immaterial. The marginal revenue product (marginal product multiplied by the price of the output) of each factor of production is equal to its compensation. Each firm will, for example, hire labour until such a point that the marginal product generated by the next hour of work is equal to the cost of that hour. Using Equation (2), we can now link the marginal product of labour ( $MP_{labour}$ ) to the real wage:

$$\frac{\partial y}{\partial L} = MP_{labour} = w \quad (3)$$

where  $w$  is the real wage (expressed in terms of compensation to labour in units of output that the labour has helped to produce, referred to in this report as the "product wage").

In a world where perfect competition does not exist, labour does not earn its marginal product, but its marginal revenue product (MRP), that is, the additional revenue that the last hour of labour generates. Multiplying Equation (1) by the price of output,  $P_Y$ , yields

$$Y = P_Y AK^{\alpha} L^{1-\alpha} \quad (4)$$

where  $Y$  is output measured in current dollars (nominal output). The marginal revenue product of labour is

$$\frac{\partial Y}{\partial L} = \frac{P_Y AK^{\alpha(1-\alpha)}}{L^{\alpha}} = MRP_{Labour} = P_Y w = W \quad (5)$$

where  $W$  is the nominal wage, expressed in current dollars per hour worked, as opposed to the real wage,  $w$ , which was expressed in units of output. In order to convert nominal wages to real wages, divide by the price of output,  $P_Y$ :

$$\frac{W}{P_Y} = w \quad (6)$$

Labour productivity is measured as the real average product of labour, that is, real output  $y$ , divided by  $L$ , the number of hours worked.

$$\text{Labour productivity} = \frac{y}{L} \quad (7)$$

Substituting from Equation (1) into Equation (7) yields

$$\text{Labour productivity} = A \left( \frac{K}{L} \right)^\alpha = \gamma \quad (8)$$

In a world with constant returns to scale, as assumed by the standard economic model outlined above, the marginal product and average product of labour are always equal, therefore

$$w = A \left( \frac{K}{L} \right)^\alpha \quad (9)$$

We also know that total compensation is the product of the nominal wages per hour worked  $W$  and the total number of hours worked  $L$  is equal to the total compensation of labour  $Y_L$ :

$$W \times L = Y_L \quad (10)$$

$$\text{Labour share} = \frac{Y_L}{Y} = 1 - \alpha = \varphi \quad (11)$$

Dividing the numerator and denominator of Equation (10) by  $P_Y$ , the price of output, and  $L$ , the number of hours worked yields

$$\frac{\left( \frac{W \times L}{P_Y \times L} \right)}{\left( \frac{Y}{P_Y \times L} \right)} = \frac{w}{\left( \frac{Y}{L} \right)} = \frac{\text{Real product wage}}{\text{Labour productivity}} \quad (12)$$

Therefore

$$\text{Labour share} = \varphi = \frac{\text{Real product wage}}{\text{Labour productivity}} \quad (13)$$

Multiplying both sides of Equation (13) by labour productivity, and then taking logs and time derivatives

$$\Delta \text{Real product wage} = \Delta \text{Labour share} + \Delta \text{Labour productivity} \quad (14)$$

Where  $\Delta$  indicates a percentage change in a variable. We see that changes in product wages are fully explained by changes in the labour share and in labour productivity. This point will be returned to in part IV.

There are several points to note from this discussion of basic economic theory:

- In Equation (12),  $P_Y$  is the price of the product that the worker has produced. This feature of the model is crucial to understand the relationship between labour productivity and real wages. The marginal product of labour will only equal the real wage if the nominal wage is divided by the price of the product, not some other price. This point will be examined in detail in the next sub-section as well as in part IV using relevant data.
- All income  $Y$  (which is equal to the nominal value of output from production) in the economy goes to either labour or capital, that is, as economists say, the “product is exhausted.” There is nothing left over. In this sense, the nominal wage  $W$  can be interpreted as the complete compensation of labour, not simply a salary. This point will also be examined in detail using relevant data in part IV.
- This model holds in equilibrium, that is, a long-run steady state. In practice the economy may deviate from a steady state and may take some time to return to a steady state (Fisher and Hostland, 2002: 65).
- This model is intentionally simple in order to illustrate the direct relationship between labour productivity and product wages. This simplicity has the disadvantage that many important economic issues are excluded. For example, the more complex general equilibrium model constructed by Blanchard and Giavazzi (2003) allows for analysis of the impact of unions and other labour and product market regulation on the relationship between labour productivity and product wages. While this model is simple, part V of the report goes beyond the model to consider a comprehensive set of hypotheses for the changing relationship between labour productivity and product wages.

This section has used standard economic theory to describe a direct relationship between labour productivity, product wages, and the labour share. The factors that influence the relationship between product wages and labour productivity, that is, factors that change labour share are explored in part V. While changes in labour share are important in understanding the relationship between labour productivity and real wages, they are only part of the story. Product wages are not necessarily a good indicator of the standard of living. The next section describes why consumption wages are a better measure of inflation-adjusted labour compensation when the objective is to analyze living standards.

## ii. The Relationship between Labour Productivity and Consumption Wages: the Importance of Labour's Terms of Trade<sup>6</sup>

The consumption wage (consumer wage) is the term used in this report for labour compensation deflated by the Consumer Price Index (CPI) or another consumption deflator, which measures changes in the price of consumption goods. Consumption wages more accurately reflect the purchasing power of labour compensation than product wages, because workers do not consume the same goods that they produce. This section explores the relationship between labour productivity and consumption wages, a relationship that depends on labour's terms of trade.

Labour's terms of trade are a measure of how shifts in the relative prices of consumption goods and output affect the consumption wages of workers. Improving terms of trade mean that the goods that workers produce are increasing in price more rapidly than the goods that workers consume. All else being equal, improvements in labour's terms of trade are good for workers, because they result in higher consumption wages.

An accounting identity relates consumption wages to labour productivity, and by extension, to product wages.

$$\frac{Y_L}{P_C \times L} = \frac{Y}{P_Y \times L} \times \frac{Y_L}{Y} \times \frac{P_Y}{P_C} \quad (15)$$

Where  $P_C$  is the price of consumption goods, measured by the CPI or other consumption deflator. The other variables have previously been introduced:  $Y$  is nominal output (GDP),  $Y_L$  is total nominal labour compensation,  $L$  is hours worked, and  $P_Y$  is the GDP deflator.  $\frac{Y_L}{P_C \times L}$  is the consumption wage;  $\frac{Y}{P_Y \times L}$  is labour productivity;  $\frac{Y_L}{Y}$  is the labour share; and  $\frac{P_Y}{P_C}$  is labour's terms of trade. The relationship becomes simpler after taking logs and time derivatives of equation (15):

$$\Delta \text{Consumption wage} = \Delta \text{Labour productivity} + \Delta \text{Labour share} + \Delta \text{Labour's terms of trade} \quad (16)$$

And note that substituting equation (14) into equation (16) yields the direct relationship between the consumption wage and the product wage, which is also affected solely by labour's terms of trade:

$$\Delta \text{Consumption wage} = \Delta \text{Real product wage} + \Delta \text{Labour's terms of trade} \quad (17)$$

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<sup>6</sup> Labour's terms of trade should not be confused with the related but narrower concept of terms of international trade. The terms of international trade relate changes in the price of exports to changes in the price of imports. If export prices increase faster than import prices, a country's terms of international trade are said to have improved. Summary Table 16, in part IV, provides an accounting explanation of how Canada's international terms of trade have affected the terms of trade of Canadian workers.

Intuitively equation (17) tells us that changes in consumption wages are determined by the changes in how much labour produces and changes in how much of the product of labour can be exchanged for each unit of consumption.

## B. The Relationship between Labour Productivity and Gross Domestic Product Per Capita

While this report focuses on real wages as a measure of living standards, real wages are not the only, and certainly not the most common, measure of economic performance, although they are the measure most directly related to labour productivity. This section explores the relationship between GDP per capita, perhaps the most widely used and well known measure of living standards, and labour productivity.

GDP per capita is real output  $y$  divided by population  $Z$ :

$$GDP \text{ per capita} = \frac{y}{Z}$$

As above, labour productivity is real output  $y$  divided by hours worked  $L$ :

$$Labour \text{ Productivity} = \frac{y}{L}$$

The average hours worked per employed person per week is the total hours worked by all employed people in the economy  $L$  divided by the total number of employed people in the economy  $N$  divided by 52 weeks:

$$Average \text{ Hours Worked per Employed Person per Week} = \frac{\frac{L}{N}}{52}$$

The employment/population rate is the number of employed people  $N$  divided by the total population  $Z$ :

$$Employment/Population \text{ Rate} = \frac{N}{Z}$$

Mathematically, GDP per capita can be separated into three components as follows:

$$\frac{y}{Z} = \frac{y}{L} \times \frac{L}{N} \times \frac{N}{Z} \tag{18}$$

Equation (18) says that GDP per capita is the product of labour productivity (real output per hour worked), average hours worked per employed person, and the employment/population rate (proportion of the population that is employed).

**Summary Table 1: The Relationship between Real GDP per capita and Labour Productivity in Canada, 1961-2007**

	Real GDP per Capita	Labour Productivity (Real Output per Hour Worked)	Average Hours Worked per Week	Employment/Population Rate
	y/Z	y/L	L/N/52	N/Z*100
<b>Levels</b>				
	(chained 2002 dollars)		(hours)	(per cent)
	A=B*(C*52)*(D/100)	B	C	D
1961	14,512	20.20	39.10	35.34
1973	21,987	28.81	35.93	40.85
1981	26,118	31.91	34.18	46.05
1989	30,268	34.96	34.19	48.70
2000	35,909	41.36	34.00	49.11
2007	40,134	44.43	33.38	52.04
<b>Compound Average Annual Growth Rates (per cent)</b>				
	A=B+C+D	B	C	D
1961-2007	2.23	1.73	-0.34	0.84
1961-1973	3.52	3.00	-0.70	1.22
1973-1981	2.17	1.29	-0.62	1.51
1981-1989	1.85	1.15	0.00	0.70
1989-2000	1.57	1.54	-0.05	0.08
2000-2007	1.60	1.03	-0.26	0.83
<b>Relative Contribution to the Growth Rate of GDP per Capita (per cent)</b>				
	A=B+C+D	B	C	D
1961-2007	100.00	77.5	-15.4	37.9
1961-1973	100.00	85.4	-20.0	34.6
1973-1981	100.00	59.2	-28.6	69.3
1981-1989	100.00	61.9	0.2	37.9
1989-2000	100.00	98.5	-3.3	4.9
2000-2007	100.00	64.3	-16.3	52.0

Sources:

[A]-[C]-[D]: Appendix Table 8

[B]: Appendix Table 1

Taking logs and time derivatives of equation (18) yields a decomposition of the percentage change in GDP per capita into percentage changes in labour productivity, average hours worked per week, and the employment-population rate.

$$\begin{aligned}
 \Delta GDP \text{ per capita} &= \Delta Labour \text{ Productivity} \\
 &+ \Delta Average \text{ Hours Worked per Week} \\
 &+ \Delta Employment/Population \text{ Rate}
 \end{aligned}
 \tag{19}$$



Summary Table 1 demonstrates this decomposition using Canadian data for the 1961-2007 period and cyclically neutral sub-periods. It provides estimates of the levels and growth rates of GDP per capita, labour productivity, average hours worked per week, and the employment/population rate as well as the contribution of these latter three factors to GDP per capita growth.

Over the entire period 1961-2007, labour productivity growth accounted for most of the growth in GDP per capita, 77.5 per cent. Average hours worked had a negative impact of 15.4 per cent, while increased employment/population rate contributed 37.9 per cent. Labour productivity made the greatest relative contribution to the growth in GDP per capita in the period 1989-2000, 98.5 per cent, and the smallest contribution in the period 1973-1981, just 59.2 per cent. It is also notable that the 1980s (1981-1989) was the only time when Canadians saw the length of their average work week increase, reflected in the small positive contribution of 0.2 per cent from average hours worked per week to growth GDP per capita.

Over every period examined, the employment/population rate contributed to growth in GDP per capita. In the final period, 2000-2007, the increasing number of jobs in Canada accounted for half of the increase in GDP per capita. In the future, the scope for increase the employment/population rate will be reduced, since a great social phenomenon of the latter half of the twentieth century, the entry of women and the baby boom cohort into the paid work force, has run its course. Therefore, unless Canadians are willing to work longer hours, the only source of growth in GDP per capita will be growth in labour productivity.

### **C. Key Points**

Part III has explained the theoretical framework that underpins the analysis of the relationship between labour productivity and real wages in this report. First, a simple economic model was constructed and theoretical links between labour productivity and real wages were illustrated. This part of the report acknowledged the limitations of this model and noted that hypotheses about the changing relationships between labour productivity and product wages presented in part VI would go beyond the simple model presented here.

While important measures of economic well-being, real wages and labour productivity are not the most common. The second section of this part explained the relationship between labour productivity real GDP per capita. Fundamentally, in the future, labour productivity growth will increasingly underpin economic growth as older workers leave the labour force and/or reduce their hours of work.

## IV. Understanding the Relationship between Labour Productivity and Real Wages: Conceptual, Definitional and Measurement Issues

Conceptual, definitional, and measurement issues associated with the relationship between labour productivity and real wages can be organized into four general areas:

- labour input,
- nominal wages,
- nominal output, and
- deflators.

From part III, recall that

$$\Delta \text{Consumption wage} = \Delta \text{Labour productivity} + \Delta \text{Labour share} + \Delta \text{Labour's terms of trade}$$

Recall equation (15), which reflects the underlying relationship:

$$\frac{Y_L}{P_C \times L} = \frac{Y}{P_Y \times L} \times \frac{Y_L}{Y} \times \frac{P_Y}{P_C}$$

where  $Y_L$  is the sum of all wages paid,  $P_C$  is the Consumer Price Index (CPI),  $L$  is total hours worked in the economy,  $Y$  is nominal output, and  $P_Y$  is the GDP deflator. Therefore,  $\frac{Y_L}{P_C \times L}$  is the consumption wage,  $\frac{Y}{P_Y \times L}$  is labour productivity,  $\frac{Y_L}{Y}$  is labour share of output, and  $\frac{P_Y}{P_C}$  is labour's terms of trade.

This part of the report discusses conceptual, definitional and measurement issues related to each of these four elements and how these issues affect the relationship between labour productivity and real wages.

Before discussing the four elements listed above, it is important to be clear that this report uses the total economy as the basis for analyzing the relationship between labour productivity and real wages. In the analysis of labour productivity it is very common to use the business sector, because it is difficult to measure the output of the non-business sector, which is not sold in the marketplace. Indeed, Feldstein (2008), in a recent paper on the relationship between labour productivity and real wages uses the US non-farm business sector. The principal reason that this report uses total economy is that wages are determined in the total economy through the labour market. The labour market involves both the business sector and the non-business sector as buyers of labour. In this sense, the most direct and meaningful relationship between aggregate labour productivity and wages is at the level of the total economy.

## A. Labour Input

A measure of labour input is required to produce both wage and labour productivity statistics. The most important issue is whether workers or hours worked is a more appropriate measure of labour input. A secondary issue is whether differences in quality between workers should be reflected in measures of labour input in the measurement of labour productivity, and if so, how?<sup>7</sup>

### i. Hours Worked vs. Workers

Over a year, labour input can either be measured in terms of the average number of workers or in terms of the total number of hours worked. The total number of hours worked in a year is more appropriate for the analysis of real wages and labour productivity, because it represents a more precise measure of labour input than persons employed or weeks worked.

The growth rates of output or wages per worker and output or wages per hour may differ when there is a change in the average hours worked per worker over time. Indeed, historically the large fall in average working time has meant that output per hour has grown significantly faster than output per worker. International productivity comparisons can also differ greatly when annual or weekly hours per worker vary across countries. American workers put in more hours annually than their European counterparts. Therefore, productivity measures based on output per worker portray US productivity levels in a much more favourable light than measures based on the more relevant output per hour. When comparing real wages and labour productivity in this report, hours will be used as the measure of labour input.

### ii. Quality Adjustment of Labour Inputs

Another issue is whether labour should be adjusted for quality changes. For example, an hour worked by an experienced worker is likely to be much more labour input than an hour worked by a novice. Statistical agencies produce and release unadjusted estimates of labour inputs. With quality adjustment, quality improvements increase the growth rate of the input and hence its contribution to output. This means that the size of the residual (or total factor productivity) is reduced, shedding more light on the sources of growth. This is considered by many to be the main advantage of adjustment. The advantage of non-adjustment is that the conceptual and methodological difficulties inherent in adjustment are avoided and the productivity numbers are easier to interpret and understand. In this report, labour input has not been adjusted for quality.<sup>8</sup>

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<sup>7</sup> This discussion follows Sharpe (2002).

<sup>8</sup> Statistics Canada has developed estimates of quality adjusted labour input based on methodologies developed by Jorgenson *et al.* (1987) and the US Bureau of Labor Statistics (BLS) (1993). The BLS now uses the Jorgenson approach because it is computationally simpler (Statistics Canada, 2008d). Jorgenson *et al.* (1987) group workers by a number of characteristics, and calculate average wage rates and income shares for each of the groups. The BLS groups workers by a smaller number of characteristics and then uses statistical regression to analyze the impact of other characteristics on average wage rates.

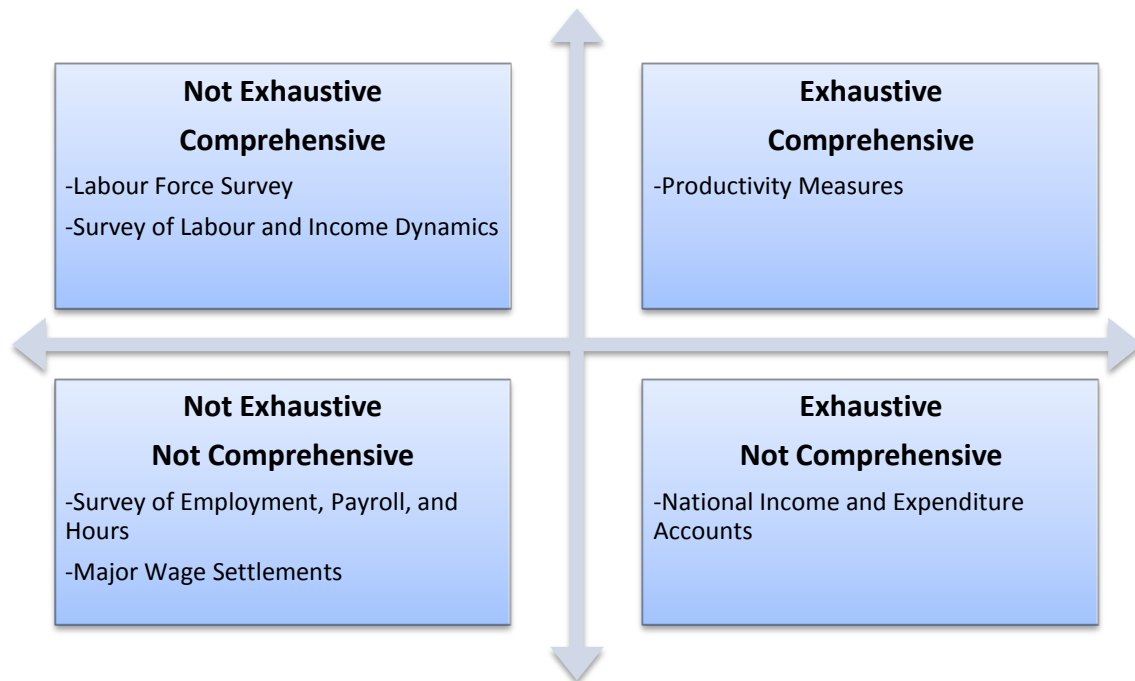
## B. Nominal Wages

This section has two sub-sections. The first reviews the various data source that can be used as measures of real wages and assesses the appropriateness of each series for analyzing the relationship between labour productivity and real wages. The second sub-sections explores trends in the appropriate nominal wage series.

### i. Definitional, Measurement, and Conceptual Issues

This sub-section reviews the numerous data sources produced by Statistics Canada that can be used to measure change in wages. First, the importance of choosing an appropriate measure of wages is discussed and two criteria for selecting an appropriate measure are developed: exhaustiveness and comprehensiveness. Next, the various measures of wages are classified according to exhaustiveness and comprehensiveness. Finally, the two exhaustive measures of wages are discussed in detail, and the report proposes that the “labour compensation” measure from Statistics Canada’s Productivity Measures is the most appropriate measure of wages for the purpose of comparison with labour productivity growth.

