Centre for the Study of Living Standards
Centre d'étude des niveaux de vie

Centre for the Study of Living Standards

111 Sparks Street, Suite 500
Ottawa, Ontario K1P 5B5
613-233-8891, Fax 613-233-8250
csls@csls.ca

Productivity Trends in the Construction Sector in Canada: A Case of Lagging Technical Progress

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Abstract

Productivity Trends in the Construction Sector in Canada: A Case of Lagging Technical Progress

Both labour and total factor productivity growth in the total and residential construction sectors in Canada have been negative over the past two decades. This report provides a detailed examination of output, employment, and productivity trends in the construction sector in Canada and by province, with particular attention to the residential construction sector. It puts forth a number of variables to explain these trends and tests these explanations in a regression model. In addition, the report looks at other potential explanatory factors for which time series are not available, with particular reference to measurement issues and technical change; discusses the micro- and macro-economic environment affecting productivity performance in the construction sector; examines the prospects for productivity growth in the construction sector; and makes a number of recommendations for future work. The major conclusion is that lagging technical progress appears to lie at the root of the construction sector's poor productivity performance. In addition, measurement problems have also likely contributed to the poor measured productivity performance in the sector.

Productivity Trends in the Construction Sector in Canada: A Case of Lagging Technical Progress

EXECUTIVE SUMMARY

Official Statistics Canada data show that real output per hour in the construction sector in Canada in 2000 was well below levels achieved in the early 1980s. This decline in productivity has dampened Canada's aggregate productivity performance and has had a negative effect on the affordability of housing. The objective of this report prepared by the Centre for the Study of Living Standards (CSLS) for Canada Mortgage and Housing Corporation (CMHC) is to provide a detailed examination of productivity trends in the construction industry in Canada, with particular reference to residential construction, in order to shed light on the lagging productivity in the sector.

The report is divided into ten major sections or parts. Part one examines output trends in the total construction and residential construction sectors in Canada and the provinces in recent decades while part two looks at employment trends. Part three presents estimates of labour, capital and total factor productivity at the national and provincial level for the total construction and residential construction sectors. Part four discuss trends in four variables that affect productivity growth – the capital-labour ratio, educational attainment, capacity utilization, and unemployment. Part five uses these four explanatory variables in a series of regressions to explain productivity trends. Part six looks at other potential explanatory factors for which time series are not available, with particular reference to measurement issues and technical change. Part seven discusses the micro- and macro-economic environment affecting productivity performance in the construction sector. Part eight looks at the prospects for productivity growth in the construction sector. Part nine makes a number of recommendations for future work and part ten concludes.

The Construction Sector: An Overview

The construction sector's importance in the Canadian economy has been declining over time. In 2000, the construction sector accounted for 5.4 per cent of real output ($1992), down from 9.9 per cent in 1961. Construction accounted for 6.5 per cent of nominal GDP in 1997, down from 9.9 per cent in 1961. In terms of employment, 6.5 per cent of all workers were in the sector in 2000, down from 9.2 per cent in 1961.

The construction sector can be divided into four major industries or components: residential construction, non-residential building construction, engineering construction, and finally repair construction, which is undertaken by all of the first three industries. In 1997, the most recent year for which industry data are available, residential construction was the largest component of the construction sector, accounting for 33.9 per cent of real output ($1992), followed by engineering construction (28.5 per cent), non-residential

building construction (20.0 per cent), and repair construction (17.6 per cent). The employment shares were similar: 33.7 per cent, 24.0 per cent, 20.4 per cent, and 21.9 per cent respectively.

The pace of growth in the construction sector has been lagging that of the total economy or business sector for the past four decades. Over the 1961-2000 period, the average annual rate of growth in the construction sector was 2.2 per cent, only 60 per cent the rate of advance of the business sector (3.8 per cent). The construction sector did particularly poorly in the 1990s, with the level of output in 2000 still below that of 1989. All four components of the construction sector experienced below-average economic growth over the 1961-97 period.

Employment growth in the construction sector was also well below the economy-wide average. Over the 1961-2000 period, it grew at a weak 1.3 per cent average annual rate, slightly above half the business sector average of 2.2 per cent. One of the components of the construction sector did enjoy above-average employment growth – residential construction saw the number of jobs increase at a 2.3 per cent average annual rate over the 1961-97 period. The three other construction industries had very weak employment growth over the period.

The stagnation in the construction sector since 1989 has been due to a number of cyclical and structural factors. They include the high interest rates in the late 1980s and early 1990s which had a negative impact on interest-rate sensitive housing and business investment spending. The weak economy produced large deficits, with governments cutting spending on public infrastructure and social housing. Structural factors accounting for slower construction growth include: the slower rate of population growth, which reduced growth in potential housing demand; the reduced need for continued rapid rates of growth in public infrastructure spending in the 1980s and 1990s following the completion of the major investments in roads, schools, hospitals, airports, etc. in the 1950s, 1960s, and 1970s; and the shift in employment from goods-producing to service-producing activities, which requires less work-space per worker.

Productivity Trends in the Construction Sector

From 1961 to 2000, the construction sector experienced less than one half the average annual rate of increase in output per hour of the business sector: 0.8 per cent versus 2.0 per cent. Business sector productivity grew at a more or less continuous pace, but construction sector productivity exhibited very different patterns in three distinct periods. From 1961 to 1974, output per hour in the construction sector stagnated. Productivity growth then surged from 1974 to 1983 advancing at a very robust 5.3 per cent average annual rate. Since 1983, productivity in the construction sector has fallen 1.1 per cent per year.

Over the 1961-2000 period for the 10 industries (service industries are excluded) for which Statistics Canada officially publishes productivity estimates, the construction sector had the second slowest rate of increase in output per hour (only fishing and trapping was worse).

Non-residential building construction enjoyed by far the best performance over the 1961-97 period, with output per hour advancing 1.6 per cent per year. This was well above the rate of increase of the other three industries: 0.9 per cent for repair construction, 0.7 per cent for engineering construction, and 0.6 per cent for residential construction. Within the period all four construction industries followed the pattern observed for the overall construction sector, namely productivity growth stagnation from 1961 to the mid-1970s, then very rapid productivity advance until the first half of the 1980s, followed by absolute declines in productivity levels to the present. This suggests that similar factors were influencing productivity growth across the four industries.

Multifactor productivity in the construction sector advanced at a meager 0.2 per cent average annual rate from 1961 to 2000, well below the 1.2 per cent rate of increase for the business sector. Like labour productivity, total factor productivity stagnated from 1961 to the mid-1970s, then rose rapidly, peaking in 1982, and has since entered a period of more or less steady decline.

Trends in Explanatory Variables and Regression Results

The capital intensity of production, as proxied by the capital-labour ratio is an important driver of labour productivity growth. There has been strong upward movement (2.6 per cent per year) in the capital -labour ratio in the construction sector over the 1961-2000 period. The path of productivity growth in the total construction sector paralleled trends in the capital-labour ratio up to 1983. Since then, the nexus between trends in capital intensity and productivity growth has been broken as the latter has stagnated while the former has increased substantially. This development is perplexing.

A second key driver of productivity growth is the skills of the workforce. Like all sectors, the pace of skills upgrading in the construction sector, as proxied by the growth in the proportion of the workforce with a post-secondary certificate or diploma, has been rapid. Between 1976 and 2000, this proportion of workers in the construction sector jumped 22.0 points or 133.3 per cent from 16.5 per cent to 38.5 per cent.

Productivity trends exhibit a strong cyclical component. One explanation of this phenomenon is the existence of lags in the adjustment of employment to changes in output. A second explanation is linked to the effect of the cycle of the financid circumstances and hence behaviour of the firm. The short-to-medium term productivity performance in the construction sector appears to correspond better to the second explanation than the first. During both the recessions of the early 1980s and 1990s, labour productivity rose as employers cut workers more than output while during the expansions of the mid and late 1980s and 1990s labour productivity fell.

The study reports a large number of regression results based on OLS regressions to explain trends in output per hour in the total construction and residential construction sectors in Canada and the provinces in recent decades. Capital intensity, educational attainment, capacity utilization, and the unemployment rate are the independent variables. The results overall are disappointing, with no variable emerging as the key explanation of the decline in productivity in the sector since the early 1990s.

In addition to the four variables used in the regression analysis, a number of other variables are examined for their effect on construction productivity, with measurement error and technical progress the most important.

Labour productivity growth estimates can be subject to a wide margin of error because of input and output measurement problems. The most important measurement issue for the construction sector is whether the price series used to deflate nominal output are capturing true changes in prices over time and hence giving true movements in real output. This may not be the case if quality changes in construction output are not captured. The introduction of the GST in 1991 gave individuals and businesses engaged in construction activities an additional incentive to fail to report or underreport income. Many observers believe that this situation has fueled the growth of underground activities in the sector, with implications for measured productivity growth. Without further work it is not possible to state with any certainty whether the decline in output per hour in the total construction sector over the last two decades can be accounted in full or in part by measurement problems, but it is likely to have played a role.

Over long periods technological or technical change is the most important determinant of productivity growth. Because of the labour-intensive nature of many construction activities, which limits the possibilities of mechanization, the pace of technical progress in construction in recent decades appears slower than it was in earlier periods and slower than it was in other sectors. The number of site person-hours needed to build a house in the mid-1940s totalled 2,400, but by the mid-1960s had fallen to 950, a decrease of 4.5 per cent per year. These large improvements were attributable to changes in production methods in the area of excavation, basement construction, wall framing, roofing, siding, plumbing and heating, interiors, and windows/cabinetry/doors, all of which significantly reduced on-site labour requirements. In contrast, between the mid-1960s and mid-1980s there was little further technical progress in production methods, with the result that there has been little additional decline in on-site labour requirements.

Economic Environment for Productivity Advance in Construction

The productivity performance of the construction sector is affected by the variables that make up the economic environment, including micro-economic variables such as tax policy, regulation, and labour market policy and macro-economic variables such as interest rate policy, demographic trends, and immigration policy. While many of these factors have great relevance for productivity trends in the construction sector, an examination of these influences failed to find that the decline in productivity in the sector was directly related to changes in any specific economic environment variable.

Prospects for Construction Productivity Growth

Economists have great difficulty forecasting future productivity growth because of their inability to understand the dynamics of past productivity growth. The labour-intensive nature of most construction activities will probably mean that trend productivity growth in the construction sector will continue to be below the economy-wide average, but it appears unlikely that productivity growth will continue to be negative, particularly if measurement techniques are improved and information technologies are diffused within the sector. A reasonable forecast for trend output per hour growth for both the total construction and residential construction sectors for the 2000-2010 period is 0.5-1.0 per cent per year.

Future Work on Construction Productivity

The topic of productivity trends in the construction sector in Canada is under-researched. Areas for future work include: development of new data, particularly estimates of capital stock for the four construction industries; verification and improvements to existing data, with particular reference to the effect of the underground economy; reconciliation of micro-productivity studies with aggregate productivity trends; and comparison of Canada's productivity performance in the construction sector with that of other countries.

Conclusion

The findings of this study are paradoxical. Despite an increased capital-labour ratio and higher levels of educational attainment in the workforce, labour productivity in the construction sector in Canada was lower in absolute terms at the end of the 1990s than in the late 1970s. The construction sector was almost unique among Canadian industries in experiencing such negative productivity developments over the period.

The study examined a large number of factors that could be responsible for this situation. The major conclusion is that lagging technical progress appears to lie at the root of the construction sector's poor productivity performance. Because of their labour-intensive nature, many construction activities appear not to be amenable to productivity advance, despite increased capital per worker and higher education levels for the workforce. While the construction sector enjoyed productivity gains in the immediate postwar period, with the labour required to build a house falling significantly, these gains have not been repeated in the last two decades. In addition, measurement problems have also likely contributed to the poor measured productivity performance of the construction sector in Canada.

Productivity Trends in the Construction Sector in Canada: A Case of Lagging Technical Progress[1]

Introduction

A key goal of Canada Mortgage and Housing Corporation (CMHC) is to increase the affordability of housing (both rental and owner-occupied) for Canadians. The price of housing is in part determined by productivity trends in the residential construction sector. Consequently, an improved productivity performance in this sector will have positive implications for housing prices and hence for housing affordability.

The primary objective of this report is to shed light on the productivity performance of the residential construction sector in Canada, although much of the report focuses on trends in the total construction sector. The topic of productivity appears to have received little attention from the housing research community in Canada, at least from an economic perspective.[2] One reason for this neglect may have been the lack of

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[1] The Centre for the Study of Living Standards (CSLS) would like to thank a number of persons for their contributions to this report, in particular CSLS staff members Leila Gharani, Jeremy Smith and Yu Zhang for the development of the data used in the report; John Baldwin and Jean-Pierre Maynard of Statistics Canada for provision of unpublished data and assistance in the understanding of these data and comments on the first draft of the report; and Eric Tsang and Julie Bernier from Canada Mortgage and Housing corporation and René Durand from Industry Canada for useful comments of earlier stages of the report.

[2] The CMHC website includes no references to studies that the organization has conducted on housing productivity. The Institute for Research in Construction undertakes extensive research on building code developments and materials evaluations, but appears to do little research from an economic perspective on productivity trends in the sector. The Canadian Home Builder's Association, in a detailed report on Canada's housing system, notes that "housing technology and productivity have improved progressively throughout the postwar period (Lampert and Pomeroy, 1998:2), but provides no discussion or data on productivity trends in the residential construction sector. In a recent brief on housing policy issues the Canadian Home Builders' Association submitted to the federal/provincial/territorial ministers responsible for housing (CHBA, 2000b), the issue of improving productivity in the residential construction sector was not directly addressed. Equally, the companion CHBA brief (CHBA, 2000a) discussing the performance of the housing sector presented no data on productivity trends in the sector.

It is interesting to note that this lack of attention to productivity issues in the housing industry was not the case in the past. In the 1930s and 1940s, concerns over the efficiency of the homebuilding industry were widespread, with lack of efficiency seen as an obstacle to reducing housing costs. For example, in 1938 W.C. Clark, the federal Deputy Minister of Finance with responsibility for housing, expressed criticism of the high costs of housing resulting from an outdated industry, as the following quotation shows:

> Perhaps the most important, certainly the most obvious, of these causes is the high cost of construction which reflects an industry relatively little unchanged in form of organization and in technical processes from that which catered to our forefathers prior to the Industrial Revolution. During a period when machine production, standardization and technological advance have been revolutionizing every other important manufacturing process, the building of houses has remained a localized, handicraft process.(CMHC, 1989a:19).

The response of the federal government to this situation was the creation of Wartime Housing Limited, Canada's first and only super residential builder/developer.

aggregate and detailed data on productivity trends in the sector. It is hoped that this report will contribute in some degree to fill this gap in our knowledge base.

The report consists of nine main sections or parts plus a conclusion and a number of appendices. Part one examines output trends for the total construction and residential sectors, part two employment trends, and part three productivity trends, including both labour and total factor productivity. Part four discusses trends in four variables (capital-labour ratio, educational attainment, capacity utilization, and unemployment) that drive productivity growth. Part five develops a regression model that tests the impact of these four variables on total construction and residential productivity for Canada and the provinces. Part six examines additional factors that affect productivity growth in the construction sector, including measurement problems, real output growth, compositional shifts, technological change, bankruptcies, labour compensation, workplace safety, labour unions, and ageing of the workforce. Part seven discusses the economic environment that has affected the productivity performance of the construction sector, including both micro-economic and macro-economic aspects. Part eight looks at the prospects for productivity growth in the construction sector. Part nine outlines possible further work on construction productivity and part ten concludes.

Statistics Canada is the source for almost all the data presented in this report. Within Statistics Canada the major source of information has been the Aggregate Productivity Measures (APM) data base produced by the Productivity Unit of the Analytical Studies Branch. This data base includes published and unpublished estimates of output, employment, and hours drawn from various sources. These numbers are in turn used to generate Statistics Canada's official productivity estimates. A weakness of the APM database is that it contains only estimates at the national level. Other sources have been used to generate provincial estimates.

In addition to the APM estimates, estimates of output by industry have been taken directly from the National Accounts while employment and hours data have been taken from the Labour Force Survey (LFS). Capital stock estimates were obtained from the Capital Stock Division.

Statistics Canada is gradually introducing the North American Industry Classification System (NAICS) and phasing out the 1980 Standard Industrial Classification (SIC). The LFS switched to the NAICS in 1999, while the National Accounts only switched to NAICS in 2001. These changes have created discontinuities in time series and a lack of concordance between output and labour input data for 1999 and 2000 at the industry level.[3]

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[3] See Appendix 3 for a discussion of the difference between the 1980 SIC and NAICS as applied to the construction sector. See Appendix 4 for a list and description of all industries in the construction sector under the 1980 SIC and NAICS.

I Trends in Real Output in the Construction Sector

A. Total Construction Sector

i) Canada

Two series on real output in the total construction sector are used in this report. The first is the National Account series produced by the Input-Output Division of Statistics Canada with a 3 to 4 year lag from the current year and by the Industry Measures Division for the most recent 3 to 4 years. Estimates are currently available to 2000 for Canada and the provinces based on the 1980 SIC. The second is the Aggregate Productivity Measures (APM) series which is available to 2000 at the national level.[4] There are no provincial estimates for this series.

The 1990s was a dismal decade for the construction industry in Canada. Due to developments in the first half of the decade, the construction sector's output growth in the 1990s was well below that of the total economy. For the 1989-2000 period, real output in the construction sector declined 0.20 per cent per year, while it grew 2.38 per cent per year in the total economy according to National Accounts estimates (Table 1 and Appendix Table 4). The relative importance of the construction sector in terms of overall output fell considerably, from 7.12 per cent of GDP in 1989 to 5.38 per cent in 2000 (Chart 1 and Appendix Table 1).

Between the 1989 cyclical peak and 1995, real output in the construction sector fell from $43,288 million (1992 dollars) to $35,660 million, an average rate of decline of 3.18 per cent per year. In contrast, total economy output grew at a rate of 1.47 per cent per year over the period. In the second half of the 1990s, the economic fortunes of the construction sector dramatically improved, with output growing 3.49 per cent per year over the 1995-2000 period, reaching $42,341 million in 2000. This growth rate was almost identical performance to that of the overall economy (3.48 per cent), but insufficient to regain the 1989 output peak. The Aggregate Productivity Measures (APM) series give a similar negative picture on output trends in the construction sector in the 1990s (Table 2 and Appendix Table 2).[5]

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[4] The APM series is in fact based on the national accounts series and differs from it only by the use of the chain Fisher index and basic prices (the national accounts uses the Laspeyres index and value output at factor cost).

[5] In the APM series, real output fell at 0.08 per cent per year from 1989 to 2000, compared to a 2.74 per cent increase in business sector output. In the 1980s, construction sector output growth was much more robust at 1.84 per cent per year, although still well below that of business sector output (3.18 per cent). In the first half of the 1990s (1989-95), the APM series shows that construction sector output fell at a 3.02 per cent rate, compared to a 1.43 per cent rate of advance for the business sector. Construction output growth rebounded strongly in the second half of the decade (1995-2000) at a 3.57 per cent annual pace, although this rate was still below that of the business sector (4.34 per cent). Both the APM series and the National Account series include in the definition of construction output own-account construction activity done by sectors outside the construction sector.

During the 1990s, out of 18 industries at the one-digit SIC level, only two (fishing and trapping and logging and forestry) experienced slower growth in real GDP than the construction sector (Appendix Table 4). In the second half of the 1990s, reflecting the recovery in construction activity, output growth in the sector outstripped ten of 17 other industries.

The stagnation in the construction sector since 1989 has been due to a number of factors. They include the high interest rates in the late 1980s and early 1990s, which had a negative impact on interest-rate sensitive housing and business investment spending; sharp cuts in government spending in the mid-1990s to reduce deficits, which had a negative effect on government infrastructure projects and social housing; slower growth in demographic requirements and hence housing demand, reflecting slower growth in the size of cohorts entering family formation age and a greater propensity of adult children to remain in the home of their parents; and the employment shift toward the service sector, where work space per employee requirements are lower.

ii) Provinces and Territories

The 1990s has been a terrible decade for the construction industry throughout Canada, with all but two provinces experiencing a decline in output (Table 1). The largest fall over the 1989-99 period occurred in Yukon, which experienced a decline of 4.37 per cent per year. This was followed by the Northwest Territories (-2.73 per cent), Prince Edward Island (-2.46 per cent), Newfoundland (-2.39 per cent), Ontario (-1.89 per cent), Quebec (-1.73 per cent), Saskatchewan (-0.78 per cent) and Manitoba (-0.73 per cent). Alberta and British Columbia were the two provinces that experienced growth in real GDP in the construction sector of 3.97 and 0.24 per cent per year respectively.

As at the national level, the slow growth in real construction GDP in the provinces in the 1990s was concentrated in the first half of the decade (1989-95). Ontario experienced the greatest decline with output falling 6.55 per cent per year. The Northwest Territories was next with output falling 5.48 per cent per year, followed by Quebec (-4.36 per cent) and Saskatchewan (-4.20 per cent). In the first half of the decade (1989-95), three provinces actually enjoyed increases in real GDP in the construction sector. In British Columbia, real construction sector GDP grew at a rate of 1.91 per cent per year, followed by Alberta (1.70 per cent) and Prince Edward Island (0.19 per cent).

In the second half of the 1990s, the downward trend in construction turned around for most provinces and territories. In Alberta, real output growth in construction accelerated to a pace of 7.47 per cent per year. Ontario followed experiencing an increase of 5.53 per cent. The few provinces and territories where output fell were Yukon (-10.14 per cent per year); Prince Edward Island (-6.29 per cent), Newfoundland (-4.75 per cent) and British Columbia (-2.21 per cent).

B. Residential Construction Sector

i) Canada

As was the case for the total construction sector, two series on real output in the residential sector have been used in this study.[6] The first is the National Accounts, with estimates currently available to 2000 at the national level and to 1999 at the provincial level. The second is the Aggregate Productivity Measures (APM) series, which is available to 1997 at the national level – there are no provincial estimates for this series.

In 2000, the value of the output ($1992) of residential construction in Canada was $13,924 million, representing 32.9 per cent of the output of the total construction sector. The residential construction sector is defined as the construction of new housing and excludes the renovation of existing housing. The inclusion of renovation activity would increase the importance of the overall residential housing sector. For example, in 1997 repair construction, which includes both residential and the less important non-residential components, accounted for 17.6 per cent of total construction output (Appendix Table 60).

Output developments in the residential construction sector in the 1990s closely paralleled that of the total construction sector. The level of real activity in 2000 was virtually identical to that at the most recent cyclical peak in 1989 ($13,938 million), indicating that real output growth over the period was nil (-0.01 per cent per year). This compares with -0.20 per cent for the total construction sector and 2.38 per cent for the total economy. The stagnation of real output in residential construction over the period resulted in the sector's relative importance falling from 2.29 per cent of GDP ($1992) in 1989 to 1.77 per cent in 2000.

The first half of the 1990s saw a very severe fall in residential construction activity, with the second half of the decade recording a strong recovery to regain the pre-recession level. Real output decreased 4.70 per cent per year from 1989 to 1995, and then advanced at a 5.92 per cent annual pace from 1995 through to 2000.

The Aggregate Productivity Measures output series for residential construction provides a similar picture, at least to 1997, the last year for which estimates are available (Appendix Table 59).[7]

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[6] The housing industry comprises four components: single-family homebuilders; residential land developers; apartment developers; and residential renovators (CMHC, 1989a). Single-family homebuilders represent the backbone of the housing industry. From the point of view of the Standard Industrial Classification upon which output and productivity estimates are based, the residential construction sector is defined to include only single-family homebuilders and apartment developers. Residential renovators are in the repair construction sector, which includes repairs to the non-residential sector as well. Land developers fall under real estate.

[7] Output fell at a 0.59 per cent average annual rate between 1989 and 1997 in this series, compared to -0.91 per cent in the national accounts series (Table 3). The level of real output in 1997 in the APM series for residential construction was $14,135 million ($1992), 9.1 per cent above the National Accounts estimate of $12,957 million.

ii) Provinces and Territories

Residential construction activity was weak in all provinces and territories in the 1990s except one, Alberta (Table 3). The two largest provinces, Ontario and Quebec, experienced declines of 1.17 per cent and 1.22 per cent per year respectively over the 1989-99 period. Newfoundland, New Brunswick, and Yukon also experienced declines. In contrast, Alberta enjoyed very strong growth of 5.18 per cent per year. The vast majority of provinces and territories saw a pick-up in residential construction activity in the second half of the decade. The exceptions were British Columbia and Yukon, which experienced a deterioration in the output performance of the residential construction sector in the second half of the 1990s.

II. Employment and Hours Worked Trends in the Construction Sector

A. Total Construction Sector

i) Canada

Two sources of data on employment and hours worked in the total construction sector have been used in this study.[8] The first is the Labour Force Survey (LFS), with estimates currently available to 2000 for Canada and the provinces. The second is the Aggregate Productivity Measures (APM) series, which is available to 2000 at the national level. There are no provincial estimates for this series.

Like output, employment growth in the total construction sector in Canada in the 1990s was extremely weak. According to LFS data, the 2000 employment level of 816 thousand was only 4 thousand above the 1989 level of 812 thousand (Appendix Table 11).[9] Employment advanced only 0.04 per cent per year in the construction sector while it increased 1.26 per cent in the total economy (Appendix Table 12). During this period only three out of sixteen one-digit industries (agriculture; forestry, fishing, mining, oil and gas; and utilities) experienced worse employment growth. The construction sector's share of

[8] A third source of data on employment and hours is the Survey of Employment, Payrolls, and Hours (SEPH), an establishment-based survey. Both SEPH and LFS are primary sources of information while APM is derived from different sources, including both the LFS and SEPH.

[9] In 1999, the LFS switched to the NAICS from the 1980 SIC, with the series revised back to 1987 on a NAICS basis. For a comparison of the NAICS and 1980 SIC-based estimates of employment in the construction sector see Appendix Table 12. For a discussion of the differences in these two industry classification systems for the construction sector see Appendix 3. There is no systematic difference in estimates, with NAICS-based estimates higher some years and 1980 SIC-based estimates higher other years. Over the 1989-98 period when the two series overlap, the NAICS-based employment series declined at a 1.04 per cent average annual rate, while the 1980 SIC series fell at a 0.75 per cent average annual rate.

total employment, as measured by the LFS, has also fallen slightly, from 6.25 per cent in 1989 to 5.47 per cent in 2000.

The fall in employment in the construction sector was concentrated in the first half of the 1990s. Total construction employment fell 1.77 per cent per year from 1989 to 1995, but picked up considerably in the second half of the decade (2.27 per cent per year in 1995-2000), with almost all this growth concentrated in 1999 (4.9 per cent) and 2000 (5.3 per cent)(Appendix Table 11).

Growth in total hours worked in the construction sector in the 1990s was almost identical to that of total employment over the 1989-2000 period: -0.01 per cent per year from 1989 to 2000 (Appendix Table 17). Average weekly hours fell at a 0.05 per cent average annual rate from 38.35 in 1989 to 38.12 in 2000.

The Aggregate Productivity Measures (APM) series showed similar trends to LFS estimates for construction employment growth over the 1989-2000 period: 0.11 per cent per year versus 0.04 per cent (Tables 2 and 4).[10] On the other hand, the APM estimate for total hours growth for the 1989-2000 period was slightly above that of the LFS: 0.25 per cent per year versus -0.01 per cent.

ii) Provinces[11]

In the 1990s (1989-2000), employment in the construction sector declined in Eastern Canada, while it increased in Western Canada. Employment growth was highest in Alberta, increasing 4.18 per cent per year and lowest in Quebec, declining at a rate of 2.22 per cent per year (Table 4).

During the first half of the 1990s (1989-95), growth in employment in the construction sector in Quebec fell at an average annual rate of 3.94 per cent, the greatest decline among the provinces. Alberta experienced the greatest increase in employment in the construction sector among the provinces, an average annual increase of 2.34 per cent.

During the second half of the decade (1995-2000), Prince Edward Island, Newfoundland, Quebec and British Columbia experienced a decline in employment growth in this sector. Alberta enjoyed the highest growth in employment.

[10] At the aggregate level, APM employment growth is benchmarked to LFS employment growth. This is not true at the industry level. Consequently, the similar growth rate of the two series cannot be explained by the use of LFS as a benchmark. It should also be noted that the construction employment measure in the LFS captures only contract construction, while the APM construction employment concept includes own account construction, which comprises one quarter of total construction employment.

[11] Data on employment and hours for the territories are not available because LFS does not cover this part of Canada.

In the 1990s, total hours growth by province in the construction sector (Table 4) was similar to employment growth as average weekly hours changes in most cases were not large (Appendix Table 19).

B. Residential Construction Sector

i) Canada

Two sources of data on employment and hours in the residential sector were used in this study. The first is the Labour Force Survey, with estimates currently available to 1998 for Canada and the provinces based on the 1980 SIC.[12] The second is the Aggregate Productivity Measures series, which is available to 1997 at the national level. There are no provincial estimates for this series.

According to the Labour Force Survey (1980 SIC), employment in 1998 in the residential construction sector was 151.1 thousand, representing 20 per cent of total construction employment. In contrast, the Aggregate Productivity Measures series estimate of residential construction employment in 1997 was 294.3 thousand, nearly double the LFS estimate. It represented 34 per cent of total construction employment and is in line with residential construction's share of total construction output. The discrepancy between estimates is explained by differences in the definition of residential construction employment, with the LFS definition excluding tradespersons who work in different construction industries.

For the 1989-98 period, LFS data show that employment in the residential construction sector fell 3.19 per cent per year (Table 5 and Appendix Table 11). In the first half of the decade, employment growth in the residential construction sector fell 5.46 per cent per year. For the 1995-98 period, employment growth rebounded in the residential sector, growing at a rate of 1.52 per cent per year. Residential construction's share of total employment has deteriorated in the 1990s, falling from 1.56 per cent in 1989 to 1.07 per cent in 1998 (Appendix Table 11).

For the 1989-97, period APM data show that employment in the residential construction sector declined 1.93 per cent per year (Appendix Table 63). This compares with a 4.57 per cent annual decline over the period for the LFS series. The APM series likely provides a more reliable picture of employment trends in the sector because of its more comprehensive definition of employment.

[12] With the introduction of NAICS into the LFS in 1999, estimates for residential construction employment are no longer provided with publicly accessible data. It is important to note that these employment estimates for residential construction exclude tradespersons working in the residential sector and so underestimate employment in residential construction (compare Appendix Tables 11 and 63). Growth rates for residential construction employment from the LFS may approximate the true residential construction employment growth rate if the proportion of tradespersons in total employment is constant.

Total hours worked are determined by trends in total employment and average weekly hours. LFS data show that average weekly hours declined 0.51 per cent per year from 1989 to 1998, from 38.16 to 36.45 (Appendix Table 17). On the other hand, APM data show that average weekly hours fell 0.22 per cent per year from 1989 to 1997 from 38.6 to 37.9 (Appendix Table 68). Consequently, total hours worked based on LFS data over the 1989-98 period fell 3.68 per cent per year (4.93 per cent for 1989-97), while total hours worked based on APM data for the 1989-97 period fell 2.14 per cent per year.

Employment estimates are not currently available for residential construction for 1999 and 2000. However, there is normally a strong correlation between employment growth in the total construction sector and in residential construction. As total employment growth was very strong in 1999 and 2000 (4.9 per cent in 1999 and 5.3 per cent in 2000 for LFS estimates), it is very likely that residential employment growth was strong these two years.

ii) Provinces

Residential construction employment, based on LFS estimates (Table 5 and Appendix Table 13), declined in almost all provinces in the 1990s (1989-98). The only exceptions were Alberta (0.14 per cent per year) and Manitoba, where there was no change. In the first half of the decade, employment dropped in all provinces except British Columbia. In the second half of the decade, the employment situation improved in most provinces, except for British Columbia and Prince Edward Island. Levels and trends in average weekly hours in residential construction varied by province over the 1989-98 period (Appendix Tables 18 and 19).

III Trends in Productivity in Construction

A. Total Construction

i) Labour Productivity

a. Canada

Based on consistent 1980 SIC National Accounts and Labour Force Survey estimates, labour productivity in terms of output per worker in the construction sector fell from $53,324 ($1992) in 1989 to $51,914 in 2000, a 0.24 per cent per year decline. During this period, output per worker in the total economy grew 1.10 per cent per year, from $46,785 in 1989 to $52,766 in 2000 (Appendix Table 22). Because of this relative decline in productivity growth, the level of productivity in construction in 2000, defined on a value added per worker basis, was lower (98.4 per cent) than that of the overall economy, and was down from 114.0 per cent in 1989.

Statistics Canada recently released estimates of productivity by industry (*The Daily*, August 24, 2001), as shown in Table 32. In 1996-97, GDP per job in construction averaged $43,500 at the national level. Only two out of nine sectors for which data were released (agriculture, fishing and trapping and low-wage services) had lower productivity levels. The relatively low capital intensity of the construction sector explains, at least in part, why labour productivity levels in the sector are below the national average.

Over the 1989-98 period, data from the CSLS productivity data base show that seven out of eighteen one-digit SIC industries experienced worse productivity growth than the construction sector (fishing and trapping; logging and forestry industries; business services; educational services; health and social services; accommodation, food and beverage services; and other services) (Appendix Table 23).

In the 1989-95 period, output per worker in the construction sector fell 1.43 per cent per year, while at the total economy level it advanced 0.99 per cent. In the second half of the 1990s (1995-2000), productivity growth in the construction sector turned around, increasing at 1.20 per cent per year. During the second half of the decade the construction sector experienced productivity growth comparable to that of the total economy, which grew 1.23 per cent per year.

The output per hour measure of productivity based on National Accounts and LFS data shows the same trend as the output per worker measure. This measure declined 0.19 per cent per year from 1989 to 2000, compared to a 1.35 per cent rise at the aggregate economy level (Appendix Table 26). Over the 1989-95 period, growth in output per hour in total construction fell at an average annual rate of 0.48 per cent, rebounding at a 0.16 per cent rate from 1995 to 2000.

The Aggregate Productivity Measures (APM) series on both output per worker and output per hour in the 1990s in the construction sector show very similar trends to the National Accounts and LFS-based series (Table 2). Output per worker fell 0.19 per cent per year from 1989 to 2000 while output per hour declined 0.33 per cent.

Over the 1989-2000 period, Statistics Canada productivity data from the APM series (Table 15) show that for the 10 industries (service industries are excluded) for which data are officially published, construction sector output per hour growth at -0.33 per cent per year was the second worst (only fishing and trapping was worse).

Thus, all four aggregate measures of productivity growth for the construction sector tell the same story in the 1990s. Whether one uses output per worker or output per hour, or whether one draws from the National Accounts and LFS or the APM series, the average annual productivity growth rate for the 1989-2000 period was between -0.19 and -0.33 per cent.

The APM series (Table 2 and Appendix Table 3) show that negative productivity growth in the construction sector predated the 1990s. From 1981 to 1989, output per hour in the sector fell at a 0.62 per cent average annual rate, a worse performance than experienced in the 1990s. Indeed, the index of output per hour in 2000 (95.6) was less than in 1977 (97.1). In nearly a quarter century, no productivity gains have accrued to the total construction sector, an extremely surprising (some would say implausible if not impossible) development.

The APM series provides estimates for nine construction industries (Appendix Table 25). Over the 1981-97 period, four of these sectors experienced negative productivity growth. The largest fall was in repair construction, with output per hour falling 1.42 per cent per year. It declined 0.73 per cent per year in other construction activities, 0.46 per cent in gas and oil facility construction, and 0.35 per cent in residential construction. In contrast, output per hour advanced at a 2.59 per cent average annual rate in railway and telecommunications construction, 2.31 per cent in other engineering construction, 1.97 per cent in road, highway and airport runway construction, 1.09 per cent in electric power, dams and irrigation construction, and 0.53 per cent in non-residential building construction.

The downside of the weak productivity performance in the construction sector has been an above average increase in costs. Indeed, unit labour costs in the sector advanced at a 1.8 per cent average annual rate from 1989 to 2000, compared to 0.7 per cent for the business sector (Appendix Table 34 and 35). This leads to upward pressure on structure prices, but because construction is not a traded good, such a decline in cost competitiveness does not result in increased imports and declining exports.

An upside of weak productivity performance in a non-traded sector such as construction is that employment growth is stronger than it would have been under a regime of faster productivity growth. In other words, employment growth in the construction sector over the last two decades would likely have been much weaker if productivity growth had tracked the economy-wide average, as output growth would have been little affected by higher productivity growth.

b. Provinces

In the 1990s (1989-99), output per worker in the construction industry in Canada fell in six of ten provinces (Table 6).[13] The greatest decline took place in Manitoba (-3.06 per cent per year), followed by Prince Edward Island (-1.97 per cent), Newfoundland (-1.66 per cent), Ontario (-0.97 per cent), Saskatchewan (-0.29 per cent) and British Columbia (-0.18 per cent). The four provinces that experienced growth in output per worker in the construction sector during the decade were Nova Scotia (1.74 per cent per year), Quebec (1.26 per cent), New Brunswick (0.35 per cent), and Alberta (0.29 per cent).

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[13] Productivity estimates are not available for the territories because the LFS does not cover this part of Canada.

The slow growth in output per worker for the construction sector in the 1990s was mainly concentrated in the first half of the decade. Manitoba experienced the greatest decline during this period, with productivity falling 3.81 per cent per year from 1989 to 1995. Ontario followed with output per worker declining 3.30 per cent per year, then Saskatchewan (-2.48 per cent) and Alberta (-0.62 per cent).

In the second half of the decade (1995-99), six of ten provinces experienced positive productivity growth, with four provinces – Nova Scotia (4.16 per cent), Quebec (3.86 per cent), Ontario (2.63 per cent), and Saskatchewan (3.10 per cent) – recording productivity growth above 2 per cent per year. The provinces for which output per worker continued to fall were Newfoundland (-4.55 per cent per year), Prince Edward Island (-3.97 per cent), Manitoba (-1.92 per cent), and British Columbia (-0.20 per cent).

There is significant variation in productivity levels in the construction sector across provinces. The CSLS productivity data base shows that in 1999, the three provinces enjoying above average levels of output per worker for the construction sector (Table 8) were: Alberta (126.5 per cent of the national average for the sector), Saskatchewan (112.7 per cent), and Quebec (112.8 per cent). They were followed by Nova Scotia (97.8 per cent), British Columbia (93.9 per cent), Newfoundland (92.6 per cent), Ontario (87.2 per cent), Manitoba (83.5 per cent), New Brunswick (82.1 per cent) and finally Prince Edward Island (58.5 per cent).

Statistics Canada recently released estimates of provincial productivity by industry for 1996-97 (*The Daily*, August 24, 2001) as shown in Table 32. GDP per job in construction averaged $43,500 at the national level. The province with the highest labour productivity in the construction sector was Saskatchewan at 113.1 per cent of the national average, followed by Alberta (109.4 per cent), and Quebec (105.7 per cent). The other provinces had labour productivity levels in the construction sector below the national average: Ontario (96.8 per cent), British Columbia (95.6 per cen t), Atlantic Canada (92.4 per cent), and Manitoba (89.0 per cent).

Growth rates for real value added per hour by province for the 1989-99 period in the construction industry are provided in Table 6 and Appendix Table 27. The trends are very similar to those for output per worker.

During the 1989-99 period, eight of ten provinces experienced negative growth in output per hour in the construction industry, whereas six provinces experienced negative growth in output per worker. The greatest decline in output per hour was in Manitoba, which underwent a 3.34 per cent annual decline. The province that experienced the largest increase in output per hour was Quebec at 1.11 per cent per year.

In the first half of the 1990s (1989-95), eight provinces experienced declines in output per hour, and in the second half, seven provinces. In terms of output per worker, only four provinces had declines in the second half of the decade. Labour productivity performance as measured by output per hour draws a somewhat more pessimistic picture of productivity performance by province in the 1990s than output per worker estimates.

ii) Capital Productivity

a. Canada

Capital productivity is defined as the ratio of output to the capital stock. Appendix Table 20 provides estimates of net capital stock for the total construction industry, based on the geometric depreciation assumption. Unfortunately, at this time there is no disaggregation of the construction capital stock into estimates for the residential and other construction sectors.

For the 1989-99 period, capital stock in the construction sector grew at an average annual rate of 2.61 per cent per year, compared to a 0.55 decline in real construction output. Consequently, capital productivity fell at a rate of 3.08 per cent per year from $6,990 ($1992) per $1,000 net capital stock in 1989 to $5,110 in 1999 (Appendix Table 28). In the first half of the decade, capital productivity in the construction sector fell 5.17 per cent per year. For the 1995-99 period, capital productivity increased at a rate of 0.14 per cent per year. This cyclical pattern is similar to that experienced by labour productivity.

b. Provinces

In 1998, three provinces had higher levels of capital productivity in the construction sector than the national average of $5,070 per $1,000 output ($1992) (Table 10). Alberta produced $8,730 ($1992) worth of construction output per $1,000 capital stock, followed by British Columbia ($6,860), Saskatchewan ($5,890), Newfoundland ($5,010), Quebec ($4,570), Prince Edward Island ($4,550), Manitoba ($4,470), New Brunswick ($4,010) and finally Ontario ($3,980).

Capital productivity in the construction sector declined in most provinces in the 1990s with the exceptions of Alberta, Saskatchewan and Newfoundland. In Alberta, it increased at a rate of 7.13 per cent per year because of large declines in the capital stock. It rose 1.02 per cent per year in Saskatchewan and 0.42 per cent in Newfoundland. The greatest decline was in Ontario, with capital productivity falling 8.11 per cent per year (Table 10 and Appendix Table 28).

In the first half of the decade, capital productivity increased only in Newfoundland (3.97 per cent) and Alberta (2.48 per cent). The greatest decline was in Ontario, for which capital productivity fell 9.89 per cent per year. Quebec followed with a productivity decline of 6.95 per cent per year, then New Brunswick (-4.61 per cent), Manitoba (-4.56 per cent), and Nova Scotia (-4.49 per cent).

In the second half of the decade only three provinces experienced positive growth in capital productivity. Alberta experienced a surprisingly high rate of productivity of 17.08 per cent per year, followed by Saskatchewan with an increase of 5.69 per cent and British Columbia at 1.66 per cent. The province that experienced the greatest decline in capital stock productivity in the construction sector was Prince Edward Island, with productivity falling at a rate of 9.16 per cent per year.

iii) Total Factor Productivity

a. Canada

Total factor productivity (TFP) or multifactor productivity (MFP) is defined as the index of the ratio of output to total input, with the latter defined as the weighted average of the growth rates of capital and labour. The weights are the shares of total value added in the construction industry. It represents the growth in output not explained by increases in labour and capital inputs due to disembodied technical change (i.e. technical change that is not embodied in new capital equipment), measurement error and other factors.[14]

According to unpublished data from Statistics Canada's Aggregate Productivity Measures data series, multifactor productivity based on value-added (Fisher indices) in the construction sector rose from an index of 87.1 in 1961 to a peak of 119.9 in the recession year of 1982 and then entered a period of decline, reaching 94.6 in 2000 (Appendix Table 31). Over the 1961-2000 period, multifactor productivity advanced at a very weak 0.2 per cent per year. From the 1981 cyclical peak, multifactor productivity has declined 1.0 per cent per year.

The Centre for the Study of Living Standards has also calculated TFP estimates for the total construction sector based on two types of labour input, persons employed and total hours (Appendix Table 31). Unfortunately, since Statistics Canada does not currently produce disaggregated estimates of construction capital, TFP cannot be calculated for the residential and other construction sectors. CSLS estimates show that total factor productivity (calculated using number of workers employed) in the construction sector fell 1.16 per cent per year from 1989 to 1999 while it rose 0.98 per cent in the total economy. Just like labour productivity, the fall in total factor productivity in the construction sector was concentrated in the first half of the 1990s. From 1989 to 1995, total factor productivity declined 2.78 per cent per year, but picked up in the second half, growing 1.32 per cent per year over the 1995-99 period. Total factor productivity measures are also calculated using the number of hours worked. These data show the same pattern.

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[14] See Lipsey and Carlaw (2000) for a critique of the concept of total factor productivity as currently used by economists. Also see Sargent and Rodriquez (2000).

b. Provinces

Estimates of total factor productivity produced by the Centre for the Study of Living Standards show that in the 1990s (1989-98) total factor productivity in the construction sector – based on the number of workers employed – declined in eight provinces (Appendix Table 32). The greatest decline took place in Prince Edward Island, with TFP declining 4.23 per cent per year. Ontario followed with a 3.93 per cent drop in TFP, then Manitoba (-3.62 per cent) and New Brunswick (-2.93 per cent). The two provinces that experienced an increase in TFP were Alberta and Saskatchewan, at 3.52 and 0.60 per cent respectively.

During the first half of the 1990s, growth in TFP in the construction sector in Ontario fell at an average annual rate of 5.67 per cent, the greatest decline among the provinces. The only two provinces that experienced an increase in TFP during the first half of the decade were Newfoundland and Alberta with increases of 1.59 and 0.46 per cent per year, respectively.

During the second half of the decade, half of the provinces experienced a decline in TFP, with the largest decline in Prince Edward Island (-7.70 per cent). Alberta experienced the greatest increase in TFP in the construction sector among the provinces with an average annual increase of 9.93 per cent.[15]

B. Residential Construction

i) Labour Productivity

a. Canada

According to the APM series (Table 14 and Appendix Table 66), the value of output per worker in the residential construction sector in 1997, the most recent year for which data are available, was $48,034 ($1992). This was nearly identical to the average value of output per worker for the overall construction sector ($47,826). The value of output per hour was $24.35 ($1992).

Data from the National Accounts and the Labour Force Survey show that during the 1989-98 period, value added per worker employed in the residential construction sector increased 2.32 per cent per year (Table 7 and Appendix Table 22). This was significantly greater than the 0.02 per cent decline in productivity for the total construction sector. In the first half of the 1990s, output per worker in residential

[15] Total factor productivity has also been calculated using the number of hours worked, provided by Appendix Table 33. Based on these estimates the only province that experienced an increase in TFP in the construction sector during the 1990s was Alberta with TFP growing at a rate of 3.08 percent per year. In the first half of the decade, only Newfoundland and Alberta experienced increases in TFP, and in the second half, it was Alberta, Quebec and Saskatchewan.

construction increased at a rate of 0.80 per cent per year. In the second half of the 1990s (1995-98), output per worker in residential construction grew at a pace of 5.42 per cent per year. Because of declining average weekly hours, output per hour advanced at a somewhat faster pace than output per worker (Table 7).

Data from the Aggregate Productivity Measures series show that output per worker in residential construction increased at a 1.36 per cent rate from 1989 to 1997 (Appendix Table 66), and output per hour 1.58 per cent (Table 14). Of the four major construction industries, residential construction had the best productivity performance in the 1990s. Repair construction did particularly poorly, with output per hour falling at a 2.49 per cent annual rate from 1989 to 1997. Engineering construction excluding repairs also experienced declining productivity (-0.69 per cent). Output per hour in non -residential building construction advanced at a 1.12 per cent average annual rate. In general, the APM series appear more reliable than those based on the LFS a nd will be the growth rates used in the regression analysis later in the report at the national level.

The apparantly good productivity performance of the residential construction sector in the 1990s must be seen from a longer time perspective, encompassing in particular the collapse of residential sector productivity in the second half of the 1980s. In the 1980s, output per hour in residential construction fell at a 2.24 per cent average annual rate, with a massive 8.1 per cent per year drop over the 1985-89 period. The 1997 productivity level of $24.35 per hour worked was still 19.3 per cent below the level attained in 1985 ($30.16), and below the level in 1980. It was also only 4.1 per cent above the level reached in 1970! From the perspective of the disastrous residential construction productivity performance in the 1980s, the rebound in the 1990s is not particularly impressive.

Productivity trends have been very cyclical in the residential construction sector over the past four decades (Table 16 and Chart 3). Based on the peaks and troughs in the output per hour series, one can identify three periods of declining productivity (1961-1966, 1970-1974 and 1985-1992) and three periods of rising productivity (1966-1970, 1974-1985 and 1992-1997). The productivity cycles appear to be driven more by fluctuations in total hours worked rather than by fluctuations in output. Between 1970 and 1974, total hours rose a massive 16.7 per cent per year while between 1985 and 1992 hours worked increased 6.6 per cent per year.

Since 1981, three periods of productivity growth in the residential construction sector can be identified (Chart 5). In the first half of the 1980s, output per hour rose rapidly following the trend started in the mid-1970s, peaking in 1985. This development reflected significant declines in total hours worked (Appendix Table 17). In the second half of the 1980s, productivity plummeted as growth in total hours worked greatly outstripped output growth (77.2 per cent versus 17.2 per cent between 1985 and 1989). Since 1989, productivity growth has been relatively flat, although it picked up between 1995 and 1997. Over the thirty-six year period from 1961 to 1997, output per hour in residential construction advanced 24.3 per cent, or 0.6 per cent per year.

The pattern of productivity growth in the total construction sector since 1981 paralleled that of the residential sector. It was strong in the first half of the 1980s, then fell drastically in the second half of the 1980s, although less steeply than residential construction, and has shown no strong trend in the 1990s.

b. Provinces

In 1998, based on productivity estimates derived from LFS employment estimates (APM estimates are not available), three provinces experienced above average productivity levels in the residential construction sector relative to the national average (Table 9 and Appendix Table 24). Alberta had the highest output per worker level in the residential construction sector at $104,485 ($1992). British Columbia was second at $96,388, followed by Ontario ($86,404) and Quebec ($79,966). New Brunswick had the lowest output per worker level in the residential construction sector at $49,785.

In the 1990s, eight provinces experienced increases in productivity in residential construction, while two experienced slight declines (Table 7). Between 1989 and 1998, residential construction productivity increased at an annual rate of 5.71 per cent in Alberta, 3.21 per cent in Quebec, 2.82 per cent in British Columbia, 2.73 per cent in Nova Scotia, 2.53 per cent in New Brunswick, 1.93 per cent in Prince Edward Island, 1.50 per cent in Saskatchewan and 1.06 per cent in Ontario. Conversely, output per worker fell at an annual rate of 0.33 per cent in Manitoba and 0.10 per cent in Newfoundland. Trends in output per hour by province were similar.

In the first half of the decade, the greatest decline in output per worker in the residential construction sector was in Ontario, undergoing an average annual decline of 2.39 per cent. Output per worker also dropped in Prince Edward Island (-1.61 per cent per year) and Newfoundland (-1.54 per cent). In New Brunswick, residential construction productivity grew at an average pace of 5.48 per cent per year. Nova Scotia experienced an increase of 5.16 per cent per year, followed by British Columbia (4.08 per cent), Quebec (2.71 per cent), and Alberta (1.72 per cent).

In the second half of the 1990s, New Brunswick, Manitoba, and Nova Scotia experienced a decline in output per worker in residential construction. In Alberta, output per worker accelerated at a very rapid rate of 14.17 per cent per year, followed by Prince Edward Island (9.41 per cent), Ontario (8.34 per cent) and Saskatchewan (5.54 per cent). In six provinces, growth in output per worker in the second half of the decade was considerably faster than in the first half.

ii) Intermediate Goods Productivity

Intermediate goods productivity is defined as the ratio of output to intermediate goods, based on gross output. An increase in intermediate goods productivity means that more physical output, as represented by gross output, is produced with fewer intermediate goods, because of, for example, less wastage in raw material usage. Intermediate goods productivity of an industry can also be influenced by changes in the make or buy mix of firms in the industry, that is, whether firms do tasks internally or contract out services (and hence produce less value added). Intermediate goods data for the residential construction sector were obtained from the Input-Output Division of Statistics Canada for the 1961-97 period (Appendix Table 30).

During the 1989-97 period, intermediate goods productivity in the construction sector increased from $1.75 worth of gross output per $1.00 worth of input of intermediate goods to $2.01, a rate of increase of 1.81 per cent. This followed declines in the 1960s and 1980s. Over the 1961-97 period, there was little change in the efficiency of use of intermediate goods: only a 0.1 per cent average annual increase in intermediate goods productivity. This stability of the intermediate good ratio (the reciprocal of intermediate goods productivity) also suggests that the relative importance of contracting out of services by firms in the residential construction has been stable over time.

iii) Capital Productivity

As Statistics Canada does not produce capital stock estimates for the residential construction sector, it is not possible to calculate capital or total factor productivity for this sector.

iv) Trends in Unit Labour Costs and Housing Prices

As was seen in the previous section and in Table 14 and Chart 2, the productivity performance of the residential construction sector since 1981 has been extremely poor, both in absolute and relative terms.[16] Between 1981 and 1997 (the most recent year for which data are currently available), output per hour fell at an average annual rate of 0.35 per cent. This compares with a decline in output per hour of 0.24 per cent in the total construction sector and growth of 1.25 per cent per year in the business sector. All the decline took place in the 1980s, with output per hour falling over 2 per cent per year during this decade and then rising at 1.6 per cent per year in the 1989-97 period.

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[16] Appendix 5 based on Appendix Tables 82 and 83 and Appendix Charts 11-16 compare trends in output per hour, real output and total hours from the Aggregate Productivity Measures series with trends in these three variables taken directly from Statistics Canada's National Accounts and from the Labour Force Survey for the total construction and residential construction sectors. The story of very weak productivity growth since 1981 in the total construction series holds true for productivity estimates based on these series. That is not the case for the residential construction sector because of differences in the growth rate of total hours worked between the Aggregate Productivity Measures series and the Labour Force Survey series. Over the 1984-97 period, output per hour in residential construction rose at a 1.94 per cent average annual rate in the series using the LFS hours, but fell 1.31 per cent per year in the Aggregate Productivity Measures series (Appendix Table 83 and Appendix Chart 16). As noted earlier, the Aggregate Productivity Measures series is considered more reliable and is the one used in this report.

The below average productivity growth in the residential construction sector resulted in above average increases in unit labour costs (Chart 9). They rose 3.82 per cent per year over the 1981-1997 period, well above the 2.88 per cent average for the business sector. The negative impact of the residential sector's poor productivity performance on costs was offset somewhat by the sector's lower annual hourly labour compensation growth relative to the business sector (3.47 per cent versus 4.17 per cent).

Despite the above average increase in unit labour costs in residential construction, the price of new housing has fallen in relative terms since 1981, especially since 1989, and in absolute terms in the 1990s (Table 17 and Chart 8). The price of housing includes both the price of the land on which the house is located and the price of the new houses excluding land.[17] From the last cyclical peak in 1989 to 2000, the price of new houses, by far the most important component in the total price of housing, fell 0.4 per cent per year. Land prices rose 0.5 per cent per year and the overall price of housing (new houses and land) fell 0.3 per cent per year. In contrast, the CPI advanced 2.2 per cent per year over the 1989-2000 period. This has meant that the relative cost of housing has fallen 2.5 per cent per year throughout the 1990s.

The implicit price index for residential structures, which is a broader price index than the price of new housing for the consumer as it includes the prices of all residential structures, including rental dwellings that are not sold on the market, has not experienced a decline in its relative price over the last two decades (Table 17). This series rose at a 3.16 per cent average annual rate from 1981 to 1999, slightly higher than the rate of increase of the GDP deflator (2.87 per cent). Because of the methodology behind its construction, this series may not be as sensitive to demand conditions in the residential housing market as the new housing price index, so weak demand may have had less impact on the deflator for residential structures than the new housing price index.

In contrast to the large fall in the relative price of new housing in the 1990s, the relative price of housing declined only slightly in the 1980s. The price of new houses and land increased 5.1 per cent per year from 1981 to 1989 (5.0 per cent for new homes and 5.7 per cent for land), while the CPI advanced at a 5.3 per cent average annual rate.

This situation is paradoxical. Normally there is a strong relationship between relative productivity developments and relative price developments.[18] Sectors with above average productivity growth tend to experience below average price increases and vice versa. Yet productivity growth in the residential housing sector since 1981 has been well below average, which would imply, ceteris paribus, an increase in the relative price of new housing, not a decline of nearly 2 percentage points per year over the 1981-1997 period.

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[17] The new housing price index measures changes over time in the contractors' selling prices of new residential houses, where detailed specifications remain the same between two consecutive periods. House prices reported by sample builders are adjusted for changes in quality of both the structures and the lots serviced including variations of location to ensure similarity of specifications.

[18] See chapter two of Baldwin et al. (2001).

At least two factors in addition to productivity trends influence the relative price of housing: material and capital costs (both physical and financial capital) for construction inputs; and margins in the residential construction industry. In theory, an above average decline in the prices of materials and capital inputs for residential construction could produce a below average rate of price increase for new housing even if residential construction productivity growth was below average, particularly if the importance on material goods and capital in the price of output is large. Equally, falling margins (operating surplus per unit output) could prevent below average productivity gains from manifesting themselves in higher relative output prices, at least in the short-to-medium term.[19]

This first explanation appears unlikely for the residential construction sector for two reasons. First, the material and capital cost increases passed on to the residential construction sector have been comparable to those experienced by other sectors. Second, the importance of material and capital costs in the price of output in the residential construction sector is below average due to the low-capital intensity of the sector and the labour-intensive nature of construction production processes. There is little empirical support for the second explanation as trends in operating margins in the residential housing sector have not been out of line with those in other sectors.

A third possible explanation of productivity trends in the residential construction sector may lie in errors in the measurement of the true reality. Such errors include the misallocation of construction tradespersons across the different construction sectors and conceptual and empirical problems in the development of appropriate price indexes for construction output to deflate the nominal value of output.

As relative prices are in principle easier to measure than productivity trends, they may be more accurate. Thus, the large fall in the relative price of housing may suggest that true productivity growth in the sector may be above average, even though productivity growth, as currently measured, has been well below average. More work is needed on this issue before a definitive conclusion can be reached. Appendix 5, as noted in footnote 16 compares two sets of residential construction productivity estimates based on different sources and finds the estimates very sensitive to the choice of hours data.

v) Housing Affordability

Housing affordability is affected by trends in nominal incomes as well as the price of housing (and other factors such as mortgage rates and other costs of home ownership

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[19] The Canadian Home Builders Association (2000a) reports that profit margins for builders are below average. In 1996-98, the median profit margin for small new home builders and renovators (revenues less than $500,000) was 1.2 to 1.3 per cent, and for mid-sized builders (revenues $500,000 to $5 million) 1.7 to 1.8 per cent. This compares with median profit margins of 2.1 per cent for all non-financial corporations. On the other hand, Seaden, Guolla, Doutriaux and Nash (2001:11) report that, contrary to common belief, residential contractors in 1997 seemed to make on average good margins, especially the larger ones.

such as property taxes, repairs, utilities, and insurance) and the supply of social and subsidized housing.[20] In the 1990s, all measures of nominal income growth outpaced housing prices up a wide margin (Table 17 and Chart 10). Per capita nominal or money personal income growth rose 2.7 per cent per year over the 1989-2000 compared to a 0.2 per cent fall in housing prices, making housing 2.9 per cent more affordable per year at the national level.[21] The situation is somewhat less rosy when per capita nominal disposable (after-tax) personal income is used, as it grew 2.3 per cent per year over the same period.

The gains in housing affordability were also positive in the 1980s but less than in the 1990s. Over the 1981-89 period, per capita nominal personal income growth averaged 6.9 per cent per year and per capita nominal disposable personal income growth 6.4 per cent, both greater than the 5.1 per cent rate of increase in the housing price index, but much less of a gap than in the 1990s.

Trends in housing prices in the short-to-medium terms largely reflect overall supply and demand conditions. The lackluster economy in the 1990s produced weak growth in housing demand, keeping a lid on price increases, especially after the very rapid increases in the second half of the 1980s (from 1985 to 1989 the prices of new houses and land surged 54.4 per cent or 11.5 per cent per year).

In the long-run, housing prices are in principle more influenced by supply-side factors such as the cost of building homes, which depends on materials costs, labour costs and labour productivity. In competitive markets, the greater the productivity gains, the less the unit cost and the lower the housing prices. From this perspective, productivity improvements in the residential construction sector can enhance the affordability of housing for Canadians.

IV. Trends in Explanatory Variables

This section of the report discusses the drivers or determinants of productivity growth in the construction sector that have been included in the regression analysis of the sector. These variables are the capital intensity of production or the capital-labour ratio, the skills level of the workforce, capacity utilization, and the unemployment rate. Before examining the drivers, the characteristics of the housing industry useful for understanding the dynamics of productivity growth in the sector are outlined and limitations on the availability of certain types of data for the construction sector are discussed.

[20] For a recent, detailed discussion of the issue of affordable housing, see Pomeroy, 2001.
[21] Affordability trends at the provincial and especially metropolitan level may differ significantly from those at the national level.

A. The Characteristics of the Housing Sector

The housing sector, and more generally the construction sector, is distinct from other goods-producing industries in a number of ways, with important implications for productivity growth (CMHC, 1989a:2).

- The first difference is the geographical dispersion of the sector. It is not concentrated in one region but spread out across the country roughly in proportion to population.

- Second, consumer demand for housing is very heterogeneous, with large differences in the types of housing demanded, the amenities, and price or rent people are willing and able to pay.

- Third, most residential housing construction occurs on-site because it is more economical to bring labour and materials to the site and have the structure constructed there than to build the structure in a factory and transport the finished product to the site.

- Fourth, despite the existence of the National Building Code, municipalities differ greatly in the procedures they follow for issuing building permits and in regulating site planning. This extensive involvement of municipal authorities in the building and land development process has been one factor retarding the growth of large firms operating in many market areas.

- Fifth, since entry into the housing industry, especially the single-family homebuilding and renovations sectors, is easy given the small capital requirements, the industry structure is characterized by a large number of small firms. This makes the industry very competitive. The lack of large firms in the sector suggests that economies of scale are not important. (CMHC, 1989a:29).

- Sixth, economic activity in the housing industry is very cyclical. Because of the lengthy production period for new housing and rapid changes in market conditions, the industry can be characterized by periods of rapid expansion resulting in overbuilding, followed by deep slumps in housing activity.

B. Data Limitations

A major barrier to an econometric analysis of the factors determining productivity growth in the residential construction sector is the lack of certain types of data for the sector. The most glaring gap is the lack of capital stock data for residential construction. Statistics Canada at this time only produces capital stock data for the total construction sector. This means that it is not possible to include estimates of capital intensity, investment and capacity utilization in any equation for the residential construction sector. A second problem with the capital stock data for the construction industry is that it includes only the capital stock owned by firms classified to this industry and hence excludes capital stock owned by the financial sector and leased to the construction sector, leading to an underestimation of the sector's true capital stock.

A second gap is the lack of establishment-level data on the residential construction sector. No survey of residential construction firms was available at the time of the writing of this report.[22] This means that there is little information on the characteristics of the firms and establishments in the sector.

Because of the lack of data on the capital stock for the residential construction sector, the analysis in this section and the following section is conducted at the level of the total construction sector for most variables.

C. Capital-Labour Ratio

The capital intensity of production, as proxied by the capital-labour ratio is an important driver of labour productivity growth. It can be expected that the construction sector will become more productive as more capital stock is employed relative to workers. The underlying intuition is that there are large gains to be made from letting a few machines do the work of many workers. This variable is hence expected to have a large effect on productivity, but the magnitude of the effect is influenced by other factors, such as the amount of time needed to implement and learn how to use the machinery.

The construction industry is not a capital-intensive sector. In the 1984-88 period, it ranked 44th out of 50 industries in the gross investment intensity of production, 42nd in the machinery and equipment investment intensity of production, 43rd in the gross capital stock intensity of production, and 39th in the machinery and equipment capital stock intensity of production (Appendix Table 51). It is unlikely that this situation changed significantly in the 1990s.

As noted earlier, Statistics Canada does not produce capital stock estimates for the residential construction sector so the discussion in this section is for the total construction sector. Table 18 and Chart 11 show the trends in the capital-labour ratios in the construction sector and productivity growth for the total construction and residential construction sectors. After rising in the second half of the 1970s and early 1980s, the capital-labour ratio fell sharply over the 1983-1987 period reflecting the strong employment growth of the period. It then resumed its upward trend at 3.2 per cent per year.

The path of productivity growth in the total construction sector paralleled trends in the capital-labour ratio up to 1987. Productivity rose while capital intensity grew from

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[22] Statistics Canada will be releasing the results of a survey of the construction sector in late 2001.

1976 to 1983, and then fell when capital intensity plummeted after 1983. Since 1987, the nexus between trends in capital intensity and productivity growth has been broken as the latter has stagnated while the former has increased substantially. This development is perplexing.

D. Educational Attainment

A second key driver of productivity growth is the skills of the workforce. As a general rule the higher the level of skills the higher the productivity and the faster the pace of skills acquisition, the greater the rate of productivity growth. Unfortunately, it is very difficult to ascertain the actual aggregate skills level of the workforce. Educational attainment is used as a proxy for the skills level.

The construction sector does not rank particularly highly relative to other industries in terms of its human capital. According to figures compiled by Industry Canada (Appendix Table 49), the sector in 1986 ranked 47th out of 50 industries in the proportion of knowledge workers (9.9 per cent of the construction workforce), 34th in the proportion of scientists and engineers (2.3 per cent) and 28th in the proportion of workers with post-secondary education (36.5 per cent).

The Centre for the Study of Living Standards has obtained unpublished Labour Force Survey data from Statistics Canada on the educational attainment of workers in the total construction and residential construction sectors for the 1976-2000 period. Trends in these data are given in Table 18 and Chart 12 and in Appendix Tables 41-46.

The level of formal educational attainment in the residential construction sector, like the total construction sector, is below the national average. In 2000, 43.5 per cent of workers in the residential construction sector had a post-secondary certificate, diploma or degree (43.6 per cent in total construction), compared to 52.2 per cent in all industries (Table 19). This situation is accounted for by the small proportion of workers in the residential construction sector in particular, and in the total construction sector in general, who have a university degree (6.8 per cent and 5.1 per cent respectively compared to 19.7 per cent for all industries).

Conversely, an above average proportion of workers in the residential and total construction sectors have received a post-secondary certificate or diploma, including apprenticeship certification (36.7 per cent and 38.5 per cent compared to 32.5 per cent for all industries). For most construction occupations, non-university post-secondary educational programs such as apprenticeship training are probably more relevant than university programs.

Like all sectors, the pace of skills upgrading in the residential construction sector and the total construction sector, as proxied by the growth in the proportion of the workforce with a post-secondary certificate or diploma, has been rapid. Between 1976 and 2000, this proportion of workers in the total construction sector jumped 22.0 points or

133.3 per cent from 16.5 per cent to 38.5 per cent. In the residential construction sector it rose an even greater 24.8 points or 208.4 per cent from 11.9 per cent to 36.7 per cent. In contrast, for all industries, the proportion advanced only 13.7 points or 72.9 per cent from 18.8 per cent to 32.5 per cent (Appendix Tables 41-43).

As Chart 12 shows, there appears to be no relationship between trends in the skills level of the construction sector workforce, as proxied by educational attainment data, and productivity. Productivity growth since the early 1980s has been very weak for both the total construction and residential construction sectors, despite the massive increase in the educational credentials of the workforce.

E. Capacity Utilization

The rate of capacity utilization is the proportion of the capital stock that is engaged in production. It varies with the business cycle, falling during a recession and rising during an expansion. Table 18 and Chart 13 show trends in capacity utilization for the total construction sector for the 1961-2000 period (data for the residential construction sector are not available because of the lack of data for the capital stock for this industry). The rate ranged from a low of 76.9 per cent in 1972 to a high of 95.6 per cent in 1989.

From the 87.5 per cent recorded at the 1981 business cycle peak, capacity utilization in the total construction sector fell during the recession of the early 1980s, reaching a trough of 78.6 per cent in 1984. With the expansion of the mid - and late 1980s capacity utilization again picked up, peaking at a record 95.6 per cent in 1989. The weak economic conditions in the first half of the 1990s saw capacity utilization drop to a trough of 76.6 per cent in 1995. With the expansion during the second half of the 1990s, the rate rose, attaining 91.4 per cent in 2000.

Productivity trends exhibit a strong cyclical component. One explanation of this phenomenon is the existence of lags in the adjustment of employment to changes in output. According to this explanation, productivity behaves in a pro-cyclical manner, falling in recessions as the semi-fixity of labour input results in greater falls in output than employment and rising in the early phase of expansions as output expands faster than employment. A second explanation of the cyclical behaviour of productivity is linked to the effect of the cycle on the financial circumstances and hence behaviour of the firm. According to this explanation, productivity behaves in a counter-cyclical manner, rising in recessions as the fall in profitability forces employers to cut employment more than output, and falling in expansions as the improved profitability allows inefficiencies to develop.

The short-to-medium term productivity performance in the residential and total construction sectors appears to correspond better to the second explanation than the first. During both the recessions of the early 1980s and 1990s, labour productivity rose while during the expansions of the mid and late 1980s and 1990s it fell.

F. Unemployment Rate

There have been large variations in the unemployment rate in the total construction sector over the last two decades, as shown in Chart 14 (with extensive labour mobility within the construction sector, trends in the total construction sector provide a good approximation for trends in the residential construction sector).

The link between the unemployment rate and productivity is similar to the relationship between capacity utilization and productivity, given the correlation between capacity utilization and unemployment. On the one hand, weak demand conditions, which lead to increased unemployment, can have a negative or pro-cyclical productivity decline due to the presence of overhead labour. There will be a negative relationship between the unemployment rate and productivity even though there is no causation.

On the other hand, weak demand that produces higher unemployment may have a positive or counter cyclical effect on productivity through greater effort exerted by the employed workers because of fear of layoffs. In this channel, greater unemployment directly increases productivity so there is a causal behavioural effect on worker effort. A positive correlation between unemployment and productivity growth may also reflect non-causal influences, such as a situation where dire financial circumstances caused by a recession force employers to cut employment more than output. The quality of the workforce may also vary with the state of the economy (and hence the unemployment rate). Less productive workers may be laid off before more productive workers during downturns, boosting average productivity through a composition effect and hired during expansions, reducing productivity.

Again the second relationship seems more related to developments over the past two decades (Table 18 and Chart 14). Productivity growth in the total construction sector rose during the recessions of the early 1980s and 1990s when unemployment soared. Equally, productivity growth was flat or in decline during periods when the unemployment rate was in decline.

V. Regression Results

This section reports on the regression results to explain productivity trends in the total construction and residential construction sectors in Canada and the provinces over the past two decades. For Canada, the dependent variable is output per hour based on the Aggregate Productivity Measures, although the Labour Force Survey/National Accounts series are used to check the robustness of the results. For the provinces, lack of estimates from the APM series has meant that estimates from the Labour Force Survey/ National

Accounts series have been used. The independent variables, which have b een discussed in the previous section, are

- the capital intensity of production, proxied by the capital-employment ratio;
- the skills level of the workforce, proxied by the proportion who have completed a post-secondary certificate or diploma; and
- a cyclical variable proxied by the capacity utilization rate (for Canada only as there is no provincial data) or the unemployment rate or both.

Results are reported for both levels and rates of growth of the independent and dependent variables. Unfortunately, data limitations have meant that most of the results refer to the total construction sector, not the residential construction sector, which is the focus of this study. The time period considered is 1976-1998 for estimates for Canada and 1984-1998 for the provinces.

A. Total Construction

The section focuses on the regression results for the total construction industry. Productivity in the construction industry, the dependent variable, is measured by value added per person hour, in index form for Canada and in 1992 dollars for the provinces. Two models have been developed using these variables, the first containing the levels, expressed in both actual and logarithmic form, of the observations and the second containing the rates of change of the observations. The regressions based on the first model are in general more significant statistically than those based on the second model, but both provide relatively similar results. Likewise, the regressions using provincial data confirm the results of the regressions using national data but are in general less significant. These results are further reinforced by regressions on cross-sectional and pooled data.

i) Canada

Table 20 presents a summary of the results based on data for the 1976-98 period obtained from the regressions based on the first specification, with data in level form. The R-squared coefficient of 0.86 implies that the four variables in the equation can account for 86 per cent of the variation in output per hour over time.

One surprise is that the estimated educational attainment coefficient is a highly statistically significant negative number. As the proportion of employed Canadian workers in the construction sector holding a post-secondary diploma increases by one percentage point, the index of value added per person hour in the construction industry *decreases* by 1.4.

A second observation is that the estimated capital-labour ratio coefficient, while positive and statistically significant, is very small in magnitude. As the value of capital stock per employed worker increases by 100 dollars, the index of value added per person hour in the construction sector increases by only 0.8 points. Finally, it is found that the estimated unemployment rate coefficient is positive, suggesting that as workers are idled, the productivity of those still employed will increase. But the estimated capacity utilization coefficient is positive, which suggests the opposite of the previous finding, that as capacity utilization rises, productivity growth increases.

As trends in the unemployment rate and capacity utilization are correlated, separate regressions were run using only one of the variables. The explanatory power of the equation was reduced, which is normal when the number of independent variables is reduced. The unemployment rate also lost its statistical significance.