**Figure 1: Measures of Wages**



Statistics Canada produces a number of wage series that can be classified according to their exhaustiveness and comprehensiveness (Figure 1). This report classifies a wage series as exhaustive when it includes all monetary and in-kind compensation (wages, salaries, bonuses, commissions, overtime, supplementary labour income, etc.) of the population covered. A wage series is considered comprehensive when it covers all workers in the economy, *i.e.* from the perspective of industries and classes of workers (*e.g.* the self-employed).

Two wage series provide neither an exhaustive nor a comprehensive measure of wages. The Survey of Employment, Payroll, and Hours (SEPH) is not exhaustive because it does not include supplementary labour income (SLI). It is not comprehensive, because it does not include employees primarily involved in agriculture, fishing, trapping, private household services, religious organization, and military personnel (Statistics Canada, 2008b: 3). The Major Wage Settlements series is not comprehensive, because it tracks only wages settlements for workers covered by major collective agreements representing 500 or more employees. This measure accounts for only about 10 per cent of employees covered by SEPH (Statistics Canada, 2008b: 10). Neither of these series is appropriate when examining the relationship between labour productivity and real wages.

The wages series from the Labour Force Survey and the Survey of Labour and Income Dynamics provide comprehensive measures of wages, but are not exhaustive, because they exclude SLI, a significant component of wages, which is considered in detail in the next section.

**Summary Table 2: Alternative Nominal Wage Measures, Canada, total economy, compound annual growth rate, per cent, 1997-2007\***

Survey of Employment, Payroll, and Hours	
Employees paid by the hour	2.07
Salaried employees	2.37
Survey of Labour and Income Dynamics	3.60
Labour Force Survey	2.73
Major wage settlements	2.40
National Income and Expenditure Accounts	3.72
Productivity Measures	3.62

Source: Appendix Table 2

\*1997-2005 for Survey of Labour Income Dynamics

The Appendix to this report provides further detail on each of these series.

The importance of having an exhaustive and comprehensive wage measure is emphasized by the considerable variability in growth rates that can be observed in various wage series over the same period (Summary Table 2). For example, looking at a non-exhaustive and non-comprehensive measure, the wages of “employees paid by the hour” from the Survey of Employment Payroll and Hours, suggests that wages have grown much less than is suggested by the labour income measure from the National Income and Expenditure Accounts. If wage estimates from the Survey of Employment, Payroll, and Hours were used in an analysis of the relationship between real wages and

labour productivity, the growth in real wages would likely be underestimated, since the Productivity Measures series is more comprehensive and exhaustive.

Both the National Income and Expenditure Accounts (National Accounts) series called “wages, salaries, and supplementary labour income” (collectively “labour income”) and the Productivity Measures series called “total compensation” are exhaustive measures of wages. However, only total compensation is comprehensive, since it includes the imputed labour income of the self-employed. This section first explores the importance of including SLI in a measure of wages. Second the importance of including the labour income of the self-employed is discussed.

The National Accounts series can be separated into two major categories: wages and salaries, and supplementary labour income. Wages and salaries, is a fairly broad category including

all earnings from employment of Canadian residents, including payments in kind such as free board and lodging. Also included are such payments as commissions, directors’ fees, tips and bonuses, and taxable allowances such as cost-of-living allowances and payment in respect of vacation and sick leave. The estimates do not include earnings from self employment or partnership, income from independent professional practice, or income of farmers from farming operations.

Military pay and allowances are included. Wages and salaries include employee contribution to Employment Insurance, pensions, and other social insurance programs (Statistics Canada, 1989: 39).

The other major category is SLI. It is important to include SLI in any measures of wage growth to be compared to labour productivity growth. SLI is defined by Statistics Canada (1989: 39) as

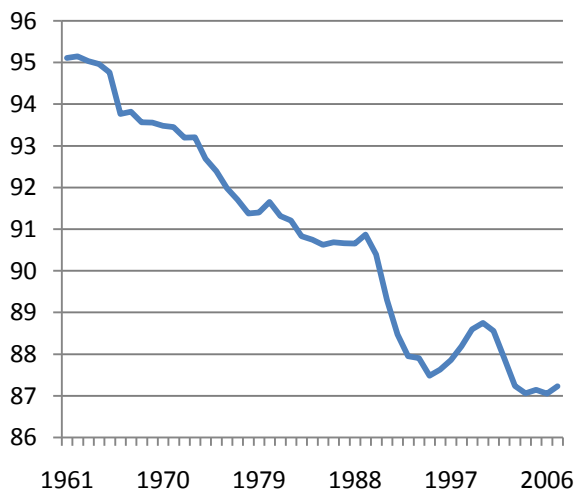
other expenditures by employers on labour account that can be regarded as payment for employees’ services. Included are employers’ contributions to pension funds, employee welfare funds, unemployment insurance and workers’ compensation.

SLI includes six major components: employer contributions to registered pension plans (not including the Canada and Quebec Pension Plans), employer contributions to Employment Insurance (EI), employer contributions to the Canada and Quebec Pension Plans (C/QPP), Workers’ Compensation, welfare, and retiring allowances. Welfare is a broad category that includes five major sub-components: employers’ contributions to accident and sickness insurance plans, group term life insurance plans, administrative service contracts (non-insurance benefits (*e.g.* for health) that are paid by employers and administered by insurance companies), premiums to provincial health plans in Alberta and British Columbia, and non-profit health plans. Retiring allowances refer to severance pay.

## ii. Trends

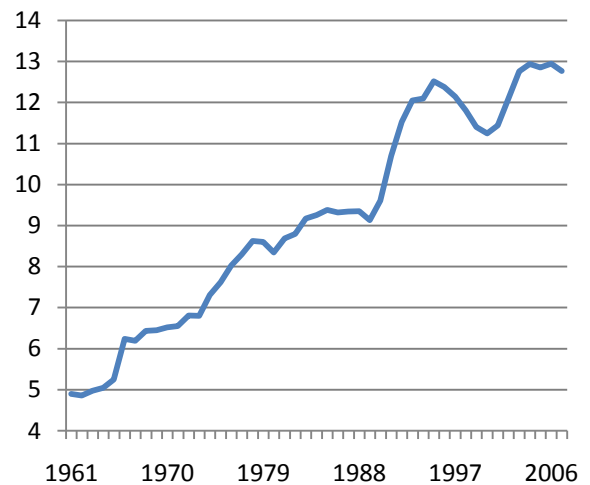
This sub-section discusses trends in labour compensation over the period 1961 to 2007. Since 1961, wages and salaries have become a smaller component of labour income (the sum of wages, salaries, and SLI) of Canadians, falling from 95 per cent of in 1961 to 87 per cent in 2007 (Chart 1). This drop means that SLI has become increasingly important (Chart 2), rising from 5 per cent of labour income in 1961 to 13 per cent in 2007. Any measure of wages that excludes SLI would lead to lower wage growth than a measure that include SLI.

**Chart 1: Wages and Salaries as a Share of Labour Income, Canada, total economy, current dollars, per cent, 1961-2007**



Source: Appendix Table 4

**Chart 2: Supplementary Labour Income as a Share of Labour Income, Canada, total economy, current dollars, per cent, 1961-2007**



Source: Appendix Table 4

All components of SLI have grown faster than wage and salaries, resulting in an increasing share of SLI in labour income since 1961 (Summary Table 3). The largest contribution was made by the introduction and subsequent rise in C/QPP premiums. Premiums were first collected in 1966, and contribution rates have increased considerably since the mid-1980s. The contribution rate for employers (and for employees) was held at 1.8 per cent of contributory earnings the plans' inception in 1966 until 1986. Between 1986 and 2003 rates were steadily increased to 4.95 per cent of contributory earnings. Rates have been held at 4.95 per cent since 2003. Contributions to the C/QPP have increased at an average annual rate of 10.5 per cent between 1966 and 2005. C/QPP accounted for 33.5 per cent of the increase in the share of SLI in total labour income between 1961 and 2005.

Welfare (employer contributions to health, dental, disability, and life insurance plans) made the second largest contribution to the increasing share of SLI, 25.5 per cent. Unfortunately, data on the components of the welfare category are not published by Statistics Canada. The contribution of employers to pension plans contributed 16.8 per cent to the increased share of SLI in labour income; EI contributed 10.1 per cent; retiring allowances contributed 8.4 per cent; and workers' compensation contributed 5.7 per cent. While wages, salaries and SLI is an exhaustive measure of wages for Canadians who are employed by someone else, they fail to capture the wages of the self employed.

The most exhaustive and comprehensive series available in Canada is the "labour compensation" series from Statistics Canada Productivity Measures, where labour compensation

includes all payments in cash or in kind that Canadian producers make to workers in return for their services. It includes labour income such as wages and salaries (including bonuses, tips, taxable allowances and back pay), supplementary income of paid workers (various employer contributions) and *the implicit labour income of self-employed workers* (Baldwin *et al.*, 2007) (*italics added*).

In comparison with the National Accounts series, wages, salaries and SLI, the total compensation series did not grow as quickly over the period 1961 to 2007 (Chart 3).

**Summary Table 3: Supplementary Labour Income, Canada, total economy, current dollars, 1961-2005**

Type of Employer Contribution	Share of Labour Income		Change in Share	Contribution to Change in Share
	1961	2005		
	(per cent)		(percentage points)	(per cent)
Pensions	2.42	3.76	1.34	16.79
UI/EI	0.65	1.46	0.80	10.09
CQPP	0.00	2.67	2.67	33.52
Workers' Comp	0.83	1.28	0.45	5.67
Welfare	0.99	3.02	2.03	25.49
Retiring Allowances	0.00	0.67	0.67	8.44
<b>Total SLI</b>	<b>4.89</b>	<b>12.86</b>	<b>7.96</b>	<b>100.00</b>

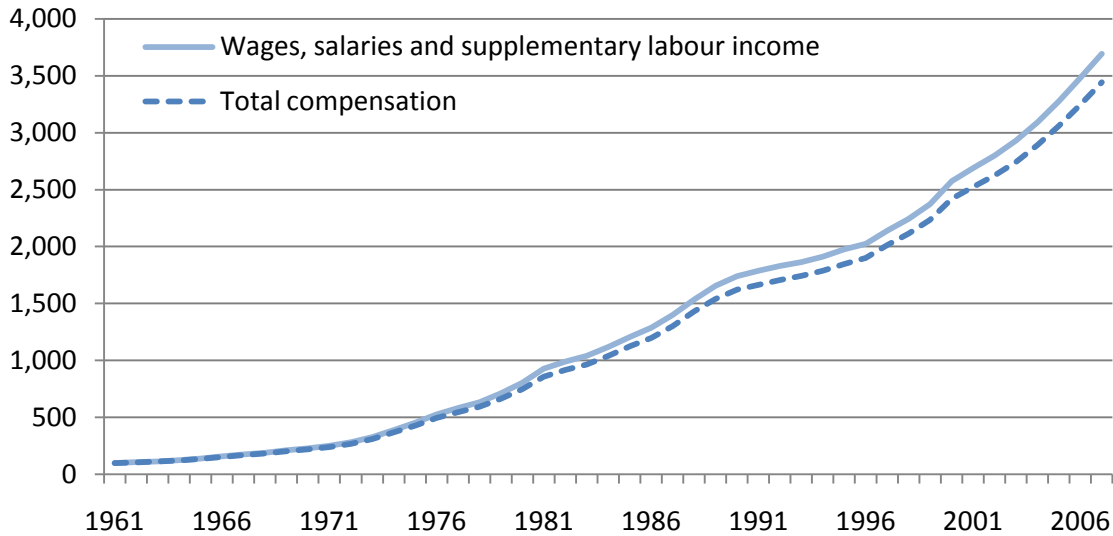
Source: Appendix Table 5

It is interesting to note that wages, salaries, and SLI as a share of total compensation increased most rapidly in the period from 1961 to 1981 (Chart 4), from less than 90 per cent to almost 97 per cent. At the same time the implicit labour income of the self employed fell from almost 10 per cent to just over four per cent. Wages, salaries and SLI then gradually declined relative to total compensation between 1981 and 1997. Since 1997, wages, salaries and SLI have returned to a share of total compensation of almost 96 per cent, similar to that observed in the early 1980s. Therefore, most of the difference in growth rates between the two series occurred prior to 1981. While this report uses total



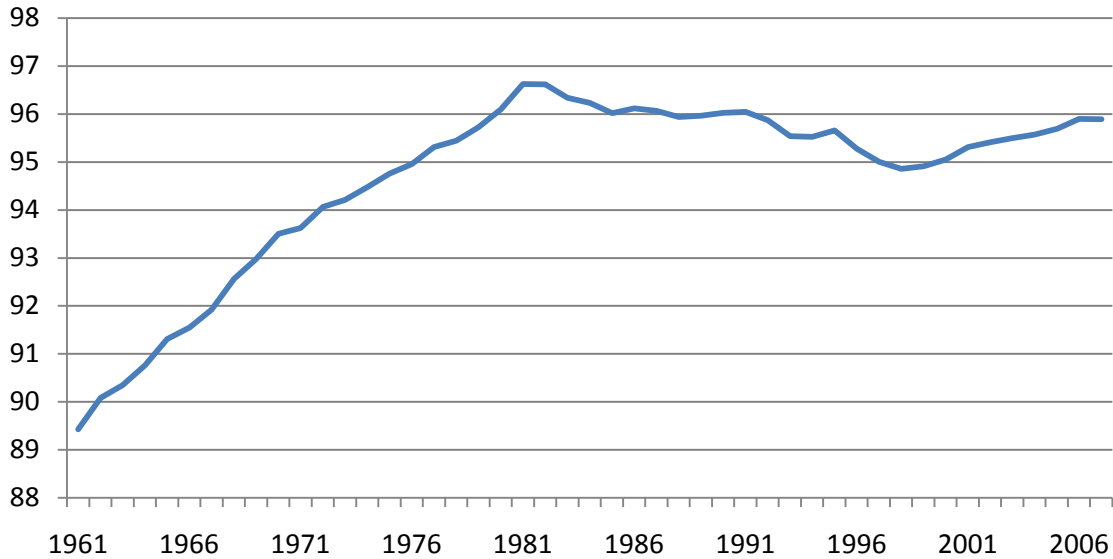
compensation as a measure of wages, using wages, salaries, and SLI over the period 1981 to 2007 is unlikely to have a major impact on conclusions.

**Chart 3: Growth in Wages, Canada, total economy, current dollars, index 1961 = 100, 1961-2007**



Source: Appendix Table 3

**Chart 4: Wages, Salaries and Supplementary Labour Income as a Share of Total Compensation, Canada, total economy, current dollars, per cent, 1961-2007**



Source: Appendix Table 3

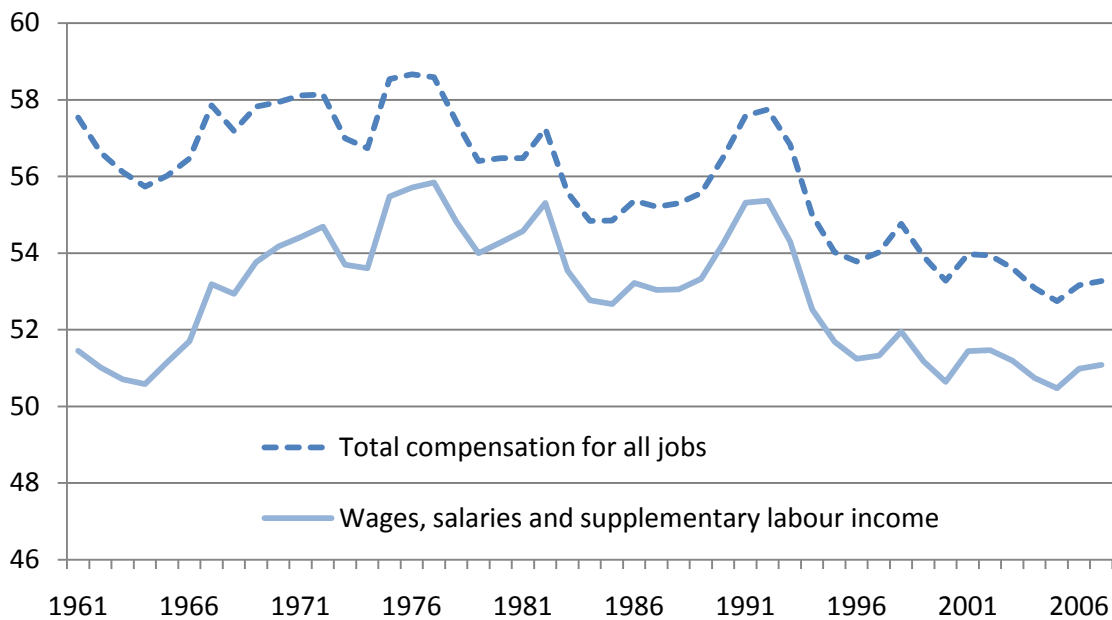
The National Accounts series, wages, salaries and SLI, differs from the Productivity Measures series, total compensation, because of the inclusion of the implicit labour income of self-employed workers in the latter. In the Productivity Measures series, Statistics Canada imputes a value for the labour income of self-employed workers by assuming that the hourly earnings of self-employed workers are proportional to the

hourly earnings of paid workers with the same level of education and experience. The relationship between the hourly earnings of paid and self-employed workers is derived from the Census of Population (Baldwin, *et al.*, 2007: 26).

The pattern of slower growth of labour compensation relative to wages, salaries and SLI has led to very different shares of labour income in GDP depending on which measure is used (Chart 5). For example, labour compensation measured to include the implicit labour income of the self employed declined from 57.5 per cent of GDP in 1961 to 53.3 per cent of GDP in 2007. In contrast, the National Accounts series, which excludes the implicit labour income of the self employed, only declined from 51.5 per cent of GDP in 1961 to 51.1 per cent of GDP in 2007. The reasons for the declining share of labour compensation in GDP will be addressed in part VI, as the falling labour share explains the divergence between the growth rates of labour productivity and product wages.

Because it is the most exhaustive and comprehensive series, the labour compensation series from the Statistics Canada Productivity Measures is used as a measure of nominal wages in this report. Therefore, hereafter, wages refer to labour compensation per hour worked from the Productivity Measures unless otherwise noted.

**Chart 5: Alternatives Measures of Wages as a Share of GDP, Canada, total economy, current dollars, per cent, 1961-2007**



Source: Appendix Table 3

## C. Output

Estimates of real output are required to produce labour productivity estimates. This section reviews a number of conceptual, definitional and measurement issues related

to measuring nominal output: non-marketed output, underground economy, and conceptual problems in the definition of output.

### **i. Non-Marketed Output**

A key requirement for the development of productivity estimates is that output be measured independently of inputs. If output is measured by the quantity of inputs, productivity growth will by definition be zero. In sectors where output is not marketed and no unit prices are generated, it is not possible to deflate the nominal value of output to produce real output and hence productivity estimates. This means that there are no reliable estimates of productivity growth for these sectors, primarily public administration and the publicly funded components of the education and health sectors. The lack of measured productivity growth in these non-marketed sectors means that total economy labour productivity growth estimates have a downward bias relative to the business sector.

It is in theory possible to develop output growth estimates for the non-business sector by measuring, in physical units, the output of the sector. Possible physical indicators include the number of graduates of the education system, the number of procedures performed in hospitals and the number of cheques processed by a government office. But such indicators may represent only part of the output of the sector and, more importantly, may exhibit significant quality changes over time. The development of reliable output and labour productivity growth estimates for the non-marketed sector is still in its early stages.

### **ii. Underground Economy**

The issue of the underground economy often arises in discussions of output trends. As well, it is pointed out that the underestimation of output because of unrecorded underground activity, not offset by a commensurate underestimation of inputs, will produce a downward bias to productivity level estimates. Estimates of the size of the underground economy vary widely. The most authoritative (and lowest) estimate is that by Statistics Canada (1994), which found that the underground economy represented around three per cent of GDP in Canada in 1992. A key reason for the small size of the underground economy relative to GDP is that Statistics Canada is aware, through various sources, that many transactions in certain sectors, such as construction, are not reported to the tax authorities; the agency can therefore make imputations for this unreported economic activity in the national accounts.

It should also be noted that it is not the existence of the underground economy *per se* that produces bias in productivity growth rates, but rather changes in its relative size over time. If the size of the underground economy remains stable, output levels may be underestimated but output growth rates will be unaffected. Of the many measurement issues affecting the relationship between labour productivity and real wages, bias associated with the underground economy is likely not particularly important.

### iii. Conceptual Problems in the Definition of Output

In certain industries in the business or marketed sector, the definition of what actually constitutes output poses conceptual problems that affect productivity estimates. For example, is the output of the banking sector the intermediation function the banks serve (as proxied by the value of the spread between what the banks earn and what they pay out in interest, net of expenses), or is it the services provided by the sector (number of accounts maintained, number of cheques processed, convenience provided by automated teller machines, etc.)? Other industries with conceptual problems include insurance, gambling, and brokerage houses.

These conceptual issues are gradually being worked out, with the result that output estimates for these industries are becoming more reliable. For example, statistical agencies have changed the definition of output in the banking sector, from the first definition noted above to the second, with the result that measured output growth in the sector has increased.

## D. Deflators

The deflator of nominal output and nominal wages that underlie labour's terms of trade are an important part of understanding the relationship between labour productivity and consumption wages. This section discusses a number of conceptual, definitional and measurement issues associated with deflators.

### i. Price Indices, Quality Adjustment, and Hedonics

Price indices for goods and services are crucial for deflating the nominal value of output to produce real output. But quality changes in goods and services over time must be integrated into price indices if true changes in (real) output are to be captured.<sup>9</sup>

The Panel to Review Productivity Statistics (1979) identified three types of quality change. Type 1 is the change in the quantity of costly resources used to produce a product, such as the addition of a remote-control device to a television set. Type 2 occurs when a technological innovation raises the quality of a product without any increase in current resource inputs, such as when new models of computers have more memory and greater processing ability but cost the same or less than the models they replace. Type 3 quality change refers to any design change in durable goods that results in higher or lower operating costs, holding constant both the quantity of services provided by the good and the wages and prices of the inputs used in its operation. An example is the redesign of an engine to improve fuel efficiency.

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<sup>9</sup> Nordhaus (1997) provides a fascinating account of the history of the price of light, showing that on a quality-adjusted basis it has experienced an enormous long-term decline. When the quality-adjusted price of light is integrated into price indexes, he finds, over the 1800-1992 period living standards have increased by between 40 (low-bias assumptions) and 190 (high-bias assumptions) times instead of the conventionally estimated factor of 13. The implications of quality adjustment for the quantification of trends in living standards are very great.

Until the 1980s, statistical agencies made adjustments for Type 1 quality change but largely ignored Types 2 and 3. Since then, there has been growing recognition of the importance of these latter types of quality change, as represented by computers and more energy-efficient consumer durables, respectively, and attempts to adjust for them. The most common method of adjustment is known as hedonics. This involves the application of a statistical regression to the different models of a given type of product available in two or more years, where the dependent variable is the price of each model and the independent variables are its measured characteristics.

The application of hedonics has produced very large decreases in the quality-adjusted price indices for computer hardware and, to a lesser degree, telecommunications equipment, leading to enormous increases in real output and hence productivity growth in these sectors. Indeed, the computer hardware sector has accounted for a highly disproportionate share of output and productivity growth in the United States and to a lesser degree in Canada, where the sector is less important. Part VI will explore in more detail the origins of the changes in labour's terms of trade, including the impact of slow inflation in the cost of business investment.

## **ii. The Choice of Consumption Deflator: CPI or Personal Consumption Expenditures Deflator**

Whether to estimate labour's terms of trade using the Consumer Price Index (CPI) or some other measure of the changes in the prices of consumption goods, like the personal consumption expenditures (PCE) deflator, is only an issue if these measures yield systematically different results (Appendix Table 7). These two alternative deflators have diverged considerably more in the United States than in Canada over the 1961-2007 (Chart 6).

In Canada, between 1961 and 2007 it is notable that whether measured using the CPI or the PCE deflator, labour's terms of trade grew at roughly similar rates, 0.11 per cent per year and 0.15 per cent per year respectively (Summary Table 4). While acknowledging that there have been periods over which labour's terms of trade have been affected by the choice of consumption deflator, the sensitivity has not been as great as in the United States. Because differences between the two measures are not large, this report uses a measure of labour's terms of trade based on the CPI for Canada.

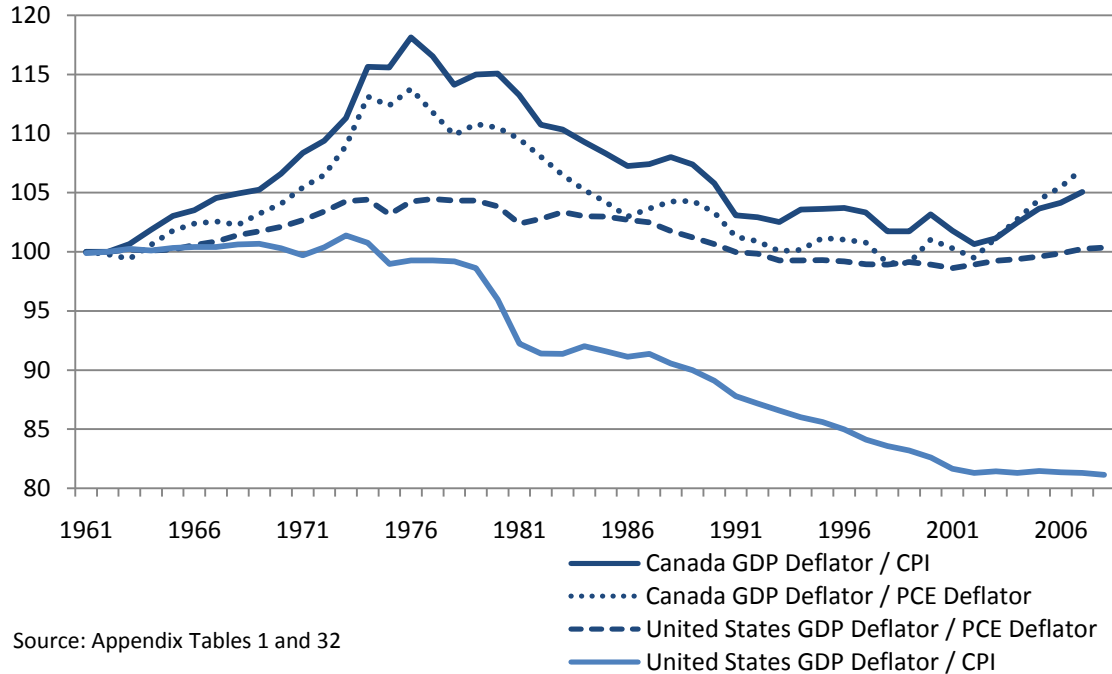
In the United States, inflation has been higher when measured with the CPI than when measured using the PCE deflator. As a result, the evolution of labour's terms of trade in the United States is highly dependent on whether the terms of trade are viewed as the ratio of the GDP deflator to the PCE deflator or as the ratio of the GDP deflator to the CPI (Chart 6).<sup>10</sup> For instance, between 1961 and 2007 labour's terms of trade fell by 0.45 per cent per year when measured using the CPI, however, when measured using the PCE

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<sup>10</sup> The lack of consistency between the CPI and the consumption deflator in the United States has been a subject of much discussion, and is widely acknowledged. The US CPI overstates the rise in price level after the late 1970s due to a change in measurement methodology related to housing prices. Bosworth *et al.* (1994) provide a summary of the issue, and argue the PCE deflator offers "a more historically consistent measure of price changes" (p. 321) than the CPI.

deflator, they rose by 0.01 per cent per year. Owing to this inconsistency and following the practice of Bosworth et al (1994), this report uses the ratio of the GDP deflator to the PCE deflator as a measure of labour's terms of trade in the United States.

**Chart 6: Labour's Terms of Trade, Index 1961 = 100, 1961-2007**



Source: Appendix Tables 1 and 32

**Summary Table 4: Labour's Terms of Trade, Canada, compound annual growth rates, per cent, 1961-2007**

	Canada		United States	
	GDP Deflator / CPI	GDP Deflator / PCE Deflator	GDP Deflator / CPI	GDP Deflator / PCE Deflator
<b>1961-2007</b>	0.11	0.15	-0.45	0.01
<b>1961-1973</b>	0.90	0.72	0.06	0.36
<b>1973-1981</b>	0.22	0.07	-1.21	-0.20
<b>1981-2007</b>	-0.29	-0.09	-0.46	-0.09
<b>1981-1989</b>	-0.66	-0.61	-0.32	-0.26
<b>1989-2000</b>	-0.36	-0.29	-0.79	-0.19
<b>2000-2007</b>	0.26	0.83	-0.09	0.25

Source: Appendix Tables 1 and 32

## E. Key Findings

This part of the report examined conceptual, definitional and measurement issues associated with labour input, nominal wages, nominal output, and deflators.

- Hours, not workers, are the most precise measure of labour input, and are therefore used in this report.
- Labour compensation, from Statistics Canada's Productivity Measures, is the only comprehensive (includes all segments of the labour force) and exhaustive (includes all types of consideration) measure of economic consideration given to labour. This measure is therefore used as a measure of wages in this report.
- The increasing importance of supplementary labour income (*i.e.* pensions, Employment Insurance, workers' compensation, welfare and retiring allowances) means that simply looking at wages and salaries offers a misleading picture of changes in labour compensation in Canada.
- None of the three issues associated with output (non-marketed output, underground economy, or conceptual issues) is likely to have a significant impact on the relationship between aggregate labour productivity and real wages.
- How output and wage series are adjusted for inflation is important. The key issue is the divergence over time between the series used to deflate nominal output (the GDP deflator) and the series used to deflate nominal wages (either the CPI or the personal consumption expenditures deflator).

## V. Trends in Labour Productivity and Wages in Canada, the United States and Other OECD Countries, 1961-2007

This part of the report is divided into four sections. The first three sections respectively analyze trends in the relationship between labour productivity, product wages, and consumption wages in Canada, at the national, provincial and industry level, in the United States, and in other member countries of the Organisation for Economic Cooperation and Development (OECD). The final part of this part summarizes key findings from this analysis.

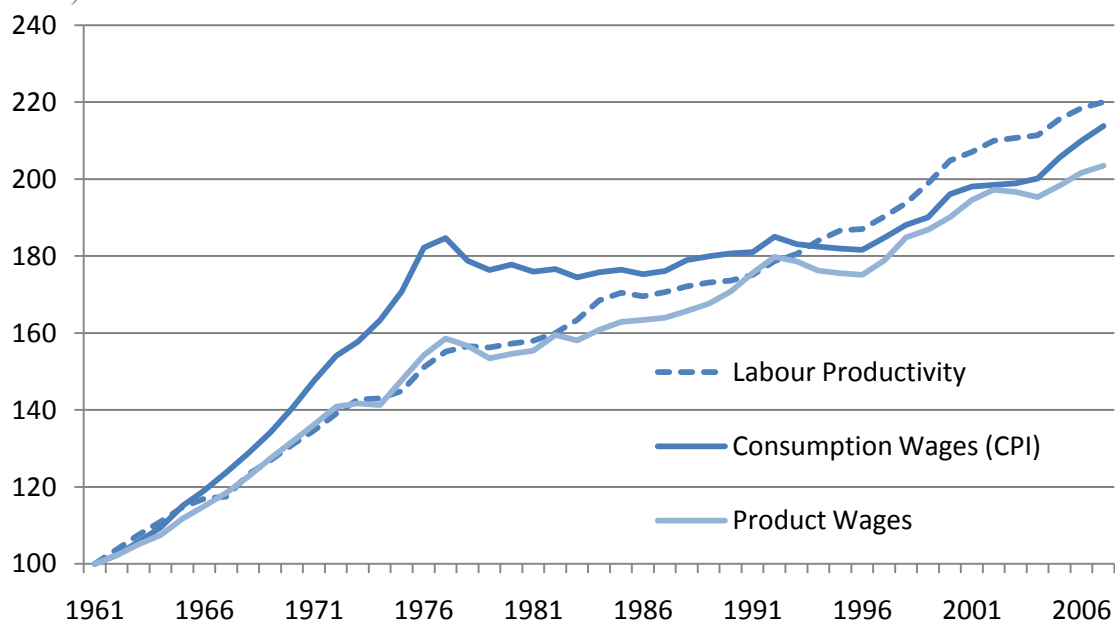
### A. Canada

This section provides an overview of trends in labour productivity, product wages, and consumption wages in Canada from 1961 to 2007. First, aggregate trends are analyzed with reference to the changing labour share and labour's terms of trade. The next section analyzes trends in labour productivity and real wages at the provincial level. The final section analyzes trends by industry.

#### i. Aggregate Trends in Labour Productivity and Real Wages

Over the period 1961 to 2007, growth in both product wages (1.56 per cent per year) and consumption wages (1.67 per cent per year) has generally lagged labour productivity (1.73 per cent per year) (Chart 7 and Summary Table 5).

**Chart 7: Labour Productivity and Real Wages, Canada, total economy, index 1961 = 100, 1961-2007**



Source: Appendix Table 1



When the period 1961 to 2007 is decomposed into sub-periods, the changing relationship between real wages and labour productivity is easier to see. Sub-periods were determined by peaks and end-points in the real GDP series (1961, 1973, 1981, 1989, 2000, 2007). From 1961 to 1973 and from 1973 to 1981, labour productivity grew slightly faster than product wages, reflecting a small decline in labour's share from 57.5 per cent of GDP to 56.5 per cent of GDP in 1981 (Chart 8). From 1981 to 1989 labour productivity grew somewhat faster than product wages, reflecting a decline in labour share to 55.6 per cent of GDP. Labour's share then shrank to 53.3 per cent of GDP by 2000 reflecting labour productivity growth of 1.54 per cent per year from 1989 to 2000, which significantly exceeded product wage growth of 1.15 per cent per year. In the 2000s, labour productivity growth only slightly exceeded the growth in product wages, reflecting a decline in the labour share from 53.3 per cent to 53.1 per cent of GDP. The declining labour share is the key trend that is the subject of potential explanations in part VI.

**Summary Table 5: Labour Productivity and Real Wages in Canada, total economy, 1961-2007**

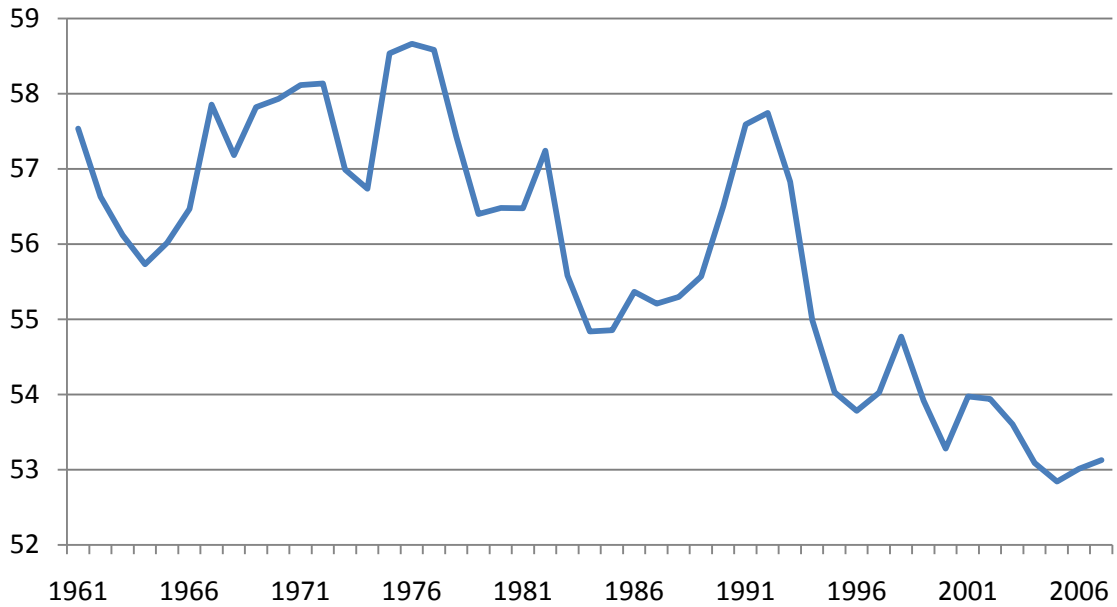
Period	Labour Productivity	Product Wage	Nominal Labour Share (Compensation/GDP)	Consumption Wage	Labour's Terms of Trade	Nominal Labour Share of GDP (per cent)	
	compound annual growth rate, per cent					in first year of period	in last year of period
	[1]	[2]	[3]=[2]-[1]	[4]	[5]=[4]-[2]	[6]	[7]
1961-2007	1.73	1.56	-0.17	1.67	0.11	57.5	53.1
1961-1973	3.00	2.95	-0.08	3.87	0.90	57.5	57.0
1973-1981	1.29	1.16	-0.11	1.38	0.22	57.0	56.5
1981-1989	1.15	0.95	-0.20	0.28	-0.66	56.5	55.6
1989-2000	1.54	1.15	-0.38	0.79	-0.36	55.6	53.3
2000-2007	1.03	0.98	-0.04	1.24	0.26	53.3	53.1

Source: Appendix Table 1

Note: Figures may not sum exactly due to rounding.

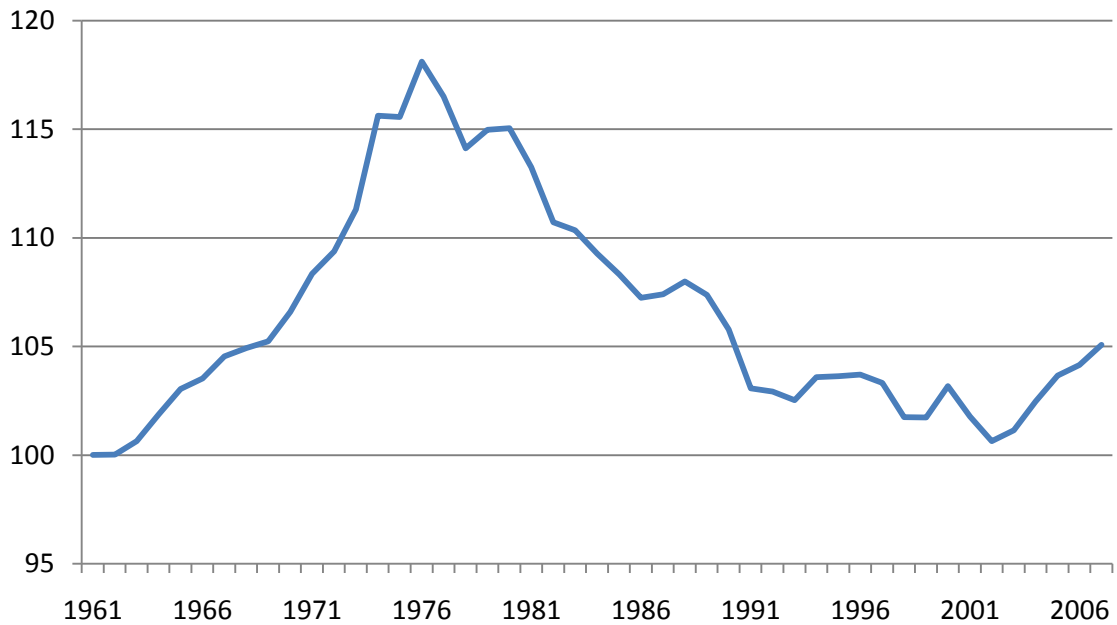
In Canada, labour's terms of trade improved slightly over the period 1961 to 2007, but this improvement concealed a major shift within the period (Summary Table 5 and Chart 9). Labour's terms of trade improved considerably from 1961 to 1973, driving consumption wage growth to exceed growth in labour productivity and growth in product wages. After further small increases to 1976, labour's terms of trade fell steadily until the early 1990s. This fall resulted in consumption wage growth from 1981 to 2000, which at 0.28 per cent per year was well behind growth in labour productivity or product wages. From 1989 to 2000, there was a further fall in labour's terms of trade, though less so than in the 1980s, but consumption wages still failed to keep pace with labour productivity or product wages. Finally, between 2000 and 2007 there has been a turnaround, consumption wage growth outpaced labour productivity and real wage growth for the first time since the 1970s. Part VI explores reasons for the major shifts in labour's terms of trade.