Table 20 also presents results where the logarithm of the productivity level and independent variables have been used in the regression instead of the absolute values of these variables. The value of R-squared increases slightly to 0.89. The signs and the statistical significance of the independent variables do not change, but the magnitude of the coefficients in certain cases do change. In particular, the negative coefficient on the educational attainment variable falls significantly (from -1.37 to -0.29) while the positive coefficient on the capital-labour ratio increases greatly (from 0.008 to 0.58).[23]

Table 21 presents the summary of regressions based on the second specification, which uses the rates of change of the observations. The fit of the equation is somewhat less, with an R-squared of 0.79. The signs on the four independent variables are the same. The coefficient for the educational attainment variable is much less and that for the capital-labour ratio much greater. As the rate of change of the proportion of employed Canadian workers in the construction sector holding a post-secondary certificate or diploma increases by one percentage point, the rate of change of the index of value added per person hour now decreases by 0.06 percentage points. An increased capital-labour ratio, capacity utilization rate, and unemployment rate still lead to a more rapidly increasing value added per person hour. All variables except educational attainment continued to be statistically significant.[24]

These somewhat startling results may stem from problems with the data rather than problems with the models. Again looking at Tables 20 and 21, the Durbin-Watson statistics suggest that none of the models exhibit extremely autocorrelated disturbance terms. There is also no evidence of multi-collinearity among the independent variables:

[23] Appendix Table 71 shows that the substitution of the output per hour series based on Labour Force Survey (LFS) and National Accounts (NA) data for the series based on the Aggregate Productivity Measures (APM) data base has minimal effect on the results for the level equations, expressed both in actual values and logarithms. This result is not surprising since there are little differences between the APM and LFS/NA output per hour series (see Appendix Tables 82 and 83).

[24] Appendix Table 72 shows that the substitution of the output per hour series based on LFS and National Accounts data also has minimal effect on the results.

the simple correlation coefficients between each pair of independent variables were calculated and found to be quite low.

The technique of ordinary least squares estimation requires a linear form for the underlying model. Looking at scatter diagrams in the appendix (Appendix Charts 1-8), it is difficult to decide whether or not the linear form is appropriate, that is, whether or not the relationship between the dependent variable and the independent variables is a linear one. However, given that no other form is apparent either, there is not likely any specification error in this area.

There is very likely to be, however, omitted variable bias. The models are stating that only four independent variables (plus a constant and a random shock term) affect the dependent variable, while it seems obvious that productivity in the construction industry is affected by many other factors. The models currently do not include a measure of workplace safety, an earnings measure, or most importantly a measure of technological innovation, and these omitted variables may cause the estimated coefficients for the included variables to be biased. This is a data problem, or more precisely with data availability, and there is no way to know the magnitudes of the biases unless data for these variables are obtained and further regression analysis is undertaken.

The data for the capital-labour ratio is sound, so the disappointingly small estimated coefficient is probably a result of omitted variable bias: the effects of the missing variables are forcing the coefficient to be underestimated. The unemployment and capacity utilization data are sound as well. As the unemployment rate falls, by definition a higher proportion of the labour force becomes employed, so there is a higher rate of capacity utilization. The two variables should have a high negative correlation, but for the national level data for the period 1976-1998 the simple correlation coefficient was only -0.47. This suggests that it was possible, for this period, to increase productivity in the construction industry by increasing both the unemployment rate and the capaci ty utilization rate. This could be achieved by laying off workers (assuming that the remaining workers become more productive to keep their jobs), and simultaneously using the capital stock much more intensively.

ii) Provinces

In addition to the regressions run with national data, a series of regressions have been run with provincial data. The provincial data cover only the 1984-98 period, a shorter period than that covered by the national (1976-98). In addition, as there are no provincial data for capacity utilization, this variable was not included in the regression.

The explanatory power of the equation to account for trends in output per hour in the construction sector is less at the provincial level than at the national level. For the level equation (actual values), the average provincial R-squared was 0.58 (Table 22), compared to 0.86 at the national level for the regression including capacity utilization and 0.63 for the equation excluding capacity utilization. The R-squares ranged from a high of

0.79 in British Columbia to a low of 0.23 in Manitoba. The educational attainment variable had the same negative sign in all provinces as at the national level, but it was statistically significant in only six provinces. The capital-labour ratio had a perverse negative sign in five provinces, with two of them statistically significant. The unemployment rate had a negative sign in two provinces and was statistically significant with a positive sign in only four provinces.

The level equation based on logarithms produced results very similar to the level equation based on actual values in terms of the signs, statistical significance and size of coefficient (Table 23). The average provincial R-square was 0.56, with a range from a low of 0.21 in Manitoba to a high of 0.75 in British Columbia.

For the regressions based on rates of change, the average provincial R-square was 0.27 (Table 24), compared to 0.79 at the national level for the regression including capacity utilization and 0.57 for the equation excluding capacity utilization. The R-squares ranged from a high of 0.43 in Quebec to a low of 0.05 in Prince Edward Island. The sign of the education attainment variable was positive in one half of the provinces and negative in the other half. It was statistically significant in no province. The sign of the capital-labour ratio was positive in eight provinces, but statistically significant in only two of these provinces. The sign on the unemployment rate varied by province and was statistically significant in no province.

In addition to the three sets of regressions run for each province, regressions were run that pooled all the provincial data for all years. Table 25 shows that the R-square for the pooled regression using actual level values was 0.48. The educational attainment had a negative sign and was statistically significant. The capital-labour ratio was also statistically significant with a positive sign and a very small coefficient. The unemployment rate had a negative sign, unlike at the national level and was also statistically significant.

The R-square for the pooled regression based on the rates of change in the variables was much smaller at 0.11. None of the three independent variables was statistically significant in this equation.

B. Residential Construction

i) Canada

Of the five variables used in the regressions for the total construction sector, only three are available for the residential sector because of the lack of data on the residential construction capital stock. Data are available for the 1976-97 period for output per hour and educational attainment in the residential construction sector. The unemployment rate for the total construction sector can be considered a good proxy for the unemployment rate in the residential sector given the free flow of workers within the overall construction sector.

An equation for the residential construction with the same independent and dependent variables was estimated. Actual data for the residential construction was used for output per hour and data from the total construction sector was used as a proxy of that in the residential construction sector for the unemployment rate, the capital-labour ratio, and capacity utilization.

For the data in level form using the actual values the results are quite similar to those obtained for total construction sector (Table 26). The fit for the equation was the same, with the R-squared at 0.86 identical to that for the total construction sector. The use of the same data for the capital-labour ratio, capacity utilization and unemployment data no doubt accounts for the similar results. The main difference for the total construction sector was the unemployment rate. In contrast to the statistically significant positive relationship for the total construction sector, in the residential construction sector the relationship was negative and statistically insignificant. As in the total construction sector, the educational attainment variable was negative and statistically insignificant and the capital-labour ratio and capacity utilization positive and statistically significant.

Equations were estimated for the residential construction sector that dropped either the unemployment rate or capacity utilization given the potential positive association between these two variables. The results were basically unchanged.[25]

A second set of regression was run for the residential construction sector with the values of variables in logarithmic form (Table 26). The results are very similar to those obtained for the equations based on the actual values of the variables, including the equations that dropped either the unemployment rate or capacity utilization and those based on the LFS and NA data (Appendix Table 73).

A third set of equations was run with the dependent and independent variables expressed as rates of change (Table 27). As was the case in the total construction sector, the fit was weaker (R-square of 0.65) than when the variables were expressed in level form (either actual values or logarithms). The main difference is that the sign of the unemployment variable turned positive. Other results are very similar to those obtained for the equations based on the actual values of the variables, including the equations that dropped either the unemployment rate or capacity utilization and those based on the LFS and NA data (Appendix Table 74).

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[25] The regressions were also run with output per hour estimates based on data from the Labour Force Survey (LFS) and National Accounts (NA) instead of the Aggregate Productivity Measures (APM) data base (Appendix Table 73). The R-square from this regression was 0.66, well below the 0.86 value for the APM data. The signs for the four independent variables were the same. Capacity utilization dropped from being statistically significant to insignificant. As noted in Appendix Table 83 and Appendix Chart 16, output per hour growth was much stronger over the 1976-98 period in the LFS/NA data than in the APM data. This appears to have produced weaker results.

ii) Provinces

In addition to the regressions run for the residential construction sector with national data, a series of regressions have been run with provincial data. Because the real output by province series only begins in 1984, the provincial data cover only the 1984-98 period, a shorter period than that covered by the national data (1976-97). In addition, as there are no provincial data for capacity utilization, this variable was not included in the regression. Data are available for residential construction output by province and the educational attainment of workers in residential construction by province. The data for the capital-labour ratio by province and the unemployment rate by province are for the total construction sector as there is no breakdown for residential construction.

The explanatory power of the equation to account for trends in output per hour in the residential construction sector is less at the provincial level than at the national level. For the level equation (actual values), the average provincial R-square was 0.50 (Table 28), compared to 0.86 at the national level for the regression including capacity utilization and 0.82 for the equation excluding capacity utilization. The R-squares ranged from a high of 0.87 in Saskatchewan to a low of 0.08 in Newfoundland. The educational attainment variable has a positive sign in four provinces and negative sign in six (of which three were statistically significant). The capital-labour ratio had a perverse negative sign in three provinces, with one of them statistically significant. This variable was statistically significant with a positive sign in four provinces. In all cases the coefficient for this variable was very small. The unemployment rate had a negative sign in seven provinces and was statistically significant in two of these provinces. It was statistically significant with a positive sign in four provinces.

The level equation based on logarithms produced results very similar to the level equation based on actual values in terms of the signs, statistical significance and size of coefficient (Table 29). The average provincial R-square was 0.52, with a range from a low of 0.07 in Newfoundland to a high of 0.91 in Saskatchewan.

For the regressions based on rates of change, the average provincial R-square was a much lower 0.22 (Table 30). The R-squares ranged from a low of 0.03 in Prince Edward Island to a high of 0.58 in Newfoundland. For the 30 province-variable pairs (10 provinces and three variables), only four were statistically significant, suggesting that the variables at the provincial level had little ability to account for year-to-year variation in output per hour in residential construction.

The R-squares for the regression that pooled all the provincial data was very low (Table 31): 0.18 for the level regressions based on actual values, 0.27 for the level regressions based on logarithms, and 0.08 for the regressions based on the rates of change. In all three regressions, the sign on the educational attainment was negative (statistically significant in two cases), the sign on the capital-labour ratio positive (statistically significant in two cases), and the sign on the unemployment rate negative (also statistically significant in two cases).

C. Limitations of Regression Analysis

The objective of regression analysis is to explain the period to period fluctuations in a series, not the long run trend. Certain of the independent variables such as the capital labour ratio and educational attainment have a strong upward trend as their values increase over time while others such as the unemployment rate or capacity utilization have a weak trend or no trend at all as the values tend to cycle around a relatively stable long-run average value. Thus the regression model may account for (as evidenced by the R-square) the year-to-year variation in productivity growth around a very weak trend, but at the same time provide no explanation for this weak trend. This appears to be the case for the regressions discussed above. As noted earlier, the large trend increases in the capital-labour ratio and in educational attainment in the construction industry would normally have been expected to increase productivity. Other factors must have been at work to offset these normally productivity-enhancing effects.

VI. Other Factors Affecting Productivity in the Construction Sector

In addition to the four independent variables that were formally incorporated into the econometric work, the study identified a number of other determinants of productivity growth in the construction sector. Unfortunately, because of data limitations and other factors, it was not possible to use these variables in the regression analysis. These variables were measurement error, technical change, weak output growth, compositional shifts in output, bankruptcies, labour compensation, workplace safety, labour unions, and the ageing of the workforce.

A. Measurement Issues

As briefly discussed earlier in the report, labour productivity growth estimates can be subject to a wide margin of error because of input and output measurement problems. An overestimation of labour input results in an underestimation of labour productivity growth. Equally, an underestimation of real output growth associated with undercoverage of the nominal value of output or incorrect deflators produces an underestimation of labour productivity growth.

As noted earlier, the productivity performance of the construction sector in general and the residential construction sector in particular over the last two decades has been extremely poor. Despite increases in capital-labour ratios and higher levels of educational attainment for the workforce, the level of output per hour in the total construction sector in 2000 was below that of 1978 and the level in the residential construction sector in 2000 below that of 1980.

Many observers find it highly improbable that there has been negative productivity growth in these two sectors over the last 20 years, especially when the relative price of new housing has fallen considerably. This suggests that measurement problems may be at play, a situation that many observers believe has plagued estimates of construction sector productivity in the United States for many years.[26] Indeed, Allen (1985) estimated that about one half the construction productivity decline in the United States was due to an over deflation of construction output.

This section discusses three potential measurement problems: biases in estimates of construction price indexes; misallocation of labour input among construction industries; and undercoverage of the construction sector because of underground activity.

i) Biases in Construction Price Indexes

The most important measurement issue for the construction sector is whether the price series used to deflate nominal output are capturing true changes in prices over time and hence giving true movements in real output. This may not be the case if quality changes in construction output are not captured. For example, new homes in recent years have become more fuel efficient because of better insulation and other features.[27] They are also increasingly likely to include landscaping and appliances. It is unclear whether housing prices reflect this quality improvement. Developing accurate structures deflators is very difficult due to the heterogeneity of most structures.

Construction prices indexes can be divided into four types based on their method of pricing components or intermediate units of output such as square footage: bid prices, hedonic price indexes, estimation indexes, and cost indexes.

Bid prices indices are based on an average of winning bids on the most important components for heavy construction projects. The main difficulty is identifying a relatively homogeneous physical measure. This problem has limited the potential use of bid prices.

Hedonic price indexes are a type of component pricing where the component prices are estimated from a cross-section regression. Experiments with hedonic price indexes for the multiunit residential sector in the United States have been largely unsuccessful and little work has been done for other types of construction (Pieper, 1990:254). Pieper notes that in practice hedonic price indexes usually include only physical characteristics such as size and ignore quality characteristics such as design, materials and construction quality, and building amenities. It is therefore not surprising that hedonic indexes for buildings differ little from price per square foot indexes.

[26] Labour productivity growth in the construction sector in the United States has been negative since 1973. Appendix Table 97 shows that real value added per hour fell 1.50 per cent per year in the 1973-79 period, 0.64 per cent in 1979-87, and 0.32 per cent in 1987-98.

[27] The CHBA (2000b:20) estimates that over the past two decades the energy efficiency of new homes has improved by more than 35 per cent.

Consequently, the main weakness of hedonic price indexes is the difficulty of quantifying many construction characteristics. Statistics Canada does not currently employ this methodology to develop price indexes for new housing. Rather the New Housing Price Index is based on a survey of contractors' selling prices on new homes, adjusted for changes in quality of both the structures and lots serviced.

The estimation price indexes for construction projects are based on estimates from contractors, cost engineers and other types of "informed judgment". Statistics Canada uses this approach, called the "Model Price Technique" to construct a price index for nonresidential buildings and apartment buildings (Mohammadian and Seymour, 1995, Mohammadian and Waugh, 1997 and Pieper, 1990).[28] The obvious advantage of estimation indexes is that they control for construction heterogeneity by keeping the specifications fixed over time. Their main weakness is that they are based on hypothetical prices rather than on actual transaction prices. Contractors submitting hypothetical bids know they will not be required to construct the project in question and do not have the normal incentive to bid as low as possible to win the contract.

The fourth and less desirable method of deflation are cost indexes based on a weighted average of material and wage costs for construction of a structure. A major weakness of such indexes is that it is assumed there is no change in construction productivity.

ii) Misallocation of Labour Input Among Construction Industries

Many tradespersons work in different sectors over the course of a year, for example working for part of the year on office building construction and then moving to housing. This mobility may pose problems for the accurate allocation of workers among construction industries as information on the specific construction industry tradespersons are working in may be limited. Labour productivity will be overestimated in industries where the number of tradespersons is underestimated and vice versa, although there will be no bias at the level of the total construction sector. Statistics Canada officials have indicated that their estimates for residential construction productivity may have a margin of error because of this allocation problem.

[28] According to Pieper (1990:355-6), "Statistics Canada uses a disaggregated approach, dividing a building into its component operations. Statistics Canada first selects prototype models of five types of nonresidential buildings: an office, warehouse, small shopping centre, light industrial building and high school. The construction of each building is divided into five main categories: architectural, structural, mechanical and electrical trades, and the general contractor's overhead and profit. Representative items for each category are priced, mostly on the basis of surveys of sub-contractors."

iii) Undercoverage of Construction Activities and the Underground Economy

The introduction of the GST in 1991 gave individuals and businesses engaged in construction activities an additional incentive to fail to report or underreport income. Many observers believe that this situation has fueled the growth of underground activities in the sector, with implications for measured productivity growth. Of course, if both employment and income are underreported in the same proportion, productivity is unaffected. But most observers believe undercoverage is much greater for income than employment, as persons have much greater incentive to underreport their income when filing tax returns than to underreport hours worked when responding to the Labour Force Survey.

If a growing proportion of construction activity is taking place underground and is not reported to the authorities, a growing gap between actual and measured labour productivity growth may emerge, assuming labour input is accurately captured. In theory, such a development could explain some of the weak measured productivity performance in the construction sector in Canada in the 1990s.

According to the CHBA (2000b), since the introduction of the GST in 1991, the underground share of total housing activity has increased significantly. A study for the Ontario Construction Secretariat (O'Grady *et al*., 1998) found a large underground economy in the construction sector. It estimated that underground construction employment in Ontario averaged between 58,000 and 79,000 annually between 1995 and 1997, with most of the underground work in the residential renovations sector. In Ontario, 53 per cent of all employment in repair construction and 44 per cent in alterations and improvements was underground. For new housing the figure was 12 per cent and for non - residential construction 10 per cent. Unfortunately, no time series information is available so one does not know if the relative importance of underground activity has increased over time.

It is important to note that the estimates of output in the construction sector produced by Statistics Canada are based on more than the income reported to tax authorities. Statistics Canada officials impute income to the sector based on employment data, building supplies sales, and other relevant information. From this perspective, the growth of the underreporting to the tax authorities will not necessarily lead to an underestimation of the output of the sector.

Without further work it is not possible to state with any certainty whether the decline in output per hour in the total construction sector and in residential construction over the last two decades can be accounted in full or in part by measurement problems. An underestimation of labour productivity growth for the total construction and residential construction sectors would imply an overestimation of price increases (overdeflation), or an underestimation of the nominal value of structures, and for residential construction a growing overallocation of labour input to residential construction at the expense of non-residential construction.

Regarding the first of these possibilities, the New Housing Price Index for residential housing rose at a 1.85 per cent average annual rate between 1981 and 1997 (Table 17), well below the 3.16 per cent increase in the GDP deflator so it might appear that new housing price increases are not being overestimated. However, the deflator for residential structures, which includes new rental accommodation as well as housing units sold directly to individuals for personal use, rose 3.28 per cent per year in 1981-97.[29]

B. Technological Change

Technical or technological change is the most important determinant of productivity growth. The amount of technical change that takes place in the construction sector according to conventional indicators is very low. For example, in the 1984-88 period the construction industry (Appendix Table 48) ranked dead last (43rd out of 43) in terms of R&D intensity and was second to last (ahead of retail trade) in both R&D personnel per worker (0.02 per cent) and professional R&D personnel per worker (0.01 per cent).

In terms of patent activity, the construction industry ranked below average on most indicators in the 1984-88 period (Appendix Table 50). It ranked 38th out of 55 industries in terms of total patents used per unit of output and 32nd in total patents granted per unit of output. It did better in the absolute number of patents given the large relative size of the sector, ranking 9th in total patents used, and 28th in total patents granted, and 16th in externally used patents.

A key characteristic of the construction sector is that it benefits from technological change undertaken in other sectors. Technological advances in construction materials and construction tools and capital goods generated by these industries in the manufacturing sector boost productivity in the construction sector, but this innovative activity is not registered in the construction sector.

Because of the small amount of R&D undertaken and limited number of patents granted, it appears that no time series on R&D and patents in the construction sector are available for Canada. For this reason, it was not possible to include a measure of technological change in the construction sector in the econometric analysis of productivity trends in the sector.

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[29] The New Housing Price Index is the major component of the overall residential structures deflator since from 1991 to 1999 non-rental starts represented 90 per cent of total housing starts (CHBA, 2000a). This situation implies that the rental accommodation component of the residential deflator rose at a rate well above the GDP deflator. As one might expect that under competitive conditions prices for new housing and for new rental accommodation will rise at roughly similar rates, this discrepancy warrants attention.

One of the first attempts to chronicle innovation activity in the construction industry has been made by the Science, Innovation and Electronic Information Division at Statistics Canada, in the publication *Innovation, Advanced Technologies and Practices in the Construction and Related Industries: National Estimates,* released in February 2001. The report, based on the first survey of innovation, advanced technologies and practices in the construction industry in Canada,[30] found that in 1999 only 16 per cent of construction businesses considered investing in research and development important, and only 14 per cent considered patenting important. E-mail was the most widely used new technology, with only 38 per cent of businesses using it at the time of the survey and another 25 per cent planning to use it within two years. The most widely used sources of information about innovation were suppliers, trade journals, and clients, rather than government programs. The intensity of the use of technologies varied greatly with the size of the enterprise, with large firms using three times as many technologies as small enterprises.

The study included information for the industries comprising the total construction industry. Residential construction was one of the furthest behind in use of technology, with residential contractors using only one third as many technologies as engineering and non-residential contractors. Only 4 per cent of residential construction businesses consider investing in research and development important, and the number is only 2 per cent for patenting. The most widespread new technology is e-mail, but only 23 per cent of businesses have adopted it.

The report on construction innovation unfortunately provides no historical data so it is not possible to compare current innovative effort and use of advanced technologies in the construction sector with past trends.

The absolute decline in labour productivity in both the total construction and residential construction sectors over the past two decades in Canada may give the impression that there has been no technical progress in these sectors. Discussion with industry experts and anecdotal evidence suggests however that this is not the case. For example, a recent article on road repair noted that “modern machinery and new asphalt ingredients mean a two-kilometer stretch of road that took months to pave decades ago now only takes 30 day” (Ottawa Citizen, 2001). In terms of productivity-enhancing innovations in the housing sector, the nailing machine has lead to significant time saving as have modularization and prefabrication, although these two latter activities may only result in the transfer of both value added and employment from construction to manufacturing and have little or no effect on productivity.

In any case, the negative productivity growth in the total and residential construction sectors since 1981 should not be taken as conclu sive evidence of technological regress. Other factors could be responsible for the decline in productivity, offsetting the productivity-enhancing technological progress in the sector.

[30] See Seaden, Guolla, Doutriaux, and Nash (2001) for a detailed analysis of the results of the survey

Nevertheless, a case can be made that the pace of technical progress is slower than in other sectors because of the labour-intensive nature of many construction activities, which limits the possibilities of mechanization, that is the substitution of capital for labour. The limited number of patents and R&D expenditures undertaken by the construction sector, noted above, may be taken as evidence that there is limited potential for productivity improvement. Otherwise, more resources would be allocated to improving productivity. Of course, one might argue that if more resources were devoted to construction R&D, technological progress would follow.

A CMHC-commissioned study prepared by Clayton Research Associates and Scanada Consults provides an excellent overview of the evolution of the housing production process in Canada over the 1946-86 period, and provides support for the view that, at least since the 1960s, technical change in residential construction has been slow. Estimates of the number of hours needed to construct a house provide an approximation of labour productivity trends over time. The study (CMHC, 1989b:21-22) found that the number of site person-hours needed to build a house in the mid-1940s totaled 2,400. By the mid-1960s the number of hours needed to construct a similar house had fallen to 950, a decrease of 4.5 per cent per year over the 20 year period.[31] Construction time in the mid-1940s was about seven months, due to delays in material supply. By the mid-1960s it had been reduced to eight weeks. The study attributed these large improvements to a number of changes in production methods, as detailed in Exhibits 1 and 2, which significantly reduced on-site labour requirements and to the application by homebuilders of factory-like "stationary assembly line" flow to on-site operations which greatly decreased the length of the production process.[32]

The study found that there has been little if any decrease in the labour requirements to build a standard house since the mid-1960s, nor any reduction in the length of time needed. It did note however that this apparent demise of productivity improvement since the mid-1960s is not completely accurate in the sense that the end product is now better. The house of the mid-1980s had markedly improved in its windows, insulation, airtightness and heating efficiency compared to the mid-1960s forerunner, and had better finishes and freedom from maintenance.

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[31] The person-hours eliminated were not simply transferred to a factory. In almost every case, the factory production of the materials consumed fewer hours.

[32] Factory-based housing has often been seen as the path to higher productivity and lower housing costs. Yet the study notes:

> But the dream of the 1930s and the following decades - the "house in a day" springing more or less wholly from a pristine factory - has failed to become common. Even as homebuilders accept higher factory content in more of the house's parts and pieces, their mainstream industry is little interested in the more completely manufactured house, which has been technically attainable (CMHC, 1989b:9)

As better materials, components and methods have been developed, the on-site builder has adapted and adopted them effectively. Factory-produced housing has not proven cost advantageous.

Trends in labour requirements for apartment construction were similar to single-family homes. According to the CMHC study (CMHC, 1989b:26), the on-site labour hours consumed in constructing walk-up apartments in 1946-47 were about 2,000 per unit. By the peak period of high-rise apartment production in Canada in the mid and late 1960s, better finished and serviced high-rise apartment units were being produced in about 1,000 site hours or less. A number of technological advances in apartment construction in the 1950s and 1960s detailed in the CMHC study were responsible for this reduction in labour requirements. It appears that the pace of technical process in apartment construction slowed down considerably after the end of the 1960s.

The above findings on the pace of change in labour requirements in the housing sector are consistent with the results of this study that show little improvement in productivity in the residential construction sector since the 1960s. They provide strong support for the view that lack of technical advance in the sector is the key explanation of this situation, just as important changes in production methods account for the rapid productivity growth from the mid-1940s to the mid-1960s. Real output per hour in residential construction in 1997 was only 6.7 per cent above the level achieved 28 years earlier in 1969 (Table 14).

While the renovations sector is not part of residential construction, it is part of the housing industry and of the overall construction sector. This sector has experienced literally no productivity growth in the last quarter century, with real output per hour in repair construction (which is dominated by the housing sector) in 1997 be low the level achieved in 1975 (Table 14). The CMHC study (CMHC, 1989b:29) sheds light on this situation by noting that renovation is extremely labour-intensive, with two-third of the renovation dollar going to labour versus one-third for single-family house construction and that there have been no technological breakthroughs in the sector given that materials have to be custom fitted and tradepersons must be able to work with design and materials that are now not commonly used.[33]

C. Weak Output Growth

Industries experiencing strong output growth tend to enjoy above average productivity growth while industries with weak growth tend to record below average productivity gains. Strong demand for a sector's output and the resulting rapid output growth can foster productivity gains through static and dynamic economies of scale,

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[33] The following quotation sums up well the state of residential renovation:

> For many renovation firms, most jobs are one-off, surprise-ridden, barely planned and never truly repeatable. In the mid-1980s, as in the mid-1940s, no pattern or discernable stage of evolution, no real changes or hints of change, no technological breakthroughs, present itself. Indeed, there may be reversals: a need in the mid-1980s and beyond for the once-traditional materials, skills and techniques that were part of the fabric of house construction/renovation in the mid-1940s, instead of some of the newer materials and procedures used for new housing production in the mid-1980s. (CMHC, 1989b:29)

greater stimulus to innovate to increase production, larger profits to finance investment, learning by doing, and other mechanisms.

The total construction sector and residential construction have both experienced below average growth in the last two decades. From the 1981 cyclical peak to 2000, real output in the total construction sector advanced at a 0.72 per cent average annual pace compared to 2.60 per cent for the total economy (Table 13). Residential construction did somewhat better at 1.21 per cent, but was less than one half the economy-wide average.

As noted earlier in the report, the weak output growth in the construction sector has reflected both cyclical and structural influences. The cyclical developments were the recessions of the early 1980s and 1990s caused by high interest rates which devastated the interest-rate sensitive housing and non-residential construction sectors. Indeed, housing starts have been below projected demographic requirements since the early 1990s.[34] The resulting deficit arising from the recession of the early 1990s in turn led governments to cut spending on public infrastructure and social housing, with a negative effect on the construction sector. Structural factors in the slower construction growth include the slower rate of population growth, which reduced growth in potential housing demand; the reduced need for continued rapid rates of growth in public infrastructure spending in the 1980s and 1990s following the completion of the major investments in roads, schools, hospitals, airports, etc. in the 1950s, 1960s, and 1970s; and a shift in employment from goods-producing to service-producing activities, which require less work-space per worker.

For the total construction sector, output per hour growth declined at a 0.45 per cent average annual rate from 1981 to 2000, compared to a 1.12 per cent rise for the total economy. Over the 1981-97 period (productivity estimates for residential construction are not available to 2000), output per hour in residential construction also fell 0.35 per cent per year.

For the total construction sector, both output growth and productivity growth were well below average in the 1980s and 1990s taken separately. From 1981 to 1989, output in the total construction sector advanced 1.84 per cent per year while output per hour fell 0.61 per cent. The comparable figures for the total economy were 2.90 per cent and 0.80 per cent. From 1989 to 2000, output fell 0.08 per cent per year while output per hour declined 0.34 per cent.

The situation was not comparable for the residential sector. Output growth in the 1980s of 3.25 per cent was slightly better than that of the overall economy, but productivity growth was very poor (-2.23 per cent per year) because of very rapid employment growth. In the 1990s (1989-97), output growth in this sector was very poor (-0.60 per cent), but productivity advanced a respectable 1.58 per cent, comparable to that of the overall economy. Unlike for the total economy, there seems to be no positive

[34] According to CMHC, potential housing demand based on household formation averaged 162,300 units in 1996-2000, but actual units averaged only 134,000 (CHBC, 2000a).

correlation between output and productivity performance in the residential construction sector in the 1980s and 1990s taken separately. From this perspective, there may be less of a case to link the weak productivity growth in the residential sector to the overall lack of growth in the sector than there is for the total construction sector.

D. Compositional Effects in the Measurement of Construction Sector Productivity

The level of average labour productivity in a sector is a weighted average of the productivity levels of the sub-sectors within the sector. Compositional shifts in the relative importance of the sub-sectors can affect the overall productivity level and growth rate when there are significant differences in productivity levels across sectors. For example, rapid growth in the employment and output shares of a below -average productivity level sub-sector would, everything else being equal, reduce the average productivity level and hence productivity growth of the sector.

It has been suggested that compositional shifts within the construction sector may have affected the sector's overall labour productivity growth rate. An inspection of the data provides little evidence of such an effect, mainly because productivity levels in the major components of the construction sector are very similar. Table 14 shows that the value of output per hour in residential construction in 1997 was $24.35 (1992$), very close to that in non-residential building construction ($23.73) and in other construction ($23.25). It is true that at a more disaggregated level there are productivity differences within the other construction sector between repair construction ($19.33) and engineering construction excluding repairs ($26.58) and further within the latter sub-sector.

In addition, compositional shifts in the construction sector over the last two decades have been relatively small, which suggests a limited impact on overall productivity. In the 1981-97 period, the output share of residential construction in the total construction sector rose 4.2 percentage points, while that of non-residential construction fell 0.2 points and that of other construction 3.9 points (Appendix Table 60). The comparable figures for the three sub-sectors for percentage point changes in total hours worked are 5.1, 2.5, and 2.6 (Appendix Table 62).

E. Bankruptcies

There may be a link between economic restructuring and productivity and the number of bankruptcies, which reflects business conditions, may be an indicator of the extent and intensity of economic restructuring. As bankruptcies are a cyclical variable, the link between this variable and productivity can in theory be procyclical or countercyclical in a similar manner to the link between capacity utilization and unemployment and productivity.

Chart 15 shows the relationship between the annual rate of change in the number of bankruptcies in the construction industry and the annual rate of change in output per hour in the total construction sector and the residential construction sector in the 1990s, the only period for which data on bankruptcies by sector are available. There appears to be little relationship between the variables.

F. Labour Compensation

The rate of labour compensation growth can influence productivity growth through its effect on the pace of capital-labour substitution. Large wage increases can induce employers to use more equipment in the production process, which increases the rate of growth of labour productivity (but not necessarily total factor productivity).

Over the entire 1961-97 period, nominal hourly labour compensation grew at a 6.4 per cent average annual rate in the total construction and 6.6 per cent in the residential construction sectors, very similar to the 6.7 per cent recorded in the business sector (Table 12). From this perspective, there was little industry-specific incentive for employers in the construction sector to substitute more or less capital for labour than in other sectors. The above average wage levels, as opposed to rates of growth in wages, in construction may have however provided some incentive.

In the 1980s and 1990s, wage growth in the construction sector lagged that of the overall economy. From 1981 to 1997, hourly labour compensation advanced at a 3.2 per cent average annual rate in the total construction industry and a 3.5 per cent rate in the residential construction sector, compared to 4.2 per cent in the business sector. This situation implies that employers in the construction sector had somewhat less incentive, ceteris paribus, to substitute capital for labour than in other sectors and hence may account for part of the slower labour productivity growth in this period.

G. Workplace Safety

The relationship between workplace safety and productivity is uncertain. One could posit a relationship running from more labour market regulation to slower productivity growth as such regulations hinder the efficient use of labour in the workplace. As one of the objectives of this regulation is to improve workplace safety, one might consequently see a positive correlation (not causation) between the incidence of workplace injuries and productivity. Regulation both reduces injuries and productivity. Another hypothesis might be that absenteeism, which creates production bottlenecks and directly reduces productivity, can be mitigated through improved workplace safety.

Chart 16 (based on Appendix Table 56) plots trends in the incidence of injuries and output per hour in the total construction and residential construction sectors over the 1984-98 period in Canada. One notes that the incidence of workplace injuries has nearly been cut in half in both sectors over the period while productivity growth has been slightly negative.

H. Labour Unions

Labour unions can influence productivity, with effects both positive and negative and their relative importance is a topic of heated debate among researchers. Some argue that workplace rules such as narrow job descriptions negotiated by unions to protect their membership impede flexibility in the workplace and reduce productivity growth. Others point out that unions provide a voice for workers, increasing job satisfaction and reducing turnover, thereby improving productivity growth.

There are two sources for data on union density, that is the proportion of all workers who are union members. The first is the Corporations and Labour Union Returns Act (CALURA) which was discontinued in 1996. The second is the Labour Force Survey (LFS), which only started to collect data on unionization in 1997. The former shows a very high rate of unionization in the construction sector (data are not available for residential construction), at 66.9 per cent in 1995, nearly double the rate for all industries (Appendix Table 58). The latter shows a much lower union density in the construction sector, at 32.5 per cent in 2000, almost identical to the rate for all industries.[35]

The discrepancy between the series may be explained by the inclusion of unemployed, retired, and part-year unioned construction workers in the CALURA series and the exclusion of unemployed and retired workers and the proration of part-year workers in the LFS series (although this does not appear to be the case for industries outside the construction sector given the similar rate for the CALURA and LFS series).

The household-based LFS union density estimates are considered superior to the CALURA administrative estimates. To construct a time series on union density for the construction sector, the LFS union density in 1997 was assumed to hold in 1995 and the rate of change in the CALURA series was used to adjust the 1995 rate back to 1976. Appendix Chart 9 shows trends in union density for all industries and for the construction sector over the 1976-2000 period. Both series show no strong trend. Union density for the construction sector was less than in all industries in most years.

Chart 17 shows trends in productivity and union density in the total construction sector over the 1976-2000 period. There appears to be no obvious relationship. Both union density and productivity increased in the early 1980s and then fell in the mid-1980s. Union density rose in the late 1980s while productivity showed little trend. From this perspective it appears that neither the level nor rate of change in union density is a

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[35] Appendix Table 58 also provides estimates on union density by province. In 2000, union density in the construction sector ranged from a high of 50.6 per cent in Quebec to a low of 13.3 per cent in Prince Edward Island. The rates in other provinces, in descending order, were: Ontario (32.4 per cent), British Columbia (31.5 per cent), New Brunswick (28.9 per cent), Newfoundland (27.5 per cent), Nova Scotia (26.6 per cent), Saskatchewan (24.8 per cent), Manitoba (21.4 per cent), and Alberta (20.7 per cent).

significant factor in explaining productivity trends in the construction sector. However, further work of a micro-economic nature on this issue is needed before a definitive conclusion can be reached.

I. Ageing of the Workforce

It is sometimes asserted that the construction sector has an older and rapidly ageing workforce, reflecting the inability of the sector to attract young workers and that this situation may have an impact on productivity reflecting differential productivity by age. Older workers may have less energy and hence be less productive. Alternatively, the greater experience of older workers may mean that their productivity is higher.

Census data on the age structure of workers in the construction sector (Dea, Lapointe, Lawlis, and Roth, forthcoming) provides little support for any major role for the demographic structure of the workforce as an explanation of productivity developments in the sector. First, the average age of workers in the construction sector, at 38.7 in 1996, is little different from the all industries average (38.2). Second, while the average age in the construction sector did rise 1.8 years between 1986 and 1996, a comparable increase (1.5 years) was experienced at the economy-wide level. In fact, the increase in the proportion of workers 45 and over, as a share of all workers, between 1986 and 1996 was actually less in construction than in all industries (2.9 percentage points versus 4.0 points).[36] These data make it difficult to argue that the age structure, or changes in the age structure, of the construction workforce has affected productivity in a manner different than it has done in the overall economy. Even if the ageing of the workforce is affecting productivity, the relatively small magnitude of these changes suggests that the productivity effect, if any, would be minor.

[36] The share of the workforce aged 45 and over in construction in 1996 was 31.1 per cent, almost identical to the share for all industries (30.9 per cent). The average age of retirement from the construction sector over the 1993-97 period was 64.7, well above the all industries average of 61.6 and the second highest (after agriculture) among 17 industries.

VII. Economic Environment and the Productivity Performance in the Construction Sector

This section of the report provideson overview of the micro-economic and macro-economic environment affecting the Canadian construction sector in the 1990s and discusses the impact of this environment on the productivity performance of the sector.[37]

The micro-economic environment can be defined as including tax policy, regulation, labour market policy, trade policy, foreign ownership, industrial policy, and competition policy. The macro-economic environment includes such factors as inflation, government deficit and debt, interest rates and exchange rates. Certain of these areas have little direct relevance for the construction sector while others have great importance.

A. Micro-economic environment

i) Tax Policy[38]

The most important micro-economic policy affecting the construction sector is tax policy, both in terms of corporate tax and employer payroll tax. The link to the sector's productivity performance is through investment in both physical and human capital. Higher tax burdens may reduce profits and have a negative effect on purchases of new equipment and expenditure on upgrading the skills of the workforce while lower taxes may have the opposite effect.

The tax system affects both the demand for housing and the supply of housing.[39] On the demand side, taxes operate both indirectly and directly. Income tax rates determine disposable or after tax income. Increased taxes can indirectly reduce the demand for housing by decreasing disposable income. Provisions in the income tax code related to housing can directly affect the demand for housing. These measures include the Home Buyers Plan associated with RRSPs and the exemption of principal residences from capital gains taxation.

On the supply side, taxes directly affect the price of housing. Such taxes include provincial charges such as land transfer taxes and registration fees; municipal levies, fees and charges such as development cost charges, building permit fees and property taxes; and government regulations regarding carrying costs, soft costs, and depreciation for builders, developers and real estate property owners. Corporate income taxes and payroll

[37] For a very useful overview of the public policy environment affecting the housing sector from an industry perspective see Lampert and Pomeroy (1998). Also see Canadian Home Builders' Association (2000b) and Miller (2001).
[38] This section draws from the *Report of the Technical Committee on Business Taxation*, commonly known as the Mintz Report (Finance Canada, 1997). Readers are referred to that report for a more detailed discussion of the material presented.
[39] For a discussion of how Canada's tax system affects the housing sector see Lampert and Pomeroy (1998).

taxes, including workers compensation also influence the supply of housing. Finally, the introduction of the GST in 1991 has had a major effect on the price of housing.

The impact of Canada's tax system on the productivity of residential construction goes through a number of channels and is largely indirect. To the degree that changes in taxes increase output growth in the sector by increasing demand and supply, productivity growth may be boosted through economies of scale and learning by doing. Higher taxes, particularly the GST, may have been a factor in accounting for the weak demand growth, and hence, output growth in the residential sector over the past two decades.

Taxes can also have differential effects on factor costs and thereby influence productivity. For example, if taxes on capital are increased and those on labour reduced, employers will tend to use less capital and more labour in the production process, thereby reducing labour productivity. There is little evidence that tax changes in recent years have significantly biased production in either a capital-saving or labour-saving manner.

The general combined federal-provincial statutory corporate tax rate that faced the construction sector in 1997 was 43 per cent, consisting of a 29 per cent rate at the federal level and an average 14 per cent at the provincial level (Appendix Table 75). The provincial rate ranged from a low of 9.2 per cent in Quebec to a high of 17.0 per cent in Manitoba, New Brunswick, and Saskatchewan.

Canadian-controlled private corporations (CCPCs), including those in the construction sector, are eligible for a lower rate on the first $200,000 of active business income. In 1997, the combined federal-provincial tax rate for CCPCs was 21 per cent, 13 per cent at the federal level and an average provincial rate of 8 per cent.

In the February 2000, federal budget the government announced that it would be reducing the federal corporate tax rate on business income not currently eligible for special tax treatment (i.e. the general rate) from 28 per cent to 21 per cent within five years. In the October 2000 economic statement, the federal government announced an accelerated timetable for corporate income tax cuts. A number of provinces, including Ontario and Alberta, have followed the federal lead and reduced corporate taxes. According to Finance Canada (2000:102), the combined average federal-provincial corporate tax rate (including capital taxes) will fall to around 35 per cent by 2005, 5 percentage points below the U.S. rate.

Effective tax rates are the rate firms and sectors actually pay and reflect industry-specific factors. These rates are particularly important from a cash flow perspective and can differ significantly from statutory rates. In 1993 and 1994, the construction sector paid $385 million in corporate taxes to the federal government, $146 million from large corporations and $239 million from small corporations (Appendix Table 76). This represented an average overall federal effective tax of 14 per cent, 20 per cent for large corporations and 12 per cent for small corporations. This overall rate was below the average federal effective tax rate for all industries (16 per cent). The construction sector's rate for small corporations was also below the comparable rate for all industries (14 per cent). In contrast, large corporations in the sector paid an effective rate above the average (17 per cent). From the perspective of average effective rates, the construction sector is not overly burdened by corporate taxes relative to other sectors.

In addition to average effective tax rates, marginal effective tax rates can be calculated. This refers to the effective tax on additional investments. Appendix Table 77 shows that the effective tax rate on marginal investments in construction in 1997 was 37.0 per cent for large businesses (the highest among the 12 main sectors of the economy) and 17.5 per cent for small businesses (the second highest after communications among the 12 sectors). These rates were well above the average for tangible capital for all industries – 27.0 per cent for large businesses and 13.3 per cent for small businesses. From this perspective it appears that the construction sector bears a greater tax burden than other industries.

Another aspect of the tax environment facing the construction industry is the Employment Insurance (EI) system. Employers pay EI premiums and workers in the sector receive benefits (as well as pay premiums). As Appendix Table 80 shows, the construction industry, which accounted for 6.1 per cent of wages and salaries for all industries in 1989-90, received in benefits 2.94 times what it contributed in premiums. This subsidy provided the income support to allow out-of-work construction workers to wait for new employment opportunities in the sector. This represented a subsidy of 5.9 per cent of the sector's total labour costs.

A total of 25.8 per cent of employers in construction were always subsidized by the EI system over the 1986-89 period (Appendix Table 81), compared to only 12.1 per cent of all employers. Indeed, the Mintz report on business taxation (Finance Canada, 1997:Table 8.3) estimated that under an EI system with individual employer premiums subject to partial experience rating, premiums in the construction industry would be 26.6 per cent higher than the all industries average, with only fishing, forestry, and agriculture paying higher rates.

Taxes on capital and labour can be combined into an effective tax rate on input costs. Taxes on capital include federal and provincial corporate income taxes, capital taxes and sales taxes on capital goods. Taxes on labour include federal and provincial employer-paid payroll taxes net of estimated benefits of funded programs. Appendix Table 78 shows that in 1997 because of negative tax rates on labour, mainly due to subsidies from the EI system, the construction industry enjoyed well below average total effective tax rates on input costs.

Capital costs in construction for large businesses were 59.9 per cent, well above the 33.3 per cent for non-financial industries (Appendix Table 78). The respective figures for small CCPCs were 21.5 per cent and 14.6 per cent. On the other hand, labour costs for large businesses in construction were -0.6 per cent, compared to the average of 2.8 per cent. For small CCPCs the respective figures were very similar: -0.9 per cent and 2.4 per cent. Total input costs, calculated as an average of capital and labour taxes based on the shares of business value-added attributed to each component, was 5.5 per cent for large businesses in construction, nearly half the overall average of 9.4 per cent. For small CCPCs, the respective figures were 1.7 per cent and 5.1 per cent.

This brief overview of the tax environment facing the construction sector suggests that the sector is relatively well favoured from a tax point of view. It enjoys lower average effective tax rates than other sectors and is subsidized by other sectors in terms of its use of the EI system. It does however pay high effective tax rates on marginal investments. In absolute terms, the tax environment for the construction sector is expected to improve in the future, with the planned reductions in the general corporate tax rates and expected cuts in EI premiums.

ii) Regulation

The construction industry is subject to a high degree of regulation in a number of areas. A recent submission by the Canadian Home Builders' Association (2000b:18) to the federal/provincial/territorial ministers responsible for housing succinctly summarized the industry attitude to regulation by stating:

> "Reforms of building regulations are long overdue. At present, the housing industry works within an environment of virtually unlimited liabilities, unwieldy and time-consuming building approval processes (which stifle innovation), and a general lack of encouragement for the professional builder."

Indeed, in his inaugural address to the Canadian Home Builders' Association in February 2001, incoming President Dick Miller argued that the key to productivity improvement in the sector was the drastic reform of the regulatory environment affecting the industry.[40]

The stifling of innovation can have a negative effect on productivity. A study for CMHC (Habitat Design+Consulting and Archerny Consulting, 1997) documented the regulatory obstacles encountered by designers, builders and homemakers during the construction of homes and found that local code or planning authorities were reluctant to accept innovations with which they were not familiar and for which they lacked the

[40] "It is time to remove the barriers between productivity gains and social and economic benefits. It is time to remove the impediments to further productivity improvements. We must not be satisfied with ad hoc, piecemeal changes to the regulatory environment. We must not be satisfied with occasional efforts to soften the burden of the tax environment. We must not countenance periodic, short-term measures to paper over very real systemic problems. Rebuilding our business environment requires a clean break with the past. As a country, we must have the courage to test new ways of doing things- we must break out of the box" (Miller, 2001:6-7).

training necessary for evaluation. It also cited the length of time, complexity and greater costs associated with attempting to secure approvals of innovative designs and materials. [41]

It should also be noted that building codes can have a positive effect on productivity as they can force builders to more quickly adopt new materials and production technologies. A CMHC study (CMHC, 1989b:19), summarized in Exhibit 3, found that out of 25 technological changes in mainstream homebuilding, building codes played a substantial positive role in their implementation in three instances and some positive role in eight instances. On the other hand, in eight cases building codes played an inhibiting or delaying role, at least in the initial years.

It is difficult to quantify the cost of regulation in terms of productivity, and to our knowledge, no studies of the effect of regulation on construction sector productivity in Canada have been undertaken.[42] One indication of the cost of regulation is the amount of time devoted to compliance. Consequently, one way to calculate the impact of regulation would be to construct a time series on the total number of hours or number of workers devoted to compliance and recalculate productivity trends by subtracting this unproductive labour input (at least in terms of construction sector output, not necessarily in terms of social welfare as regulations are enacted for a reason). If it could be shown that labour devoted to compliance represents a significant proportion of total labour in the sector, and that this share has been growing over time, then the weak productivity performance of the sector may in part be due to a greater regulatory burden. More research is needed on this issue.

iii) Labour Market Policy

From the point of view of the construction sector, the most important aspects of labour market policy include government programs for training and immigration policy. With the high unemployment rates that characterized the construction sector in the 1990s until late in the decade, the sector did not suffer from a shortage of workers so the state of public support for skills upgrading was not of crucial importance. The relatively high level of immigration also contributed to the relatively slack construction labour market.
A key development in labour market policy in Canada in the 1990s was the devolution in 1996 of responsibility for training policy from the federal government to the provinces. The implications of this policy for the construction sector are uncertain.

With the strong revival in activity in the construction sector in recent years, the unemployment rate has fallen significantly and human resources issues have assumed

[41] See CHBA (1999) for a discussion of alternatives to regulation in achieving public policy goals and the identification of circumstances when government intervention is justified. The report provides the basis for evaluating the effectiveness of regulations and their costs and benefits.
[42] The Fraser Institute has recently updated a study on the cost of regulation in Canada (Jones and Graf, 2001). It found that the cost of complying with regulation in Canada in 1997/98 was equal to 12 per cent of GDP. There appears to be a slight downward trend in these costs. The social benefits of regulation were not estimated.

greater importance. Examples of the sector's new focus on HR issues and the government commitment to the development of more effective training include the establishment in 1999 of the Canadian Apprenticeship Board to improve the functioning of Canada's apprenticeship system,[43] which is largely concentrated in construction occupations, and the announcement earlier this year of the formation of a sector council for the construction industry. Indeed, both the private sector and governments have increasingly recognized the importance of upgrading the skills of the workforce for a vibrant economy and are putting in place appropriate policies and institutions to take up this challenge.[44]

An issue that reappears near the peak of the business cycle is labour shortages. The late 1990s has been no exception to this rule. It is argued that such shortages lead to higher construction costs, delays, reduced affordability and lost economic potential. In other words, shortages impede productivity growth. Temporary immigration is often advocated as a solution to the shortages, as are more training programs. Greater interprovincial labour mobility is another way to reduce regional shortages. The Red Seal Program administered by the federal government fosters interprovincial mobility for 44 of 169 designated apprenticeable trades. About one half of persons who complete apprenticeship programs receive Red Seal certification.

The case that labour shortages have contributed to the poor productivity performance in the construction sector is weak, if non-existent. First, empirical evidence of severe labour shortages, particularly generalized shortages, is sparse, and even anecdotal evidence has only appeared the last few years. Second, the linkages between shortages and productivity are complex. To the degree that shortages drive up wages, employers will substitute capital for labour and labour productivity will rise. The negative impact of shortages on measured productivity through the creation of bottlenecks in the production process is mitigated if workers are not at work when awaiting other tradespersons to complete a stage in the production process. Their potential labour input is not part of the productivity calculation since they are not employed.

It should be noted that in cyclical sectors like construction shortages play a useful role in spreading work over longer periods and smoothing out the boom-bust cycle. From a human resource perspective, it is sub-optimal to train the number of workers needed at the peak of the cycle as all these workers will only be employed for two or three high-activity years every decade.

iv) Other Micro-economic Policies

Trade, foreign investment and competition policies have limited direct relevance for the construction sector. Trade policy has no direct effect on the construction industry in Canada since by definition construction activity is nontradeable. Of course, trade policy

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[43] For discussion of weaknesses of Canada's apprenticeship system, see Sharpe (1999).
[44] For private sector views on how to improve the efficiency of Canada's labour market in the areas of apprenticeship, labour market information, immigration, and sector councils, see CSLS (2001).

can have indirect effects on construction activity through the higher incomes generated by exports.

In 1994, foreign direct investment in Canada's construction industry represented only 5 per cent of industry assets, well below an average for all industries of 20 per cent (Finance Canada, 1997: Table 3.4). There are currently no restrictions on direct foreign investment in the sector.

Competition policy has limited relevance for the construction sector because of the large number of small firms operating in the sector and the lack of market domination by one firm or a small number of firms. There are limited barriers to entry in the se ctor, particularly the residential part of the sector. The proportion of employment that is accounted for by businesses with over 500 employees in the construction sector in 1993 was 5.0 per cent, the lowest for any sector other than agriculture. Equally, the proportion of employment in firms of less than 20 employees was 56.3 per cent, again the second highest for any sector. (Finance Canada, 1997: Table 3.6)

B. Macro-economic Environment

i) Interest Rate Policy

Activity in the construction sector is very cyclical. Periods of intense activity, such as occurred in the late 1970s, late 1980s, and late 1990s are followed by periods of stagnation, such as occurred in the early 1980s and early and mid 1990s. A key driver of these fluctuations is interest rates as this variable is a major determinant of business investment on structures and consumer spending on new housing. The recessions of the early 1980s and 1990s were precipitated by increases in interest rates by the Bank of Canada, justified on the basis of the inflationary threats affecting the economy (Fortin, 2001). The expansions of the mid and late 1980s and late 1990s were in turn made possible by falls in interest rates. Thus, the level of activity in the construction sector is directly linked to the level of interest rates.

As the econometric evidence presented earlier in the report showed, the productivity performance in the construction sector is positively related to capacity utilization. This latter variable in turn is determined by spending in the economy, which is regulated by interest rates. From this perspective, a low-interest rate policy represents a most effective manner to promote productivity growth in the construction sector. Over the past two decades high interest rates have hindered activity in the construction sector and impeded productivity growth.

ii) Demographic Trends and Immigration Policy

A key determinant of the demand for the output of the construction sector, particularly the residential component, is population growth. As the population expands, more housing is needed. The strong growth in housing starts in the 1970s reflected the rapid growth of the number of households during this period arising from the entry of babyboomers into the household formation phase of their life cycle.

Population growth in Canada is determined by natural increase (births-deaths) and net immigration. With the decline in birth rates in the 1960s, the rate of natural increase has been weak and much of population growth has been fueled by immigration. This has particularly been the case in the 1990s when immigration levels have averaged around 200,000 per year. Without this immigration, the rate of increase in housing requirements driven by demographic developments would have been much weaker. Canada's immigration policy has thus played an important role in stimulating demand for residential construction in the 1990s.

iii) Other Macro-economic Policies

The macro-economic environment facing the construction sector also includes the exchange rate, inflation, and government deficits and debt. The direct impact of these variables on the construction sector in the 1990s has been much less important than interest rates and demographic developments.

The exchange rate is a key determinant of the cost competitiveness of the Canadian economy and is crucial for the health of industries producing tradeable output. The output of the construction sector is non-tradeable and hence not subject to competition from foreign suppliers. Consequently, the exchange rate does not directly affect activity in this sector. There is, of course, an indirect effect though the impact of the exchange rate on output and income in other sectors, which creates demand for the output of the construction sector. In this regard, the low exchange rate in recent years has been a boon for the construction sector.

Canada has experienced very low inflation in the 1990s, a result of the Bank of Canada's decision to focus monetary policy on achieving price stability. Some argue that this policy has been beneficial for the economy by restoring investor confidence and that it has been responsible for the economic boom in the late 1990s (Jenkins and O'Reilly, 2001). Others argue that the robust growth of recent years would have come in any case and that the weak economic growth during the first half of the 1990s can be blamed on the low-inflation policy (Fortin, 2001). The impact of this policy on the construction industry is thus an issue of debate.

Canada in the 1990s experienced a massive turnaround in the fiscal position of both the federal and provincial governments. Deficits evaporated and were replaced by surpluses. Government debt levels have shrunk, both in absolute and relative terms. These developments were due to the fiscal retrenchment that took place mid-decade and the strong economic growth in the latter years of the decade. Some argue that the improvement in the fiscal situation in the mid-1990s was a necessary condition that allowed the Bank of Canada to cut interest rates, thus reviving the economy (Drummond, 2001). Others argue that the government overreacted, causing unnecessary harm and that the inevitable rebound in the economy would have restored the fiscal health of governments without the drastic actions that were undertaken (Stanford, 2001). Like monetary policy, the impact of fiscal policy on the construction sector in the 1990s continues to be subject to debate, although the current situation is certainly favourable. Governments now have resources to devote to public infrastructure, which is provided by the construction sector.

C. Business Strategies

Businesses have adopted many different strategies in the 1990s so it is difficult to discuss the role of business strategies on construction productivity in general terms. The goal for many construction firms in the early and mid 1990s was to survive, given the weak demand for their product. This objective was often pursued through a strategy of downsizing and cost-cutting. While such a strategy may have positive effects on productivity in the short-to-medium term by cutting fat in operations, it can have negative long-run implications for productivity by reducing the morale of the workers and through the loss to the firm of highly skilled workers who may be impossible to replace in an upturn.

VIII. Prospects for Productivity Growth in Construction

Economists have great difficulty explaining productivity trends and even greater difficulty forecasting productivity growth. For example, no economist predicted the post-1973 productivity slowdown, and despite more than 20 years of research, economists have not reached a consensus on the factors responsible for the slowdown. Equally, few economists forecast the acceleration in productivity growth that took place in the United States in the second half of the 1990s. There is also great uncertainty about whether this upward shift in productivity will be permanent, or at least long-term in nature, or ephemeral and whether this development will spread to other industrial countries.

The failure of economists to forecast with any degree of accuracy productivity trends stems from our inability to fully understand the dynamics of productivity growth. This in turn relates to the large number of drivers or determinants of productivity and their complex interaction (Sharpe, 1998). Indeed, all factors that affect in any way the production process influence productivity. It is very difficult, if not impossible, to fully understand the impact of these myriad factors on productivity growth, which may vary over time and across space.

From this perspective, attempts to forecast productivity growth in the construction industry, or in any industry, are foolhardy and should not be taken particularly seriously. A second caution is that revisions to productivity data, reflecting new information or changes in statistical methodologies or definitions, also make forecasting very hazardous as changes to the historical record have implications for the path of future productivity growth. Despite these caveats, this section discusses the likely prospects for productivity growth in Canada in coming years, based on the trends presented earlier in the report as well as the discussion of the drivers of productivity.

A. Productivity Forecast for the Total Construction Sector

Labour productivity growth in the total construction sector in Canada has been well below average in the last two decades, falling 0.45 per cent per year between 1981 and 2000, according to official Statistics Canada estimates (Table 12). The decline took place during both decades, with a 0.61 per cent annual fall in the 1980s and a 0.34 per cent drop in the 1990s. As detailed in this report, this trend is paradoxical as trends in many of the determinants or drivers of productivity growth in the sector, such as the capital-labour ratio and the skills levels of the workforce as proxied by educational attainment, should have increased productivity.

It is certainly possible that the factors at play over the last two decades in the determination of productivity growth in the construction sector will continue in coming years, with the result that productivity levels will continue to fall in the sector. But since we do not understand the reasons for the decline in construction productivity, it seems inappropriate to project a continuation of this negative long-run trend. Eventually, productivity-augmenting developments or forces in the sector such as increased capital-labour ratios, technological change and educational attainment of the workforce should produce positive productivity growth, as they do in other sectors of the economy and as they did in the 1961-1981 period in the total construction sector when output per hour rose 1.97 per cent per year in Canada.

Aggregate trend labour productivity growth, defined as output per hour in the business sector, averaged 1.3 per cent per year over the 1981-2000 period. The future trend is obviously very uncertain. Some analysts believe that the large investments in information technologies made by many Canadian firms in the 1990s will produce increased productivity growth in coming years, as has been the case since 1995 in the United States. Sharpe and Gharani (2000), for example, project trend productivity growth for Canada in the 2.0-2.5 per cent per year range for the first decade of the 21st century. On the other hand, others are less optimistic about the productivity gains arising from information technologies and forecast a basic continuation of past trends (Wilson and Dungan, forthcoming).

The labour-intensive nature of most construction activities will probably mean that trend productivity in construction will be below the economy-wide average. For example, there may be less potential for information technology to raise productivity in this sector than elsewhere in the economy. For this reason, a reasonable projection for output per hour in the total construction sector in Canada over the 2000-2010 period in our view would be in the 0.5-1.0 per cent per year range.

B. Productivity Forecast for the Residential Construction Sector

Labour productivity growth in the residential construction sector in Canada has also been well below average in the last two decades, falling 0.35 per cent per year between 1981 and 1997, according to official Statistics Canada estimates. However, unlike total construction, the decline was concentrated in the 1980s when output per hour fell at a 2.23 per cent average annual rate. From 1989 to 1997, output per hour in residential construction advanced at a respectable 1.58 per cent rate. But the very strong employment growth in total construction over the 1997-2000 period, at least to the degree that this development is an indication of employment trends in residential construction, suggests that residential construction productivity may have been negative in the 1997-2000 period and consequently that the growth rate for the 1989-2000 period was considerably below that observed in 1989-1997.[45]

The key issue in developing a forecast for residential productivity for the 2000-2010 period is whether the trends of the 1980s or the 1990s are more relevant. We believe that the positive productivity growth of the 1990s is more likely to continue than a return to the negative growth of the 1980s, because the 1990s represent a more recent period and the future course of productivity is path dependent and resembles the recent past, and because positive productivity growth is more consistent with trends in the drivers of residential construction productivity, namely the increased capital-labour ratio, technological change, and educational attainment of the workforce.

In our view, a reasonable forecast for output per hour growth in the residential construction sector for the 2000-2010 period would be in the 0.5 to 1.0 per cent range, similar to that of the total construction sector. Again, the labour-intensive nature of most residential construction activities will probably mean that productivity growth in the sector will continue to be below the economy-wide average.

A study by CMHC (CMHC, 1989e:26) provides support for the view that labour productivity growth in the housing sector will be below the economy-wide average, based on the relatively limited potential uses of computer-based technologies. It argues that innate characteristics of the single-family housing market, which have inhibited the widespread adoption of factor-type assembly techniques, are also likely to restrain the introduction of computer-aided manufacturing (CAM) in the homebuilding process. It does note that there is greater potential for the adoption of computer-aided design (CAD) technologies, particularly in the renovation sector. But it concludes that the adoption of computer-aided technologies will be evolutionary rather than revolutionary, and that the

[45] Employment growth in the total construction sector increased 10.7 per cent between 1997 and 2000, with total hours up 13.5 per cent (Appendix Tables 15 and 16). Output in the residential sector increased 7.5 per cent over the period (Appendix Table 1). On the assumption that total hours growth in the residential sector was the same as in the total construction sector, output per hour in this sector would fall 6.0 per cent or 2.0 per cent per year. This would reduce output per hour growth to 0.58 per cent per year in the 1989-2000 period from 1.58 per cent per year in the 1989-97 period.

impacts will be felt more in the areas of higher quality products and greater consumer choice than in reduced costs for builders or renovators.

The CMHC study (1989e:29) also pointed out that the trend toward factory-based housing, which was supposed to give the housing industry the status of an efficient manufacturing industry, has slowed down. Significant productivity gains from source may thus continue to be elusive, another reason for a pessimistic outlook for productivity in the sector, although the CMHC study (1989f:26) expects the market penetration of factory-built components to continue to increase.

IX. Future Work on Construction Productivity

The topic of productivity trends in the construction sector in Canada is greatly under-researched. This report represents only a first attempt to examine the determinants of productivity in the sector. New data needs to be developed and analysis of trends undertaken. Future work can be grouped into four types: the development of new data; verification of and improvements if needed in the quality of existing data; reconciliation of studies of construction productivity at the micro-level with aggregate statistics; and international comparisons of construction productivity.

A. Development of New Data

The overall database available for the analysis of construction productivity in Canada produced by Statistics Canada is quite good, particularly compared to what is available in other countries. Nevertheless, the availability of a number of new data series would foster our understanding of construction productivity. These data gaps are highlighted below.

- By far the greatest data deficiency is the absence of estimates of the capital stock disaggregated by construction industry. At this time, Statistics Canada only produces capital stock estimates for the total construction sector. This means it is not possible to produce estimates of capital-labour ratios, capacity utilization, and total factor productivity for the residential and other construction industries. According to Statistics Canada officials, with the current information system it is indeed possible to develop disaggregated capital stock estimates for the construction sector, but it would be a major undertaking. However, it is unclear how much additional light the availability of this data would shed on the construction productivity paradox and therefore how great a priority the elimination of this data gap should be. Data on the total capital stock and hence capital productivity and total factor productivity are already available as are data on labour productivity for the different construction industries. However, estimates of total factor productivity for the residential construction sector (and other construction industries) would be very useful.

- Statistics Canada's Aggregate Productivity Measures series provides unofficial unpublished estimates of output, labour input, and productivity for ten construction industries with a four year lag. Current estimates are available only up to 1997. In contrast, the official, published estimates for the total construction sector are currently available up to 2000. This is extremely useful for tracking recent productivity developments in the sector. Statistics Canada should be encouraged to make these disaggregated industry estimates available at the same time as estimates for the total construction sector, even if these data cannot be based on input-output benchmarks and are subject to revision.

- Statistics Canada currently produces no productivity estimates by province, although such estimates have, of course, been developed by others, as is the case in this report, from Statistics Canada estimates of output and labour input by province. As Statistics Canada has greater resources, data access, and credibility than other organizations, it should be encouraged to publish estimates of productivity levels and growth rates on a detailed industry basis by province.

- The availability of information on the characteristics of the workforce in the construction sector appears limited. Indeed, information on the educational attainment of workers in the construction sector was not readily available for this report. The Centre for the Study of Living Standards had to request Statistics Canada to undertake a special run of LFS data to obtain such information. Information on the occupational composition, literacy and numeracy levels, skills levels, and other traits of the construction labour force would be very useful for productivity analysis. Such information could probably be gleaned from existing data sources, such as the census and the adult literacy survey.

B. Verification and Improvements to Existing Data

This report outlined a number of potential measurement problems that bedevil construction productivity statistics, namely, the reliability of the deflators for the construction sector, the underestimation of output because of the underground economy, and the misallocation of employment among construction industries. More work is needed to ascertain whether existing construction data do indeed suffer from these measurement problems, and if such is indeed the case, to resolve these problems to improve the quality of the data.

- Statistics Canada currently does not use a hedonic methodology to construct its new housing price index. Adjustment for quality improvement of new houses appears to be made on an ad hoc basis. Given the possibility that overdeflation may contribute to the negative productivity growth in the residential construction industry, it is recommended that Statistics Canada develop hedonic estimates of new house prices and examine the implications for productivity growth.

- Statistics Canada (1994) has already conducted a comprehensive study on the underground economy, which was published in 1994 for a 1992 benchmark. The study found that the underground economy accounted for only 3.5 per cent of GDP in Canada. With the introduction of the GST in 1991, many observers argue that in the 1990s underground activity in the construction sector, and in particular in residential construction and renovations, has grown greatly, leading to significant underestimation of output and productivity growth. It is recommended that Statistics Canada revisit the issue of the underground economy in the construction sector, and in particular the implications for productivity measures in the sector.

- The measurement of the industry allocation of construction tradespersons who frequently move between industries is difficult and is important for the development of reliable industry productivity estimates. As misallocation will bias construction productivity estimates by industry, it is recommended that Statistics Canada examine the issue and take appropriate action where warranted.

C. Reconciliation of Micro-Productivity Studies and Aggregate Productivity Trends

As noted repeatedly throughout this report, the finding that labour productivity has been declining in the total construction and residential construction sectors over the last two decades in Canada is very surprising, particularly when anecdotal evidence suggests that there have been positive productivity gains in construction over the period.

An important research priority consequently should be to reconcile negative aggregate labour productivity growth with micro-evidence of productivity trends in the construction sector. Micro-studies that describe and quantify productivity gains should be gathered and surveyed or undertaken if not available. For example, information should be available from a number of sources, including industry experts and practitioners on how many hours are needed to perform certain tasks in construction (lay foundations, put up walls, install electrical systems, obtain zoning approvals, etc.) and how this has changed over time. Major innovations in the construction sector, such as modularization and prefabrication could be catalogued and their impact on productivity analyzed. A bottom-up estimation of gains to overall productivity advance from these specific productivity improvements can be made and compared to the top-down official productivity statistics.[46]

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[46] For a discussion of international productivity comparisons built from the firm level, see Baily and Solow (2001). They conclude that it is indeed possible, although difficult, to build productivity comparisons from the bottom-up with firm- and industry-level data and that the results of the bottom-up productivity studies are consistent with those based on the top-down approach. An advantage of using case studies and drawing on the expertise of business practitioners is to deepen the understanding of why there are productivity gaps. In terms of international differences in productivity levels in residential construction, Baily and Solow find that scale matters. Countries zoning large plots of land for residential housing, such as the United States and the Netherlands can exploit the benefits of scale by building large numbers of similar homes at the same time. They also found that the key explanation for the much higher productivity levels in the United States relative to Brazil in construction did not come from higher skill levels in the United States, but rather from the superior ability of U.S. supervisors and project managers to coordinate people and activities. A second

D. International Comparisons of Construction Productivity

This report has focused on productivity trends in the construction sector in Canada. A key question for future research is whether the negative productivity growth experienced in Canada in the sector since 1981 has also been the experience of other industrial countries. It was noted briefly in the report that this has indeed been the experience of the United States. A detailed examination of construction productivity trends in the two countries is needed to shed light on the similarities and differences between the Canada and our neighbour to the south.[47] Equally, it is important to know whether European countries experienced an equally poor productivity performance in construction, and if so, what are factors that have been put forward to explain this phenomenon in these countries.

X. Conclusion

The findings of this report are paradoxical. Despite increased capital-labour ratios, higher levels of educational attainment in the workforce, and below average increases in the price of new housing, labour productivity in total construction and residential construction in Canada was lower in absolute terms at the end of the 1990s than in the late 1970s and early 1980s. The construction sector was almost unique among Canadian industries in experiencing such negative productivity developments over the period.

The report has examined a large number of factors that could be responsible for this situation. The major conclusion is that lagging technical progress appears to lie at the root of the construction sector's poor productivity performance. Because of their labour-intensive nature, many construction activities appear not to be amenable to productivity advance, despite increased capital per worker and higher education levels for the workforce. While the construction sector enjoyed productivity gains in the immediate postwar period up to the 1970s, with the labour required to build a house falling significantly, these gains have not been repeated in the last two decades. In addition, measurement problems have also probably contributed to the poor measured productivity performance of the construction sector in Canada.

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advantage of the United States was the use of specialized workers who are brought into the site when needed. Brazil lacks these mobile, independent, specialized trade workers.

[47] Appendix Tables 84-100 provide data on productivity trends in the total construction sector in Canada and the United States. The tables were prepared by the Centre for the Study of Living Standards (CSLS) at the request of Robert Gordon of Northwestern University. The CSLS is considering undertaking a research project comparing Canada-U.S. construction productivity trends.

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Appendix 1: Glossary of Technical Terms Used in the Report

Autocorrelation: A characteristic of many economic time series, whereby deviations from the equilibrium tend to persist over time. For example, if the unemployment rate is unusually high in one month it tends to remain high for the next s everal months. The unemployment rate is then said to exhibit positive autocorrelation. When autocorrelated disturbance terms arise from regression analysis, the resulting estimated coefficients cannot necessarily be relied upon even if the t-ratios are high. To determine if autocorrelation is likely to be a problem, the Durbin-Watson modified 'd' statistic can be calculated. A value of 2 indicates that there is no autocorrelation, and a value between 1 and 1.5 indicates that there is some positive autocorrelation. If the 'd' statistic is below 1 there is serious positive autocorrelation and the estimated coefficients can be considered statistically insignificant.

Bottleneck: A physical constraint. For example, production can only take place as quickly as the machinery and workers will allow. A bottleneck is said to occur when production has increased as much as possible given the constraints.

Business Cycle: Output tends to move in cycles, reaching a peak, falling to a trough, then rising to another peak and so on. A recession occurs when output is falling towards its trough. Other variables tend to move in cycles also, but their peaks and troughs do not necessarily coincide with the peaks and troughs of the business cycle. For example, the unemployment rate is said to be counter-cyclical because its trough occurs at the business cycle's peak: as output increases unemployment decreases. Other variables tend to move in the same direction as output and are said to be pro-cyclical.

Capacity Utilization (Rate): The percentage of all factors of production available that are being used in a given time period. Less than 100 per cent capacity utilization of the capital stock implies that some machines are sitting idle.

Capital: A factor of production, most commonly associated with machinery but also including all tools, equipment, and buildings used in production. A firm's capital stock is the total value of its capital at a given point in time, and can be calculated taking into account several factors such as inflation and depreciation. The capital-labour ratio is the capital stock divided by employment, giving the value of capital employed per worker. As the capital-labour ratio increases, more capital is being used relative to labour, and production is said to be more capital intensive.

Coefficient: The magnitude of the effect of the independent variable on the dependent variable. Regression analysis produces estimated coefficients.

Correlation Coefficient: A measure of the strength of the relationship between two variables. A value of 1 indicates that the variables move in perfect relation to one another, or as one increases by 1 per cent, the other also increases by 1 per cent. A value of -1 indicates that the variables move in perfect negative relation to one another, or as one increases by 1 per cent the other decreases by 1 per cent. A value of 0 implies no relation, and a value above 0.6 or below -0.6 implies a strong relationship. This measure, however, does not make any assumption about the direction of causation, that is, what variable changes first and causes a change in the other.

Constant and Current Dollars: see **Nominal Value**

Constant Term: An estimate of the level of the dependent variable if the level of all the independent variables was 0.

Counter-Cyclical: see **Business Cycle**

CPI: Consumer Price Index. An average of the prices of consumer goods. The rate of change of the CPI is the most common measure of inflation.

Cross-Sectional Data: A series presented over a unit other than time, such as geographic location. For example, a cross-sectional series of GDP could show the value of GDP in each province for a given time period.