**Chart 8: Labour's Share in Canada, total compensation as a share of GDP, current dollars, per cent, 1961-2007**



Source: Appendix Table 1

**Chart 9: Labour's Terms of Trade in Canada, GDP deflator divided by CPI, index 1961 = 100, 1961-2007**



Source: Appendix Table 1

## ii. Provincial Trends in Labour Productivity and Real Wages

This sub-section explores the relationship between labour productivity and real wages in the Canadian provinces. Over the period 2000-2007<sup>11</sup> in Canada as a whole, labour productivity grew at an average annual rate of 1.03 per cent and product wages advanced by 0.98 per cent per year reflecting a decline in the labour share from 53.3 per cent of GDP to 53.1 per cent. Consumption wages grew by 1.24 per cent per year on average, as labour's terms of trade improved slightly.

**Summary Table 6: Labour Productivity and Real Wages by Province, total economy, 2000-2007**

	Labour Productivity	Product Wage	Nominal Labour Share (Compensation/GDP)	Consumption Wage	Labour's Terms of Trade	Nominal Labour Share of GDP (per cent)		
	compound annual growth rate, per cent						2000	2007
	[1]	[2]	[3]=[2]-[1]	[4]	[5]=[4]-[2]	[6]	[7]	
<b>Canada</b>	1.03	0.98	-0.04	1.24	0.26	53.3	53.1	
<b>NL</b>	3.47	-1.24	-4.55	2.69	3.98	47.6	34.4	
<b>PE</b>	1.27	1.03	-0.24	0.65	-0.38	55.2	54.3	
<b>NS</b>	1.16	1.02	-0.15	0.93	-0.09	55.7	55.1	
<b>NB</b>	1.47	1.46	0.00	0.94	-0.51	55.1	55.1	
<b>QC</b>	1.05	1.17	0.12	1.23	0.06	54.9	55.4	
<b>ON</b>	0.76	1.04	0.28	0.58	-0.46	55.8	56.9	
<b>MB</b>	1.29	0.84	-0.44	1.65	0.81	53.4	51.8	
<b>SK</b>	1.24	0.58	-0.66	2.24	1.64	42.6	40.7	
<b>AB</b>	0.63	1.44	0.81	2.84	1.38	43.7	46.3	
<b>BC</b>	0.75	0.62	-0.13	1.02	0.39	55.0	54.5	

**Source:** Appendix Tables 1 and 9-18.

**Note:** Figures may not sum exactly due to rounding.

Labour productivity, product wages and consumption wages varied by province (Summary Table 6). The labour share declined the most in Newfoundland and Labrador (from 47.6 per cent to 34.4 per cent) reflecting growth in labour productivity of 3.47 per cent per year and a decline in product wages of 1.24 per cent per year. At the same time Newfoundland and Labrador's terms of trade for labour improved significantly, resulting in a rise in consumption wages of 2.69 per cent per year. Although product wages grew relatively slowly, workers in Newfoundland and Labrador have benefitted from rapidly increasing prices for their output, especially energy, relative to the prices of consumer goods. Across the rest of the country, the pattern was broadly similar, the labour share declined as labour productivity exceeded the growth in product wages. In many cases

<sup>11</sup> While data on labour productivity and real wages were available from 1961 to 2007 for Canada as a whole, provincial data on hours worked and labour compensation were only available from 1997 to 2007 at the time this report was prepared. Because the cyclical peak was in 2000, the time period examined is 2000-2007.

consumption wages grew more rapidly as product wages, reflecting in improvements in labour's terms of trade.

Some provinces were exceptional. Both Ontario and Quebec saw growth in product wages outpace growth in labour productivity, but also deteriorating terms of trade for labour as output prices failed to keep pace with increases in the cost of consumption goods and services. In Ontario, the labour share rose from 55.8 per cent of GDP in 2000 to 56.9 per cent in 2007. In Quebec, the increase was from 54.9 per cent to 55.4 per cent. Nova Scotia and Prince Edward Island saw both falling labour shares and deteriorating terms of trade of labour.

### **iii. Sectoral Trends in Labour Productivity and Real Wages**

This section explores the relationship between labour productivity and real wages at the level of the sectors that make up the Canadian economy. Over the period 1997 to 2004, labour productivity for all sectors, that is, in the total economy, grew at 1.47 per cent per year (Summary Table 7). Product wages grew at 1.15 per cent per year and consumption wages grew at 1.16 per cent per year. This reflected a slight decline in labour's share from 58.4 per cent of GDP to 57.1 per cent. Labour's terms of trade hardly changed. This picture conceals significant variability across industries.

In percentage terms, labour's share of GDP advanced most rapidly in utilities (from 23.7 per cent to 26.9 per cent) and in finance, insurance, real estate rental and leasing (26.2 per cent to 28.0 per cent). Labour's share fell most in mining and oil and gas (from 28.2 per cent to 16.5 per cent). Declines were also large in construction (from 83.1 per cent to 74.9 per cent) and retail trade (from 80.3 per cent to 72.2 per cent).

While on average, consumption wages grew slightly faster than product wages, this was not the case in all industries. The terms of trade of workers in some industries improved substantially over the period. In mining and oil and gas extraction, for example, consumption wages increased by 2.03 per cent per year, while product wages declined 7.04 per cent per year. On the other hand, some sectors, like wholesale trade, saw consumption wages, which grew by 0.50 per cent per year, fall behind product wages, which grew at 2.31 per cent per year.

Overall, the period for which official and consistent Statistics Canada data were available is short. This lack of a longer time series means that it is difficult to draw strong conclusions from changes in labour share. Certainly, the changes in the mining and oil and gas sector have been dramatic over such a short period of time and reflect just how weak the relationship between consumption wages and labour productivity growth is at the sector level.

**Summary Table 7: Labour Productivity and Real Wages by Sector, Canada, total economy, 1997-2004**

Sector	Labour Productivity	Product Wages	Nominal Labour Share (Compensation/GDP)	Consumption Wage	Labour's Terms of Trade	Nominal Labour Share of GDP (per cent)	
	(compound annual growth rate, per cent)					1997	2004
	[1]	[2]	[3]=[2]-[1]	[4]	[5]=[4]-[2]	[6]	[7]
All industries	1.47	1.15	-0.33	1.16	0.01	58.4	57.1
Agriculture, forestry, fishing and hunting	6.45	5.46	-0.93	4.31	-1.15	43.1	40.3
Mining and oil and gas extraction	0.34	-7.04	-7.35	2.03	9.06	28.2	16.5
Utilities	-1.74	0.07	1.84	0.17	0.10	23.7	26.9
Construction	1.77	0.26	-1.48	-0.27	-0.52	83.1	74.9
Manufacturing	2.23	2.19	-0.04	1.16	-1.04	56.8	56.7
Wholesale trade	3.01	2.31	-0.68	0.50	-1.81	69.0	65.8
Retail trade	3.16	1.61	-1.51	0.98	-0.63	80.3	72.2
Transportation and warehousing	0.55	1.01	0.45	0.31	-0.70	66.4	68.6
Information and cultural industries	2.19	2.78	0.58	0.69	-2.09	48.0	49.9
Finance, insurance, real estate and rental and leasing	1.09	2.03	0.93	1.13	-0.89	26.2	28.0
Professional, scientific and technical services	2.30	2.57	0.27	2.60	0.03	79.7	81.2
Administrative and support, waste management and remediation services	-0.10	-0.04	0.06	0.57	0.61	75.6	75.9
Education services	0.30	0.27	-0.02	0.99	0.72	91.9	91.7
Health care and social assistance	0.56	0.69	0.12	2.12	1.43	79.7	80.3
Arts, entertainment and recreation	-2.79	-2.14	0.67	-0.92	1.22	73.0	76.4
Accommodation and food services	0.98	0.82	-0.15	0.84	0.02	77.7	76.9
Other services (except public administration)	1.95	1.08	-0.85	1.22	0.15	86.3	81.2
Public administration	1.28	1.78	0.49	1.56	-0.22	73.3	75.9

**Source:** Appendix Tables 28-31.

**Note:** Figures may not sum exactly due to rounding.

In the presence of competitive labour and product markets, there should be no direct relationship between labour productivity growth and growth in real consumption wages at the sector level. Wages are determined at the level of the total economy labour market and labour productivity gains are reflected in lower output prices rather than

higher wages in sectors with above average labour productivity growth. Lower prices benefit all workers rather than only workers in the sector experiencing above average labour productivity growth.

This phenomenon can best be understood with an example. Assume that labour productivity in the trucking industry doubles because of an increase in the size of trucks. If increases in trucking labour productivity did lead to higher wages for truckers, we would expect an increase in the number of workers who want to work as truckers. With perfectly competitive labour markets, the wages of truckers would in fact remain unchanged. Would an increase in industry productivity, with industry wages unchanged, thus lead to increased profits? Not if product markets are competitive – the increased productivity would rather push output prices down as firms can now produce increased quantity with identical costs. Ironically, agriculture is the sector with the most rapid labour productivity growth over the last 50 years is the sector with the lowest current productivity level (nominal output per hour worked), because the productivity gain has been passed on to consumers as lower prices for agricultural goods.

Of course, when either labour markets or product markets are not perfectly competitive, there can be an observed correlation between sectoral productivity gains and sectoral consumption wage growth. Even then, however, the relationship is not straightforward. In the case of imperfect labour markets, wage bargaining will provide workers with a share of excess profits. Yet, sectors can increase profits through labour productivity growth (if product markets are imperfect) and/or better sectoral terms of trade (price of output/price of intermediate inputs). In the mining and oil and gas sector, for example, labour productivity has been falling in recent years, but profits have nonetheless been rising due to improved sectoral terms of trade, *i.e.* output prices rising faster than the average price level. Workers have thus been able to increase real wages by extracting a share of ballooning profits, even though labour productivity in the sector has been declining.

#### **iv. Key Findings: Canada**

Key findings from this analysis of trends in labour productivity and real wages in Canada, at the aggregate, provincial and industry levels are as follows:

- In Canada, over the period 1961 to 2007 growth in both product wages (1.56 per cent per year) and consumption wages (1.67 per cent), has generally been slightly slower than labour productivity growth (1.73 per cent).
- By definition, the gap between product wage growth and labour productivity growth reflects trends in the labour share. The labour share thus fell 0.17 per cent per year between 1961 and 2007, from 57.5 per cent of GDP to 53.1 per cent. The fall in the labour share was almost entirely due to developments between 1992 and 1997, when the labour share fell from 57.7 per cent to 54.0 per cent, an average of 1.32 per cent per year. Over that five-year period, labour productivity

increased 1.26 per cent per year while product wages decreased 0.11 per cent per year.

- The gap between the growth in product wages and consumption wages reflects changes in labour's terms of trade, the price of output relative to price of consumption goods. From 1961 to 2007 labour's terms of trade improved slightly, helping to offset the effect of the fall in labour share on the growth in consumption wages. Labour's terms of trade experienced major swings over the period. They improved from 1961 to 1976; declined from 1976 to 2002; then rose from 2002 to 2007.
- In the presence of competitive labour and product markets, labour productivity growth and consumption wage growth at the sector level should have no direct relationship. Wages are determined at the level of the wider labour market and above average labour productivity gains are reflected in lower output prices rather than higher industry wages. Lower prices benefit all workers rather than only workers in the industry experiencing labour productivity growth.
- A stark example of the disconnection between labour productivity and real wages growth at the sector level in Canada is in the mining and oil sector. In this sector, labour compensation has been growing healthily since 2000 despite negative labour productivity growth.

## B. The United States

The United States is the largest economy in the world and stands out as a benchmark for other countries. Comparisons to the United States are especially relevant for Canada given our strong economic, social, and political connections, as well as our geographical proximity. Like Canada, the United States is a high-income economy that has experienced sustained growth in both labour productivity and real wages over the past 45 years.

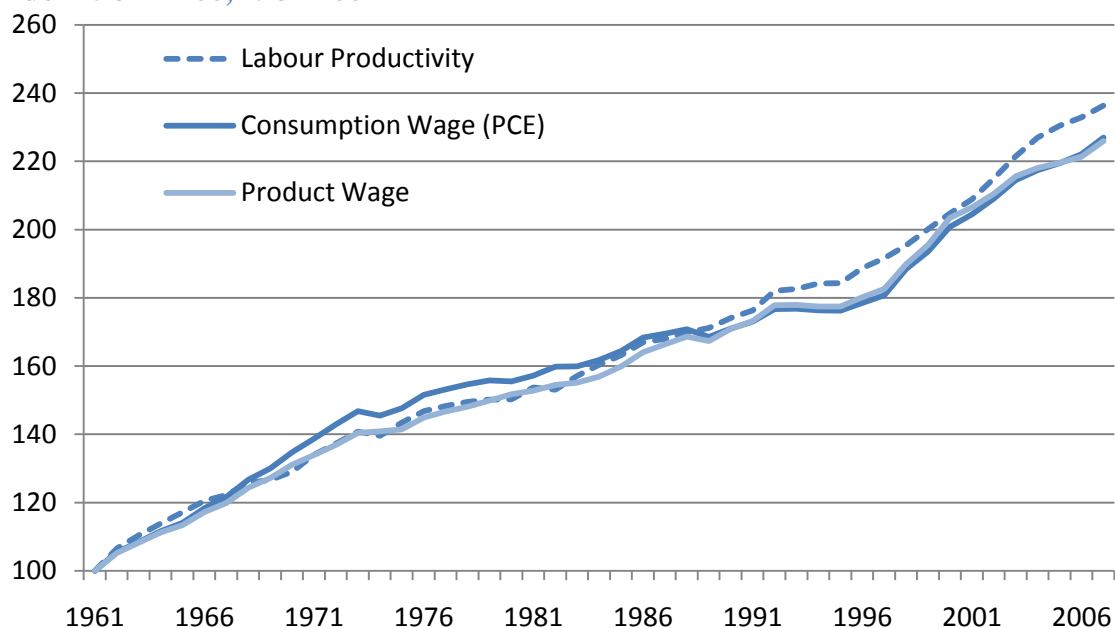
This section reviews the relationship between labour productivity and real wages in the United States over the period from 1961 to 2007.<sup>12</sup> As in the previous section, the discussion centres on trends in labour's share of nominal GDP and labour's terms of

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<sup>12</sup> Data on the number of hours worked in the whole economy as well as average hourly compensation in the aggregate economy are from unpublished data from the Bureau of Labor Statistics (BLS). Unlike data from the Bureau of Economic Analysis (BEA) and the Organization for Economic Cooperation and Development (OECD), this measure of compensation and hours worked includes the self-employed. Total labour compensation is the product of average hourly compensation and total hours worked. The Consumer Price Index (CPI) for all urban consumers, produced by the BLS, reflects the price increases in a typical basket of goods and services purchased by urban consumers. The GDP deflator, a weighted index of price increases for domestically produced goods and services, was calculated by the BEA. Nominal GDP and chained GDP in 2000 dollars are from the NIPA tables produced by the BEA. Nominal GDP is the output of the economy in current prices, whereas chained GDP is a form of real GDP that accounts for price changes in the goods produced. The labour share was calculated by dividing total compensation paid in nominal terms by nominal GDP; this is fully equivalent to taking GDP deflated compensation as a share of chained GDP. Productivity is calculated by dividing chained GDP by the number of hours worked. The real wage gap is the difference between the geometric average growth rates of productivity and GDP-deflated labour compensation.

trade. Lastly, results and methodologies presented in this report are compared to another recent paper on US labour productivity and real wage growth.

**Chart 10: Labour Productivity and Real Wages in the United States, total economy, index 1961 = 100, 1961-2007**



Source: Appendix Table 32

**Summary Table 8: Labour Productivity and Real Wages in the United States, total economy, 1960-2007**

Period	Labour Productivity	Product Wage	Nominal Labour Share	Consumption Wage	Labour's Terms of Trade	Nominal Labour Share of GDP (per cent)	
	compound annual growth rate, per cent					in first year of period	in last year of period
	[1]	[2]	[3]=[2]-[1]	[4]	[5]=[4]-[2]	[6]	[7]
<b>1961-07</b>	1.82	1.73	-0.09	1.74	0.01	64.1	61.5
<b>1961-73</b>	2.63	2.65	0.01	3.02	0.36	64.1	64.2
<b>1973-81</b>	1.11	1.06	-0.05	0.86	-0.20	64.2	64.0
<b>1981-89</b>	1.35	1.14	-0.21	0.87	-0.26	64.0	62.9
<b>1989-00</b>	1.64	1.79	0.15	1.60	-0.19	62.9	63.9
<b>2000-07</b>	2.07	1.51	-0.54	1.77	0.25	63.9	61.5

Source: Appendix Tables 32 and 33.

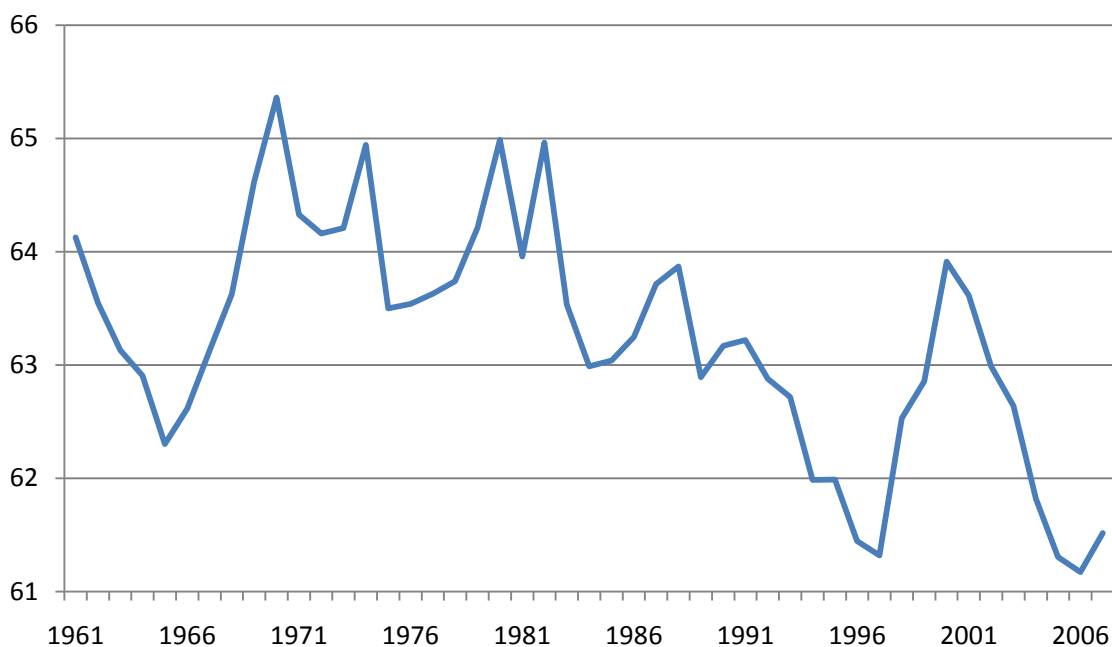
Note: Figures may not sum exactly due to rounding.

Over the 1961-2007 period product wages grew somewhat more slowly, at an average annual rate of 1.73 per cent, than labour productivity, which grew at an average annual rate of 1.82 per cent (Chart 10 and Summary Table 8). Total labour compensation as a share of GDP fell from 64.1 per cent in 1961 to 61.5 per cent in 2007. Turning to



cyclically neutral sub-periods, labour's share has fluctuated considerably, but experienced significant declines in the early 1990s and early 2000s (Chart 11). In contrast to Canada, the United States experienced strong growth in labour's share of GDP in the latter half of the 1990s, from 61.4 per cent in 1996 to 63.9 per cent in 2000. This increase in the labour share was completely reversed in the subsequent years to 2007.

**Chart 11: Labour's Share in the United States, total compensation as a share of GDP, current dollars, per cent, 1961-2007**



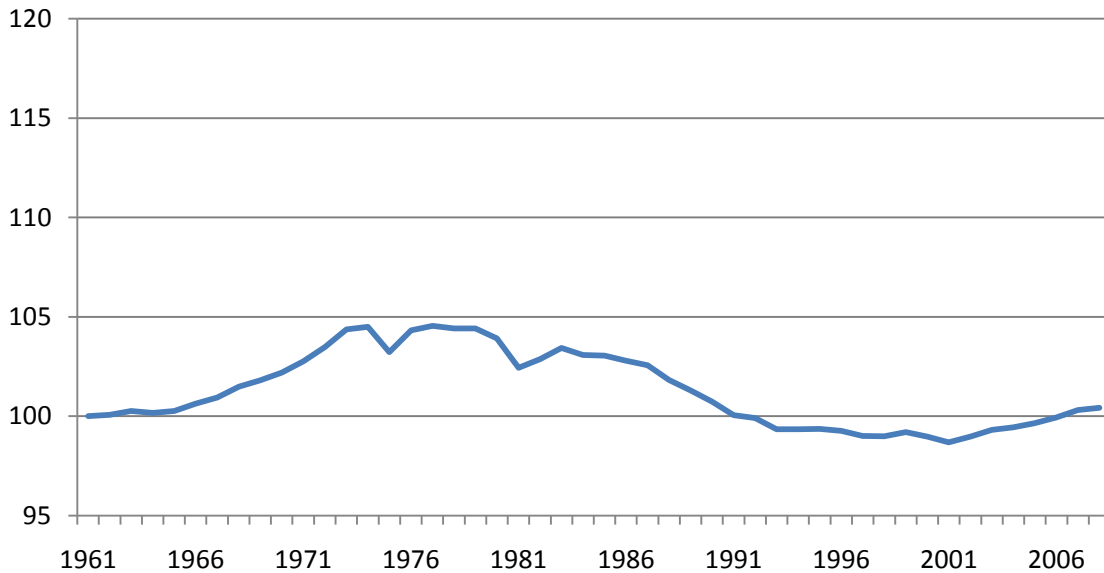
Source: Appendix Table 32

As in Canada, labour's terms of trade in the United States were unchanged over the period 1961-2007 as a whole (Chart 12).<sup>13</sup> Labour's terms of trade also exhibited a similar pattern over this period in both countries, but improvements and deteriorations were much smaller in the United States. As in Canada, there were three swings in labour's terms of trade in the United States between 1961 and 2007 but those in the United States were much smaller. From 1961 to 1973, labour's terms of trade improved slightly, resulting in growth in consumption wages of 3.02 per cent per year on average, while product wages advanced by only 2.65 per cent per year. From the mid 1970s until the early 2000s labour saw a steady erosion of its terms of trade. But this trend turned around in 2001 and labour's terms of trade exceeded their 1961 level in 2007 for the first time since 1991. Overall, labour's terms of trade did not change very much in the United States over the period from 1961 to 2007.

<sup>13</sup> Because of the measurement issues noted in part IV, this report uses the deflator for personal consumption expenditures (PCE) instead of the CPI as a measure of consumer prices changes. This choice of consumer price deflator is appropriate because of issues of consistency in the US CPI.

In summary, in the United States, labour productivity growth of 1.82 per cent per year on average over the period 1961-2007 somewhat exceeded both growth in product wages (1.73 per cent) and growth in consumption wages (1.74 per cent). This divergence between real wages and labour productivity reflected a decline in labour share in the United States from 64.1 per cent in 1961 to 61.5 per cent in 2007. Labour's terms of trade had essentially no impact on this relationship over the period as whole.

**Chart 12: Labour's Terms of Trade in the United States, GDP deflator divided by PCE deflator, index 1960 = 100, 1961-2007**



Source: Appendix Table 33

### Box: A Comparison of Findings

In a recent paper, Martin Feldstein (2008), of Harvard University, analyzed the relationship between labour productivity and real wages in the non-farm business sector in the United States and found results very similar to those presented above. He found that for the period 1970 to 2006, labour productivity grew by 1.9 per cent per year, while product wages increased by 1.7 per cent per year, reflecting a decline in labour share from 66 per cent to 64 per cent in 2006. From 2000 to 2007, Feldstein found that labour productivity increased at 2.9 per cent per year, while product wages increased 2.5 per cent per year.

This report uses the total economy as the basis for measuring labour productivity. Using the total economy offers several advantages over the more limited non-farm business sector used by Feldstein. The non-farm business sector excludes both farming and government, which together account for a non-negligible share of production. The price deflators for the non-farm business sector and for the total economy are different, which further explains the data discrepancies.

The trends reported in this report are quite similar to Feldstein's findings, but differences remain. Using the total economy, over the 1970-2006 period labour productivity grew at an average annual rate of 1.65 per cent, while product wages grew by 1.47 per cent. These results are consistent with Feldstein's finding, because they result in a similar decline in labour share of 0.18 per cent per year. For the more recent period, 2000-2007, total economy labour productivity grew at 2.07 per cent per year and product wages grew at 1.51 per cent per year.

## C. Other OECD Countries

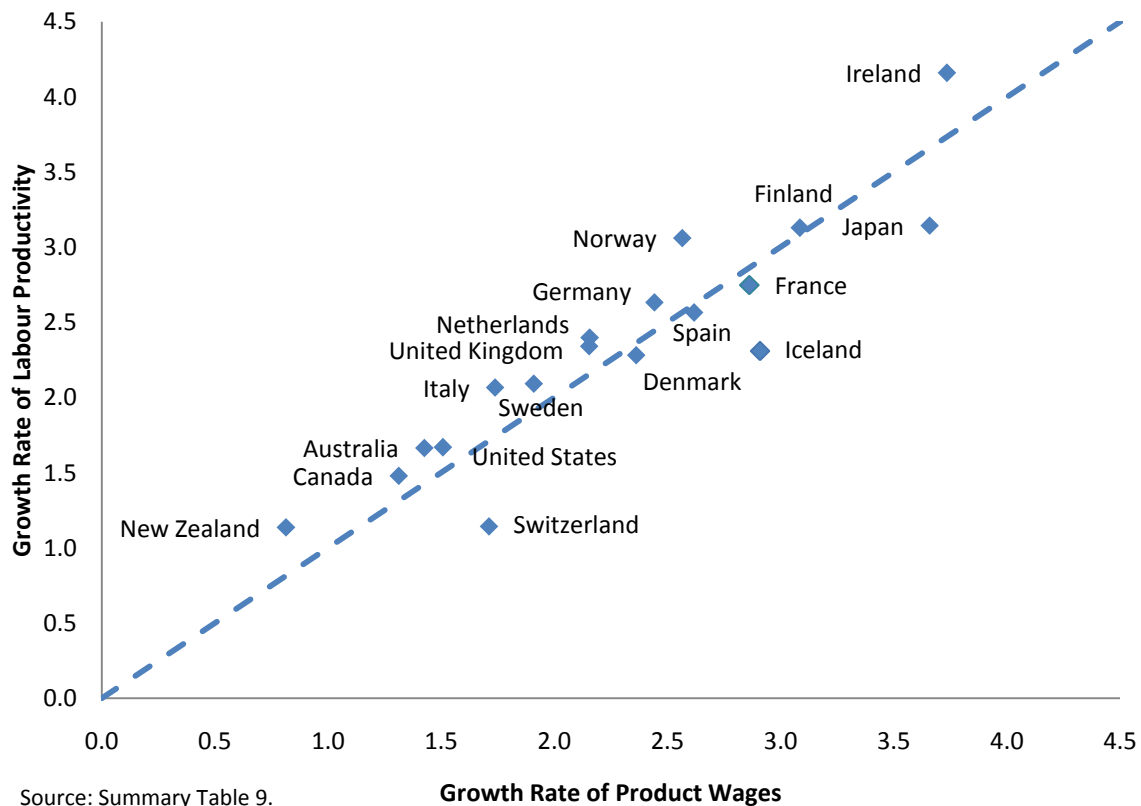
This section reviews trends in labour productivity and real wages across a selection of high-income countries.<sup>14</sup> First, the entire 1970-2006 period is reviewed, although data availability restricts the comparison to 18 countries. The 1980-2006 period is then analyzed, which allows for more countries to be included. Next, we examine the period from 1995 to 2006, which allows for the inclusion of the largest number of countries. Lastly, key findings of this section are summarized.

<sup>14</sup> Data on wages and deflators for OECD countries were obtained from the online databases of the OECD. Labour productivity is defined as the real GDP in constant units of national currency divided by the number of hours worked in the total economy. Product wages were calculated with data on labour compensation, the same hours series used to calculate labour productivity, and the GDP deflator for each country. Consumption wages were calculated using consumer price indexes for each country. The labour compensation series provided by the OECD includes not only wages and salaries, but also all in-kind benefits, pensions and social contributions.

### i. 1970-2006

Between 1970 and 2006, an un-weighted average of the growth rates of labour productivity and product wages across OECD countries was almost identical (2.33 per cent and 2.28 per cent per year respectively) (Summary Table 9). Within the OECD, only six out of 18 countries experienced a rise in labour share, represented by a country appearing below the 45-degree line in Chart 13: Denmark, Iceland, France, Japan, and Switzerland. Meanwhile, the other 12 countries experienced a decline in labour share, these countries appear above the 45-degree line because they experienced more rapid labour productivity growth than product wage growth, representing a decline in labour share. Ireland saw its labour share fall from 48.5 per cent of GDP in 1970 to 41.8 per cent in 2006. Norway saw its labour share fall from 48.0 per cent to 40.6 per cent. Other countries saw their labour shares increase substantially over the period: Iceland from 48.8 per cent to 60.1 per cent in 2005, Japan from 43.3 per cent to 51.6 per cent in 2005, and Switzerland from 50.8 per cent to 62.1 per cent in 2006.

**Chart 13: Labour Productivity and Product Wages, OECD countries, compound annual growth rate, per cent, 1970-2006**



Source: Summary Table 9.

On average (un-weighted), across OECD countries, consumption wages grew more slowly (2.21 per cent per year) either than labour productivity (2.33 per cent) or product wages (2.28 per cent) over the 1970-2006 period. This slower growth rate reflected deteriorating terms of trade for labour in OECD countries. A few countries experienced notably stronger growth in consumption wages than in product wages or labour productivity. In Finland consumption wages advanced at an average annual rate of

3.27 per cent, compared to labour productivity growth of 3.13 per cent and product wage growth of 3.08 per cent. In Italy consumption wages grew by 2.26 per cent per year on average, outstripping growth in labour productivity of 2.07 per cent and growth in product wages of 1.74 per cent. Finally, the United Kingdom also experienced strong consumption wage growth (2.63 per cent) compared to labour productivity growth of 2.34 per cent and product wage growth of 2.15 per cent.

**Summary Table 9: Labour Productivity and Real Wages, selected OECD countries, 1970-2006**

Country	Labour Productivity	Product Wage	Nominal Labour Share	Consumption Wage	Labour's Terms of Trade	Nominal Labour Share of GDP (per cent)	
	(compound annual growth rate, per cent)					1970	2006
	[1]	[2]	[3]=[2]-[1]	[4]	[5]=[4]-[2]	[6]	[7]
Australia	1.67	1.42	-0.25	1.31	-0.08	51.9	47.6
Canada	1.48	1.31	-0.17	1.25	-0.06	54.2	51.0
Denmark	2.28	2.36	0.08	2.23	-0.12	51.1	52.6
Finland	3.13	3.08	-0.03	3.27	0.18	48.9	48.3
France	2.75	2.86	0.11	2.75	-0.11	49.8	51.9
Germany	2.63	2.44	-0.19	2.21	-0.23	53.0	49.5
Iceland	2.31	2.91	0.58	..	..	48.8	60.1
Ireland	4.16	3.73	-0.41	..	..	48.5	41.8
Italy	2.07	1.74	-0.33	2.26	0.52	46.3	41.1
Japan	3.14	3.66	0.50	3.04	-0.61	43.3	51.6
Netherlands	2.40	2.16	-0.29	2.07	-0.09	54.7	49.2
New Zealand	1.14	0.81	-0.39	0.78	-0.02	49.9	43.6
Norway	3.06	2.57	-0.46	2.80	0.23	48.0	40.6
Spain	2.57	2.62	0.06	2.80	0.18	45.5	46.5
Sweden	2.09	1.91	-0.18	2.07	0.16	57.7	54.1
Switzerland	1.14	1.71	0.56	1.64	-0.07	50.8	62.1
United Kingdom	2.34	2.15	-0.19	2.63	0.46	59.5	55.5
United States	1.67	1.51	-0.16	..	..	60.2	56.8
Un-weighted averages	2.33	2.28	-0.06	2.21	0.02	51.2	50.2

**Source:** Appendix Tables 34-46.

**Notes:**

Australia, New Zealand and Japan use 2005 data, rather than 2006 data.

Some figures may not add up due to rounding. Data on US consumption wages are omitted because of the CPI inconsistency.

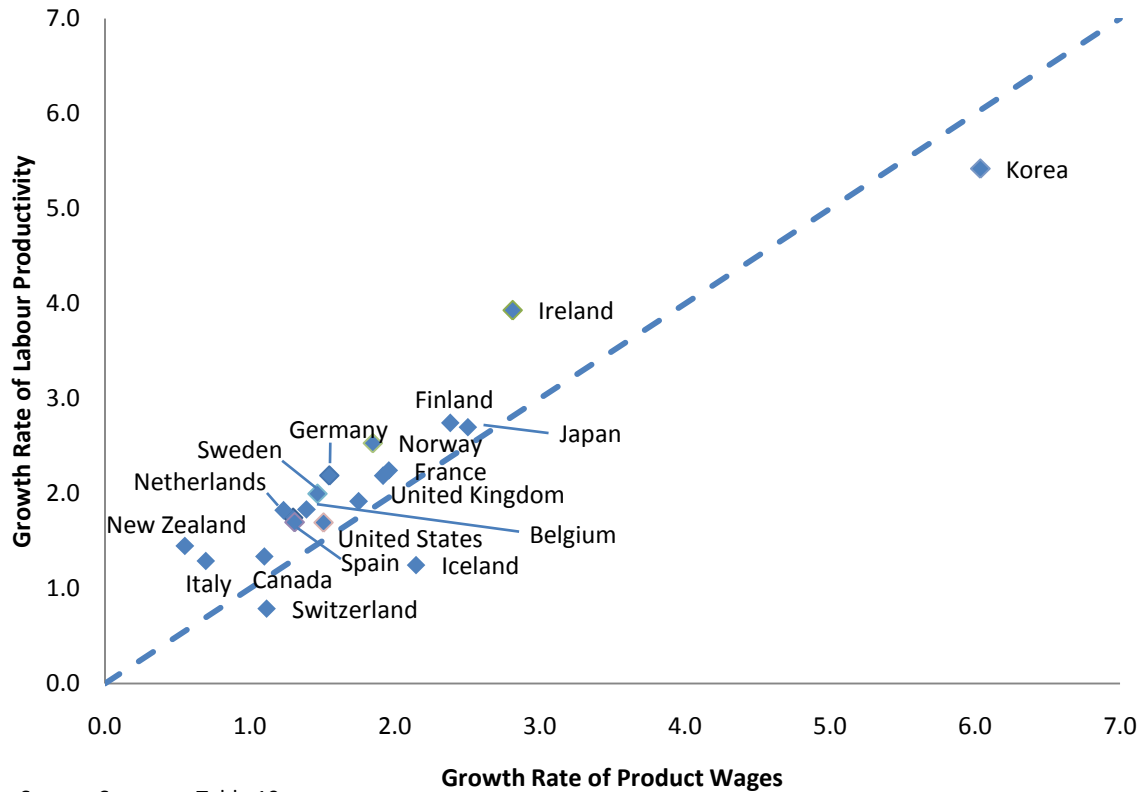
Over the 1970-2006 period, growth in consumption wages failed to keep up with labour productivity growth or growth in product wages in Australia, Canada, Denmark, Germany, Japan, the Netherlands, New Zealand, and Sweden. Labour's terms of trade

deteriorated most substantially in Japan, where consumption wages grew at 3.04 per cent per year compared to product wages, which grew at 3.66 per cent per year. On the other hand, Japan's increase in labour share over this period meant that consumption wage growth was not far off the 3.14 per cent average annual growth in labour productivity. Germany also experienced deterioration in its terms of trade, but this was not offset by an increase in labour share, so consumption wage growth fell further behind labour productivity growth than it fell behind real wage growth.

## ii. 1980-2006

In the 1980-2006 period product wages grew more slowly than labour productivity in the un-weighted average of 20 OECD countries (Summary Table 10). The 17 countries above the 45-degree line in Chart 14 all saw labour productivity grow faster than product wages, meaning labour share declined. This reflected an average decline in labour's share of GDP from 54.1 per cent to 50.0 per cent. Relatively large drops in labour share occurred in Germany, Ireland, Italy, the Netherlands, New Zealand, Norway, and Sweden. Increases occurred in only Iceland, Korea, and Switzerland. The most dramatic fall in labour's share took place in Ireland, where it fell from 55.4 per cent in 1980 to 41.8 per cent in 2006. At the other end of the spectrum and across North Atlantic, Iceland's labour share surged from 47.7 per cent to 60.1 per cent.

**Chart 14: Change in Labour Productivity and Product Wages, selected OECD countries, compound annual growth rates, per cent, 1980-2006**



Source: Summary Table 10

**Summary Table 10: Labour Productivity and Real Wages, selected OECD countries, 1980-2006**

Country	Labour Productivity	Product Wage	Nominal Labour Share	Consumption Wage	Labour's Terms of Trade	Nominal Labour Share of GDP (per cent)	
	(compound annual growth rate, per cent)					1980	2006
	[1]	[2]	[3]=[2]-[1]	[4]	[5]=[4]-[2]	[6]	[7]
Australia	1.75	1.30	-0.45	0.94	-0.29	53.3	47.6
Belgium	1.83	1.39	-0.44	1.24	-0.15	55.9	50.0
Canada	1.34	1.10	-0.24	0.71	-0.38	54.3	51.0
Denmark	1.92	1.75	-0.17	1.62	-0.13	54.9	52.6
Finland	2.74	2.38	-0.36	2.56	0.18	53.0	48.3
France	2.24	1.96	-0.29	1.83	-0.12	55.8	51.9
Germany	2.19	1.55	-0.64	1.22	-0.32	58.4	49.5
Iceland	1.25	2.15	0.90	2.23	0.08	47.7	60.1
Ireland	3.93	2.81	-1.12	2.95	0.14	55.4	41.8
Italy	1.29	0.70	-0.60	1.08	0.38	48.3	41.1
Japan	2.70	2.50	-0.20	2.10	-0.42	54.1	51.6
Korea	5.42	6.04	0.62	6.43	0.38	39.0	45.4
Netherlands	1.82	1.23	-0.59	0.99	-0.24	57.6	49.2
New Zealand	1.45	0.55	-0.90	0.28	-0.25	55.7	43.6
Norway	2.53	1.85	-0.68	2.26	0.41	48.0	40.6
Spain	1.70	1.31	-0.39	1.63	0.32	51.3	46.5
Sweden	2.00	1.47	-0.53	1.54	0.07	61.9	54.1
Switzerland	0.79	1.12	0.33	0.93	-0.18	57.1	62.1
United Kingdom	2.19	1.92	-0.27	2.47	0.54	59.7	55.5
United States	1.70	1.51	-0.19	..	..	59.7	56.8
Un-weighted Averages	2.14	1.83	-0.31	1.84	0.00	54.1	50.0

**Source:** Appendix Tables 34-46.

**Notes:**

Australia, New Zealand and Japan use 2005 data, rather than 2006 data.

Some figures may not add up due to rounding. Data on US consumption wages are omitted because of the CPI inconsistency. See the previous section for US analysis.