Cyclical: see **Business Cycle**

Dependent Variable: A variable whose fluctuations are directly caused by fluctuations in other variables. For example, changes in consumer spending are caused by changes in income. Consumer spending is hence dependent on income. Income is an example of an independent variable because it fluctuates independently of consumer spending, the dependent variable.

Disturbance Terms: Also called residuals, these are a product of regression analysis, along with estimated coefficients. They only become significant in the context of this report if they exhibit autocorrelation.

Durbin-Watson: see **Autocorrelation**

Factor of Production: Anything that is used in the production of goods, such as land, labour, capital, and entrepreneurial ability.

GDP: Gross Domestic Product, a measure of output. The value of all goods produced in a given time by a given group (not including goods that are used as inputs in the production of other goods).

Hourly Labour Compensation: The total amount paid to all workers divided by the total number of hours worked. This is a general measure of the average hourly wage.

Independent Variable: see **Dependent Variable**

Index: A series of numbers, each component of which has been multiplied by the same value. This is usually done to achieve a value of 100 for a certain component. For example, a time series of GDP can be changed so that the value in 1992 is 100. This facilitates easy comparison with other variables. A second time series, for example the unemployment rate, can be changed so that the 1992 value is 100, and the two series are now of similar magnitude and can be easily compared.

Input: see **Factor of Production**

Model: A mathematical equation hypothesizing what independent variables determine the fluctuations in the dependent variable.

Model Specification: An hypothesis as to the specific nature of the relationship between the dependent variable and the independent variables. For example, the levels of the independent variables could affect the level of the dependent variable, or the natural logarithm of the independent variables could affect the natural logarithm of the dependent variable.

Multicollinearity: When two or more independent variables are highly correlated, that is, they fluctuate in a similar manner to one another, there is said to be multicollinearity. If multicollinearity is present in the regression model, the estimated coefficients may be more statistically significant than the t-ratios imply. Estimates with a low t-ratio may still be considered reliable when multicollinearity is present.

Nominal Value: A value expressed in current dollars, that is, in terms of its price or cost in the current period. However, inflation changes the value of the dollar. For example, nominal wages may increase over a given period, but if prices increase more, the actual value of the wage, called the real wage, has decreased. Real values are hence expressed in constant dollars, or dollars that are adjusted for inflation and so have a constant value over time.

Observation: A set of numbers consisting of a value for each independent variable and the corresponding value of the dependent variable.

Omitted Variable Bias: The dependent variable is affected by many independent variables, some of which are left out of the model because of lack of data. This causes the estimated coefficients resulting from regression analysis to be biased: that is, the true effect of an independent variable on the dependent variable is slightly more or less than the estimated effect. If the omitted variable has a large effect on the dependent variable, the difference between the true and estimated effects of the included variables is likely to be large also.

Ordinary Least Squares (OLS) Estimation: A specific method of regression analysis.

Output: see **GDP**

Output per Hour: see **Productivity**

Peaks and Troughs: see **Business Cycle**

Per Capita Per person: The total value of a given variable divided by the population, which gives the proportion of the total per person.

Pooled Data: A combination of time series and cross-sectional data. For example, a pooled GDP series could show GDP in each province for several years rather than a single given year.

Pro-Cyclical: see **Business Cycle**

Productivity: The amount of output produced per unit of input used in production. The specific measure of productivity used in this report is value added per person hour, where output is defined as real GDP (also called value added) and input is defined as the total number of hours worked.

R-Squared: A measure of how well all the independent variables together explain fluctuations in the dependent variable. A value of 1 indicates that 100 per cent of the fluctuations in the dependent variable can be explained by fluctuations in the independent variables.

Real Value: see **Nominal Value**

Regression Analysis: A statistical technique whose purpose is to estimate the magnitude of the effect that each independent variable has on the dependent variable.

Relative Price: The price of a good relative to the price of all other goods. Since the price of houses has increased more slowly than the CPI, houses have become less expensive relative to other goods.

Statistical Significance: Since the coefficients produced by regression analysis are only estimates, a level of confidence must be obtained to determine whether these estimates are a reliable approximation to the true effect of each independent variable on the dependent variable. Estimates not meeting this confidence level are called statistically insignificant, or statistically not different from 0. In general, if the t-ratio accompanying an estimated coefficient is above 2.5 or below -2.5, the estimate meets the confidence level and is considered statistically significant.

T-Ratio: see **Statistical Significance**

Time Series Data: A series presented over time. For example, a time series of GDP could show the value of GDP in each month for several months for a given geographical area.

Unemployment Rate: The number of unemployed people as a percentage of the number of employed people plus the number of unemployed people.

Unit Labour Cost: The total amount paid to workers divided by total output, giving the amount paid per worker. This is a general measure of the cost of production.

Value Added per Person Hour: see **Productivity**

Appendix 2: **Literature Review on the Econometrics of the Determinants of Productivity Growth in the Construction Sector**

Little econometric work has been done on the issue of productivity trends in the construction sector. Indeed, only one study was identified in the literature review. Given the lack of a literature on the topic addressed, the methodology adopted by this study does not strictly follow the methods of any specific paper or set of papers in this area, but rather develops a productivity equation based on the general determinants of productivity found in the literature.

In econometric models, total factor productivity growth is taken as an exogenous variable. Labour productivity growth in the long run is related to total factor productivity and capital accumulation, and in the short run, to trends in output, employment and average hours. Consequently, the macro-econometric modelling literature sheds little light on the determinants of productivity growth at the aggregate level, let alone the sectoral level.

The one econometric study of productivity in the construction sector that we could find was a paper by Steven G. Allen. In 'Why Construction Industry Productivity is Declining', *The Review of Economics and Statistics*, Vol. 67, Nov, 1985, he examines the sources of productivity change in the construction industry in the United States between 1968 and 1978. In order to assign weights to the various factors responsible for productivity change, he estimates a Cobb-Douglas production function with data from the 1972 and 1977 Censuses.

The dependent variable is the log of output per employee, while the independent variables are the log of employees per establishments, the log of predicted earnings, percentage unionized, three region dummies, and the ratios of receipts from three different types of construction (single-family homes, office and industrial buildings, and educational and hospital buildings) to total construction receipts.

His results for cross-section estimates from 1972 and 1977 prove to be insignificant, whereas the coefficients for the pooled time-series and cross-section estimates for the two years prove to be significant and thus he uses these results to analyse the sources of the productivity decline in construction. His results show a strong positive correlation between employees per establishment, capital intensity, labour quality and productivity.

He also finds that interstate differences in the composition of construction output are strongly correlated with measured productivity. For example, a 10 percentage point increase in the share of single-family homes is associated with a 2.7 per cent decrease in productivity. The same increase in the share of office and industrial buildings is associated with a 3.4 per cent increase in productivity.

He finds that the biggest factor for the 1968-78 productivity decline was the reduction in skilled labour intensity resulting from a shift in the mix of output from large scale commercial, industrial, and institutional projects to single-family houses. This factor accounted for 21 per cent of the decline. The declines in the average size of establishments, percentage union, and the capital-labour ratio were the three next most important factors, explaining about 7 per cent, 6 per cent and 4 per cent of the productivity decline, respectively.

In another paper of interest to this study, a more general productivity equation is developed. In *Beyond the Wasteland: A Democratic Alternative to Economic Decline* (also in *Brookings Papers on Economic Activity*, 1983), Samuel Bowles, David M. Gordon and Thomas E. Weisskopf construct an Ordinary Least Squares time-series productivity equation for the period 1948-79 in order to express changes in U.S.A. productivity in terms of changes in a set of exogenous variables.

Their dependent variable is the annual rate of change of productivity measured as real output per hour worked. Their independent variables are changes in capital intensity, capacity utilization, measured as the ratio of actual to potential real GNP, relative cost of non-agricultural crude materials and quality of working conditions, which was measured as the inverse of the accident rate in manufacturing and business failure rate (in levels). Another, is changes in the employer leverage over workers which they calculated as the product of the rate of supervision and the cost of losing a job in the non-agricultural labour force, adjusted by weighted earnings inequality and union representation.

Their regression results indicate a highly significant positive association between changes in productivity and changes in capital intensity, capacity utilization, employer leverage over workers, quality of working conditions and the level of business failure rates. They find a negative association between changes in productivity and the changes in the relative cost of non-agricultural materials. Their findings are in line with the underlying theory of the determinants of productivity growth.

Using the results of their regression analysis, they computed the average annual contribution of each variable to the average annual rate of productivity growth over three selected periods. They computed this by calculating the average annual value of each variable for the three selected periods and multiplying these period averages by the coefficient on that variable from their regression results.

They then set out to explain the productivity slowdown from the 1948-66 period to the 1966-73 period and the 1948-66 period to the 1973-79 period. For the latter periods, they argue that the two percentage point decline in productivity between 1948-66 and 1973-79 was mainly due to declining capital intensity, accounting for 27 per cent of the decline. Capacity utilization and work intensity which is a combination of quality of working conditions and employer leverage over workers, accounted for 18 per cent of the decline. Innovative pressure (business failures) and popular resistance (relative cost of non-agricultural materials) accounted for 15 per cent and 23 per cent of the total slowdown, respectively.

Appendix 3: A Comparison of the Construction Industry as Classified by the 1980 Standard Industrial Classification (SIC80) and the North American Industry Classification System (NAICS)

Construction Industries as classified by SIC80 (division F) coincide closely with Construction as classified by NAICS (division 23), but the two are not identical. Divisions are broken into major groups, which are broken into industry groups, which are then broken into specific classes. For the most part, businesses belonging to a specific class within the Construction Industries division of SIC80 also belong to a specific class within the Construction division of NAICS. However, in a few instances, businesses belonging to certain specific classes within the Construction Industries division of SIC80 are captured in divisions of NAICS other than Construction. For example, in SIC80 some landscaping businesses are classified as belonging to the specific class called “Other Site Work,” while in NAICS all landscapers belong to specific classes within the Administrative and Support, Waste Management and Remediation Services division. Consequently, if there is above-average growth in landscaping employment in a given year, the SIC80 estimate for employment in the construction industry for that year will grow more than the NAICS estimate for construction industry employment, which does not include landscapers. There are two other similar incidences. The SIC80 specific class called “Other Trade Work” includes businesses involved in specialized trade work, including replacing asbestos insulation; businesses performing this task are captured by NAICS in specific classes of the same division containing landscapers. Finally, the SIC80 specific class called “Other Services Incidental to Construction” contains businesses classed in NAICS as belonging to the specific class called “Inspection Services” of the Professional, Scientific and Technical Services division.

Meanwhile, some specific classes of the NAICS Construction division include businesses captured in divisions of SIC80 other than Construction Industries. The specific class called “Highway, Street, and Bridge Construction” contains some businesses captured by specific classes in the Transportation and Storage Industries division of SIC80. Some sandblasting businesses are captured in the NAICS specific class called “Building Painting and Paperhanging Work” but belong to specific classes within the Other Service Industries division of SIC80. Finally, some businesses performing heating equipment conversions are classed by NAICS as belonging to the specific class called “Plumbing, Heating, and Air-Conditioning Installation,” but are classified by SIC80 as belonging to specific classes of the Communication and Other Utility Industries division.

It cannot be said unequivocally that the construction industry as defined by NAICS is larger than the construction industry as defined by SIC80. As seen in Appendix Table 12, NAICS employment estimates are sometimes higher and sometimes lower than SIC80 employment estimates. This is explained by the fact that each system includes some businesses that the other does not.

Belonging to the Construction Industries Division of SIC80 but not the Construction Division of NAICS	Belonging to the Construction Division of NAICS but not the Construction Industries Division of SIC80
Landscapers in specific class "Other Site Work" Asbestos Removers in specific class "Other Trade Work" Building Inspectors in specific class "Other Services Incidental to Construction"	Highway, street, and bridge repair workers in specific class "Highway, Street, and Bridge Construction" Sand-blasters in specific class "Building Painting and Paperhanging Work" Heating equipment conversion workers, in specific class "Plumbing, Heating, and Air-Conditioning Installation"

Detailed Break-Down of Major Groups and Industry Groups

SIC80 Division F – Construction Industries

Major Group 40 – Building, Developing, and General Contracting
- Industry Group 401 – Residential Building and Development
- Industry Group 402 – Non-Residential Building and Development

Major Group 41 – Industrial and Heavy (Engineering) Construction Industries
- Industry Group 411 – Industrial Construction (Other than Buildings)
- Industry Group 412 – Highway and Heavy Construction

Major Group 42 – Trade Contracting Industries
- *Industry Group 421 – Site Work*
- Industry Group 422 – Structural and Related Work
- Industry Group 423 – Exterior Close-In Work
- Industry Group 424 – Plumbing, Heating and Air Conditioning, Mechanical Work
- Industry Group 425 – Mechanical Specialty Work
- Industry Group 426 – Electrical Work
- Industry Group 427 – Interior and Finishing Work
- *Industry Group 429 – Other Trade Work*

Major Group 44 – Service Industries Incidental to Construction
- Industry Group 441 – Project Management, Construction
- *Industry Group 449 – Other Services Incidental to Construction*

Note: Industry Groups in italics contain specific classes that include businesses not included in specific classes in the NAICS Construction division.

NAICS Division 23 – Construction

Major Group 231 – Prime Contracting

Industry Group 2311 – Land Subdivision and Land Development

Industry Group 2312 – Building Construction

Industry Group 2313 – Engineering Construction

Industry Group 2314 – Construction Management

Major Group 232 – Trade Contracting

Industry Group 2321 – Site Preparation Work

Industry Group 2322 – Building Structure Work

Industry Group 2323 – Building Exterior Finishing Work

Industry Group 2324 – Building Interior Finishing Work

Industry Group 2325 – Building Equipment Installation

Industry Group 2329 – Other Special Trade Contracting

Note: Industry Groups in italics contain specific classes that include businesses not included by specific classes in the SIC80 Construction Industries division.

Appendix 4: List and Description of Industries Included in the Construction Sector Under 1980 SIC and NAICS

1980 SIC-E Division F: Construction Industries

MAJOR GROUP 40 BUILDING, DEVELOPING AND GENERAL CONTRACTING

Building, developing, general contracting and other establishments primarily engaged in the construction and development of residential, commercial and institutional (non-residential) buildings and real estate. Establishments classified here build for sale and bid on contracts for projects designed by architects and engineers. The project will cover several components, varying proportions of which can be sub-contracted out to trade contractors or can be done by the builder's own labour force. Included in this MAJOR GROUP are establishments of integrated real estate companies engaged in land assembly, development, financing, building and sale of large projects or community facilities, as are establishments engaged in building under such arrangements as joint venture, design-build, turnkey, lease-back and engineer/procure/construct. Also included are establishments primarily engaged in erecting pre-fabricated buildings on site or in building alterations and repairs involving more than one trade. Establishments primarily engaged in specialized aspects of construction or repair, e.g. mechanical and electrical work, are classified in the appropriate class of trade contractor in MAJOR GROUP 42 - Trade Contractor Industries. Establishments engaged in building but having another primary activity such as renting, leasing, managing-operating, land subivision, manufacturing, mining or utility supply are not included here but are classified to the industry of principal activity.

Industry Group 401 Residential Building and Development

Establishments primarily engaged in the construction and development of single and multi-residential buildings providing housing to families and individuals.

4011 Single Family Housing

> Establishments primarily engaged in the development and construction of single detached and single attached dwellings.

4012 Apartment and Other Multiple Housing

> Establishments primarily engaged in the development and construction of buildings containing three or more dwellings. Included in this industry are establishments primarily engaged in the construction of collective dwellings.

4013 Residential Renovation

Establishments primarily engaged in residential additions, major improvements and repairs, renovation, rehabilitation, retro-fitting and conversions involving more than one trade.

Industry Group 402 Non-Residential Building and Development

Establishments primarily engaged in the construction and development of buildings providing shelter to light industrial activities and commercial and institutional services other than housing.

4021 Manufacturing and Light Industrial Building

Establishments primarily engaged in the construction of manufacturing and light industrial buildings including related warehouses. Establishments primarily engaged in constructing warehouses are included in 4022 - Commercial Building, construction and those primarily engaged in heavy industrial structures are classified in Industry Group 411 - Industrial Construction (Other Than Buildings).

4022 Commercial Building

Establishments primarily engaged in the construction and development of commercial buildings.

4023 Institutional Building

General contracting establishments primarily engaged in erecting institutional buildings.

MAJOR GROUP 41 INDUSTRIAL AND HEAVY (ENGINEERING) CONSTRUCTION INDUSTRIES

Industrial and heavy construction contractors primarily engaged in the construction of projects other than buildings. Establishments classified here undertake complete projects which will cover several components, varying proportions of which can be either sub-contracted to trade contractors or can be done by the general contractor's own labour force. Establishments that do some construction work but which are primarily engaged in another activity such as utility operation, manufacturing or mining are classified by their principal activity.

Industry Group 411 Industrial Construction (Other Than Buildings)

Establishments primarily engaged in the construction of power plants oil, gas and other energy related structures pipelines and other industrial structures not elsewhere classified.

4111 Power Plants (Except Hydroelectric)

> Establishments primarily engaged in the construction of nuclear and thermal generating stations. Establishments primarily engaged in the construction of hydroelectric generating stations are classified in 4123 - Hydroelectric Power Plants and Related Structures (Except Transmission Lines), construction.

4112 Gas, Oil and Other Energy Related Structures (Except Pipelines)

> Establishments primarily engaged in the construction of gas and oil processing and storage structures. Included are establishments primarily engaged in the construction of solar energy plants and structures. Establishments primarily engaged in constructing gas and oil pipelines are classified in 4113 - Gas and Oil Pipelines, construction.

4113 Gas and Oil Pipelines

> Establishments primarily engaged in the construction of gas and oil pipelines and gas mains. Excluded are establishments primarily engaged in the construction of compressor, metering or pumping stations, which are classified in 4112 - Gas, Oil and Other Energy Related Structures (Except Pipelines), construction.

4119 Other Industrial Construction

> Establishments primarily engaged in the construction of heavy industrial structures not elsewhere classified. Establishments primarily engaged in lighter industrial, manufacturing type, building construction are classified in 4021 - Manufacturing and Light Industrial Building, construction.

Industry Group 412 Highway and Heavy Construction

Establishments primarily engaged in constructing highways, streets and bridges, waterworks and sewage systems and other heavy construction projects.

4121 Highways, Streets and Bridges

Establishments primarily engaged in the construction and repair of highways, streets and bridges. Establishments primarily engaged in asphalt paving other than on highways, streets and bridges are classified in 4216 - Asphalt Paving, construction those specializing in steel erection are classified in 4227 - Structural Steel Erection and those primarily engaged in highway, street or bridge maintenance are classified in 4591 - Highway, Street and Bridge Maintenance Industry.

4122 Waterworks and Sewage Systems

Establishments primarily engaged in the construction of water mains, sewers and drains. Establishments primarily engaged in the construction of sewage treatment plants and filtration plants are classified in 4021 - Manufacturing and Light Industrial Building, construction.

4123 Hydroelectric Power Plants and Related Structures (Except Transmission Lines)

Establishments primarily engaged in constructing hydroelectric generating stations, including power dams, penstocks and other related structures.

4124 Power and Telecommunication Transmission Lines

Establishments primarily engaged in erecting power and telecommunication transmission and distribution towers and lines, including antennas.

4129 Other Heavy Construction

Establishments primarily engaged in marine and railway construction, parks and sports facility construction (other than arenas) and other heavy construction (engineering) work not elsewhere classified. Establishments primarily engaged in constructing hydroelectric dams are classified in 4123 - Hydroelectric Power Plants and Related Structures (Except Transmission Lines), construction and those primarily engaged in constructing buildings such as arenas are classified in 4022 - Commercial Building, construction.

MAJOR GROUP 42 TRADE CONTRACTING INDUSTRIES

While general contractors, in response to market demand, build complete structures classifiable to broad specialization groups, trade contractors are classified by the specific component they contribute to the total structure. The specialized trade contractors are engaged in one aspect common to different structures requiring specialized skills or equipment. Normally they supply the general contractor with their specialized service but in repair construction, and to a lesser degree in new construction, trade contractors are often engaged as "prime contractors", or jobbers, dealing directly with the principals involved. Establishments primarily engaged in maintenance, i.e. cleaning, rather than repair construction are classified in Industry Group 995 - Services to Buildings and Dwellings those primarily engaged in maintenance of highways, streets and bridges are classified in 4591 - Highway, Street and Bridge Maintenance Industry and those primarily engaged in maintaining wharves and docks are classified in 4559 - Other Service Industries Incidental to Water Transport.

Industry Group 421 Site Work

Establishments primarily engaged in wrecking and demolition, water well drilling, septic systems installation, excavating and grading, equipment rental (with operator), asphalt paving, fencing and other site work.

4211 Wrecking and Demolition

Establishments primarily engaged in wrecking and demolishing buildings and other structures, clearing of building sites and sales of materials from demolished structures. Establishments primarily engaged in house (or other building) moving are classified in 4499 - Other Services Incidental to Construction n.e.c.

4212 Water Well Drilling

Establishments primarily engaged in drilling, or digging water wells, installation and repair of water well pumps and well piping systems. Establishments primarily engaged in installing and repairing piping systems within buildings are classified in 4241 - Plumbing those primarily engaged in drilling water intake wells in oil and gas fields are classified in 0919 - Other Service Industries Incidental to Crude Petroleum and Natural Gas.

4213 Septic System Installation

Establishments primarily engaged in the installation of septic systems.

4214 Excavating and Grading

Establishments primarily engaged in construction site excavating and grading. Establishments primarily engaged in land clearing and breaking for agricultural use are classified in 0221 - Soil Preparation, Planting and Cultivating Services.

4215 Equipment Rental (With Operator)

Establishments primarily engaged in the rental of construction machinery and equipment with operators. Establishments primarily engaged in equipment rental without operator are included in Industry Group 991 - Machinery and Equipment Rental and Leasing Services.

4216 Asphalt Paving

Establishments primarily engaged in asphalt paving and repair of residential driveways, commercial parking lots and other private parking areas. Establishments primarily engaged in road building as general contractors are classified in 4121 - Highways, Streets and Bridges, construction.

4217 Fencing Installation

Establishments primarily engaged in erecting fencing.

4219 Other Site Work

Establishments primarily engaged in site work not elsewhere classified. Included in this industry are establishments primarily engaged in landscape contracting who purchase nursery stock. Establishments primarily engaged in growing or retailing nursery stock are classified in 0163 - Nursery Products and in 6522 - Lawn and Garden Centres, respectively.

Industry Group 422 Structural and Related Work

Establishments primarily engaged in piledriving, form work, steel reinforcing, concrete pouring and finishing, precast concrete installation, rough and framing carpentry, structural steel erection and other structural and related work.

4221 Piledriving Work

Establishments primarily engaged in piledriving and related work.

4222 Form Work

Establishments primarily engaged in placing and stripping forms for poured-in-place concrete, including steel forms and false work.

4223 Steel Reinforcing

Establishments primarily engaged in the setting of reinforcing rod, bar, mesh, cage, etc., to reinforce poured-in-place concrete.

4224 Concrete Pouring and Finishing

Establishments primarily engaged in concrete pouring or placement and concrete finishing. Establishments primarily engaged in masonry block foundation work are classified in 4231 - Masonry Work, construction those primarily engaged in producing ready-mix concrete are classified in 3551 - Ready-Mix Concrete Industry and those primarily engaged in asphalt paving are classified in 4216 - Asphalt Paving, construction, or in 4121 - Highways, Streets and Bridges, construction. Establishments primarily engaged in building and/or installing residential swimming pools of all types are classified in 4293 - Residential Swimming Pool Installation.

4225 Precast Concrete Installation

Establishments primarily engaged in the installation of precast and manufactured concrete panels and other concrete shapes.

4226 Rough and Framing Carpentry

Establishments primarily engaged in structural wood framing and sheathing, installation of pre-fabricated wood roof trusses, exterior and interior wall components and other related carpentry work. Establishments primarily engaged in finish carpentry are classified in 4274 - Finish Carpentry, construction.

4227 Structural Steel Erection

Establishments primarily engaged in structural and related steel erection from purchased fabricated metal parts. Establishments primarily engaged in fabricating heavy steel parts classified in 3029 - Other Fabricated Structural Metal Products Industries may erect such parts as a secondary activity.

4229 Other Structural and Related Work

Establishments primarily engaged in structural and related work not elsewhere classified.

Industry Group 423 Exterior Close-In Work

Establishments primarily engaged in close-in work such as masonry, siding, glass and glazing work, insulation, roofing and other exterior close-in work.

4231 Masonry Work

Establishments primarily engaged in conventional or specialty masonry work, except interior marble work. Establishments primarily engaged in interior marble work are classified in 4276 - Terrazzo and Tile Work, construction.

4232 Siding Work

Establishments primarily engaged in the installation and repair of siding, cladding, metal doors and window frames and related work. Establishments primarily engaged in glass cladding are classified in 4233 - Glass and Glazing Work, construction.

4233 Glass and Glazing Work

Establishments primarily engaged in the installation of glass, glass cladding, mirrors and other glass products. Establishments primarily engaged in cladding, other than glass, are classified in 4232 - Siding Work, construction.

4234 Insulation Work

Establishments primarily engaged in weather-proofing exterior wall cavities and roof attic spaces by installing various insulating materials. Establishments primarily engaged in insulating pipes and duct runs are classified in 4256 - Thermal Insulation Work, construction.

4235 Roof Shingling

Establishments primarily engaged in roof installation and repair involving asphalt shingles or roll roofing, cedar shakes, etc.

4236 Sheet Metal and Built-Up Roofing

Establishments primarily engaged in sheet metal roofing, built-up tar and gravel roofing, roof tiling or slating, and associated metal roof work. Establishments primarily engaged in sheet metal and other ductwork are classified in 4244 - Sheet Metal and Other Duct Work, construction.

4239 Other Exterior Close-In Work

Establishments primarily engaged in exterior close-in work not elsewhere classified.

Industry Group 424 Plumbing, Heating and Air Conditioning, Mechanical Work

Establishments primarily engaged in mechanical trades such as plumbing, dry heating and gas piping, wet heating and air conditioning, sheet metal and other ductwork.

4241 Plumbing

> Establishments primarily engaged in the installation and repair of primary hot and cold water piping systems (i.e. except space heating). Establishments primarily engaged in the installation and repair of secondary hot water systems or water pumping systems for space heating are classified in 4243 - Wet Heating and Air Conditioning Work, construction and those primarily engaged in installing eavestroughing are classified in 4236 - Sheet Metal and Built-Up Roofing, construction.

4242 Dry Heating and Gas Piping Work

> Establishments primarily engaged in natural gas pipe fitting and the installation and repair of dry heating systems, except electric heating and duct work. Establishments primarily engaged in electric heating are classified in 4261 - Electrical Work, construction and those primarily engaged in sheet metal duct work are classified in 4244 - Sheet Metal and Other Duct Work, construction.

4243 Wet Heating and Air Conditioning Work

> Establishments primarily engaged in the installation and repair of secondary hot water or steam heating systems, cooling and air conditioning equipment and solar heating systems involving liquids. Establishments primarily engaged in primary hot and cold water piping systems are classified in 4241 - Plumbing, construction those primarily engaged in sheet metal duct work are classified in 4244 - Sheet Metal and Other Duct Work, construction and those primarily engaged in installing purchased power boilers are classified in 4227 - Structural Steel Erection.

4244 Sheet Metal and Other Duct Work

> Establishments primarily engaged in the installation and repair of metallic and non metallic duct work for heating, cooling and ventilation exhaust and dust collection systems along with related diffusers, grilles and air registers. Establishments primarily engaged in sheet metal roofing are classified in 4236 - Sheet Metal and Built-Up Roofing, construction.

Industry Group 425 Mechanical Specialty Work

Establishments primarily engaged in process piping, automatic sprinkler systems, commercial refrigeration, environmental controls, millwright and rigging, thermal insulation and other mechanical specialty work.

4251 Process Piping Work

Establishments primarily engaged in the installation and repair of industrial process piping.

4252 Automatic Sprinkler System Installation

Establishments primarily engaged in the installation and repair of automatic sprinkler fire protection systems. Establishments primarily engaged in installing sprinkler systems for lawns and gardens are classified in 4241 - Plumbing, construction.

4253 Commercial Refrigeration Work

Establishments primarily engaged in the installation and repair of commercial, industrial and scientific refrigeration and cold storage systems. Establishments primarily engaged in providing a refrigeration service are classified in 4791 - Refrigerated Warehousing Industry.

4254 Environmental Control Work

Establishments primarily engaged in the installation and repair of central temperature control panels, remote temperature, humidity and smoke detection sensors and related systems and control wiring in multi-unit residential and non-residential buildings.

4255 Millwright and Rigging Work

Establishments primarily engaged in the hoisting, installation and dismantling of large-scale apparatus and special equipment such as central air conditioning plants, industrial process and materials handling equipment, hydroelectric station and sewage treatment plant components. Establishments primarily engaged in installing elevators and escalators are classified in 4291 - Elevator and Escalator Installation.

4256 Thermal Insulation Work

Establishments primarily engaged in applying insulation to hot and chilled water pipes, boilers and duct runs. Establishments primarily engaged in insulating wall cavities and attics are classified in 4234 - Insulation Work, construction.

4259 Other Mechanical Specialty Work

Establishments primarily engaged in mechanical specialty work not elsewhere classified.

Industry Group 426 Electrical Work

4261 Electrical Work

Establishments primarily engaged in the installation and repair of electrical and communication wiring systems, except transmission and distribution lines. Establishments primarily engaged in installing transmission and distribution lines are classified in 4124 - Power and Telecommunication Transmission Lines, construction.

Industry Group 427 Interior and Finishing Work

Establishments primarily engaged in plastering, drywall, acoustical, finish carpentry, painting and decorating, terrazzo and tile, flooring and carpeting and other interior and finishing work.

4271 Plastering and Stucco Work

Establishments primarily engaged in the installation and repair of interior and exterior plaster or stucco including related lathing materials.

4272 Drywall Work

Establishments primarily engaged in the installation of drywall sheets or panels, including related taping of joints, sanding and other drywall finishing.

4273 Acoustical Work

Establishments primarily engaged in the application of acoustical panels, tiles and other materials to interior walls and ceilings.

4274 Finish Carpentry

Establishments primarily engaged in on-site cabinetry, millwork installation, pre-fabricated sash and door installation, garage door installation, exterior and interior trimming and miscellaneous hardware installation. Establishments primarily engaged in installing metal doors and window frames are classified in 4232 - Siding Work, construction.

4275 Painting and Decorating Work

Establishments primarily engaged in painting, paperhanging and decorating in buildings and painting of heavy (engineering) structures. Included are establishments primarily engaged in paint or paper stripping and parking lot or road surface marking. Establishments primarily engaged in furniture stripping and refinishing are classified in 6213 - Furniture Refinishing and Repair Shops.

4276 Terrazzo and Tile Work

Establishments primarily engaged in the installation of poured-in-place terrazzo and tile work and interior marble, granite or slate work. Establishments primarily engaged in exterior marble or slate work are classified in 4231 - Masonry Work, construction.

4277 Hardwood Flooring Installation

Establishments primarily engaged in the installation and repair of hardwood flooring materials such as hardwood strip and wood parquet including related sanding and other finishing.

4278 Resilient Flooring and Carpet Work

Establishments primarily engaged in the installation and repair of resilient flooring, carpeting and underlay.

4279 Other Interior and Finishing Work

Establishments primarily engaged in interior finishing trade work not elsewhere classified. Establishments primarily engaged in installing acoustical suspended ceilings are classified in 4273 - Acoustical Work, construction.

Industry Group 429 Other Trade Work

Establishments primarily engaged in the installation of elevators and escalators, ornamental metal, residential swimming pools and other construction work not elsewhere classified.

4291 Elevator and Escalator Installation

Establishments primarily engaged in the installation and repair of elevators and escalators, moving sidewalks and similar conveying equipment.

4292 Ornamental and Miscellaneous Fabricated Metal Installation

> Establishments primarily engaged in the installation and repair of standard or custom fabricated sheet metal components (except for roofing and duct work), decorative iron or steel work, ornamental or architectural metal work. Establishments primarily engaged in installation of sheet metal roofing are classified in 4236 - Sheet Metal and Built-Up Roofing, construction and those primarily engaged in the installation of sheet metal duct work are classified in 4244 - Sheet Metal and Other Duct Work, construction.

4293 Residential Swimming Pool Installation

> Establishments primarily engaged in the installation of permanent and semi-permanent residential swimming pools of all types.

4299 Other Trade Work n.e.c.

> Establishments primarily engaged in specialized trade work not elsewhere classified.

MAJOR GROUP 44 SERVICE INDUSTRIES INCIDENTAL TO CONSTRUCTION

Establishments primarily engaged in providing services closely related to the construction process.

Industry Group 441 Project Management, Construction

4411 Project Management, Construction

> Establishments primarily engaged in project management, contract management or construction management. The participation in the construction process of this type of establishment is restricted to coordination and supervision on behalf of the principals. Establishments primarily engaged in consulting engineering, quantity surveying, construction planning consulting and construction economists services are classified in Industry Group 775 - Architectural, Engineering and Other Scientific and Technical Services.

Industry Group 449 Other Services Incidental to Construction

Establishments primarily engaged in land developing and providing other services incidental to construction not elsewhere classified.

4491 Land Developers

Establishments primarily engaged in the acquisition, assembly, subdivision and servicing of land for subsequent resale to builders. Builder-developers are classified in MAJOR GROUP 40 - Building, Developing and General Contracting Industries.

4499 Other Services Incidental to Construction n.e.c.

Establishments primarily engaged in providing on-site services not in themselves contributing to structures. Establishments specializing in financial services to the construction industry are classified in industries 7129 - Other Business Financing Companies or 7339 - Other Property and Casualty Insurers.

Construction Industries 23: NAICS

23 Construction
This sector comprises establishments primarily engaged in constructing, repairing and renovating buildings and engineering works, and in subdividing and developing land. These establishments may operate on their own account or under contract to other establishments. They may produce complete projects or just parts of projects. Establishments often subcontract some or all of the work involved in a project. Establishments may produce new construction, or undertake repairs and renovations to existing structures.

A construction establishment may be the only establishment of an enterprise, or one of several establishments of an integrated real estate enterprise engaged in the land assembly, development, financing, building and sale of large projects.
Establishments classified in this sector are known by a variety of trade designations depending on the scope of the projects they undertake, the degree of responsibility and risk that they assume, and the type of structure that they produce. Prime contractors are primarily engaged in the construction of complete works, while trade contractors primarily undertake a component of a project, under contract to a prime contractor or a principal.

There are two main types of construction produced - buildings and engineering works. Buildings are distinguished by their primary function, such as residential, commercial and industrial. Engineering works include dams; non-building industrial works such as refineries; highways, roads and streets; bridges; sewers; power and communications transmission lines; and similar structures and works.
Exclusion(s): Establishments primarily engaged in:

- manufacturing and installing building equipment, such as power boilers; manufacturing pre-fabricated buildings (31-33, Manufacturing);

- operating highways, streets and bridges (48-49, Transportation and Warehousing); and
- project management (56, Administrative and Support, Waste Management and Remediation Services).

231 Prime Contracting
This sub-sector comprises establishments primarily engaged in constructing complete works, whether buildings or engineering works. Projects undertaken by these establishments typically have several components, varying proportions of which can be subcontracted to trade contractors or done by the establishment's own labour force. Establishments in this sub-sector operate under a variety of contractual arrangements, and assume varying degrees of risk. General contractors bid on contracts let by principals; they assume responsibility for successfully completing the structure but not for its sale. Developers build on own account, that is, for sale, or for transfer to a real estate operating establishment of an integrated enterprise. This type of establishment is often known in the trade as an own-account or speculative builder. Construction managers are paid to manage a construction project on a fee-for-service basis.
Prime contractors may operate under standard contractual arrangements between client and builder, or may employ arrangements such as joint venture, design-build and turnkey. In all cases, establishments in this sub-sector primarily undertake or manage the construction activity, as distinct from doing design work, project financing, building operation or similar activities classified to other sectors.
Establishments primarily engaged in erecting prefabricated buildings on site, and establishments acting as the prime contractor on repair projects involving more than one construction trade, are also included in this sub-sector.
Exclusion(s): Establishments primarily engaged in:

- undertaking a component of a project (232, Trade Contracting).

2311 Land Subdivision and Land Development
See industry description for 23111, below.

23111 Land Subdivision and Land Development
This industry comprises establishments primarily engaged in the acquisition, assembly, subdivision into lots and servicing of raw land for subsequent sale to builders.
Exclusion(s): Establishments primarily engaged in:

- developing land and building upon it (2312, Building Construction).