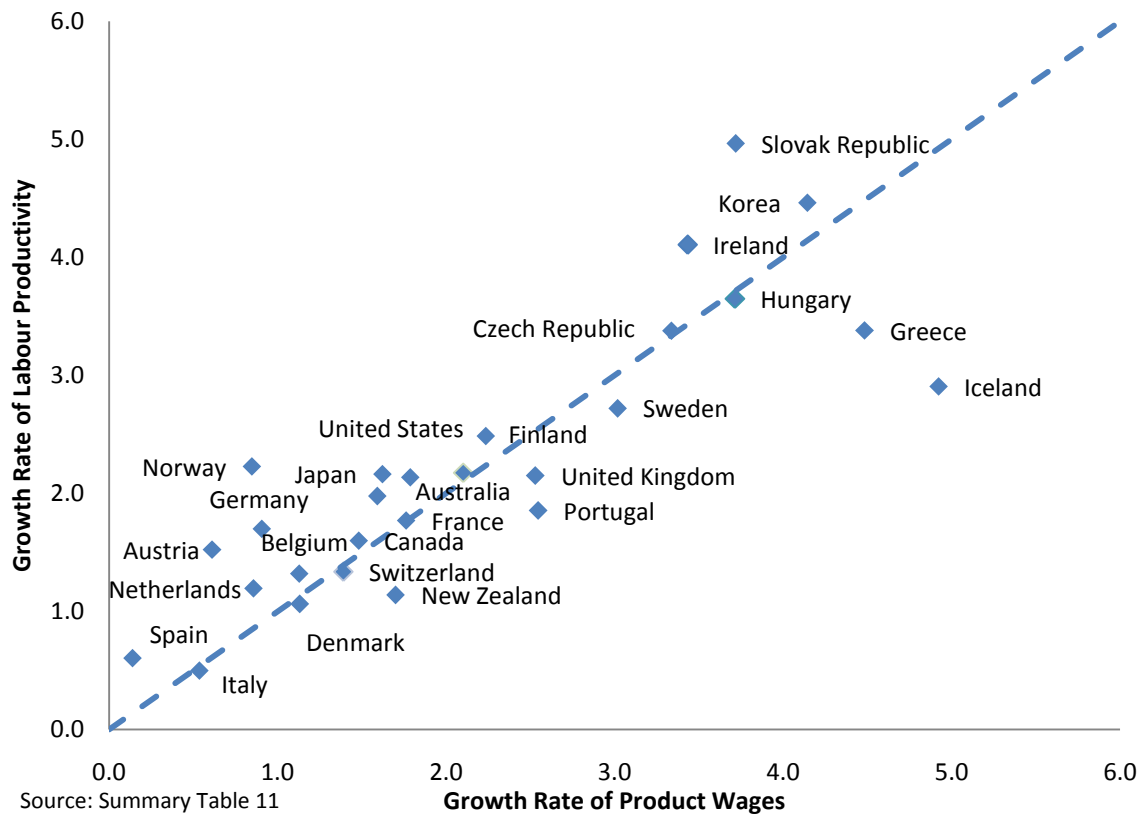
Turning to labour's terms of trade, the un-weighted OECD average did not change between 1980 and 2006. Labour in Australia, Canada, Germany, and Japan saw substantial deterioration in its terms of trade, while Italy, Korea, Norway Spain, and the United Kingdom saw strong improvements. Consumption wages grew most rapidly in Korea, by 6.43 per cent per year on average, and were most anemic in New Zealand,

where they advanced by a mere 0.28 per cent per year. While no other country approached Korea, strong consumption wage growth also occurred in Finland (2.56 per cent per year) and Ireland (2.95 per cent per year).

### iii. 1995-2006

The 1995-2006 period saw similar rates of growth in labour productivity and product wages. Labour productivity grew by 2.24 per year on average over this period in an un-weighted average. On the same basis, product wages advanced at an annual rate of 2.14 per cent. The resulting decline in labour share of GDP was from 48.9 per cent in 1995 to 48.3 per cent in 2006. Norway and the Slovak Republic saw the largest declines in labour share from 46.9 per cent to 40.6 per cent and from 42.0 per cent to 36.8 per cent respectively. Iceland saw the biggest increase in labour share over this period, from 48.6 per cent to 60.1 per cent.

**Chart 15: Change in Labour Productivity and Product Wages, selected OECD countries, compound annual growth rates, per cent, 1995-2006**





**Summary Table 11: Labour Productivity and Real Wages, selected OECD countries, 1995-2006**

Country	Labour Productivity	Product Wage	Nominal Labour Share	Consumption Wage	Labour's Terms of Trade	Nominal Labour Share of GDP (per cent)	
	(compound annual growth rate, per cent)					1995	2006
	[1]	[2]	[3]=[2]-[1]	[4]	[5]=[4]-[2]	[6]	[7]
Australia	2.14	1.79	-0.38	2.03	0.33	49.4	47.6
Austria	1.52	0.61	-0.89	0.16	-0.44	53.5	48.5
Belgium	1.32	1.13	-0.20	0.91	-0.22	51.0	50.0
Canada	1.60	1.48	-0.12	1.52	0.03	51.7	51.0
Czech Republic	3.38	3.34	-0.04	3.41	0.07	43.0	42.8
Denmark	1.06	1.13	0.07	1.17	0.04	52.2	52.6
Finland	2.49	2.24	-0.23	2.24	0.01	49.5	48.3
France	1.76	1.77	0.02	1.73	-0.04	51.8	51.9
Germany	1.70	0.91	-0.78	0.16	-0.74	54.0	49.5
Greece	3.38	4.48	1.08	4.59	0.11	31.9	35.9
Hungary	3.65	3.71	-0.22	3.19	-0.48	46.3	45.3
Iceland	2.91	4.92	1.96	5.34	0.40	48.6	60.1
Ireland	4.11	3.43	-0.67	4.17	0.71	45.0	41.8
Italy	0.50	0.54	-0.03	0.81	0.27	41.2	41.1
Japan	2.16	1.62	-0.53	0.71	-0.92	54.4	51.6
Korea	4.46	4.14	-0.29	3.25	-1.02	46.9	45.4
Luxembourg	1.98	1.59	-0.37	2.06	0.47	47.1	45.2
Netherlands	1.19	0.86	-0.33	1.14	0.28	51.1	49.2
New Zealand	1.14	1.70	0.32	1.76	0.09	42.2	43.6
Norway	2.23	0.85	-1.29	3.55	2.68	46.9	40.6
Portugal	1.86	2.55	0.36	2.85	0.23	48.2	49.8
Slovak Republic	4.96	3.72	-1.19	2.15	-1.51	42.0	36.8
Spain	0.60	0.14	-0.45	0.72	0.58	48.9	46.5
Sweden	2.72	3.02	0.29	3.32	0.29	52.4	54.1
Switzerland	1.34	1.39	0.06	1.19	-0.20	61.7	62.1
United Kingdom	2.15	2.53	0.35	3.52	0.97	53.4	55.5
United States	2.17	2.10	-0.06	1.69	-0.40	57.2	56.8
Un-weighted Averages	2.24	2.14	-0.13	2.20	0.06	48.9	48.3

Source: Appendix Tables 34-46.

**Notes:**

Australia, New Zealand and Japan use 2005 data and Portugal uses data from 2004, rather than 2006 data.

Some figures may not add up due to rounding. Data on US consumption wages are omitted because of the CPI inconsistency.

#### iv. Key Findings: OECD Countries

**Summary Table 12: The Relationship between Real Wages and Labour Productivity in OECD Countries**

	<b>Consumption wages grew faster than labour productivity</b>	<b>Labour productivity grew faster than consumption wages</b>
1970-2006	Finland Italy Spain Switzerland	Australia Canada Denmark Germany Japan Netherlands New Zealand Norway Sweden
1980-2006	Iceland Korea Switzerland United Kingdom	Australia Belgium Canada Denmark Finland France Germany Ireland Italy Japan Netherlands New Zealand Norway Spain Sweden
1995-2006	Czech Republic Denmark Greece Iceland Ireland Italy Luxembourg New Zealand Norway Portugal Spain Sweden United Kingdom	Australia Austria Belgium Canada Finland France Germany Hungary Japan Korea Netherlands Slovak Republic Switzerland United States

Note:

1. The following countries are excluded from the period 1970-2006 due to data limitations: Iceland, Ireland, and the United States

2. The United States is excluded from the period 1980-2006 due to data limitations.

Source: Summary Tables 9, 10, and 11.

Summary Table 12 provides a summary of which countries have seen persistent differences between the growth rates of consumption wages and labour productivity. No countries saw consumption wages growth faster than labour productivity in every period,

but Finland, Italy, Spain and Switzerland, all saw consumption wages grow faster than labour productivity over the 1970-2006 period. On the other hand, a number of countries saw labour productivity growth consistently exceed the growth of consumption wages. These countries included Australia, Belgium, Canada, Germany, Japan, and New Zealand among others.

From this review of trends in the labour productivity and real wages across OECD countries, we can see that the difference between the growth rates of labour productivity and real wages is smaller over longer periods of time (Summary Table 13). This reflects the diminishing impact of cyclical factors on the relationship between labour productivity and real wages as the time horizon increases.

**Summary Table 13: Change in Labour Share, compound annual growth rate, Standard Deviation**

Period	Standard deviation (percentage points)
1970-2006	0.33
1980-2006	0.47
1995-2006	0.69

Source: Calculated from Summary Tables 9, 10, and 11.

## D. Summary of Key Findings: Canada, the United States, and OECD Countries

This part began by analyzing trends in labour productivity and real wages in Canada, at the national, provincial, and industry levels. It then analyzed trends in labour productivity and real wages in the United States and in other countries that are members of the Organisation for Economic Cooperation and Development (OECD). Key findings of this part were as follows:

- In Canada, over the period 1961 to 2007, growth in both product wages (1.56 per cent per year) and consumption wages (1.67 per cent), has been slightly slower than labour productivity growth (1.73 per cent).
- By definition, the gap between product wage growth and labour productivity growth reflects trends in the labour share. The labour share thus fell 0.17 per cent per year between 1961 and 2007, from 57.5 per cent of GDP to 53.1 per cent. The fall in the labour share was almost entirely due to developments between 1992 and 1997, when the labour share fell from 57.7 per cent to 54.0 per cent, an average of 1.32 per cent per year. Over that five-year period, labour productivity increased 1.26 per cent per year, while product wages decreased 0.11 per cent per year.
- The gap between the growth in product wages and consumption wages reflects changes in labour's terms of trade, the price of output relative to price of

consumption goods. From 1961 to 2007 labour's terms of trade improved slightly, helping to offset the effect of the fall in labour share on the growth in consumption wages. Labour's terms of trade experienced major swings over the period. They improved from 1961 to 1976; declined from 1976 to 2002; then rose from 2002 to 2007.

- In the presence of competitive labour and product markets, labour productivity growth and real consumption wages growth at the sector level should have no direct relationship. Wages are determined at the level of the wider labour market and labour productivity gains are reflected in lower output prices rather than higher sector wages. Lower prices benefit all workers rather than only workers in the sector experiencing labour productivity growth.
- A stark example of the disconnection between labour productivity and real wages growth at the sector level in Canada is in the mining and oil and gas sector. In this sector, labour compensation has been growing healthily since 2000 despite negative labour productivity growth.
- In the United States, over the period 1961 to 2007, labour productivity and product wages grew at similar average annual rates, 1.82 per cent and 1.73 per cent respectively. The difference in growth rates resulted from a decline in the labour share of 0.09 per cent per year, from 64.1 per cent of GDP to 61.5 per cent of GDP. Consumption wages, which grew by 1.74 per cent per year between 1961 and 2007, followed product wages very closely, reflecting very little change in labour's terms of trade.
- Other OECD countries have seen significant and varied changes in labour share over the period 1970-2006. The largest absolute change was in Iceland, where the labour share grew from 48.5 per cent in 1970 to 60.1 per cent in 2006. Switzerland saw a large increase as well, from 50.8 per cent to 62.1 per cent.
- The largest declines in labour share occurred in Norway and Ireland, with declines from 48.0 per cent to 40.6 per cent of GDP and from 48.5 per cent to 41.8 per cent of GDP respectively. Among G7 countries, Japan showed the largest change in labour share, an increase from 43.3 per cent of GDP to 51.6 per cent of GDP, while Italy experienced a decline in labour share from 46.3 per cent of GDP to 41.1 per cent of GDP.
- Broadly speaking, the trend among OECD countries has been for labour productivity and product wages to grow at almost the same rate. From 1970 to 2006, the un-weighted average of the 20 OECD countries examined in this report shows that labour productivity grew at an average annual rate of 2.33 per cent, while product wages grew by 2.28 per cent per year. The resulting average decline in labour share of GDP was from 51.2 per cent to 50.2 per cent.

## **VI. Explanations of Developments in the Relationship between Labour Productivity and Real Wages in Canada**

Previous sections have summarized the theory and challenges underlying the measurement of the relationship between labour productivity and real wages as well as reviewed recent trends in Canada and other OECD countries. This part of the report suggests possible explanations for changes in the relationship in Canada. The first section provides a decomposition of the difference in growth rates between a commonly used indicator of compensation, median earnings, and labour productivity since 1980. The second section briefly examines how labour's terms of trade have evolved since 1961, and points out potential areas for further research. The third section narrows the discussion to the labour share. It discusses the potential effect of business cycles and structural factors on the labour share in Canada.

### **A. An Accounting Perspective on the Relationship between Labour Productivity and Real Wages in Canada**

In May 2008, Statistics Canada (2008) released a comprehensive review of the earnings of Canadians between 1980 and 2005 based on census data. A widely reported finding was that the median earnings of full-time, full-year workers in Canada rose only \$53 dollars, from \$41,348 (2005 dollars) in 1980 to \$41,401 in 2005. In light of the significant labour productivity gains over the same period (37.4 per cent), this finding begs the question of whether workers have an interest in labour productivity growth when they do not seem to benefit from it. This part of the report also seeks to explain where these productivity gains have gone.

As was discussed in part IV, a number of conceptual and methodological hurdles stand in the way of a meaningful comparison between labour productivity and earnings growth. This section provides an accounting analysis of the gap between stagnant median earnings and labour productivity growth in an attempt to quantify the role of particular methodological differences between the two measures.<sup>15</sup>

The apparent discrepancy between labour productivity and earnings is in part a result of inconsistent measurement. The two measures embody different definitions and concepts that are either not comparable, or cannot be meaningfully compared as they lack consistency. As shown in Summary Table 14, about one fifth of the 1.26 percentage-point gap between annual median earnings growth and annual labour productivity growth over the 1980-2005 period was due to measurement issues.

First, to make a meaningful comparison between earnings and labour productivity, the same unit of labour input must be used. While census earnings are

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<sup>15</sup> The analysis contained in this introductory section pertains to the 1980-2005 period instead of the 1961-2007 period which was the focus of part V on real wage and labour productivity trends in Canada. We have adopted the 1980-2005 period in order for the discussion to remain in the context of the current public debate in Canada about the gap between productivity and real wages. The lack of median wage data prior to 1980 also prevented us from extending the analysis further back in time.

reported for full-time full-year workers, productivity is reported for all workers and is generally expressed on an hourly basis. In our analysis, the transformation from full-time, full-year workers to hours was divided in two steps (Summary Table 15). First, it was noted that the average earnings of full-time full year earners grew at about the same rate as that of all earners, where an earner is defined as anyone with earnings during the year rather than an average of the monthly number of earners as is the case for the definition of annual average employment. Second, it was found that the number of hours worked per year per earner has increased slightly over the 1980-2005 period, up 2.25 per cent or 0.09 per cent on an annual basis.<sup>16</sup> Adopting a more appropriate measure of labour input, hours worked, thus increases the gap by 0.10 percentage points (7.9 per cent).

Second, the census earnings definition is not an exhaustive measure of total labour compensation as it excludes supplementary labour income, which includes employer contributions to social insurance programs such as CPP and EI, which can be considered a form of delayed or future earnings. As noted earlier in the report, national accounts data show that nominal supplementary labour compensation increased much faster than census earnings, boosting average total labour compensation. On an annual basis, average total compensation grew 0.35 percentage points faster than average earnings, which explains slightly more than a quarter of the gap.

**Summary Table 14: Factors Explaining the Median Real Earnings and Labour Productivity Growth in Canada, 1980-2005**

	<b>Absolute (points)</b>	<b>Relative (per cent)</b>
<b>Median Real Earnings and Productivity Gap, of which:</b>	1.26	100.0
Measurement Issues	0.25	19.8
Inequality	0.35	27.6
Labour's Terms of Trade	0.42	33.3
Labour Share	0.25	19.8

Source: Summary Table 15

The use of median earnings in place of average earnings accounted for about one-quarter (27.6 per cent) of the gap between median real earnings and labour productivity growth. The difference between median and average earnings growth reflects increasing earnings inequality in Canada over the period. Median real earnings of the top 20 per cent of full-time full-year earners grew 16.4 per cent, while those of the bottom 20 per cent fell 20.6 per cent. While of great social importance, trends in inequality are largely independent of the relationship between labour productivity and real wages. As such, comparing median earnings and labour productivity may be slightly misleading as it conflates issues of inequality with those of productivity growth. The next section will

<sup>16</sup> The number of hours worked per earner tends to be pro-cyclical, *i.e.* favorable labour market conditions tend to increase the average number of hours worked for individuals working in a given year. Over the 1980-2005 period, the number of hours worked per earner per year reached a trough in 1982 at 1,463 hours and peaked in 1998 at 1,593 hours (Labour Force Survey). In this context, the difference between 1980 and 2005 is relatively small at 35 hours per year, from 1,521 hours in 1980 to 1,556 in 2005.

provide a short review of potential explanations for increasing earnings inequalities in Canada, as well as a brief discussion of the impact of a stagnating median wages on the public's perception of the importance of labour productivity growth.

The use of different deflators, *i.e.* the change in labour's terms of trade, accounted for one-third of the median earning/labour productivity growth gap between 1980 and 2005. From a consumer perspective, total compensation must be adjusted using the CPI in order to obtain a consistent indicator of purchasing power through time. Over the 1980-2005 period, the CPI grew faster than the GDP deflator, meaning growth in product wages exceeded that of consumption wages.<sup>17</sup> Yet, as explained in part III, the theoretical link between labour compensation and productivity requires that both variables be deflated using the same deflator. When both measures are deflated using the GDP deflator, a further 0.42 percentage points, or 33.3 per cent, of the gap is explained. A later section provides an outline explanation for changes in labour's terms of trade.

**Summary Table 15: Reconciling Growth in Median Real Earnings and Labour Productivity in Canada, 1980-2005**

Earnings and Productivity Growth Gap	Compound Annual Growth Rates	
	Real median earnings of full-time full-year workers	0.01
Labour productivity (Real output per hour)	1.27	
Total gap	1.26	
Contribution to Median Real Earnings and Productivity Gap	Absolute (points)	Relative (per cent)
From median to average earnings	0.35	27.6
Change in definition of labour input, of which:	-0.10	-7.9
from full-time full-year workers to all earners	-0.01	-0.6
from earners to hours	-0.09	-7.3
From earnings to total compensation	0.35	27.8
From CPI to GDP deflator	0.42	33.3
Change in the labour share of nominal GDP	0.25	19.8
Total – All Factors	<b>1.26</b>	<b>100.0</b>

Source: Appendix Table 1 and Appendix Table 22

The remaining 0.25 percentage points (19.8 per cent) gap is due to the falling labour compensation to GDP ratio, *i.e.* labour share. In an accounting sense, faster growth in the non-wage components of GDP explains the falling labour share. During the 1980-2005 period, average annual growth of nominal wages, salaries and supplementary income was 5.77 per cent, slightly slower than nominal GDP growth of 6.08 per cent per year, and significantly slower than the 6.42 per cent per year rate of increase of nominal GDP excluding wages (Appendix Table 3). Of the six largest non-wage components of

<sup>17</sup> As noted previously, there are potential alternative measures of price change for consumer goods. Over the period from 1980-2005, the consumer price index grew by 3.62 per cent per year, while implicit deflator for personal consumption expenditures (PCE deflator) grew by only 3.42 per cent per year (Appendix Table 1).

income-based GDP (accounting for 97.4 per cent of GDP excluding wages), five grew faster than wages and thus contributed to the faster growth of GDP relative to wages. Profits, growing at a robust 6.59 per cent per year, made the most important contribution.<sup>18</sup> In 1980, profits represented 12.2 per cent of GDP. By 2005, the share had risen to 13.8 per cent.

## B. Real Wage Growth and Inequalities in Canada

As we have seen in Summary Table 15, the difference between the growth rates of median and average earnings explains 27.6 per cent of the difference between the growth of median earnings and the growth of labour productivity over the 1980-2005 period. This difference reflects growing earnings inequality. Indeed, the median real earnings of the top quintile increased 16.4 per cent between 1980 and 2005, while those of the bottom quintile decreased 20.6 per cent.

While income inequalities in Canada have increased between 1980 and 2005, the trend has not been stable over the period. The Gini coefficient for households' market income in Canada, the most commonly used indicator of income inequality, increased from 0.437 in 1980 to 0.508 in 2005 (Chart 16). It should be noted that household market income inequality is only a rough proxy for labour compensation inequality among workers; household inequality would only reflect trends in inequality among workers if there is no change in assortative matching, *i.e.* the phenomenon of high-income individuals forming households together. The increase in household market income inequality took place in two steps: first, the recession of the early 1980s led to an initial increase from 0.434 in 1981 to 0.469 in 1983; second, the recession and ensuing stagnation of the first half of the 1990s spurred a second increase from 0.460 in 1989 to 0.524 in 1997. Since 1997, the Gini coefficient has not changed much, decreasing slightly before 2000 and stabilizing around 0.51 since then.

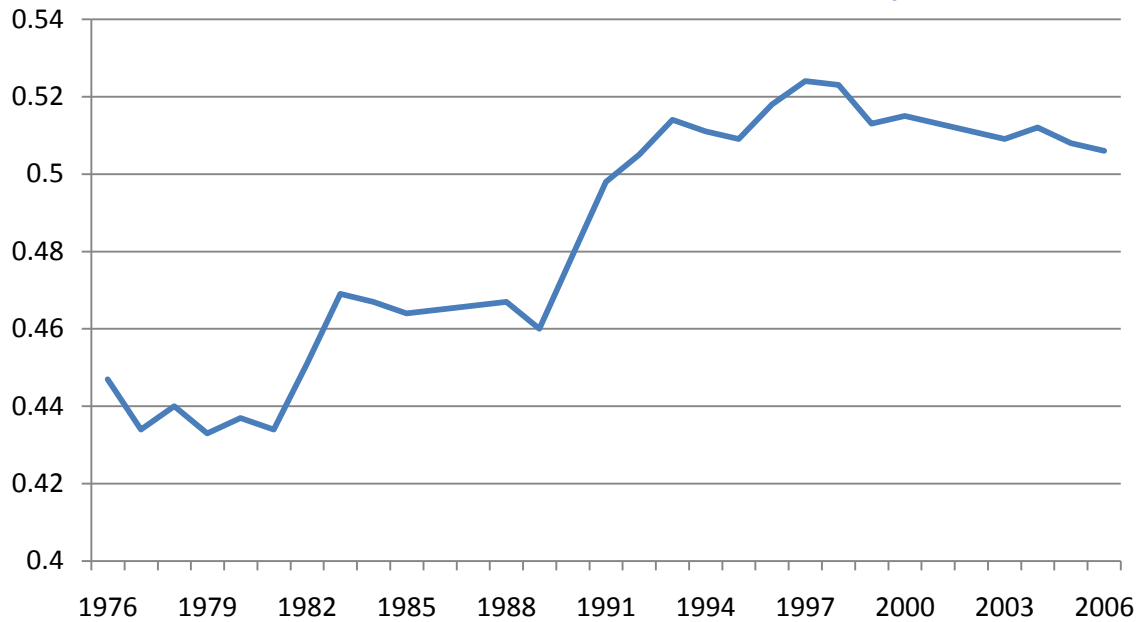
The reasons for the growing earnings' inequality in Canada are poorly understood. Some argue that this development reflects market forces at play and more specifically the growing demand for highly skilled labour. An extreme example of market forces leading to large gains for skilled labour is J.K. Rowling, the author behind the Harry Potter series. She was the first person to become a billionaire by writing books, a reality made possible by the new market forces at play which among other things facilitate the distribution of products across markets.<sup>19</sup> Others make the case that it reflects governance structures that allow persons in positions of power, such as Chief Executive Officers, to obtain earnings increases not commensurate with their contribution to output.

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<sup>18</sup> Nominal net income of unincorporated businesses including rent grew at a 7.54 per cent average annual growth rate between 1980 and 2005, with capital consumption allowances increasing at a 6.42 per cent average annual rate, and net taxes (taxes less subsidies) at a 7.75 per cent rate. Interest and miscellaneous investment income advanced at only a 3.28 average annual rate. In relative terms, the faster growth of corporate profits account for 34.5 per cent, or 23.13 percentage points, of the 67.1 percentage-point difference between the growth of wages and the growth of GDP minus wages for the 1980-2005 period. Net taxes contributed 36.2 percent, capital consumption allowance 25.9 per cent, unincorporated businesses 29.5 per cent and interest and investment income, which grew slower, had a negative contribution of 51.7 per cent.

<sup>19</sup> Other examples include professional athletes, musicians and performers in general.



**Chart 16: Gini Coefficient for Market Income, Canada, All Family Units, 1976-2006**

Source: Appendix Table 48

Saez and Veall (2005) find that the increase in total income since the late 1970s in Canada is concentrated among the top one per cent of earners, whose share of income increased from 5 per cent in the late 1970s to 10 per cent in 2000. The top 0.1 per cent in turn accounted for much of the increase, with their share growing from 1.0 to 4.3 per cent over the period. Saez and Veall suggest that the threat of migration to the United States, where the surge in top income share started earlier (1970), might have spurred the surge in Canada. They support their case with evidence from Quebec where residents have a lower propensity to migrate because of language and cultural differences and where the top income share increase has been much more modest. While the finding of increased income inequality due to the fast rise of incomes at the top of the scale has been confirmed in many subsequent studies (Murphy, Michaud and Wolfson (2008) and Heisz (2007) for example), the drivers behind this trend remain areas where more research is required. .

### C. An Explanation for Trends in Labour's Terms of Trade

As was noted in Summary Table 15, one-third of the difference in the growth rate between median real earnings and labour productivity over the period from 1980 to 2005 can be explained by differences in the growth rates between the GDP deflator and the Consumer Price Index. This report refers to the relationship between the GDP deflator and the CPI as labour's terms of trade. This section outlines an explanation for the shift in labour's terms of trade in terms of the underlying changes in the GDP deflator.

The Consumer Price Index (CPI) measures changes in the prices of a basket of goods and services purchased by consumers. On an annual basis, the basket is not changed in terms of quantity or quality of goods and services, so that pure price changes can be observed. The CPI is a useful measure of the change in the purchasing power of Canadians. The GDP deflator is a measure of the change in the prices of all components of output in the economy. It is composed of personal expenditure on consumer goods and services, government spending, government investment, business investment, exports, and imports.

To understand how changes in the GDP deflator and the CPI impact labour's terms of trade, recall from part III that labour's terms of trade are defined as

$$T_L = \frac{P_Y}{P_C} \quad (20)$$

where  $T_L$  is labour's terms of trade,  $P_Y$  is the GDP deflator, and  $P_C$  is the CPI.

Taking logs and time derivatives yields

$$\Delta \text{Labour's Terms of Trade} = \Delta \text{GDP Deflator} - \Delta \text{CPI}$$

where  $\Delta$  indicates a percentage change. The change in labour's terms of trade is equal to the change in the GDP deflator less the change in the CPI. This makes sense intuitively. If the prices of the goods produced by workers, which are measured by the GDP deflator, rise more quickly than the prices of goods consumed by workers, measured by the CPI, then the workers are better off, because their terms of trade have improved.<sup>20</sup>

<sup>20</sup>The GDP deflator is an average of the components of GDP weighted by the share of each component in GDP:

$$P_Y = \frac{C}{Y} P_{PC} + \frac{G_C}{Y} P_{GC} + \frac{G_I}{Y} P_{GI} + \frac{I}{Y} P_I + \frac{X}{Y} P_X - \frac{M}{Y} P_M \quad (21)$$

where  $C$  is personal consumption,  $G_C$  is government consumption,  $G_I$  is government investment,  $I$  is business investment,  $X$  is exports, and  $M$  is imports.  $P_{PC}$  is the personal consumption deflator (which is not equal to  $P_C$ , the CPI),  $P_{GC}$  is the government consumption deflator,  $P_{GI}$  is the government investment deflator,  $P_I$  is the business investment deflator,  $P_X$  is the exports deflator, and  $P_M$  is the import deflator.

Substituting equation (21) into equation (20) yields

$$T_L = \frac{\left[ \frac{C}{Y} P_{PC} + \frac{G_C}{Y} P_{GC} + \frac{G_I}{Y} P_{GI} + \frac{I}{Y} P_I + \frac{X}{Y} P_X - \frac{M}{Y} P_M \right]}{P_C} \quad (22)$$

Again, taking logs and time derivatives yields

$$\Delta T_L = \bar{\bar{C}}(\Delta C - \Delta CPI) + \bar{\bar{G}_C}(\Delta G_C - \Delta CPI) + \bar{\bar{G}_I}(\Delta G_I - \Delta CPI) + \bar{\bar{I}}(\Delta I - \Delta CPI) + \bar{\bar{X}}(\Delta X - \Delta CPI) + \bar{\bar{M}}(\Delta M - \Delta CPI)$$

where two bars over a character (e.g.  $\bar{\bar{C}}$ ) indicate an average share of GDP, and  $\Delta$  indicates a percentage change. This relationship underlies Summary Table 16.

**Summary Table 16: Decomposition of Labour's Terms of Trade, Canada, total economy, 1961-2007**

	Labour's Terms of Trade	CPI	Domestic Economy Deflators					International Trade Deflators		
			GDP	Consumption	Government Current Spending	Government Investment	Business Investment	Total	Exports	Imports
<b>Index (2002 = 100)</b>										
1961	99.4	15.7	15.6	15.5	10.6	21.1	19.4	..	17.6	17.9
1976	117.4	31.1	36.5	31.9	31.8	49.6	44.3	..	40.2	35.2
1980	114.3	44.0	50.3	45.3	44.0	67.6	59.7	..	65.5	59.7
2002	100.0	100.0	100.0	100.0	100.0	100.0	100.0	..	100.0	100.0
2005	103.0	107.0	110.2	104.9	108.3	103.4	103.6	..	103.7	90.1
2007	104.4	111.5	116.4	108.0	114.8	110.3	109.4	..	104.8	87.4
<b>Average Share of GDP (per cent)</b>										
1961-07	..	..	100.0	59.3	17.8	3.7	18.2	0.8	26.3	25.6
1961-76	..	..	100.0	58.4	18.9	4.0	18.5	-0.6	20.0	20.6
1976-02	..	..	100.0	55.4	20.6	2.9	18.6	1.8	31.9	30.0
2002-07	..	..	100.0	56.3	19.5	2.7	18.2	3.2	38.2	35.0
1980-05	..	..	100.0	54.5	20.2	2.8	19.3	2.8	33.0	30.1
<b>Compound Annual Growth Rate (per cent)</b>										
1961-07	0.11	4.45	4.57	4.41	5.44	3.74	3.92	..	4.05	3.59
1961-76	1.12	4.66	5.83	4.92	7.59	5.85	5.66	..	5.66	4.63
1976-02	-0.61	4.59	3.95	4.49	4.51	2.74	3.18	..	3.57	4.10
2002-07	1.08	2.76	3.87	1.95	3.52	2.48	2.28	..	1.19	-3.32
1980-05	-0.42	3.62	3.19	3.42	3.67	1.71	2.23	..	1.85	1.66
<b>Absolute Contribution (percentage points)</b>										
1961-07	0.11	..	..	-0.03	0.17	-0.03	-0.10	0.11	-0.11	-0.22
1961-76	1.12	..	..	0.15	0.55	0.05	0.18	0.21	0.20	-0.01
1976-02	-0.61	..	..	-0.06	-0.02	-0.05	-0.26	-0.18	-0.33	-0.15
2002-07	1.08	..	..	-0.46	0.15	-0.01	-0.09	1.53	-0.60	-2.13
1980-05	-0.42	..	..	-0.11	0.01	-0.05	-0.27	0.01	-0.58	-0.59
<b>Relative Contribution (per cent)</b>										
1961-07	100.0	..	..	-24.2	152.4	-23.1	-84.9	98.2	-93.6	-191.8
1961-76	100.0	..	..	13.1	47.4	4.0	15.8	17.7	17.0	-0.7
1976-02	100.0	..	..	9.0	2.7	8.4	40.9	27.9	51.0	23.1
2002-07	100.0	..	..	-41.2	13.3	-0.7	-7.9	137.6	-54.1	-191.7
1980-05	100.0	..	..	25.3	-2.3	12.3	62.2	-1.9	134.8	136.6

Source: Appendix Table 7

Note: Some figures may not add due to rounding and to small exclusions from GDP

As noted above, labour's terms of trade improved slightly over the period 1961 to 2007.<sup>21</sup> In the sub-period 1961-1976, during which labour's terms of trade improved considerably, strong growth in the deflator for government consumption explained close to half the improvement. Growth in the prices of investment goods explained 15.8 per cent of the increase in labour's terms of trade, and an improvement in Canada's

<sup>21</sup> This section uses different sub-periods than the cyclically-neutral periods that were used elsewhere in this report (1961-1973, 1973-1981, 1981-1989, 1989-2000, and 2000-2007), because the focus of this section is on changes in labour's terms of trade.

international terms of trade explained 17.7 per cent of the improvement in labour's terms of trade. Between 1976 and 2002, the story was somewhat different. Labour's terms of trade deteriorated. Government-led inflation was no longer the major driver of labour's terms of trade. Almost 40 per cent of the deterioration resulted from relatively slow growth in the cost of investment and 27.9 per cent resulted from worsening international terms of trade. In the final period, 2002-2007, when labour's terms of trade turned around, the improvement was led by Canada's international terms of trade. While export prices rose only slowly, by 1.19 per cent per year, import prices declined by 3.32 per cent per year.

It is also interesting to examine what happened to labour's terms of trade between 1980 and 2005, in order to be consistent with the discussion presented in the previous section. Over this period, labour's terms of trade deteriorated. This deterioration was driven by slower growth in the prices of business investment goods, primarily in the 1990s. Slower growth in the business investment deflator reflects falling real prices for information and communications technology goods like computers.

This section has briefly outlined an explanation for the small improvement in labour's terms of trade in Canada from 1961 to 2007. While this report does not pursue these issues further, they are a promising area for further research related to the relationship between consumption wages and labour productivity.<sup>22</sup>

#### **D. Explaining the Falling Labour Share in Canada**

Historically, the concept of labour share has played an important role in political and economic debates. It has been associated with the worker's "fair share", a proxy for how wealth was divided between workers and owners of capital. As noted in parts IV and V, trends in the labour share in Canada are not only sensitive to the period under analysis, but also to the source of the primary data. According to estimates from the National Accounts, the labour share in Canada was around 51 per cent in both 1961 (51.5 per cent) and 2007 (51.1 per cent). This similarity obscures significant changes that occurred over the period, with a peak of 55.8 per cent in 1977 and a trough of 50.5 per cent in 2005 (Chart 5). In contrast, the series from the Productivity Accounts, which includes the implicit labour income of the self-employed, suggests that the labour share has fallen from 57.5 per cent in 1961 to 53.1 per cent in 2007, a decrease of 4.4 percentage points. The latter series also contains significant variability, peaking at 58.7 per cent in 1976 and reaching a low of 52.8 per cent in 2005. Both series, however, suggest a considerable fall in labour share between 1980 and 2005, which was largely concentrated over the relatively short 1992-1996 period.

These stylized facts raise questions about the reasons behind the recent decline in the labour share. The first sub-section discusses the effect of business cycles on the

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<sup>22</sup> The GDP deflator is complex. While outside the scope of this report, decomposition of its elements, beyond what is included below, would be an interesting avenue for future research. For example, it would be interesting to further decompose the business investment deflator from 1980 to 2005 to determine the source of the slow growth in prices of investment goods.

relationship between real wages and labour productivity. The second sub-section explores a number of structural or long-term factors with differential effects on wage and profits that have potentially affected the labour share in Canada.

### **i. The Effect of the Business Cycle**

The labour productivity growth is affected by business cycles. In theory, this cyclical need not affect the long-term relationship between labour productivity and real wages. In practice the sources of business cycles have implications for the underlying relationship. Indeed, a large portion of the cyclical of labour productivity is explained by lags in the adjustment of labour inputs to changes in output, which in turn follow from firms' unfulfilled expectations concerning demand conditions, the existence of overhead labour and a tendency for firms to hoard skilled labour in downturns. In other words, firms tend to have excess labour during downturns, *i.e.* the ratio of hours worked to GDP increases. The increase in hours worked-to-GDP ratio, everything else being equal, then translates into an increase in the labour share.

Of course, firms could reduce the level of compensation during downturn, which could stabilize the labour share at its initial level. Empirical evidence, however, suggests that changes in labour productivity are not immediately reflected in levels of compensation. A simple regression of changes in nominal compensation on changes in nominal GDP over the 1961-2006 period performs better when independent variables include a one-period lag for changes in nominal GDP, a finding consistent with those of Feldstein (2008) for the United States.<sup>23</sup>

Growth in profits also has a tendency to overshoot when the economy is booming, and fall well below economic growth during downturns. This reinforces the effect of business cycles on the relationship between labour productivity and real wages, as the increasing share of profit during an upswing puts downward pressure on the labour share and vice versa. Theoretically the effect of business cycles on the relationship between labour productivity and real wages is the result of imperfect information, *i.e.* compensation of the factors of production does not adjust instantaneously.<sup>24</sup>

### **ii. Structural and Long-Term Factors**

Of greater interest than short- and medium-term or cyclical factors are long-term or structural factors affecting the labour share. These factors include commodity prices, which greatly affect profits; the institutional setting for wage bargaining labour market conditions; factors affecting labour supply such as demographic developments and immigration; factors affecting labour demand such as technological change; the state of domestic and international competition in product and labour markets; and inflation expectations. This section will explore these factors.

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<sup>23</sup> The one period relationship is strong in Canada, with a coefficient of 0.98 and an R-square of 0.847. The model with the lagged variable has an R-square of 0.876.

<sup>24</sup> For a review of factors affecting the speed of adjustment, see Centre for Spatial Economics (2007).

### a. Commodity prices

Since 2002, commodity prices, particularly oil prices, have risen. In Canada, a rise in commodity prices interacts with the relationship between labour productivity and real wages through a number of channels. The direct impact of a demand-induced increase in commodity prices is an increase in profits in commodity-producing industries. In the mining, oil and gas industry, profits have doubled between 2000 and 2006 (Arsenault and Sharpe, 2008). As the commodity-based industries compete for labour with other industries which do not benefit from increased prices, they do not have to significantly increase their (real) consumption wages to retain workers. This explains the large discrepancy between producer and consumer wages in the mining and oil and gas industry in Canada noted in part V. This effect, which would tend to lower the labour share as the profit share increases, is the intra-industry effect. For example, the labour share in the mining and oil and gas industry has decreased from 21.7 per cent in 2002 to 16.5 per cent in 2004, the latest year for which data were available.

Yet, because Canada has relatively abundant natural resources, an increase in commodity prices also has the potential to affect other industries, an inter-industry effect. First, higher commodity prices may lead to employment shifts across industries. Between 2000 and 2007, employment in the manufacturing sector fell almost 10 per cent while employment in the mining and oil and gas industry increased about 60 per cent. Because commodity-based industries tend to have larger profit shares and lower labour shares, in part because they are more capital intensive, employment shifts towards these industries should lead to a decreasing labour share.

Yet, increasing commodity prices in Canada also generally translate into an appreciating currency. The effect on other industries can be considerable. A rising currency meant falling prices for Canada's exports (expressed in Canadian dollars), consequently manufacturing industries experienced a 29 per cent decrease in profits between 2000 and 2006. The economic slowdown in manufacturing in the early 2000s, which was magnified by the appreciation of the Canadian dollar in step with commodity prices, led to an increase in labour share in the sector from 54.9 per cent in 2002 to 56.7 per cent in 2006.<sup>25</sup>

In the long term, the main effect of a permanent increase in commodity prices flows through the resulting changes in industrial structure. While firms, including manufacturers and commodity producers, will eventually adjust to the new set of relative prices at home and abroad, employment shifts towards industries with lower labour share have the potential to translate into a permanently lower labour share at the aggregate economy level.

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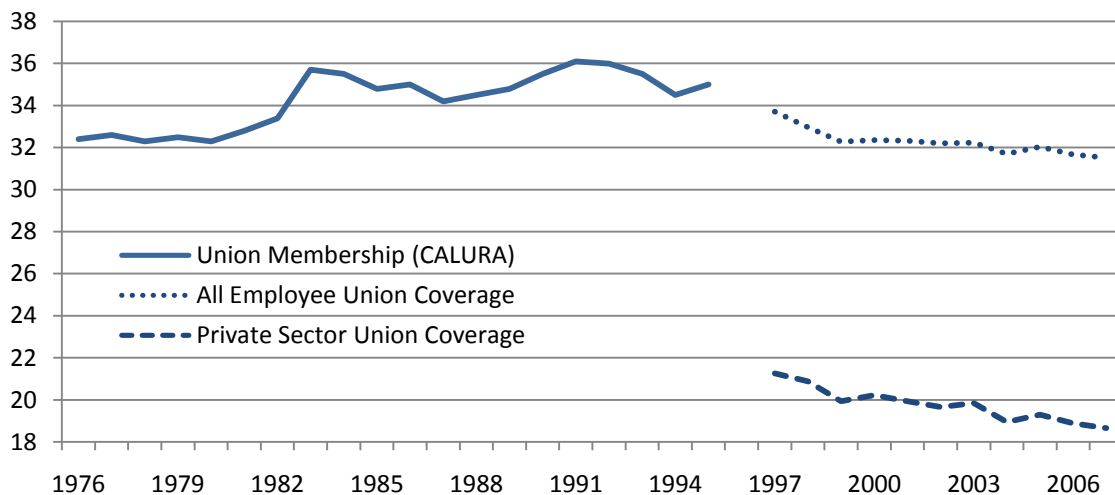
<sup>25</sup> Another effect of increasing commodity prices which potentially affect consumer wages are international terms-of-trade effects. Indeed, as Canada is a net exporter of commodities, the effect of increasing prices is reflected into a larger increase in the GDP deflator than in the CPI. As such, it has potentially beneficial effects on real consumer wages beyond that captured by the labour share. As this report focuses on the labour share, there will be no extensive discussion of these international terms-of-trade effects.