231110 Land Subdivision and Land Development
See industry description for 23111, above.

2312 Building Construction
This industry group comprises establishments primarily engaged in constructing residential and non-residential buildings. Contractors primarily engaged in work on existing buildings, involving more than one trade, are included in this industry group.

Work on existing buildings includes repairs, renovations, additions, rehabilitation, retro-fitting and conversions.
Exclusion(s): Establishments primarily engaged in:

- constructing heavy industrial plants and mills, of which a building is incidental to the complex (2313, Engineering Construction).

23121 Residential Building Construction
This industry comprises establishments primarily engaged in constructing residential buildings, such as houses, garden homes, cottages, apartments and townhouses. Establishments primarily engaged in erecting prefabricated homes are also included.

Apartment building, construction
Condominium developers
Cottages, construction
Custom builders, residential
Log home, construction
Mobile home repair, on site, contractors
Prefabricated homes, erecting
Residential house construction
Residential renovation, contractors

Exclusion(s): Establishments primarily engaged in:

- constructing hotels and motels (23122, Non-Residential Building Construction).

231210 Residential Building Construction
See industry description for 23121, above.

23122 Non-Residential Building Construction
This industry comprises establishments primarily engaged in constructing commercial, institutional and industrial buildings. Important types of commercial and institutional buildings are offices, hotels, restaurants, arenas, churches and penitentiaries. Important types of industrial buildings are factories, and heavy industrial plants for the production of such products as aluminum and cement. The erection of prefabricated commercial or institutional buildings is also included.

Arena, construction
Building alterations, renovation and repairs, non-residential, general contractors
Cement plants, construction
Design-build non-residential contractors
Hotel, construction
Industrial building construction, general contractors
Institutional buildings, construction
Office buildings and complexes, construction
Pre-engineered non-residential buildings, installation
Schools and other educational buildings, construction
Shopping centres and complexes, construction

Exclusion(s): Establishments primarily engaged in:

- constructing apartment buildings (23121, Residential Building Construction);

- constructing heavy industrial plants and mills, of which a building is incidental to the complex (23139, Other Engineering Construction); and
- constructing water filtration, sewage treatment and garbage disposal plants (23139, Other Engineering Construction).

231220 Non-Residential Building Construction
See industry description for 23122, above.

2313 Engineering Construction
This industry group comprises establishments primarily engaged in construction projects other than buildings. Engineering works include dams; non-building industrial works, such as refineries; highways, roads and streets; bridges; sewers; power and communications transmission lines; and similar structures and works. Establishments providing specialized services of a type related to engineering construction, and not normally performed on buildings or building-related projects are included.

23131 Highway, Street and Bridge Construction
This industry comprises establishments primarily engaged in constructing, maintaining and repairing highways, streets and bridges, public sidewalks and airport runways. A general contractor building a new roadway would normally be responsible for preparing the roadbed, surfacing it, and installing any sidewalks and landscaping. Special trade contractors primarily engaged in the installation and repair of guardrails and roadway signs, and in line-painting on roadways and parking areas, are included.

Airport runway construction, general contractors	Gutters and curbing (except residential), installation
Bridge approaches, construction	Highway sign, installation
Bridge, construction	Highway, street and road, construction (except maintenance)
Culvert, construction	Road resurfacing
Guardrail construction on highways	Road surfaces and parking areas, marking

Exclusion(s): Establishments primarily engaged in:
- steel erection (23223, Structural Steel and Precast Concrete Erection Work);
- roadside lamppost erection (23251, Electrical Work);
- asphalt paving other than on highways, streets, bridges and runways (23292, Residential and Commercial Paving Contracting); and
- operating highways, streets and bridges (48849, Other Support Activities for Road Transportation).

231310 Highway, Street and Bridge Construction
See industry description for 23131, above.

23132 Water and Sewer Construction
This industry comprises establishments primarily engaged in constructing gas and water mains, sewers and drains.

Gas mains, construction
Pumping stations, water, construction
Sanitary sewers, construction
Storm sewers, construction
Water mains and hydrants, construction

Exclusion(s): Establishments primarily engaged in:
- constructing water filtration and sewage treatment plants (23139, Other Engineering Construction).

231320 Water and Sewer Construction
See industry description for 23132, above.

23133 Oil and Gas Pipelines and Related Industrial Complexes Construction
This industry comprises establishments primarily engaged in constructing oil and gas pipelines; compressor, metering and pumping stations; storage tanks; natural gas cleaning and processing plants; and petroleum refineries and chemical complexes.

Chemical complex or facilities construction, general contractors
Compressor, metering and pumping stations, gas and oil, construction
Natural gas processing plants, construction
Petroleum refineries, construction
Pipeline wrapping, contractors
Pipelines, oil and gas, construction
Storage tanks, natural gas or oil, construction

Exclusion(s): Establishments primarily engaged in:
- constructing gas mains (23132, Water and Sewer Construction).

231330 Oil and Gas Pipelines and Related Industrial Complexes Construction
See industry description for 23133, above.

23139 Other Engineering Construction
This industry comprises establishments, not classified to any other industry, primarily engaged in constructing engineering works.

Causeway, construction
Dock and pier construction
Electric power transmission lines and towers, construction
Filtration plant, construction
Flood control project construction
Power plant construction, general contractors
Railway construction (track, roadbed, trestles, signals, interlockers)
Sewage treatment and disposal plants, construction
Subway construction, general contractors
Telecommunication transmission lines, construction

Generating station, construction (hydro)
Industrial incinerator construction, general contractors
Tunnel, construction
Utilities, underground, construction

231390 Other Engineering Construction
See industry description for 23139, above.

2314 Construction Management
See industry description for 23141, below.

23141 Construction Management
This industry comprises establishments primarily engaged in managing a construction project for a fee. These establishments provide day-to-day co-ordination, supervision and management of a construction site. These activities would otherwise be performed by a general contractor.

231410 Construction Management
See industry description for 23141, above.

232 Trade Contracting
This sub-sector comprises establishments engaged in one aspect common to different structures, requiring specialized skills or equipment. They are known as trade contractors, and are classified by the specific component they contribute to the total structure or work. Trade contractors normally supply their specialized service under contract to a general contractor. In repair construction, and to a lesser degree in new construction, trade contractors, included in this sub-sector, may be engaged as “prime contractors”, or jobbers, dealing directly with the principals involved.
Exclusion(s): Establishments primarily engaged in:

- providing specialized services of a type related to engineering construction, and not normally performed on buildings or building-related projects (2313, Engineering Construction).

2321 Site Preparation Work
See industry description for 23211, below.

23211 Site Preparation Work
This industry comprises establishments primarily engaged in site preparation activities, such as agricultural land clearing; land drainage and reclamation; demolition of buildings and other structures; excavating and grading; cutting of rights-of-way; pile driving; concrete breaking for roads; water well drilling; septic system installation; and house moving. Establishments primarily engaged in equipment rental with operator (except cranes) are also included.

Concrete breaking for streets and highways, contractor
Land clearing contractor

Cutting of rights-of-way contractor
Demolishing buildings and structures
Excavating contractors
Grading, construction site
House moving services
Land drainage contractor
Land reclamation contractor
Pile driving, contractors
Septic tanks and weeping tile, installation
Water well drilling (except water intake wells in oil and gas fields)

Exclusion(s): Establishments primarily engaged in:

- crane rental with operator (23224, Crane Rental Services);
- equipment rental without operator (53241, Construction, Transportation, Mining, and Forestry Machinery and Equipment Rental and Leasing); and
- maintenance of rights-of-way by mowing, spraying and otherwise controlling vegetation (56173, Landscaping Services).

232110 Site Preparation Work
See industry description for 23211, above.

2322 Building Structure Work
This industry group comprises establishments primarily engaged in erecting the basic structure of buildings by pouring concrete; framing with lumber; welding, bolting or tying steel; and placing precast or pre-stressed concrete members. Crane rental services with operator are also included because they support the erection process.

23221 Forming Work
This industry comprises establishments primarily engaged in placing and stripping wooden or steel forms for poured-in-place concrete or installing insulated foundation systems. Establishments primarily engaged in erecting false-work used to support concrete until it sets are also included.

Exclusion(s): Establishments primarily engaged in:

- installing rigid foam insulation as an incidental activity of sealing and coating foundations (23229, Other Building Structure Work).

232210 Forming Work
See industry description for 23221, above.

23222 Concrete Pouring and Finishing Work
This industry comprises establishments primarily engaged in pouring or gunning concrete, and concrete finishing.

Exclusion(s): Establishments primarily engaged in:

- concrete sealing, coating, waterproofing or damp-proofing (23229, Other Building Structure Work); and
- paving with concrete (23292, Residential and Commercial Paving Contracting).

232220 Concrete Pouring and Finishing Work
See industry description for 23222, above.

23223 Structural Steel and Precast Concrete Erection Work
This industry comprises establishments primarily engaged in structural and related steel erection by welding, rivetting or bolting purchased fabricated parts; installing precast and manufactured concrete panels and other concrete shapes, such as pre-stressed concrete beams, precast stairs and precast balconies; and placing and tying steel reinforcing rods or bars for reinforced concrete.

Balconies, precast, concrete, installation	Stairs, precast concrete, installation
Pre-stressed concrete beams, slabs or other components, installation	Structural steel erection
Reinforcing rods, bars, mesh and cage, installation	Welding, rivetting or bolting purchased fabricated parts for steel erection

232230 Structural Steel and Precast Concrete Erection Work
See industry description for 23223, above.

23224 Crane Rental Services
This industry comprises establishments primarily engaged in renting cranes with operators. The crane operator takes direction from the contractor responsible for the building erection work, when hoisting steel beams, concrete or other materials.

232240 Crane Rental Services
See industry description for 23224, above.

23225 Framing and Rough Carpentry Work
This industry comprises establishments primarily engaged in structural wood framing and sheathing, installing prefabricated wooden roof trusses, exterior and interior wall components, and other related carpentry work. While carpenters work mainly with wood, other materials may also be used, such as steel wall studs.

Framing house or building wood construction	Sheathing (house, building, structure), wood, construction
Partitions, wooden, rough installation	Stud walls, wood or steel, installation
Prefabricated wood trusses and other building wood-frame components, installation	Wood frame components, installation

Exclusion(s): Establishments primarily engaged in:

- finish carpentry (23246, Finish Carpentry and Wood Flooring Work).

232250 Framing and Rough Carpentry Work
See industry description for 23225, above.

23229 Other Building Structure Work
This industry comprises establishments, not classified to any other industry, primarily engaged in building structure work.

Cathodic protection, installation
Concrete damp-proofing
Epoxy application, contractors
Fireproofing buildings, contractors
Waterproofing concrete
Welding contractors, operating at site of construction

232290 Other Building Structure Work
See industry description for 23229, above.

2323 Building Exterior Finishing Work
This industry group comprises establishments primarily engaged in closing-in and finishing the exterior structure of buildings.

23231 Masonry Work
This industry comprises establishments primarily engaged in bricklaying, stone setting and stucco work.

Blocklaying
Bricklaying
Field stone, installation
Masonry work, construction
Stone cutting and setting, construction

Exclusion(s): Establishments primarily engaged in:

- concrete work (23222, Concrete Pouring and Finishing Work); and
- laying precast stones or bricks for patios, driveways and the like (23291, Fencing and Interlocking Stone Contracting).

232310 Masonry Work
See industry description for 23231, above.

23232 Glass and Glazing Work
This industry comprises establishments primarily engaged in installing glass window units, glass cladding, mirrors and other glass products, and in glazing work.

Decorative glass and mirrors, installation
Glass cladding installation
Glass installation (except automotive), contractors
Glass tinting, construction
Glazing work, contractors
Hermetically sealed glass for window units, installation

232320 Glass and Glazing Work
See industry description for 23232, above.

23233 Roofing and Related Work
This industry comprises establishments primarily engaged in installing shingles, built-up roofing and other roofing materials; and associated work, such as installing flashing and eavestroughs.

Asphalt roof shingles, installation
Built-up roofing, installation
Eavestroughing, contractors
Roof membrane, installation
Sheet metal roofing, installation
Skylights, installation
Wooden roof shingles and shakes, installation

Exclusion(s): Establishments primarily engaged in:

- installing sheet metal duct work (23252, Plumbing, Heating and Air-Conditioning Installation).

232330 Roofing and Related Work
See industry description for 23233, above.

23234 Metallic and Other Siding Work
This industry comprises establishments primarily engaged in installing and repairing siding and cladding of aluminum, steel, asbestos, vinyl and hardboard.

Architectural sheet metal work, contractors
Door and window frames, metal, installation
Exterior siding, metal, hardboard and vinyl, installation
Fascia and soffit, metal and plastic, installation
Siding, contractors (installation and repair)
Vinyl siding, soffit and fascia, installation
Wood siding, installation

232340 Metallic and Other Siding Work
See industry description for 23234, above.

23239 Other Building Exterior Finishing Work
This industry comprises establishments, not classified to any other industry, primarily engaged in building exterior finishing work.
Awnings, canopies and shutters, metal, installation
Balconies, metal, installation
Caulking installation
Fire escapes and stairways, metal, installation
Ornamental metal work, installation
Overhead door installation, commercial
Revolving doors, installation
Store front frames, metal, installation
Weatherstripping installation

232390 Other Building Exterior Finishing Work
See industry description for 23239, above.

2324 Building Interior Finishing Work
This industry group comprises establishments primarily engaged in finishing building interiors. This work generally involves covering the interior structure with various materials.

23241 Drywall and Plaster Work
This industry comprises establishments primarily engaged in drywall installation, including related taping of joints, sanding and other finishing, or in applying plain or ornamental plaster, including the installation of lathing or other fixtures to receive plaster.

Ceiling tiles, installation
Fresco work (i.e., decorative plaster finishing)
Gypsum wallboard, installation
Lath installation
Plastering, plain or ornamental, contractors
Suspended ceilings, installation
Taping and finishing drywall, contractors

Exclusion(s): Establishments primarily engaged in:

- applying stucco (23231, Masonry Work).

232410 Drywall and Plaster Work
See industry description for 23241, above.

23242 Terrazzo and Tile Work
This industry comprises establishments primarily engaged in setting and installing ceramic tile, marble, granite, slate and mosaic, and in mixing marble particles and cement for poured-in-place terrazzo at the site of construction.

Finishing (e.g., grinding, polishing) terrazzo or tile
Interior marble, granite or slate work, installation
Mantel work (stone) installation
Marble installation, interior (including finishing), contractors
Mosaic installation
Plastic wall tile installation, contractors
Terrazzo, pouring, setting and finishing
Tiling (ceramic, plastic, stone), installation

Exclusion(s): Establishments primarily engaged in:

- manufacturing precast terrazzo steps, benches and other terrazzo articles (32739, Other Concrete Product Manufacturing).

232420 Terrazzo and Tile Work
See industry description for 23242, above.

23243 Carpet and Resilient Flooring Work
This industry comprises establishments primarily engaged in installing and repairing resilient flooring, carpeting and underlay.

Carpet and underlay (including carpet tiles), installation
Resilient floor laying, contractors

Mastic flooring	Rubber composition tile or floor covering, installation Vinyl floor tile and sheet installation, contractors

Exclusion(s): Establishments primarily engaged in:

- laying ceramic floor tile (23242, Terrazzo and Tile Work).

232430 Carpet and Resilient Flooring Work
See industry description for 23243, above.

23244 Insulation Work
This industry comprises establishments primarily engaged in weather-proofing exterior wall cavities and roof attic spaces, by installing various insulating materials.

Blown-in insulation (e.g., vermiculite, cellulose), installation	Insulation work
Installation of glass fibre or mineral wool materials	Wall cavities and attic space, insulating Weatherproofing (i.e., insulation), contractor

Exclusion(s): Establishments primarily engaged in:

- installing insulated foundation systems (23221, Forming Work);
- installing rigid foam insulation as an incidental activity of sealing and coating foundations (23229, Other Building Structure Work), installing roofs (23233, Sheet Metal and Roofing Work), or installing siding (23234, Metallic and Other Siding Work); and
- insulating pipes and duct runs (23259, Other Building Equipment Installation).

232440 Insulation Work
See industry description for 23244, above.

23245 Building Painting and Paperhanging Work
This industry comprises establishments primarily engaged in painting, paperhanging and decorating in buildings and painting heavy (engineering) structures. Paint or paper stripping, including sandblasting, is included in this industry, because it is usually an incidental part of these activities.

Bridges and structures, painting	Painting ships, contractors
General contractor, painting and decorating	Rustproofing contractor, buildings and structures (except automotive)
House painting, contractors	Wallpaper hanging and removing

Exclusion(s): Establishments primarily engaged in:

- painting lines on roadways and parking lots (23131, Highway, Street and Bridge Construction); and

- stripping furniture (81142, Re-upholstery and Furniture Repair).

232450 Building Painting and Paperhanging Work
See industry description for 23245, above.

23246 Finish Carpentry and Wood Flooring Work
This industry comprises establishments primarily engaged in finish carpentry and installing wood flooring, including related floor sanding and other finishing. Some important finish carpentry activities are on-site cabinetwork, millwork installation, and prefabricated sash and door installation.

Cabinet work performed at the construction site	Joinery, ship, contractors
Floor laying, scraping, finishing, and refinishing, contractors	Millwork installation
Garage door, wooden, installation	Wood moulding and trim, installation
Hardwood flooring, installation	

Exclusion(s): Establishments primarily engaged in:

- laying resilient flooring (23243, Carpet and Resilient Flooring Work).

232460 Finish Carpentry and Wood Flooring Work
See industry description for 23246, above.

23249 Other Building Interior Finishing Work
This industry comprises establishments, not classified to any other industry, primarily engaged in building interior finishing work, such as bathtub refinishing and installing drapery hardware, window shades and blinds.

232490 Other Building Interior Finishing Work
See industry description for 23249, above.

2325 Building Equipment Installation
This industry group comprises establishments primarily engaged in installing or erecting building equipment.

Exclusion(s): Establishments primarily engaged in:

- manufacturing and installing building equipment, such as power boilers (31-33, Manufacturing).

23251 Electrical Work
This industry comprises establishments primarily engaged in installing and repairing electrical and communication wiring systems, including panel boxes, wires, outlets, lights and appliances. The installation and repair of environmental controls, security systems and fire detection devices are also included.

Cable television hookup, contractors
Electric power control panels and outlets, installation
Electrical wiring contractors
Environmental control systems, central, installation
Highway lighting and electrical signal construction, contractors
Intercommunication systems, installation
Lighting systems, electric, installation
Telephone and telephone equipment installation, contractors
Wire installation, houses, buildings and structures, electrical, construction

Exclusion(s): Establishments primarily engaged in:

- installing power transmission and distribution lines (23139, Other Engineering Construction).

232510 Electrical Work
See industry description for 23251, above.

23252 Plumbing, Heating and Air-Conditioning Installation
This industry comprises establishments primarily engaged in installing primary water piping systems, plumbing fixtures, secondary piping systems for wet heating, natural gas pipe fitting for dry heating, and central air-conditioning equipment. The installation of sheet metal duct work is included.

Air-conditioning systems, installation or repair
Bathroom plumbing fixtures and sanitary ware, installation
Central air-conditioning equipment, installation
Central dry heating equipment, installation
Cooling towers, installation
Duct work (e.g., heating, cooling, exhaust, dust collection), installation
Furnace conversion from one fuel to another
Heating system installation or repair
Natural gas piping, installation
Primary hot water plumbing, installation
Snow melting systems (hot water or glycol), installation
Sprinkler systems, lawn and garden, installation

232520 Plumbing, Heating and Air-Conditioning Installation
See industry description for 23252, above.

23253 Automatic Sprinkler System Installation
This industry comprises establishments primarily engaged in installing automatic sprinkler fire protection systems, by cutting and threading pipe, hanging it from ceilings and attaching sprinkler heads.

232530 Automatic Sprinkler System Installation
See industry description for 23253, above.

23254 Commercial Refrigeration Installation
This industry comprises establishments primarily engaged in installing and repairing commercial, industrial and scientific refrigeration and cold storage or freezer systems.

232540 Commercial Refrigeration Installation
See industry description for 23254, above.

23255 Elevator and Escalator Installation
This industry comprises establishments primarily engaged in installing and repairing elevators and escalators, moving sidewalks and similar conveying equipment in buildings.

Exclusion(s): Establishments primarily engaged in:

- installing and dismantling construction elevators (23229, Other Building Structure Work).

232550 Elevator and Escalator Installation
See industry description for 23255, above.

23259 Other Building Equipment Installation
This industry comprises establishments, not classified to any other industry, primarily engaged in building equipment installation.

Conveyor system, installation	Process piping, installation
Dismantling large-scale machinery and equipment	Rigging large-scale equipment
Insulation of pipes and boilers, contractors	Service station equipment installation, maintenance and repair, contractors
Millwrighting service for industrial machinery	Television and radio stations, service and repair of, contractors
Power boilers, purchased, erection	Vacuum cleaning systems, built-in, contractors

232590 Other Building Equipment Installation
See industry description for 23259, above.

2329 Other Special Trade Contracting
This industry group comprises establishments, not classified to any other industry group, primarily engaged in specialized trades.

23291 Fencing and Interlocking Stone Contracting
This industry comprises establishments primarily engaged in erecting fencing of any material and laying precast stones or bricks for patios, driveways and the like.

Fences and enclosures, any material, installation	Precast stones or bricks for patios or driveways, installation
Patio construction, concrete, contractors	Sound barriers (fences), construction

Exclusion(s): Establishments primarily engaged in:

- a combination of landscaping services (installing and/or maintaining trees, shrubs, plants, lawns or gardens), and fencing and interlocking stone work (56173, Landscaping Services).

232910 Fencing and Interlocking Stone Contracting
See industry description for 23291, above.

23292 Residential and Commercial Paving Contracting
This industry comprises establishments primarily engaged in paving and repairing residential driveways, commercial parking lots and other private parking areas. The establishments in this industry may pave with asphalt or concrete.

Asphalt paving contractors (driveways and parking lots)	Sidewalks and curbs of concrete, residential, construction
Concrete work, private driveways, sidewalks and parking areas, contractors	

Exclusion(s): Establishments primarily engaged in:

- paving public roads (23131, Highway, Street and Bridge Construction); and
- paving with precast stone and brick (23291, Fencing and Interlocking Stone Contracting).

232920 Residential and Commercial Paving Contracting
See industry description for 23292, above.

23299 All Other Special Trade Contracting
This industry comprises establishments, not classified to any other industry, primarily engaged in specialized trades. Some important examples of work done by these establishments are coating and sealing driveways and parking areas; steeplejack work; sign installation, maintenance and repair, except roadway; scaffold erecting and dismantling; mobile home set-up and tie-down; non-electrical cable splicing; antenna installation; and lightning rod and conductor installation.

Antennas, household, installation and service	Mobile home site set up and tie down, contractors
Cable splicing service, non-electrical, contractors	Scaffolds, erecting and dismantling
Coating and sealing driveways and parking areas	Signs, installation, maintenance and repair (except road)
Core drilling (concrete)	Steeplejack work
Lightning rods and conductors, installation	Swimming pool construction (residential)

Exclusion(s): Establishments primarily engaged in:

- installing, maintaining and repairing highway road signs (23131, Highway, Street and Bridge Construction).

232990 All Other Special Trade Contracting
See industry description for 23299, above.

Appendix 5: Comparison of Estimates of Real Output, Total Hours Worked and Output per Hour in the Total Construction and Residential Construction Sectors

Two sources of data for real GDP and total hours worked are available for the total construction industry and residential construction industry. Output per hour series can be constructed from both sources of output and labour input. The first source is Statistics Canada's Aggregate Productivity Measures and the second is Statistic Canada's National Accounts and Labour Force Survey.

The Aggregate Productivity series are available from 1961 through 2000 for total construction and 1961 through 1997 for residential construction. Output data from the National Accounts are available from 1962 through 2000 for total construction and 1962 through 1999 for residential construction, and hours worked data from the Labour Force Survey (LFS) are only available from 1984 through 1998 for both total and residential construction. Post-1998 LFS estimates are based on the North American Industry Classification System (NAICS), making them inconsistent with the 1980 SIC classification system still in use for output up to 2000. The National Accounts/LFS output per hour series are hence only available from 1984 through 1998, while the Aggregate Productivity output per hour series are available for a much longer period.

The data for both series are found in Appendix Tables 82 and 83. Appendix Charts 11-16 plot the two series and are discussed below.

Appendix Chart 11: Real GDP in Total Construction

This chart compares the two estimates of real GDP in total construction. There are very similar growth patterns in both measures; they have a general upward trend. From 1984 to 1997, the growth patterns are almost identical, and their average annual growth rates are the same at 4.4 per cent from 1984 to 1989 and –1.1 per cent from 1989 to 1997. But during the period 1976 -1983, the Aggregate Productivity Measure of real GDP lagged behind the National Accounts measure. Both series peak at the same time, 1989-1990.

Appendix Chart 12: Real GDP in Residential Construction

This chart compares the two estimates of real GDP in residential construction. Here again, the growth patterns are quite similar. Both display a general upward trend, but are dominated by short-term erratic fluctuations. From 1989 to 1998 the two series are close enough to make the lines nearly identical. During the 1962-1997 period, the average annual growth rates of the real GDP series were similar, 3.1 per cent (for the Aggregate Productivity series) against 2.5 per cent (for the National Accounts series). The peak period is 1987 to 1990 for both measures.

Appendix Chart 13: Hours Worked in Total Construction

This chart compares the two series of total hours worked in total construction. The series show similar growth patterns: they do not evolve smoothly, but have an upward trend in general. The average annual growth rates of both measures are similar, but in each period the LFS series is growing slightly more per year than is the Aggregate Productivity series. Refer to Appendix Table 82. During the 1976 to 1998 period, the LFS series grew at an average rate of 0.8 per cent per year, while the Aggregate Productivity series grew at an average rate of 0.5 per cent per year.

Appendix Chart 14: Hours Worked in Residential Construction

This chart compares the two estimates of total hours worked in residential construction. Again, the growth patterns of the series are very similar when considering only the period from 1984 to 1998, with strong growth in hours worked during the second half of the 1980s, a steep fall during the first half of the 1990s, and a moderate upturn in the second half of the decade. But because the level of hours worked was much lower in 1984 in the Aggregate Productivity Measures series than in the LFS series, the average annual growth rates are significantly different. The LFS series declined, on average, by 0.3 per cent per year from 1984 through 1997 while the Aggregate Productivity series grew at a very robust average annual rate of 3.5 per cent per year for the same period.

Appendix Chart 15: Output per Hour in Total Construction

This chart compares the two estimates of output per hour in total construction. As might be expected given the similarity of output and hours growth for the two series, the output per hour series followed a similar growth pattern, except that the series constructed from data from the National Accounts and the LFS fluctuates more dramatically than the Aggregate Productivity series. The average annual growth rates are somewhat different for the 1976 through 1998 period, the Aggregate Productivity series growing at 0.47 per cent per year on average and the National Accounts/LFS series shrinking by 0.04 per cent per year on average.

Appendix Chart 16: Output per Hour in Residential Construction

This chart compares the two estimates of output per hour in residential construction. Given the major differences in total hours growth between data sources, it is not surprising that the output per hour series exhibit very different growth rates. Both series exhibit the same cyclical pattern, with productivity falling in the second half of the 1980s, although the fall for the Aggregate Productivity Measures series is much sharper. This reflects the much more rapid growth of hours in this series during this period. The average annual growth rates are significantly different during the 1984 to 1997 period. The National Accounts/LFS series grew at an average rate of 1.9 per cent per year, while the Aggregate Productivity series shrank at an average rate of 1.3 per cent per year.

Conclusion

The growth patterns of the two series for the total construction sector are comparable for output, total hours and consequently for output per hour. In contrast, for the residential construction sector, only output growth is similar for the two series. Because of much greater hours growth in the second half of the 1980s in the Aggregate Productivity Measures series, this series exhibits much lower productivity growth over the 1984-97 period.

Tables, Exhibits, and Charts

List of Tables in the Text

List of Exhibits

List of Charts in the Text

Table 1: Real Output in the Construction Sector by Province, Average Annual Growth Rates

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories
1984-89	4.38	0.28	6.54	2.75	2.32	4.43	7.65	4.97	-0.39	-0.81	4.27	1.00	3.25
1989-98	-1.06	-4.09	-3.29	-1.76	-1.81	-2.44	-3.07	-0.72	-0.72	4.53	0.36	-7.50	1.85
1989-99	-0.55	-2.39	-2.46	-0.19	-0.01	-1.73	-1.89	-0.73	-0.78	3.97	0.24	-4.37	-2.73
1989-00	-0.20												
1989-95	-3.18	-0.78	0.19	-3.75	-1.44	-4.36	-6.55	-3.61	-4.20	1.70	1.91	-0.32	-5.48
1995-98	3.32	-10.37	-9.87	2.35	-2.56	1.53	4.28	5.31	6.63	10.43	-2.67	-20.34	18.26
1995-99	3.53	-4.75	-6.29	5.39	2.16	2.35	5.53	3.75	4.58	7.47	-2.21	-10.14	1.53
1995-00	2.49												

Source: GDP by Industry, National Accounts, Statistics Canada, November 2000.
Appendix Table 5.

Table 2: Output, Employment, Output Per Worker, and Output Per Hour in the Business Sector and the Construction Sector in the 1980s and 1990s, Average Annual Growth Rates

	1981-89		1989-00		1989-95		1995-00	
Business Sector								
Real GDP	3.18		2.74		1.43		4.34	
Employment	1.97		1.40		0.19		2.88	
Hours	2.02		1.36		1.49		1.20	
Output Per Worker	1.18		1.32		1.24		1.42	
Output Per Hour	1.14		1.36		1.49		1.20	
Construction Sector								
Real GDP	1.84		-0.08		-3.02		3.57	
Employment	1.93		0.11		-2.20		2.96	
Hours	2.48		0.25		-2.57		3.75	
Output Per Worker	-0.09		-0.19		-0.84		0.59	
Output Per Hour	-0.62		-0.33		-0.46		-0.17	

Source: Aggregate Productivity Measures, May 2001. Appendix Tables 2 and 3.

Table 3: Real Output in Residential Construction by Province, Average Annual Growth Rates

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories
1984-89	5.96	6.27	4.64	0.13	2.14	1.94	8.81	-1.99	-4.99	8.58	9.71	-1.16	0.63
1989-97	-0.91	-4.50	-1.49	1.01	-0.23	-2.63	-3.26	-2.07	-0.62	5.27	4.70	-0.39	-8.07
1989-98	-0.94	-4.07	-0.56	-0.68	-1.42	-2.30	-2.90	-0.33	0.24	5.86	2.63	-3.76	0.21
1989-99	-0.20	-3.78	1.07	0.93	-0.26	-1.22	-1.17	0.03	0.72	5.18	1.12	-2.88	1.38
1989-00	-0.01												
1989-95	-4.70	-7.97	-3.32	0.33	-4.20	-5.97	-9.05	-4.00	-5.23	0.23	5.21	-1.71	-7.95
1995-98	7.02	4.25	5.20	-2.67	4.37	5.49	10.68	7.44	12.15	18.10	-2.36	-7.75	18.76
1995-99	6.95	2.87	8.03	1.82	5.94	6.37	11.94	6.40	10.35	13.06	-4.72	-4.61	17.19
1995-00	5.92												

Source: GDP by Industry, National Accounts, Statistics Canada, November 2000. Appen
Table 5.

Table 4: Construction Sector Employment and Total Hours, Average Annual Growth Rates

Employment

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	6.53	2.40	7.17	7.14	8.50	7.64	7.55	0.53	1.35	2.22	8.44
1989-98	-1.04	-2.89	-0.55	-2.36	-0.11	-4.09	-1.51	2.12	-1.08	2.88	0.70
1989-99	-0.47	-0.74	-0.50	-1.90	-0.36	-2.95	-0.93	2.41	-0.50	3.67	0.43
1989-00	0.04	-1.24	-0.69	-0.64	-0.18	-2.22	-0.17	1.93	-0.26	4.18	0.16
1989-95	-1.77	-1.10	0.80	-3.90	-1.47	-3.94	-3.36	0.22	-1.76	2.34	2.09
1995-98	0.45	-6.38	-3.20	0.79	2.66	-4.39	2.31	6.04	0.30	3.95	-2.01
1995-99	1.53	-0.21	-2.41	1.18	1.34	-1.45	2.82	5.78	1.43	5.69	-2.02
1995-00	2.27	-1.41	-2.44	3.41	1.38	-0.13	3.80	4.02	1.57	6.43	-2.10

Source: Statistics Canada, Labour Force Survey. Appendix Tables 11 and 13.

Total Hours Worked

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	7.87	2.07	5.20	5.02	8.75	8.23	9.58	1.06	0.93	4.27	10.19
1989-98	-0.95	-1.94	-0.64	-0.85	0.30	-3.51	-2.15	2.71	0.37	3.55	0.72
1989-99	-0.65	0.47	0.79	-0.43	0.58	-2.92	-1.57	2.56	0.54	3.62	-0.13
1989-00	-0.01	0.16	0.67	0.41	0.97	-2.02	-0.74	2.40	0.60	4.15	0.04
1989-95	-2.72	-1.07	2.17	-3.46	-1.30	-3.58	-5.78	0.73	-0.69	1.96	1.67
1995-98	2.67	-3.66	-6.02	4.58	3.59	-3.38	5.53	6.78	2.53	6.80	-1.14
1995-99	2.54	2.82	-1.25	4.29	3.47	-1.92	5.11	5.37	2.41	6.14	-2.77
1995-00	3.33	1.66	-1.09	5.25	3.77	-0.12	5.67	4.44	2.17	6.83	-1.87

Source: Labour Force Survey, Statistics Canada. Appendix Tables 17 and 18.

Table 5: Residential Construction Employment and Total Hours, Average Annual Growth Rates

Employment

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	6.24	0.57	7.39	2.47	8.45	8.36	8.20	0.00	-2.00	0.40	5.12
1989-97	-4.57	-7.08	-1.31	-4.56	-5.91	-7.99	-5.57	-3.16	-2.31	0.16	0.46
1989-98	-3.19	-3.97	-2.45	-3.32	-3.86	-5.34	-3.92	0.00	-1.24	0.14	-0.19
1989-95	-5.46	-6.53	-1.74	-4.59	-9.17	-8.46	-6.82	-3.80	-4.79	-1.47	1.08
1995-98	1.52	1.37	-3.85	-0.73	7.72	1.21	2.15	8.06	6.27	3.45	-2.68

Source: Statistics Canada, Labour Force Survey. Appendix Tables 11 and 13.

Total Hours Worked

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	7.71	1.46	8.14	3.57	10.09	10.75	8.74	1.50	-0.73	2.27	8.17
1989-97	-4.93	-6.98	-1.50	-4.63	-5.84	-8.87	-5.69	-4.11	-1.11	-0.07	-0.49
1989-98	-3.68	-3.92	-1.27	-4.26	-3.82	-6.36	-4.38	-0.18	-1.02	-0.03	-0.70
1989-95	-6.42	-6.39	-3.08	-5.24	-8.92	-9.37	-7.84	-3.57	-4.62	-3.08	-0.15
1995-98	2.06	1.23	2.44	-2.26	7.23	-0.04	2.94	6.96	6.61	6.36	-1.79

Source: Labour Force Survey, Statistics Canada. Appendix Tables 17 and 18.

Table 6: Productivity in Construction, Average Annual Growth Rates

Output per Worker

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	-2.02	-2.08	-0.59	-4.10	-5.70	-2.98	0.10	4.42	-1.71	-2.96	-3.84
1989-98	-0.02	-1.23	-2.75	0.61	-1.70	1.72	-1.59	-2.78	0.37	1.61	-0.34
1989-99	-0.08	-1.66	-1.97	1.74	0.35	1.26	-0.97	-3.06	-0.29	0.29	-0.18
1989-00	-0.24										
1989-95	-1.43	0.32	-0.61	0.15	0.03	-0.44	-3.30	-3.81	-2.48	-0.62	-0.17
1995-98	2.87	-4.26	-6.89	1.54	-5.09	6.18	1.93	-0.69	6.31	6.24	-0.67
1995-99	1.97	-4.55	-3.97	4.16	0.81	3.86	2.63	-1.92	3.10	1.69	-0.20
1995-00	1.20										

Source: National Accounts and LFS. Appendix Tables 22 and 24.