## b. Institutional setting for wage bargaining

In a world of perfect competition and constant returns to scale, wage bargaining has no effect on the labour share. Indeed, there is no excess profit (only normal profit) to be shared and labour requests for higher wages will remain either unanswered, or will drive the targeted business out of the market. In reality, however, few firms operate in a perfectly competitive market, opening the door to excess profits. This excess profit can, in turn, be shared between the owners of the firm and labour. This is where wage bargaining can play an important role in affecting the labour share.

Wage bargaining power is affected by many variables, one of which is the institutional setting. In Canada, the unionization rate has exhibited a downward trend since the late 1990s (Chart 17). Union density data from the Canadian Auto Workers Union (CAW), focusing exclusively on the private sector, show a clear downward trend since the early 1970s (Canadian Auto Workers, 2005). Moreover, even at a given level of unionization, it is possible that labour law modifications changed the balance of power between unions and employers. For example, many provinces introduced essential services laws that curtailed the power of public sector unions to strike. In the last 25 years, however, there was no overwhelming change in labour law in Canada which could account for a large part of the falling labour share. In addition, there was no institutional change that could have realistically driven the halving in union density suggested by the CAW. Overall, the downward trend in unionization rates since the late 1990s suggests that workers may be losing some power to bargain for higher wages, resulting in a decline in the labour share.

**Chart 17: Unionization Rate,\* Canada, Proportion of Employees with Union Coverage, per cent, 1976-1995 and 1997-2007**



Source: Statistics Canada, Cansim Table 379-0025 and 282-0078. Corporations and Labour Unions Returns Act (CALURA) and Labour Force Survey (LFS). Appendix Table 47.

\*From 1976 to 1995, the series is derived from CALURA and refers to union membership. For the 1997-2007 period, data are from LFS and refers to employees who are members of a union and employees who are covered by a collective agreement or a union contract.



### c. Market competition

The capacity of unions to extract a higher labour share is not, however, only a function of the institutional setting. The power of unionized workers also depends on the state of the market in which they operate. Indeed, deregulation in product and labour markets as well as increased international competition may have contributed to a significant erosion of the role and power of wage bargaining by unions. The operating mechanism by which these factors decreased labour's wage bargaining power is explored in the following paragraphs.

Deregulation in product markets leads to increasing competition. By increasing competition, deregulation can reduce the level of excess profits and often puts in direct competition firms with and without a unionized labour force. While in a protected economy unions were creating value for workers by extracting a share of excess profits, in the new deregulated world their capacity to extract higher wages is diminished as profits are eroded by competition. Unions must therefore accept market conditions or face plant closure. In the longer term, the unwillingness of unions to accept such conditions may potentially lead unionized firms to bankruptcy, while non-unionized competitors increase their market share.

The recent downward trend in product market regulation in Canada and other OECD countries is well documented. Nicoletti and Scarpetta (2003) find sweeping product market deregulation in many OECD countries over the 1984-1998 period. This deregulation took the form of privatization, entry and price liberalization of potentially competitive domestic markets, pro-competitive regulation of natural monopoly markets, and liberalization of international trade and foreign direct investment. In a recent analysis, Conway, Janod and Nicoletti (2005) report on objective indicators of product market regulation developed by the OECD in three policy domains: state control; barriers to entrepreneurship; and barriers to trade and investment. They find that (1) in absolute terms, product market barriers are low in Canada, with all scores below 2 on a scale of 0 to 6, where 0 is the least restrictive and 6 the most restrictive; and more importantly that (2) in all three policy domains Canada moved to a slightly less restrictive product regulatory environment between 1998 and 2003.

Labour market deregulation has similar negative effects for the labour share in the short term. Indeed, with less employment protection legislation and reduced employment insurance benefits, for example, the capacity of workers to negotiate a larger share of excess profits is reduced as their threat of leaving is less credible due to higher transition costs. Similarly, employers' threats of layoffs are more credible due to reduced administrative burdens such as advance notice or severance pay. In a stylized model of product and labour market regulation, Blanchard and Giavazzi (2003) indeed find that a decrease in worker's bargaining power should translate into a falling labour share and increasing unemployment in the short-term.



In the long-term, however, Blanchard and Giavazzi (2003) predict that a decrease in workers' bargaining power should have no effect on the labour share and should lead to a permanent decrease in the unemployment rate. For Canada, the evidence is mixed. The 1980s and 1990s saw a declining labour share and increasing unemployment rate. More recently, the unemployment rate has fallen significantly. Yet, despite mounting labour shortages and the lowest unemployment rate since the early 1970s (Sharpe, Arsenault and Lapointe, 2008), the labour share in Canada has been stable at around 53 per cent of GDP. With labour markets tightening significantly in Canada up to 2007, we might have expected the labour share to return to a level close to that of 1980. But, such an increase in the labour share is yet to materialise. Nonetheless, if Blanchard and Giavazzi are right, we can expect a secular increase in labour share in the future.

More generally, competitive intensity has increased due to globalization. Recent developments in the auto industry reflect this new market reality. The North American auto sector is increasingly made up of foreign firms, which generally have much lower unionization rates. Competition is intense and real auto prices are falling year after year. In this context, unionized North American workers have had a hard time maintaining their high levels of compensation. Indeed, with union density falling, unions are fighting for survival rather than better working conditions. Most recently, the Canadian Auto Workers (CAW) succeeded in unionizing Magna Corporation workers, but only by relinquishing the right to strike. This is a strong testament to current market conditions in the sector and of the effect of increased competition. Even more recently, the CAW accepted a nominal wage freeze in its agreement with Chrysler, Ford, and General Motors, which will in effect lead to a reduction in real wages. Moreover, new employees will begin at only 70 per cent of full wages (Keenan, 2008). A similar case is the US airline industry which was deregulated in the 1980s and in which unionized firms are, by and large, struggling against non-unionized competitors.

#### d. Technological change

Technological change can also shift labour and capital shares if the technology is biased in favour of either factor of production. If a new technology is capital-biased, it means that at given factor prices, the technology uses less labour and more capital, thus decreasing the marginal productivity of labour at a given ratio of labour to capital. The other channel through which technological change can affect the labour share is related to GDP accounting. If newer technologies depreciate at a faster rate than older technologies, the share of capital consumption allowance (CCA) in GDP will increase, pushing the labour share downwards.

Recent discussions in the literature on biased technological change revolved mostly around the skill-bias content of technological change rather than its labour or capital bias. While skill-biased technological change does affect the wage distribution, it does not necessarily affect the labour share. The OECD evidence in part V, which showed only a negligible change in the un-weighted average labour share, suggests that widespread capital-biased technological change is an unlikely culprit for the decline in labour share.

Fisher and Hostland (2002) find that the shift towards ICT technologies, with higher depreciation rates and a larger share of CCA (capital consumption allowance), is one of the key factors in the decrease in the US labour share. Increases in CCA decrease the share of output going to labour, because CCA is a component of the non-labour share of output. In Canada, CCA has also accounted for an increasing share of GDP, but has not increased as fast as it did in the United States. In fact, over the 1961-2006 period as a whole, the share of CCA in GDP barely increased. In the more recent 1989-2000 period, however, the share of CCA increased almost one per cent per year as ICTs were more widely adopted (up 1.2 percentage points between 1989 and 2006). This coincided with a decline in the labour share. After 2000, however, the share of CCA in GDP decreased slightly as ICT investment growth decreased, but it was not followed by a commensurate increase in labour share. Increased CCA seems to have accounted for part of the decrease in labour share in the early 1990s, but it cannot account for the sustained low levels of the labour share observed after 2000.

#### e. Demographic developments and immigration

Demographic developments, and especially population aging, will have significant effects on Canada's labour market. Dostie (2006) finds that the labour productivity of older workers tends to fall more rapidly than their wages, which could lead to an increase in the labour share as the economy adjusts to an older workforce. Moreover, a shrinking labour force could shift the bargaining power in favour of employees as labour shortages rather than labour surpluses become the norm. From an historical perspective, the large influx of workers into the labour force in the 1970s could have adversely affected the labour share. Yet, this does not fit well with the trend observed that showed most of the fall in labour share occurring in the mid 1990s.

Immigration is yet another factor that potentially puts downward pressure on the labour share, through an increase in labour supply, and thus increased competition in labour markets. Immigration to Canada, at about 0.71 per cent of total population in 2007, is high by international standards. While immigration has been relatively stable in the last decade, it has fluctuated significantly in earlier periods. Particularly, annual immigration levels were very low during the late 1970s and early 1980s, hovering between 0.3 and 0.5 per cent of population. Beginning in 1987, these rates increased and reached a peak of 0.9 per cent in 1992. They have fallen slightly since then, but have generally remained above 0.7 per cent. It is possible that higher labour supply induced by immigration has marginally diminished the share of compensation going to labour in Canada. Yet, it must be remembered that lower wages could also have led to a substitution towards more labour intensive production processes, thus increasing the labour share. Ultimately, the effect of immigration on the labour share is ambiguous and depends on the long-term elasticity of labour with respect to wages.

## f. Inflation and inflation expectations

Changes in inflation expectations and inflation levels have fundamentally changed the dynamic of collective bargaining. Before inflation targeting was introduced in Canada in 1991, inflation expectations were, in general, very volatile and relatively high. Since then, inflation has stabilized around 2.0 per cent annually.

There are many reasons to believe that higher inflation variability led to a larger labour share.<sup>26</sup> The fact the labour share in Canada diminished dramatically at the same time as the Bank of Canada was implementing a strong anti-inflation program is suggestive. The concurrence of these two events may be coincidental, but it is hard to believe that the joint effect of government policy to freeze public workers' wages and the hawkish behaviour of the Bank of Canada, which contributed to the recession, have had no impact on the aggregate labour share. Of course, there was a business cycle effect; profits reached their lowest share of GDP over the 1961-2006 period in 1992 (4.7 per cent) and the labour share increased to 55.4 per cent in the same year. Between 1992 and 1996, the profit share increased every year, and the labour share decreased every year. Yet, since the profit share has remained high (higher than 10.0 per cent in all but one year between 1997 and 2007) and the National Accounts labour share was low (below 51.5 per cent in all but one year between 1997 and 2007). In other words, the structure of GDP, and particularly the shares going to profits and labour, seemed to have changed significantly following the 1990s recession.

### iii. Key Findings

This section began with an explanation for the paradoxical finding of the 2006 Census that real median earnings had not increased between 1980 and 2005 and the 37.4 per cent improvement in labour productivity. Key findings of this section were as follows:

- While measurement issues associated with wages are important, both exhaustive measures of wages (Income and Expenditure Accounts and Productivity Accounts) suggest a decline of around 5.0 percentage points in labour's share of GDP in Canada from the late 1970s to the present.
- Business cycles have an impact on the relationship between labour productivity and real wages as a result of lags in adjustment and imperfect competition in product and labour markets. While important in the short term, business cycles are

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<sup>26</sup> As documented in Alcalá and Sancho (2000), more rapid inflation can decrease the profit share through, for example, (1) increased competition due to increase mark-up differential across firms, or (2) lower profits relative to wages due to higher fixed costs (*e.g.* menu costs). Moreover, they argue that the effect of unexpected inflation on the labour share lasts longer as central bank independence as well as government commitment to low inflation makes wage indexation less likely. Indeed, wage indexation impedes the control of inflation and limits the capacity of central banks to absorb negative supply shocks (*e.g.* oil). Using a panel of 18 OECD countries over the 1960-1998 period, the authors find a robust positive relationship between inflation and labour shares and a negative relationship between unexpected inflation and labour shares. In both cases, however, Canada is an exception, with no relationship between inflation and the labour share.

not a major determinant of the relationship between labour productivity and real wages in the long run, which is of greater interest.

- Higher commodity prices have the potential to affect Canada's industrial structure. If labour shifts from industries with a high labour share to industries with a low labour share, like mining and oil and gas, then the aggregate labour share will fall.
- Since the late 1990s declining unionization rates offer a potential explanation for some of the decline in labour share.
- Reductions in the regulation of labour and product markets as well as increasing competition resulting from globalization have lowered the labour share. Going forward, low unemployment and reduced regulation should lead to tightening labour market conditions and potentially an increase in labour share.
- Technology may affect the labour share in two ways. First, technological change may result in processes that require fewer workers and more capital, but there is little evidence for this. Second, new technology may depreciate more rapidly, resulting in a larger share of GDP being required to offset such depreciation (capital consumption allowance or CCA). This explanation could account for some of the decrease in labour share in the 1990s, but not the sustained low labour share after 2000.

## VII. Policy Implications

This part outlines potential policy implications of the findings of this report. Since the objective of government policy is to increase well-being, increasing real wages, which in turn raise living standards, a key determinant of well-being, can be an important policy objective. The key motivation for this report was to assess the relationship between labour productivity and real wages. If Canadians do not see the benefit of labour productivity growth in the form of higher real wages, it is less likely that they would be willing to support policies that foster labour productivity growth.

First and foremost, the relationship between real wages and labour productivity is strongest and most meaningful over long periods of time. The growth rate of real wages, whether measured as consumption wages or product wages, can diverge from the growth rate of labour productivity in the short and medium term. In the long-run, cyclical factors average out, and growth in consumption wages tends to closely follow labour productivity growth. Cyclical changes in labour's share and labour's terms of trade should be of less concern to policy makers. For instance, a higher labour share is historically associated with recessions, a result of reduced profits margins. In sum, the labour share is not an indicator of well-being, and should not be the focus of attention.

A factor which potentially should be the focus of policy makers is inequality. As noted in part VI, the factors that drive labour productivity growth do not appear to be the same factors that drive earnings inequality. While labour productivity growth increases real wages, over the period from 1980 to 2005, labour productivity growth has not resulted in an increase in median earnings. At the same time, it is quite possible that in the absence of labour productivity growth, real median earnings might even have fallen, because average real earnings would not have increased.

Third, it is very important that consistent data be used by those studying the relationship between labour productivity and real wages. For instance, as was noted in part IV, very different conclusions about the relationship between labour productivity and real wages can be reached depending on the definition of real wages that is used. Real wages should be defined to include all workers and all source of labour income. As noted in part II, this point has been made by many authors in the United States, but it bears repeating in the Canadian context.

Fourth and finally, the aggregate (or national) level is the most meaningful level at which to analyze the relationship between labour productivity and real wages. At the provincial level, and especially at the sector level, the relationship breaks down. In the presence of competitive labour and product markets, labour productivity and consumption wage growth at the sector level should have no direct relationship. Wages are determined in the wider labour market and labour productivity gains are reflected in lower output prices rather than higher industry wages. Lower prices benefit all workers rather than only workers in the industry experiencing labour productivity growth. This effect is more muted at the provincial and national levels, because there is less difference between what is consumed and what is produced at higher levels of aggregation.

Therefore, policy makers should not be concerned with changes labour share at the sector level.

## VIII. Conclusion

The median real earnings of Canadians barely increased between 1980 and 2005; over the same period, labour productivity rose by 37.4 per cent. This divergence can be explained by four factors: measurement issues associated with wages, an increase in earnings inequality, a decline in labour's terms of trade, and a decline in labour's share of national income.

The most important measurement issue is the definition of real wages. The labour compensation series from the Canadian Productivity Accounts covers the widest definition of labour compensation and covers the widest definition of worker. It is therefore used as the measure of real wages in this report. Moving from earnings of full-time full-year workers to labour compensation per hour explains about one-fifth of the real wages and labour productivity growth gap over the 1980-2005 period.

Rising earnings inequality, as captured by the difference in average and median real earnings growth, accounts for about one-quarter of the gap. The sources of the significant increase in earnings inequality in Canada since the late 1970s are still under investigation, but any convincing explanation will have to focus on the increasing concentration of income among top earners.

Labour's terms of trade deteriorated significantly from 1980 to 2005, and accounted for 33.3 per cent of the gap between the growth in real median earnings and labour productivity. Three-quarters of this deterioration was the result of the quality-adjusted prices of investment goods rising much more slowly than the Consumer Price Index.

The fall in labour's share explained the last fifth of the gap between the growth of real median earnings and the growth of labour productivity over the 1980-2005 period. A substantial fall in the labour share occurred during the recession and prolonged stagnation of the first half of the 1990s. The relationship stabilized after 1996, with real wages growing at roughly the same pace as labour productivity. Yet, the ground lost was never made up.

Workers were unable to recover the same share of income they had enjoyed earlier for three key reasons. First, bargaining power was weakened by declining unionization, deregulation, and increased competition from low-wage countries. Second, a boom in commodity prices led to an increased profit share, particularly in resource-related industries. Finally, the structural shift to short-lived assets such as ICT investment goods increased the share of CCA in GDP.

In some sense, this report raises more questions than answers. Further research is required to understand more fully what has driven changes in earnings inequality, labour's terms of trade, and labour's share. Labour productivity growth is the only way to raise living standards in the long run, and real wages are the most direct mechanism to transfer the benefits of productivity growth to Canadians. It is worrying, therefore, that

real median earnings failed to increase from 1980 to 2005, while labour productivity grew 37.4 per cent. If most Canadians are not seeing the benefits of labour productivity growth in the form of higher real wages, why should they support policies favouring productivity growth?



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## Appendix: Defining Wages

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### Non-Exhaustive Measures of Wages

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<b>Source:</b>	<b>Survey of Employment, Payroll and Hours (SEPH)</b>
<b>Variables:</b>	Average hourly earnings for employees paid by the hour and salaried employees
<b>Availability:</b>	1983-2007
<b>Description:</b>	Excludes overtime and dollar amounts that are taxable allowances and benefits, certain types of non-wage compensation as well as employer contributions to employment insurance, Canada/Quebec pension plans, provincial medical plans, workers compensation and other welfare plans. Some annual special payments are excluded. Does not include employers primarily involved in agriculture, fishing and trapping, private household services, religious organizations and the military personnel of the defence services. Does not include supplementary labour income.
<b>Source:</b>	<b>Survey of Labour and Income Dynamics (SLID) (1993-present) and Survey of Consumer Finances (SCF) (1980-1997)</b>
<b>Variables:</b>	Earnings per hour worked
<b>Availability:</b>	1980-2005
<b>Description:</b>	Earnings from both paid employment (wages, salaries and commissions) and self-employment.
<b>Source:</b>	<b>Labour Force Survey (LFS)</b>
<b>Variables:</b>	Average hourly wages rate, full- and part-time employees, all occupations, both sexes, 15 years of age and over
<b>Availability:</b>	1997-2007
<b>Description:</b>	Usual wages or salaries of employees at their main job. Includes tips, commissions, and bonuses. Does not include supplementary labour income.
<b>Source:</b>	<b>Major wage settlements</b>
<b>Variables:</b>	Effective wage increase in base rates
<b>Availability:</b>	1978-2007
<b>Description:</b>	Data on major wage settlements obtained from collective agreements settled in Canada and covering 500 or more employees. Covers only unionized workers.

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### Exhaustive Measures of Wages

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<b>Source:</b>	<b>National Income and Expenditure Accounts</b>
<b>Variables:</b>	Wages, salaries and supplementary labour income
<b>Availability:</b>	1961-2007
<b>Description:</b>	All earnings from employment of Canadian residents, including payments in kind, not including income of the self-employed.
<b>Source:</b>	<b>Productivity Measures and Related Variable</b>
<b>Variables:</b>	Labour compensation
<b>Availability:</b>	1961-2006

**Description:** Most comprehensive measure of labour compensation; it includes imputed labour income of the self-employed.