Output per Hour

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	-3.23	-1.76	1.28	-2.17	-5.91	-3.51	-1.76	3.87	-1.31	-4.87	-5.37
1989-98	-0.11	-2.19	-2.67	-0.91	-2.11	1.11	-0.93	-3.34	-1.09	0.95	-0.36
1989-99	0.10	-2.85	-3.22	0.24	-0.59	1.22	-0.33	-3.20	-1.32	0.34	0.37
1989-00	-0.19										
1989-95	-0.48	0.29	-1.94	-0.30	-0.14	-0.81	-0.81	-4.30	-3.54	-0.26	0.24
1995-98	0.64	-6.97	-4.10	-2.13	-5.94	5.07	-1.19	-1.38	4.00	3.40	-1.54
1995-99	0.96	-7.36	-5.10	1.06	-1.26	4.35	0.40	-1.53	2.11	1.25	0.57
1995-00	0.16										

Source: National Accounts, LFS. Appendix Tables 26 and 27.

Table 7: Productivity in Residential Construction, Average Annual Growth Rates

Output per Worker

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	-0.26	5.68	-2.57	-2.28	-5.82	-5.92	0.56	-1.99	-3.05	8.15	4.37
1989-97	3.83	2.78	-0.18	5.83	6.04	5.83	2.44	1.12	1.72	5.10	4.22
1989-98	2.32	-0.10	1.93	2.73	2.53	3.21	1.06	-0.33	1.50	5.71	2.82
1989-95	0.80	-1.54	-1.61	5.16	5.48	2.71	-2.39	-0.21	-0.46	1.72	4.08
1995-98	5.42	2.84	9.41	-1.96	-3.12	4.23	8.34	-0.57	5.54	14.17	0.33

Source: National Accounts and LFS. Appendix Tables 22 and 24.

Output per Hour

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	-1.63	4.75	-3.24	-3.32	-7.23	-7.95	0.06	-3.44	-4.29	6.16	1.43
1989-97	4.23	2.66	0.01	5.91	5.96	6.85	2.57	2.12	0.50	5.35	5.21
1989-98	2.84	-0.16	0.72	3.74	2.50	4.34	1.55	-0.15	1.27	5.90	3.35
1989-95	1.84	-1.69	-0.25	5.88	5.18	3.74	-1.31	-0.45	-0.64	3.41	5.37
1995-98	4.86	2.98	2.69	-0.42	-2.67	5.54	7.51	0.45	5.20	11.04	-0.58

Source: National Accounts, LFS. Appendix Tables 26 and 27.

Table 8: Productivity by Province in the Construction Sector

Output per worker as % of national average

	1989	1999
Newfoundland	108.6	92.6
Prince Edward Island	70.8	58.5
Nova Scotia	81.6	97.8
New Brunswick	78.7	82.1
Quebec	98.8	112.8
Ontario	95.3	87.2
Manitoba	112.9	83.5
Saskatchewan	115.0	112.7
Alberta	121.8	126.5
British Columbia	94.9	93.9
Canada	100.0	100.0

Source: National Accounts and LFS. Appendix Tables 22 and 24.

Table 9: Productivity by Province in the Residential Construction Sector

Output per worker as % of national average

	1989	1998
Newfoundland	90.8	73.2
Prince Edward Island	65.1	63.0
Nova Scotia	65.9	68.3
New Brunswick	57.7	58.8
Quebec	87.3	94.4
Ontario	114.0	102.0
Manitoba	83.0	65.5
Saskatchewan	82.6	76.9
Alberta	91.9	123.3
British Columbia	108.9	113.8
Canada	100.0	100.0

Source: National Accounts and LFS. Appendix Tables 22 and 24.

Table 10: Capital Productivity by Province in the Construction Sector

(Thousands of 1992 constant dollar GDP per $1000's of 1992 constant dollars of year-end net capital stock)

	Capital stock productivity, 1998	Capital stock productivity as % of national average, 1998	Capital stock productivity, growth rate, 1989-98
Newfoundland	5.01	98.7	0.42
Prince Edward Island	4.55	89.6	-6.89
Nova Scotia	4.75	93.6	-3.08
New Brunswick	4.01	79.0	-5.16
Quebec	4.57	90.0	-5.48
Ontario	3.98	78.5	-8.11
Manitoba	4.47	88.2	-5.15
Saskatchewan	5.89	116.0	1.02
Alberta	8.73	172.1	7.13
British Columbia	6.86	135.3	-1.02
Canada	5.07	100.0	-3.49

Source: Centre for the Study of Living Standards, based on GDP and Capital Stock data from Statistics Canada. Appendix Table 24.

Table 11: Total Factor Productivity in the Construction Sector, (average annual growth rates)

Based on number of workers employed

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
1984-89	-1.15	-2.81	1.49	-2.89	-4.18	-1.99	0.37	3.14	-2.43	-2.56	-1.37
1989-98	-1.27	-0.65	-4.23	-0.7	-2.93	-0.87	-3.93	-3.62	0.6	3.52	-0.58
1989-95	-2.78	1.59	-2.44	-1.51	-1.62	-2.78	-5.67	-4.08	-2.04	0.46	-0.94
1995-98	1.82	-4.99	-7.7	0.93	-5.5	3.05	-0.36	-2.7	6.09	9.93	0.15

Source: Centre for the Study of Living Standards, based on Statistics Canada Labour Force Survey, GDP, and Capital Stock data.
Appendix Table 27

Table 12 Productivity Trends in the Business Sector, Construction Sector, and its Components, 1961-2000 , Average Annual Growth Rates

	Real GDP	Number of Jobs	Average Hours	Hours Worked	Real GDP per Hour	Hourly Labour Compen-sation	Total Labour Compen-sation	Unit Labour Cost
Business Sector								
1961-1981	4.73	2.64	-0.65	1.97	2.71	8.75	10.90	5.87
1981-1989	3.18	1.97	0.04	2.02	1.13	5.52	7.63	4.35
1989-1997	2.06	0.79	-0.12	0.67	1.38	2.83	3.53	1.44
1989-2000	2.74	1.40	-0.04	1.36	1.37	2.97	4.37	1.58
1961-2000	3.85	2.15	-0.33	1.81	2.00	6.43	8.35	4.33
1961-1997	3.78	2.08	-0.38	1.69	2.06	6.69	8.50	4.53
1981-1997	2.61	1.38	-0.04	1.34	1.25	4.17	5.56	2.88
Total Construction								
1961-1981	3.69	1.79	-0.09	1.70	1.97	9.09	10.94	6.99
1981-1989	1.84	1.93	0.53	2.48	-0.61	4.23	6.81	4.87
1989-1997	-1.09	-1.11	-0.12	-1.23	0.14	2.07	0.81	1.94
1989-2000	-0.08	0.11	0.14	0.25	-0.34	2.24	2.49	2.58
1961-2000	2.23	1.34	0.10	1.45	0.78	6.12	7.65	5.29
1961-1997	2.20	1.17	0.04	1.21	0.98	6.41	7.69	5.38
1981-1997	0.36	0.40	0.20	0.61	-0.24	3.15	3.77	3.39
Residential Construction								
1961-1981	4.36	3.07	-0.13	2.95	1.37	9.23	12.48	7.76
1981-1989	3.25	4.74	0.82	5.60	-2.23	4.63	10.51	7.00
1989-1997	-0.60	-1.93	-0.21	-2.14	1.58	1.52	0.14	0.75
1961-1997	2.99	2.30	0.06	2.37	0.61	6.64	9.18	5.99
1981-1997	1.31	1.35	0.31	1.66	-0.35	3.47	5.19	3.82
Non-Residential Building Construction								
1961-1981	3.84	1.47	-0.12	1.35	2.45	8.38	9.85	5.79
1981-1989	3.97	3.49	0.53	4.04	-0.07	4.20	8.41	4.27
1989-1997	-3.04	-3.97	-0.14	-4.11	1.12	1.94	-2.25	0.81
1961-1997	2.30	0.68	0.02	0.70	1.59	5.99	6.73	4.33
1981-1997	0.41	-0.31	0.19	-0.12	0.53	3.07	2.94	2.53
Repair Construction								
1961-1981	2.16	-0.56	0.02	-0.54	2.72	11.35	10.75	8.41
1981-1989	2.59	2.77	0.16	2.93	-0.33	4.34	7.40	4.68
1989-1997	-1.96	0.67	-0.13	0.54	-2.49	1.86	2.41	4.46
1961-1997	1.32	0.44	0.02	0.46	0.86	7.60	8.10	6.68
1981-1997	0.29	1.71	0.02	1.73	-1.42	3.09	4.87	4.57
Engineering Construction (Excluding Repairs)								
1961-1981	3.54	2.84	-0.13	2.70	0.81	7.98	10.90	7.11
1981-1989	-1.24	-3.74	0.78	-2.98	1.79	4.48	1.37	2.64
1989-1997	0.84	1.65	-0.11	1.54	-0.69	1.81	3.38	2.52
1961-1997	1.86	1.08	0.08	1.16	0.69	5.80	7.02	5.07
1981-1997	-0.21	-1.08	0.33	-0.75	0.55	3.14	2.37	2.58

Source: Aggregate Productivity Measures, Statistics Canada, May 28, 2001.

Note: The growth rate of the Number of Jobs plus the growth rate of Average Hours gives the growth rate of Hours Worked. The growth rate of Hours Worked plus the growth rate of Hourly Compensation gives the growth rate of Total Compensation. The growth rate of Real GDP subtract the growth rate of Hours Worked gives the growth rate of Real GDP per Hour. The growth rate of Total Compensation subtract the growth rate of Real GDP gives the growth rate of Unit Labour Cost.

Table 13

A Comparison of Output and Productivity Growth, Average Annual Growth Rates

	Output	Output Per Hour
	Total Economy (National Accounts)	
1981-2000	2.60	1.12
1981-1989	2.90	0.80
1989-1997	1.81	1.30
1989-2000	2.38	1.35
	Business Sector (Aggregate Productivity Measures)	
1981-2000	2.93	1.27
1981-1989	3.18	1.13
1989-2000	2.74	1.37
	Total Construction (Aggregate Productivity Measures)	
1981-2000	0.72	-0.45
1981-1989	1.84	-0.61
1989-2000	-0.08	-0.34
	Residential Construction (National Accounts)	
1981-2000	1.21	-
1981-1989	2.90	-
1989-2000	-0.01	-
	Residential Construction (Aggregate Productivity Measures)	
1981-1997	1.31	-0.35
1981-1989	3.25	-2.23
1989-1997	-0.60	1.58

Source: Appendix Tables 1, 4, 26, 34, 35, and 36.

Table 14: Levels of Output Per Hour in the Construction Sector by Industry, 1961-2000, 1992$

	Total Construction	Total Excluding Residential	Residential Construction	Non-Residential Bldg. Construction	Other Construction	Repair Construction	Engineering Excluding Repairs	Road, Highway & Airstrip Const.	Gas & Oil Facility Const.	Dams & Irrigation Projects	Railway & Telephone Telegraph Const.	Other Engineering Construction	Construction, Other Activities
	(1)	(2)	A	B	C	D	E	F	G	H	I	J	K
1961	16.89	16.13	19.59	13.45	17.32	14.20	20.72	17.97	27.43	22.59	12.30	20.91	16.47
1962	16.14	15.57	18.14	13.54	16.56	13.71	19.82	16.89	27.69	21.54	11.96	20.28	16.67
1963	15.92	15.31	18.07	13.24	16.27	13.51	19.23	15.86	26.43	21.03	11.61	19.82	19.63
1964	16.30	15.72	18.07	14.21	16.38	13.90	18.75	15.23	25.64	21.30	11.80	19.25	17.72
1965	16.20	15.65	17.97	14.22	16.36	14.71	17.82	13.99	24.31	20.19	10.81	18.40	19.68
1966	15.08	14.66	16.72	13.51	15.25	13.55	16.72	13.00	22.18	19.21	9.97	17.50	19.41
1967	16.24	15.83	17.74	13.69	16.92	15.05	18.64	15.26	21.55	21.40	11.81	20.17	21.68
1968	18.13	17.17	21.29	14.80	18.29	16.68	19.80	16.17	21.77	22.78	12.18	21.02	23.55
1969	18.14	16.62	22.80	14.45	17.63	16.04	19.03	15.71	20.34	22.94	11.59	19.22	25.18
1970	18.79	17.58	23.38	15.07	18.77	16.18	20.81	17.23	21.37	25.51	13.31	21.07	25.44
1971	18.39	17.43	21.49	14.89	18.61	16.47	20.00	16.51	21.66	24.89	13.48	18.98	28.65
1972	18.51	18.08	19.61	14.70	19.56	18.00	20.55	17.75	21.33	27.81	11.73	18.62	30.70
1973	17.54	17.80	16.99	13.84	19.77	18.34	20.76	17.05	21.72	26.90	13.37	19.12	32.07
1974	17.07	17.15	16.90	13.71	18.97	18.67	19.18	13.72	19.14	25.90	14.22	18.25	34.49
1975	18.95	19.08	18.62	15.13	21.27	21.05	21.41	15.22	19.91	30.38	15.79	19.50	35.10
1976	20.83	21.49	19.65	18.23	22.93	22.46	23.24	18.04	21.96	28.89	17.55	22.26	38.41
1977	22.44	22.64	22.04	20.14	23.63	23.46	23.74	17.85	22.89	32.84	17.76	20.83	38.48
1978	22.49	22.26	22.97	19.47	23.32	22.89	23.59	18.13	20.22	36.29	15.60	20.58	31.62
1979	22.19	21.66	23.43	19.00	22.83	22.82	22.83	16.88	19.58	36.55	14.78	19.61	31.73
1980	23.34	22.10	26.91	20.65	22.75	22.72	22.76	17.56	18.27	38.51	18.19	19.39	34.06
1981	24.16	23.56	25.73	21.83	24.33	24.28	24.36	16.21	25.32	36.13	21.33	19.26	39.50
1982	26.94	26.12	29.38	23.47	27.18	26.92	27.32	18.34	27.45	44.04	22.65	21.70	41.30
1983	27.13	26.21	29.57	24.54	26.84	23.67	28.90	18.25	28.50	53.99	20.28	22.14	40.97
1984	25.71	24.56	28.89	25.67	24.14	23.22	24.76	17.14	25.41	41.62	21.67	20.09	40.66
1985	26.22	24.78	30.16	25.62	24.40	23.66	24.91	19.66	24.60	44.86	20.98	20.40	41.16
1986	26.48	25.56	28.44	25.64	25.52	24.05	26.73	20.77	27.48	47.35	20.85	22.22	38.53
1987	24.91	25.03	24.71	23.89	25.67	23.47	27.73	23.80	27.33	45.04	21.20	23.20	39.39
1988	23.63	24.12	22.70	22.58	25.03	23.29	26.55	22.33	27.98	38.76	20.66	22.64	34.26
1989	23.29	24.29	21.47	21.72	25.96	23.65	28.09	23.27	28.82	40.27	23.71	23.54	31.89
1990	23.56	24.69	21.34	21.62	26.61	24.41	28.52	24.04	28.73	37.73	24.29	24.30	37.01
1991	24.31	25.54	21.70	23.77	26.44	23.10	29.20	25.78	25.38	38.62	27.17	26.65	35.41
1992	23.53	24.86	21.06	23.58	25.44	21.78	29.13	24.30	24.36	39.62	26.90	26.40	36.29
1993	22.94	23.91	21.10	24.27	23.78	20.00	27.53	24.03	23.58	38.16	27.86	24.37	35.87
1994	22.60	23.14	21.53	23.61	22.97	19.93	25.51	22.61	21.77	36.24	30.66	23.96	38.28
1995	22.63	22.90	22.03	22.66	22.99	18.85	26.40	21.78	23.87	37.14	35.17	25.95	35.01
1996	23.27	23.12	23.62	22.95	23.18	18.55	27.37	21.58	25.03	42.92	38.61	25.01	34.88
1997	23.71	23.40	24.35	23.74	23.25	19.33	26.58	22.17	23.51	43.00	32.10	27.74	35.11
1998	23.62												
1999	22.99												
2000	22.61												
	Average annual growth rates												
61-97	0.95	1.04	0.61	1.59	0.82	0.86	0.69	0.58	-0.43	1.80	2.70	0.79	2.12
61-81	1.81	1.91	1.37	2.45	1.71	2.72	0.81	-0.52	-0.40	2.37	2.79	-0.41	4.47
81-89	-0.46	0.39	-2.24	-0.07	0.81	-0.33	1.79	4.62	1.63	1.37	1.33	2.53	-2.64
89-97	0.22	-0.47	1.58	1.12	-1.37	-2.49	-0.69	-0.61	-2.51	0.82	3.86	2.08	1.21
89-00	-0.27												
95-00	-0.02												

Notes: A+B+C=(1), D+E=C , E=F+G+H+I+J+K, (2)=(1)-A

Source: Aggregate Productivity Measures, May 28, 2001, Statistics Canada. Appendix Tables 59 and 61.

Table 15: Trends in Labour Productivity, Output, and Hours Worked in Canada, 1961-2000

	Average annual rate of change in output per hour					
	1961-1973	**1973-1981**	**1981-1989**	**1989-2000**	**1989-1995**	**1995-2000**
Business Sector	3.7	1.2	1.1	1.4	1.5	1.2
Agriculture	5.9	3.6	1.8	5.2	4.3	6.3
Fishing and Trapping	2.7	-0.5	-3.0	-0.9	-1.4	-0.3
Logging and Forestry	4.0	1.8	3.4	-0.2	-2.0	2.0
Mining, Quarrying and Oil Well	6.1	-5.9	3.0	1.6	3.4	-0.6
Manufacturing	4.2	2.0	2.3	2.0	3.0	0.9
Construction	0.5	4.1	-0.6	-0.3	-0.5	-0.2
Transportation and Storage	5.1	0.0	2.2	1.6	1.8	1.3
Communication and other Utility Industries	5.8	3.1	1.6	2.3	1.4	3.5
Wholesale Trade	2.3	1.7	4.4	1.9	1.2	2.8
Retail Trade	3.6	1.5	1.0	1.8	0.4	3.5

	Average annual rate of change in real GDP					
	1961-1973	**1973-1981**	**1981-1989**	**1989-2000**	**1989-1995**	**1995-2000**
Business Sector	5.7	3.3	3.2	2.7	1.4	4.3
Agriculture	2.1	3.7	1.2	3.0	3.4	2.6
Fishing and Trapping	-0.3	2.7	2.2	-3.5	-7.1	1.0
Logging and Forestry	3.0	0.0	3.3	-0.3	-1.4	1.1
Mining, Quarrying and Oil Well	7.4	-2.7	2.5	2.2	3.0	1.4
Manufacturing	6.6	1.8	3.0	2.6	0.9	4.7
Construction	2.7	5.2	1.8	-0.1	-3.0	3.6
Transportation and Storage	6.0	2.3	3.3	3.3	2.4	4.3
Communication and other Utility Industries	8.7	7.6	3.8	3.4	2.5	4.5
Wholesale Trade	7.1	3.4	6.7	4.5	2.0	7.7
Retail Trade	6.0	4.1	3.1	2.6	0.9	4.7

	Average annual rate of change in hours worked					
	1961-1973	**1973-1981**	**1981-1989**	**1989-2000**	**1989-1995**	**1995-2000**
Business Sector	1.9	2.0	2.0	1.4	-0.1	3.1
Agriculture	-3.5	0.1	-0.6	-2.0	-0.8	-3.5
Fishing and Trapping	-2.9	3.2	5.4	-2.7	-5.8	1.3
Logging and Forestry	-0.9	-1.8	-0.1	0.0	0.7	-0.9

Mining, Quarrying and Oil Well	1.3	3.4	-0.5	0.6	-0.5	2.0
Manufacturing	2.3	-0.2	0.8	0.6	-2.0	3.8
Construction	2.1	1.0	2.5	0.3	-2.6	3.7
Transportation and Storage	0.8	2.4	1.1	1.7	0.6	3.0
Communication and other Utility Industries	2.8	4.3	2.2	1.0	1.1	0.9
Wholesale Trade	4.7	1.7	2.2	2.5	0.7	4.8
Retail Trade	2.3	2.5	2.1	0.8	0.5	1.2

Source: Aggregate Productivity Measures, Statistics Canada, May 22, 2001

Note: Since the May 22 release Statistics Canada has updated the business sector series for the 1987-2000 period to reflect changes in the national accounts released May 31. Output per hour growth has risen to 1.7 per cent per year from 1.2 per cent for the 1995-2000 period, but was virtually unchanged for the 1987-1995 period. The other industries series have not yet been updated.

Table 16 Productivity Cycles in the Residential Construction Sector, average annual rates of change

Peak to Trough and Trough to Peak based on Output per Hour	Output per Hour	Output	Total Hours
1961-1966	-3.1	0.8	4.1
1966-1970	8.7	5.1	-3.3
1970-1974	-7.8	7.6	16.7
1974-1985	5.4	3.2	-2.1
1985-1992	-5.0	0.5	6.6
1992-1997	2.9	3.0	0.1
1961-1997	0.6	3.0	2.4

Source: Aggregate Productivity Measures, Statistics Canada, May, 2001

Note: Peaks and Troughs in output per hour are used to date the cycles.

Table 17
CPI, Housing Prices, and Income Indexes for Canada, 1981 = 100, 1981 - 2000

Year	GDP Deflator	Residential Structures, GDP Implicit Price Index	Non-Residential Structures, GDP Implicit Price Index	Consumer Prices	New Houses	Land	New Houses and Land	Nominal Personal Income Per Capita	Nominal Personal Disposable Income Per Capita	Price of New Houses and Land, Adjusted for Disposable Income Per Capita
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10) = (7)/(9)
1981	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1982	108.6	102.2	107.4	110.9	99.3	95.1	97.9	109.3	109.1	89.7
1983	114.4	105.6	106.7	117.3	96.9	90.6	94.7	114.1	113.0	83.8
1984	118.2	110.2	110.7	122.4	97.6	90.9	95.1	122.4	121.5	78.3
1985	121.2	113.1	114.1	127.3	98.9	92.0	96.2	131.4	130.0	74.0
1986	124.6	121.3	115.7	132.6	108.8	97.3	104.5	139.2	135.6	77.0
1987	130.4	133.6	121.2	138.4	125.7	106.8	118.9	147.8	142.6	83.4
1988	136.4	142.7	128.0	144.0	136.9	122.9	131.1	160.1	153.4	85.5
1989	142.7	151.2	133.6	151.1	148.0	155.3	148.5	171.0	165.1	89.9
1990	147.0	150.2	137.8	158.4	147.2	164.6	150.6	180.9	172.0	87.6
1991	151.0	154.8	134.8	167.2	136.3	156.2	140.3	184.3	175.4	80.0
1992	152.9	156.5	133.9	169.8	135.5	159.2	140.3	186.8	177.4	79.1
1993	155.2	161.2	135.6	172.8	136.6	164.2	142.1	188.3	179.6	79.1
1994	156.9	165.4	140.2	173.2	136.7	165.1	142.4	190.0	179.9	79.1
1995	160.5	165.9	142.0	176.9	135.4	163.4	140.7	195.4	184.2	76.4
1996	163.1	165.4	146.2	179.8	132.4	161.5	138.0	197.7	185.2	74.5
1997	164.4	167.6	150.1	182.7	134.1	161.5	139.0	203.7	189.7	73.3
1998	163.4	170.6	153.4	184.4	136.2	162.1	140.4	210.7	195.2	71.9
1999	166.2	175.0	155.6	187.6	138.1	162.4	141.7	219.1	203.3	69.7
2000	172.4			192.7	142.4	163.5	144.7	230.2	212.6	68.1
Average Annual Growth Rates										
1981-1989	4.54	5.30	3.69	5.30	5.02	5.65	5.07	6.94	6.47	
1981-1997	3.16	3.28	2.57	3.84	1.85	3.04	2.08	4.55	4.08	
1989-1997	1.79	1.30	1.46	2.40	-1.22	0.49	-0.83	2.21	1.75	
1981-2000	2.91			3.51	1.88	2.62	1.97	4.49	4.05	
1989-2000	1.73			2.24	-0.35	0.47	-0.23	2.74	2.32	

Source: Statistics Canada. (1) - CANSIM, D15689, 2000; (2)- CANSIM II, v688281, August 2001; (3) - CANSIM II, v688282, August 2001; (4)- CANSIM, P200000, March 2000; (5), (6), (7) - CANSIM II, v734264, v734291, v734237, April 2001; (8), (9), Population - CANSIM II, v498977, v498998 CANSIM, D1, May 2001.

Table 18
Summary of Variables in the Regression Analysis, Canada, 1976 - 2000

	Output per Hour in the Total Construction Industry, 1992 = 100	Capital-Labour Ratio in the Total Construction Industry, 1992$/worker	Proportion of Employed holding a Post-Secondary Certificate or Diploma, Total Construction Industry, %	Unemployment Rate in the Total Construction Industry, %	Capacity Utilization Rate in the Total Construction Industry, %	Output per Hour in the Residential Construction Industry, 1992 = 100	Proportion of Employed Holding a Post-Secondary Certificate of Diploma, Residential Construction Industry, %
1976	90.0	5,418	16.5	11.7	89.5	93.3	11.9
1977	97.1	5,928	15.6	13.7	88.5	104.7	11.7
1978	97.3	6,264	14.9	14.8	80.4	109.1	12.1
1979	96.1	6,461	13.6	12.3	78.8	111.3	11.4
1980	101.4	7,028	14.3	12.9	80.7	127.8	10.3
1981	104.2	7,228	16.1	11.9	87.5	122.2	14.0
1982	117.0	8,144	19.7	19.0	85.6	139.5	16.2
1983	117.4	8,701	19.0	21.0	83.8	140.5	15.4
1984	110.8	8,646	19.3	19.8	78.6	137.2	16.2
1985	112.5	8,447	20.5	17.4	85.1	143.2	15.4
1986	112.8	8,003	21.4	15.6	89.6	135.1	17.6
1987	106.1	7,380	22.3	13.3	93.4	117.3	18.5
1988	100.6	7,451	22.4	11.9	94.6	107.8	18.7
1989	99.2	7,634	26.3	11.7	95.6	102.0	24.0
1990	100.2	7,913	27.9	14.7	91.8	101.4	25.7
1991	103.4	8,639	28.8	20.4	85.2	103.1	25.5
1992	100.0	9,225	30.2	19.9	81.3	100.0	28.1
1993	97.5	9,720	31.7	19.2	77.8	100.2	27.9
1994	96.1	9,528	34.5	16.8	79.6	102.3	31.5
1995	96.4	9,629	36.1	15.7	76.6	104.6	32.0
1996	98.7	9,977	37.3	14.6	79.5	112.2	34.1
1997	100.3	10,188	38.9	12.6	84.6	115.6	34.3
1998	99.9	10,497	38.0	11.7	84.5		35.7
1999	97.3	10,352	38.2	10.5	89.3		36.3
2000	95.6		38.5	9.0	91.4		36.7
Average Annual Growth Rates							
1976-1998	0.48	3.05	3.87	0.00	-0.26		5.11
1976-1981	2.97	5.93	-0.47	0.34	-0.45	5.54	3.31
1981-1989	-0.61	0.69	6.33	-0.21	1.11	-2.24	6.95
1989-1998	0.08	3.60	4.18	0.00	-1.36		4.50

Source: Statistics Canada; CANSIM, the Labour Force Survey, Aggregate Productivity Measures, and Microeconomic Analysis Division

Table 19
Employed by Educational Attainment for All Industries, Total and Residential Construction, Canada, 1990 and 2000, Percentage of Total Employment

	All Industries				**Total Construction**			
Education Level	1990	2000	Absolute Change	Rate of Change	1990	2000	Absolute Change	Rate of Change
0 - 8 years	14.7	3.7	-11.0	-74.5	12.8	6.6	-6.2	-48.2
9 - 10 years	23.1	13.1	-10.0	-43.1	24.0	17.8	-6.2	-25.7
11 - 13 years	20.7	21.1	0.4	2.1	22.6	23.4	0.8	3.5
Some post-secondary	8.9	9.8	0.9	10.3	8.4	8.5	0.1	1.6
Post-secondary certificate or diploma	21.8	32.5	10.7	48.9	27.9	38.5	10.6	38.1
University degree	10.8	19.7	8.9	82.4	4.4	5.1	0.7	15.9
Completed Post -Secondary	32.7	52.2	19.5	59.6	32.3	43.6	11.3	35.0
Total	100.0	100.0			100.0	100.0		

	Residential Construction			
	1990	**2000**	**Absolute Change**	**Rate of Change**
0 - 8 years	13.4	6.7	-6.7	-49.8
9 - 10 years	23.8	16.9	-6.9	-28.9
11 - 13 years	23.2	24.2	1.0	4.2
Some post-secondary	8.2	8.6	0.4	5.4
Post-secondary certificate or diploma	25.7	36.7	11.0	42.8
University degree	5.7	6.8	1.1	19.9
Completed Post -Secondary	31.4	43.5	12.1	38.5
Total	100.0	100.0		

Source: CSLS, based on unpublished data from the Labour Force Survey.

Table 20: Regression Results -- Canada, Total Construction, Levels (Actual Values and Natural Logarithms)

	Actual Values, All Variables	Actual Values, Excluding Unemployment Rate	Actual Values, Excluding Capacity Utilization	Natural Logarithms, All Variables	Natural Logarithms, Excluding Unemployment Rate	Natural Logarithms, Excluding Capacity Utilization
Constant Term (t-ratio)	-2.1263 (-0.1480)	11.438 (0.7035)	71.819 (10.06)	-3.2225 (-4.202)	-3.0347 (-2.626)	1.3765 (1.571)
Educational Attainment coefficient (t-ratio)	-1.3702 (-7.548)	-1.6211 (-8.420)	-1.2113 (-4.343)	-0.29338 (-8.853)	-0.34316 (-7.177)	-0.22752 (-3.694)
Capital - Labour Ratio coefficient (t-ratio)	0.00821 (7.201)	0.009815 (8.148)	0.006699 (3.891)	0.58184 (8.633)	0.69599 (7.249)	0.41576 (3.390)
Unemployment Rate coefficient (t-ratio)	0.72469 (3.051)	n/a	0.35951 (1.014)	0.14849 (5.150)	n/a	0.08342 (1.574)
Capacity Utilization coefficient (t-ratio)	0.70406 (5.429)	0.59204 (4.001)	n/a	0.70623 (7.443)	0.55810 (4.092)	n/a
R-Squared	0.8563	0.7859	0.6334	0.89	0.7366	0.5694
Durbin - Watson modified "d"	1.2771	1.3969	0.8296	1.2137	1.1334	0.6204

Note: Results are based on data from 1976 - 1999. The dependent variable is (the natural logarithm of) value added per person hour, in index form with 1992 = 100.

Table 21: Regression Results -- Canada, Total Construction, Rates of Change

	Total Construction, All Variables	Total Construction, Excluding Unemployment Rate	Total Construction, Excluding Capacity Utilization
Constant Term (t-ratio)	-0.87844 (-1.256)	-2.2286 (-3.082)	-1.1518 (-1.175)
Educational Attainment coefficient (t-ratio)	-0.05519 (-0.6873)	0.0887 (1.036)	0.11013 (1.101)
Capital - Labour Ratio coefficient (t-ratio)	0.44706 (3.118)	0.76310 (5.553)	0.36196 (1.810)
Unemployment Rate coefficient (t-ratio)	0.14616 (3.429)	n/a	0.0731 (1.321)
Capacity Utilization coefficient (t-ratio)	0.53493 (4.430)	0.37475 (2.690)	n/a
R-Squared	0.7942	0.6598	0.5699
Durbin - Watson modified "d"	1.0803	1.469	1.0775

Note: Results are based on data from 1976 - 1999. The dependent variable is the rate of change of value added per person hour, calculated from an index with 1992=100.

Table 22: Regression Results -- The Provinces, Total Construction, Levels (Actual Values)

	Newfoundland	PEI	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
Constant Term (t-ratio)	35.396 (4.419)	33.234 (8.508)	26.727 (3.288)	12.049 (1.580)	22.855 (10.08)	27.281 (16.71)	25.426 (2.890)	55.167 (4.373)	70.432 (5.567)	23.171 (2.349)
Educational Attainment coefficient (t-ratio)	-0.15653 (-2.731)	-0.3051 (-2.788)	-0.0138 (-0.1004)	-0.046737 (-0.4483)	-0.37755 (-4.519)	-0.28088 (-2.305)	-0.20835 (-1.101)	-0.67107 (-2.013)	-0.70957 (-2.687)	-0.073886 (-0.3682)
Capital - Labour Ratio coefficient (t-ratio)	0.000062998 (0.1034)	-0.0014 (-1.934)	-0.0014 (-2.525)	-0.00095 (-1.217)	0.00124 (3.393)	0.00027 (0.5768)	0.0002 (0.2091)	0.0006562 (0.7386)	-0.0013608 (-2.839)	-0.00052 (-0.4780)
Unemployment Rate coefficient (t-ratio)	-0.019305 (-0.09142)	0.0631 (0.6101)	0.46790 (2.179)	0.80951 (2.631)	0.43173 (3.735)	0.19192 (2.332)	0.38203 (1.213)	-0.48008 (-0.8678)	0.39851 (1.180)	0.79456 (1.994)
Capacity Utilization coefficient (t-ratio)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
R-Squared	0.4616	0.6755	0.476	0.7056	0.7439	0.7216	0.2308	0.3859	0.6467	0.786
Durbin - Watson modified "d"	1.6011	1.8479	1.6551	1.5011	2.3935	1.5271	0.6798	1.8293	1.3973	1.3634

Note: Results are drawn from data from 1984 - 1998. The dependent variable is value added per hour, in 1992$. The educational attainment data for PEI is for all industries but is for the total construction industry for all other provinces.

Table 23: Regression Results -- The Provinces, Total Construction, Levels (Natural Logarithms)

	Newfoundland	PEI	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
Constant Term (t-ratio)	3.5515 (1.830)	7.2163 (4.551)	6.3604 (4.140)	3.8834 (2.219)	1.2673 (1.596)	3.8985 (4.257)	2.7923 (1.163)	4.2084 (2.091)	10.605 (5.829)	3.7220 (1.608)
Educational Attainment coefficient (t-ratio)	-0.16612 (-2.812)	-0.29134 (-2.586)	-0.0958 (-0.3996)	-0.04452 (-0.4459)	-0.25672 (-3.659)	-0.20839 (-1.777)	-0.16080 (-1.004)	-0.50053 (-1.725)	-0.83683 (-3.458)	-0.22456 (-1.094)
Capital - Labour Ratio coefficient (t-ratio)	0.0875 (0.3551)	-0.41228 (-2.102)	-0.44668 (-2.466)	-0.35995 (-1.492)	0.25258 (2.259)	0.02771 (-0.2012)	0.05234 (0.1979)	0.14340 (0.4713)	-0.45883 (-2.304)	-0.03521 (-0.1141)
Unemployment Rate coefficient (t-ratio)	-0.10927 (-0.3934)	0.06925 (0.5349)	0.40186 (2.156)	0.81999 (2.391)	0.25039 (3.186)	0.0844 (2.041)	0.20686 (1.217)	-0.11256 (-0.5066)	0.0799 (0.5283)	0.26801 (1.170)
Capacity Utilization coefficient (t-ratio)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
R-Squared	0.4656	0.6437	0.4888	0.675	0.6843	0.6977	0.2142	0.335	0.6539	0.7499
Durbin – Watson modified "d"	1.4816	1.6577	1.7449	1.4338	2.1675	1.5502	0.6661	1.7108	1.3633	1.3956

Note: Results are drawn from data from 1984 - 1998. The dependent variable is the natural logarithm of value added per hour, in 1992$. The educational atta inment data for PEI is for all industries but is for the total construction industry for all other provinces.

Table 24: Regression Results -- The Provinces, Total Construction, Rates of Change

	Newfoundland	PEI	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
Constant Term (t-ratio)	-1.6535 (-0.6786)	-0.37665 (-0.1133)	-1.8487 (-0.8877)	-2.6727 (-0.8402)	-1.6456 (-0.5223)	0.80186 (0.3360)	-2.4050 (-0.9462)	-2.1792 (-0.8869)	-1.4955 (-0.5185)	-1.4592 (-0.5680)
Educational Attainment coefficient (t-ratio)	-0.04515 (-0.3068)	-0.0222 (-0.0744)	-0.0184 (-0.1107)	0.00009 (0.0005701)	0.01918 (0.0731)	-0.33194 (-1.484)	0.07258 (0.5148)	0.12919 (0.5383)	-0.12763 (-0.2740)	0.15597 (0.5351)
Capital - Labour Ratio coefficient (t-ratio)	0.40348 (1.297)	-0.22392 (-0.5712)	0.60478 (1.705)	0.21227 (0.4655)	0.30689 (0.9271)	0.02044 (0.07268)	0.41217 (2.203)	0.78728 (2.531)	-0.05217 (-0.1995)	0.0878 (0.2355)
Unemployment Rate coefficient (t-ratio)	-0.25707 (-0.6905)	-0.036 (-0.3195)	0.0223 (0.1148)	0.39419 (1.141)	0.27585 (1.894)	0.11276 (1.729)	0.02299 (0.1799)	-0.17520 (-0.9962)	-0.13936 (-1.123)	0.23851 (1.212)
Capacity Utilization coefficient (t-ratio)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
R-Squared	0.1714	0.0515	0.3067	0.2089	0.4318	0.3069	0.3494	0.3981	0.1534	0.2915
Durbin - Watson modified "d"	2.3169	2.1491	1.812	2.4697	2.4931	2.075	1.1225	2.2273	2.1583	2.6991

Note: Results are drawn from data from 1984 - 1998. The dependent variable is the rate of change of value added per person hour, calculated from a series in 1992$. The educational attainment data for PEI is for all industries, but is for the total construction industry for all other provinces.

Table 25: Regression Results -- The Provinces, Total Construction, Pooled Data

	Pooled, Total Construction, Levels (Actual Values)	Pooled, Total Construction, Levels (Natural Logarithms)	Pooled, Total Construction, Rates of Change
Constant Term (t-ratio)	28.873 (14.71)	0.77183 (2.264)	-0.74471 (-0.8885)
Educational Attainment coefficient (t-ratio)	-0.48050 (-6.173)	-0.41092 (-6.764)	-0.19582 (-1.421)
Capital - Labour Ratio coefficient (t-ratio)	0.001292 (11.10)	0.44745 (11.59)	0.26753 (3.270)
Unemployment Rate coefficient (t-ratio)	-0.10265 (-2.572)	-0.0861 (-2.956)	0.02182 (0.5361)
Capacity Utilization coefficient (t-ratio)	n/a	n/a	n/a
R-Squared	0.4767	0.4972	0.1053
Durbin - Watson modified "d"	0.5702	0.615	2.2943

Note: The pooled data set contains observations from 1984 - 1998 for each province. The educational attainment data for PEI is for all industries, but is for total construction for all other provinces.

Table 26: Regression Results -- Canada, Residential Construction, Levels (Actual Values and Natural Logarithms)

	Actual Values, All Variables	Actual Values, Excluding Unemployment Rate	Actual Values, Excluding Capacity Utilization	Natural Logarithms, All Variables	Natural Logarithms, Excluding Unemployment Rate	Natural Logarithms, Excluding Capacity Utilization
Constant Term (t-ratio)	-28.907 (-0.8999)	-36.503 (-1.088)	41.267 (3.453)	-9.3338 (-5.270)	-9.1291 (-5.312)	-4.2882 (-2.978)
Educational Attainment coefficient (t-ratio)	-3.7699 (-9.666)	-3.4402 (-9.580)	-3.6111 (-8.436)	-0.61466 (-10.09)	-0.60037 (-10.67)	-0.55249 (-7.276)
Capital - Labour Ratio coefficient (t-ratio)	0.02255 (8.270)	0.0197 (8.543)	0.0208 (7.122)	1.4160 (8.743)	1.3603 (9.908)	1.2175 (6.145)
Unemployment Rate coefficient (t-ratio)	-1.0656 (-1.735)	n/a	-1.3043 (-1.932)	-0.05131 (-0.6759)	n/a	-0.10307 (-1.064)
Capacity Utilization coefficient (t-ratio)	0.65967 (2.317)	0.74248 (2.509)	n/a	0.74445 (3.654)	0.77015 (3.907)	n/a
R-Squared	0.862	0.8376	0.8184	0.8698	0.8663	0.7675
Durbin - Watson modified "d"	1.7265	1.2174	1.4064	1.5517	1.3971	0.9358

Note: Results are based on data from 1976 - 1997. The dependent variable is (the natural logarithm of) value added per person hour, in the total or residential construction industry respectively, in index form with 1992=100.

Table 27: Regression Results -- Canada, Residential Construction, Rates of Change

	Residential Construction, All Variables	Residential Construction, Excluding Unemployment Rate	Residential Construction, Excluding Capacity Utilization
Constant Term (t-ratio)	-0.58749 (-0.3825)	-1.0452 (-0.7679)	-0.56691 (-0.3356)
Educational Attainment coefficient (t-ratio)	-0.22760 (-2.259)	-0.21142 (-2.193)	-0.16905 (-1.586)
Capital - Labour Ratio coefficient (t-ratio)	0.98283 (3.087)	1.1295 (4.870)	0.87231 (2.525)
Unemployment Rate coefficient (t-ratio)	0.0570 (0.6848)	n/a	0.01251 (0.1411)
Capacity Utilization coefficient (t-ratio)	0.53138 (2.135)	0.48870 (2.061)	n/a
R-Squared	0.6475	0.6372	0.5471
Durbin - Watson modified "d"	1.4715	1.6884	1.3954

Note: Results are based on data from 1976 - 1997. The dependent variable is the rate of change of value added per person hour, calculated from an index with 1992 = 100.

Table 28: Regression Results -- The Provinces, Residential Construction, Levels (Actual Values)

	Newfoundland	PEI	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
Constant Term (t-ratio)	4.5493 (0.1550)	23.813 (3.775)	-16.431 (-1.058)	-4.6338 (-0.5681)	33.128 (3.420)	40.605 (6.559)	71.734 (4.599)	90.683 (12.60)	55.518 (5.013)	11.972 (0.5198)
Educational Attainment coefficient (t-ratio)	0.16325 (0.7773)	-0.45823 (-2.591)	0.39601 (1.507)	-0.09154 (-0.8209)	-0.7312 (-2.158)	-0.4591 (-1.064)	-0.83199 (-1.969)	-0.45109 (-3.137)	0.0864 (0.4137)	0.28430 (0.7565)
Capital - Labour Ratio coefficient (t-ratio)	0.0013617 (0.6099)	0.00252 (2.101)	0.00263 (2.509)	0.00255 (3.063)	0.00415 (2.548)	0.00171 (1.310)	-0.0003 (-0.1571)	-0.00297 (-3.028)	-0.000699 (-0.9879)	0.005343 (1.426)
Unemployment Rate coefficient (t-ratio)	0.13692 (0.1769)	-0.24048 (-1.439)	0.30785 (0.7504)	0.5019 (1.525)	-0.73121 (-2.158)	-0.1352 (-0.4045)	-1.1239 (-1.981)	-0.79056 (-1.592)	-0.99352 (-2.295)	-1.1632 (-0.9661)
Capacity Utilization coefficient (t-ratio)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
R-Squared	0.0839	0.5037	0.5739	0.6908	0.3746	0.204	0.6553	0.8698	0.7225	0.3226
Durbin - Watson modified "d"	2.1065	1.6299	2.5883	2.3308	2.164	1.7663	1.4888	1.3833	1.5193	1.0851

Note: Results are drawn from data from 1984 - 1998. The dependent variable is value added per hour, in 1992$. The educational attainment data is for all industries for PEI, total construction for New Brunswick, Nova Scotia, and Newfoundland, and residential construction of all other provinces.

Table 29: Regression Results -- The Provinces, Residential Construction, Levels (Natural Logarithms)

	Newfoundland	PEI	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
Constant Term (t-ratio)	-1.8129 (-0.2781)	0.66723 (0.2820)	-6.1667 (-2.642)	-5.1063 (-3.019)	-2.3586 (-1.093)	1.6331 (1.059)	6.1823 (1.404)	16.297 (6.510)	4.5217 (2.091)	-6.0641 (-1.267)
Educational Attainment coefficient (t-ratio)	0.11749 (0.5921)	-0.39291 (-2.337)	0.60272 (1.656)	-0.0944 (-0.9781)	-0.39724 (-2.587)	-0.25286 (-1.327)	-0.63316 (-2.019)	-0.43086 (-3.556)	0.16237 (1.109)	0.01073 (0.04701)
Capital - Labour Ratio coefficient (t-ratio)	0.46636 (0.5631)	0.51330 (1.753)	0.70319 (2.555)	0.79746 (3.420)	0.86823 (2.912)	0.33534 (1.535)	0.05586 (0.1079)	-1.0924 (-3.179)	-0.0321 (-0.1249)	1.3127 (2.020)
Unemployment Rate coefficient (t-ratio)	0.12529 (0.1343)	-0.25634 (-1.327)	0.29991 (1.059)	0.46490 (1.403)	-0.17981 (-0.8850)	-0.04809 (-0.5248)	-0.45889 (-1.701)	-0.4578 (-2.218)	-0.4752 (-2.735)	-0.72539 (-1.634)
Capacity Utilization coefficient (t-ratio)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
R-Squared	0.066	0.4636	0.6108	0.7015	0.4394	0.2284	0.6145	0.9118	0.7765	0.3649
Durbin - Watson modified "d"	2.0698	1.6546	2.6443	2.1826	2.3756	1.8013	1.5043	1.7643	2.0125	1.286

Note: Results are drawn from data from 1984 - 1998. The dependent variable is the natural logarithm of value added per hour, in 1992$. The educational attainment data is for all industries for PEI, total construction for New Brunswick, Nova Scotia, and Newfoundland, and residential construction for all other provinces.

Table 30: Regression Results -- The Provinces, Residential Construction, Rates of Change

	Newfoundland	PEI	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
Constant Term (t-ratio)	14.253 (1.623)	-0.13620 (-0.0267)	2.5278 (0.4950)	0.29734 (0.0783)	-0.38759 (-0.0606)	-1.1310 (-0.2127)	-0.64665 (-0.1360)	2.9341 (1.016)	6.6525 (1.424)	6.1525 (1.228)
Educational Attainment coefficient (t-ratio)	-1.0723 (-2.021)	-0.0225 (-0.0493)	-0.0755 (0.1849)	0.01452 (0.0777)	0.04998 (0.1936)	0.18572 (0.6278)	-0.13521 (-0.5265)	-0.37857 (-2.561)	-0.12400 (-0.4819)	-0.33208 (-1.026)
Capital - Labour Ratio coefficient (t-ratio)	2.7487 (2.451)	0.34320 (0.5712)	0.32704 (0.3761)	0.14620 (0.2685)	0.23331 (0.2704)	0.38475 (0.5762)	0.17971 (0.4748)	-0.82085 (-2.206)	0.08997 (0.1700)	0.52656 (0.7263)
Unemployment Rate coefficient (t-ratio)	-1.6987 (-1.266)	-0.0126 (-0.0729)	0.45784 (0.9619)	0.64547 (1.565)	0.24450 (0.6444)	-0.0914 (-0.5974)	-0.35878 (-1.349)	-0.29208 (-1.458)	-0.19529 (-0.7503)	-0.26553 (-0.6692)
Capacity Utilization coefficient (t-ratio)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
R-Squared	0.5826	0.0336	0.1726	0.2771	0.0764	0.0668	0.2152	0.5507	0.1176	0.1498
Durbin - Watson modified "d"	1.7508	2.555	2.7367	2.31	2.7303	1.764	2.3007	1.9083	2.7889	2.2675

Note: Results are drawn from data from 1984 - 1998. The dependent variable is the rate of change of value added per person hour, calculated from a series in 1992$. The educational attainment data is for all industries for PEI, total construction for New Brunswick, Nova Scotia, and Newfoundland, and residential construction for all other provinces.

Table 31: Regression Results -- The Provinces, Residential Construction, Pooled Data

	Pooled, Residential Construction, Levels (Actual Values)	Pooled, Residential Construction, Levels (Natural Logarithms)	Pooled, Residential Construction, Rates of Change
Constant Term (t-ratio)	40.905 (13.03)	2.6813 (4.387)	3.1663 (1.894)
Educational Attainment coefficient (t-ratio)	-0.04643 (-0.6155)	-0.09995 (-1.668)	-0.20640 (-2.240)
Capital - Labour Ratio coefficient (t-ratio)	0.00043 (1.601)	0.23814 (3.305)	0.44384 (2.379)
Unemployment Rate coefficient (t-ratio)	-0.50881 (-5.526)	-0.35760 (-6.733)	-0.057 (-0.6160)
Capacity Utilization coefficient (t-ratio)	n/a	n/a	n/a
R-Squared	0.1788	0.268	0.0763
Durbin - Watson modified "d"	0.5673	0.5649	2.4492

Note: The pooled data set contains observations from 1984 - 1998 for each province. The educational attainment data is for all industries for PEI, total construction for Nova Scotia, New Brunswick, and Newfoundland, and residential construction for all other provinces.

Table 32: Provincial Productivity by Industry, 1996-97

	Canada	Atlantic	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
	GDP per job (thousands of current $)							
Business sector		42.0	52.0	54.0	44.0	54.0	66.0	51.0
Agriculture, fishing and trapping	24.6	26.2	29.9	20.0	25.7	30.6	24.1	20.0
Natural resources	184.2	79.0	74.4	118.3	106.3	363.9	295.7	138.9
Core manufacturing	80.9	54.7	80.9	78.1	79.8	68.1	112.7	73.9
Secondary manufacturing	91.0	55.5	90.8	97.1	71.1	68.3	82.6	65.9
Other manufacturing	67.6	58.1	64.7	71.6	49.1	70.0	71.4	71.2
Construction	43.5	40.2	46.0	42.1	38.7	49.2	47.6	41.6
Low-wage services	24.9	20.2	25.1	25.4	22.0	21.2	25.9	26.5
Medium-wage services	51.7	46.3	48.6	53.2	45.8	51.0	53.9	54.3
High-wage services	93.9	82.8	87.3	98.2	82.7	89.4	100.3	91.3

Source: Statistics Canada, *The Daily*, August 24, 2001.

Exhibit 1: Changes in the Mainstream Homebuilding Production Process, Canada, Mid-1940s to Mid-1980s

	Mid-1940s	Mid-1960s	Mid-1980s
Process	**Practice**		
Excavation	Bulldozer	Backhoe	No Change
Basement	Concrete block and site-mixed concrete used with site-built board formwork. Boards then re-used as wall and roof sheathing.	Transit-mixed concrete used with prefabricated formwork.	Little change, but some use of preserved wood foundations.
Wall framing	Platform frame. Some stationary assembly line processes. Little use of power equipment or piece-work sub-trades.	Precut studs, tilt up, stationary assembly line with sequencing of piece-work produced by sub-trades.	Little Change
Roof	Laid out and erected by skilled tradesmen.	Engineered, pre-fabricated roof trusses in general use.	Little Change
Wall and roof sheathing	Boards	Plywood sheets	Waferboard sheets
Siding	Wood clapboard, brick and stucco	Precoated aluminum and hardboard introduced.	Introduction of vinyl siding.
Plumbing and heating	Site-fitted and installed.	Prefabricated chimneys. Some ductwork sub-assemblies.	All-plastic plumbing. Chimneys and flues prefabricated.
Interiors	Wet-finished with plaster, cured and brush-painted.	Dry-finished with dry-wall and roller-painted.	Little Change
Windows/ cabinetry/doors	Fabricated on site.	Prefabricated windows, cabinetry and counter-tops.	Introduction of pre-hung doors and pre-fabricated stair units.

Source: *The Housing Industry: Perspective and Prospective*. Summary Report Table 6, p. 24 and Working Paper 2 p. 14-15. CMHC, 1988.

Exhibit 2: Changing Production Methods Reduce On-Site Labour

Changing This Operation	To This Operation	Fractioned Site Person-hours to:
Framing piece by piece, in balloon construction (still practiced here and there in the mid-1940s)	Platform framing with tilt-up, and using power tools	About a third or less
Constructing windows on site	Installing manufactured windows	A quarter or less
Sheathing walls and floors with boards	With sheet plywoods	A third or less
Forming basements with board formwork and site-mixed concrete	With prefabricated plywood forms and transit-mixed concrete	A third or less
Constructing cabinetry on site	Installing manufactured cabinetry	A quarter or less
Finishing interiors with wet plaster	Drywalling interiors	A third or less
Framing roofs piece by piece, ceiling joists/rafters/collar ties	Framing roofs/ceilings with trusses	A half or less
Brush painting interior, two or three coats	Roller painting, one or two coats	A third or less
Constructing chimneys with brick and flue tile	Installing manufactured flues	A quarter or less
DWV (drain-waste-vent) plumbing in cast iron and galvanized steel	Plastic DWV pipe	About half

Source: *The Housing Industry: Perspective and Prospective*, Working Paper Two Exhibit 3, p. 21, CMHC 1988 and Scanada Consultants Limited.

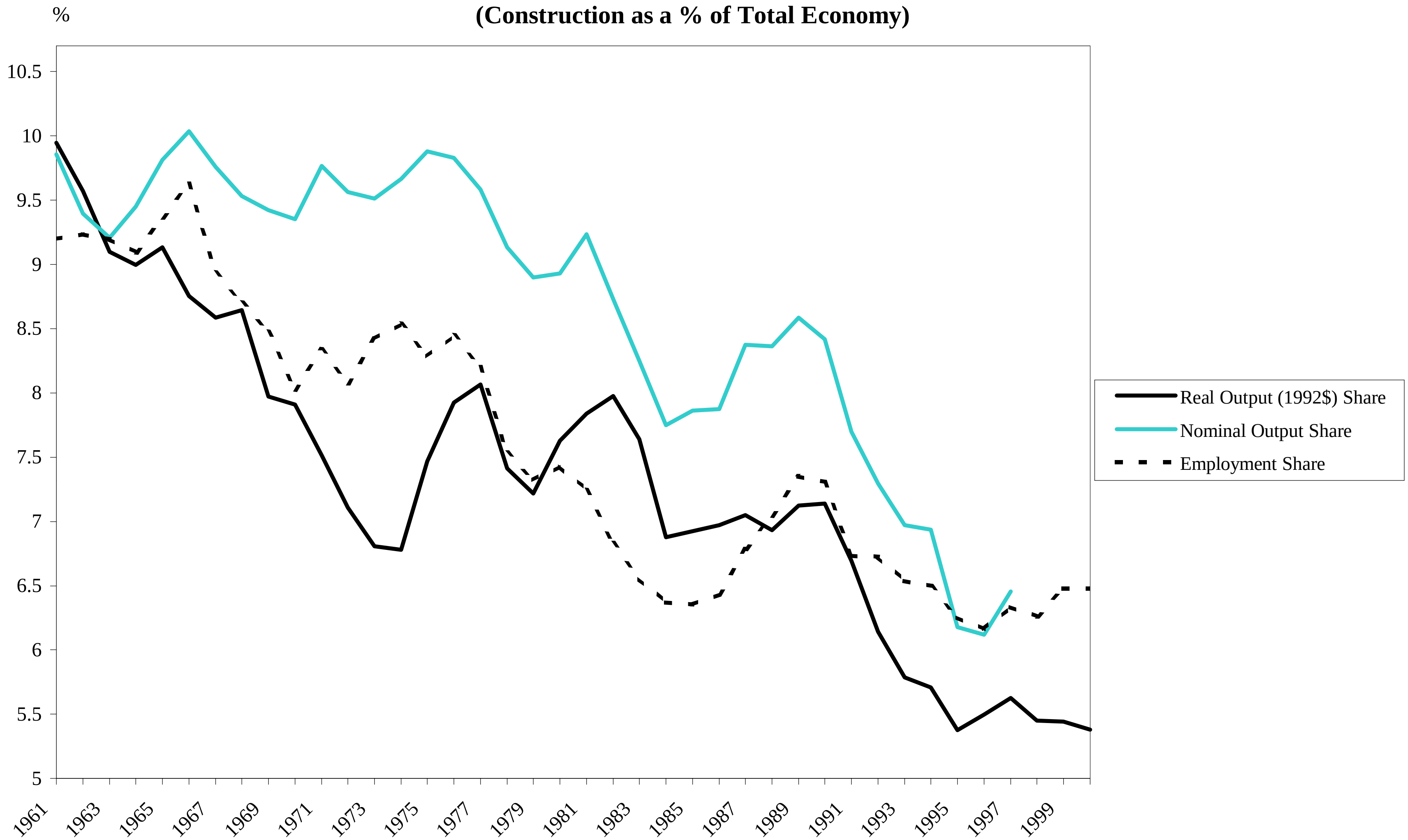
Exhibit 3: Apparent Origins and Causes of Technological Change in Housebuilding Mainstream

	Research and Development by				**Builder's Incentive to Adopt**			**Helped or Inhibited by**	
Change in Product and/or Process (with approx. date of widespread acceptance)	Mfctrs. of materials, equipment, components	Builders and their associations	Public Sector (NRC etc.)	Univer-sities	Speed with less skills and less cost	Enhance quality	Exploit public sector incentives	Building Codes	Acceptance (CMHC)
Platform frame; some tilt-up, some pre-cutting (1946)	y	y	y	y	y	y	y		
Insulation (1950)	Y		Y	Y		Y	y	y	Y
Warm air heating counter-convection (1950)	Y		y	y		y			
Manufactured windows with frames (1950)	Y				Y	y			
Transit-mix concrete basements (mid-to-late 1950s)	Y				Y	y			
Manufactured cabinetry (mid-1950s)	Y								y
Plywood sub-floors and sheathing(mid-1950s)	Y	y	y	y	Y	y		n-y	Y
Drywall interior finish (late 1950s)	Y				Y			n-y	
Prefab formwork basements (late 1950s)	Y	y			Y	y			
"Stationary assembly line" (late 1950s)	y	Y		y	Y		y		
Roof Trusses (mid-1960s)	Y		Y	Y	Y	y		n-y	Y
Fork lifts, truck-mounted hydraulic cranes, palletizing . . . (mid-1960s)	Y				Y				
Winter construction (mid-1960s)	Y	Y	Y	y	y		y	n-y	Y
Prefinished, low maintenance claddings (mid-1960s)	Y				Y				Y
More reliable sealed double windows (mid-1960s)	y		Y			Y			Y
Plastic vapour barrier (1970s)	Y		y			Y		Y	Y
Plastic dwv piping (early to mid-1960s)	Y				Y			n-y	Y
Plastic weeper tile (early 1970s)	Y	y			Y				Y
Waferboard sheathing, sub-floor (mid-1970s)	Y		y		y			n-Y	Y
Higher levels of insulation and air-tightness (mid-1970s)	y	y	y	y		y	y		
Presently making inroads:									
All-plastic plumbing	Y				Y			n-y	y
Plastic bath/shower units	Y				Y			n-y	y
Computerized cost control	Y	y			Y	y			
Mechanical air handling and heat recovery	Y	y	y	y		y	y	y	y
Exhaust air heat pump heat recovery	Y	y	y	y		y	y		

Legend
Y: "yes" -- a substantial positive role or influence
y: some positive role or influence
blank space: no known or consistent role for or against the particular change

Source: *The Housing Industry: Perspectives and Prospectives*, Working Paper Two Exhibit 2, p. 19, CMHC, 1988, and Scanada Consultants Limited 1967.

Chart 1: Trends in Output and Employment in the Construction Sector, 1961-2000
(Construction as a % of Total Economy)



Source: Statistics Canada - Labour Force Survey, GDP Data, Aggregate Productivity Measures

Chart 2
Output per Hour in the Construction and Residential Construction Industries and the Business Sector in Canada, 1981-2000

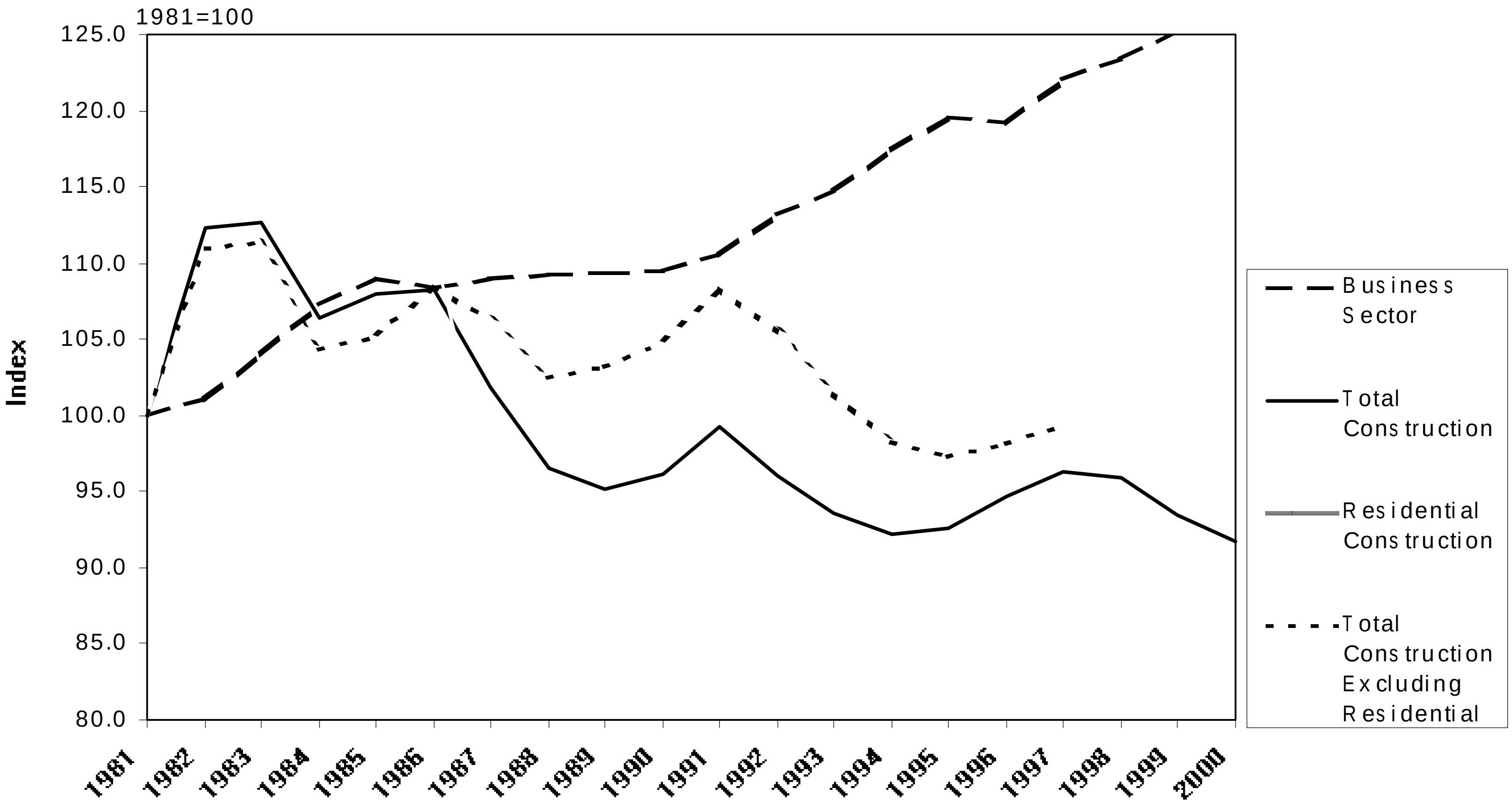


Chart 3
Output per Hour in Total Construction, Residential Construction, and the Business Sector in Canada, 1961 - 2000

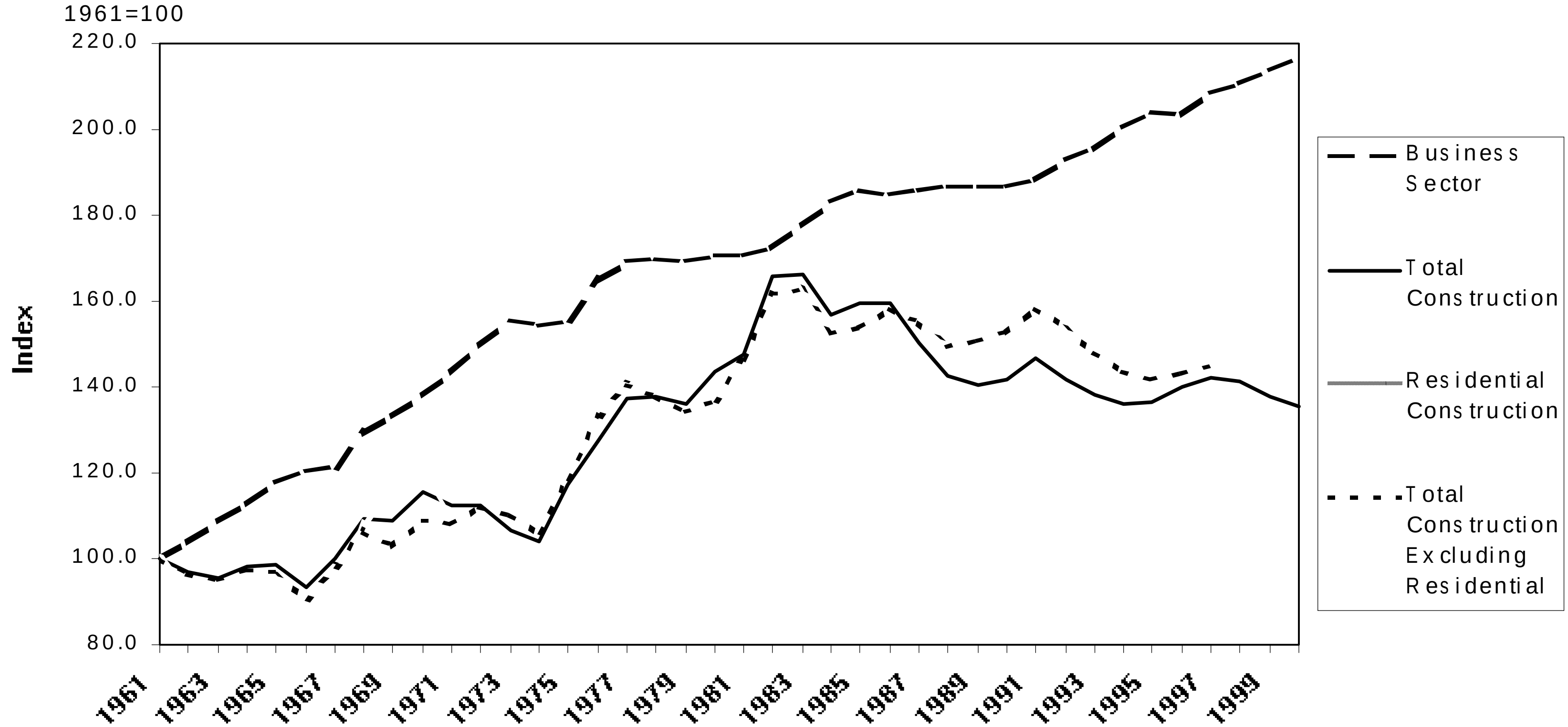
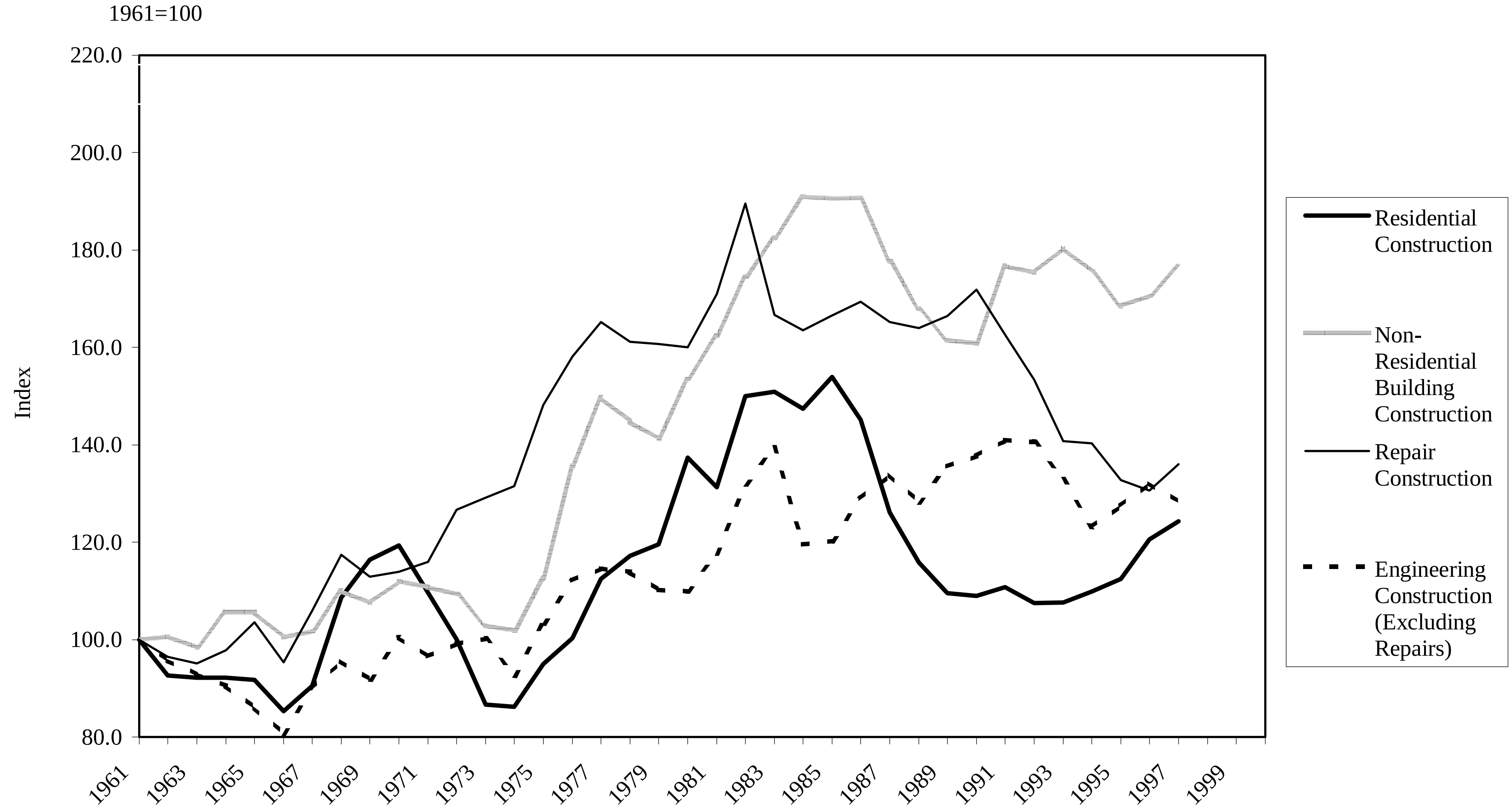


Chart 4: Output per Hour Trends in the Construction Sector by Industry, 1961 - 1997

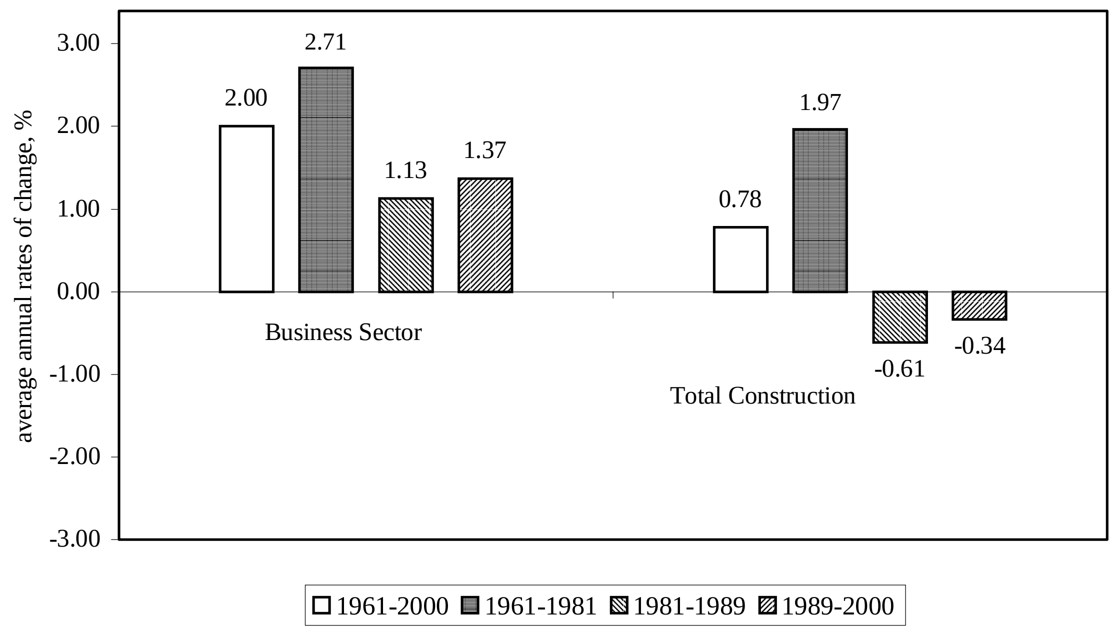


Source: Aggregate Productivity Measures, May 2001, Statistics Canada

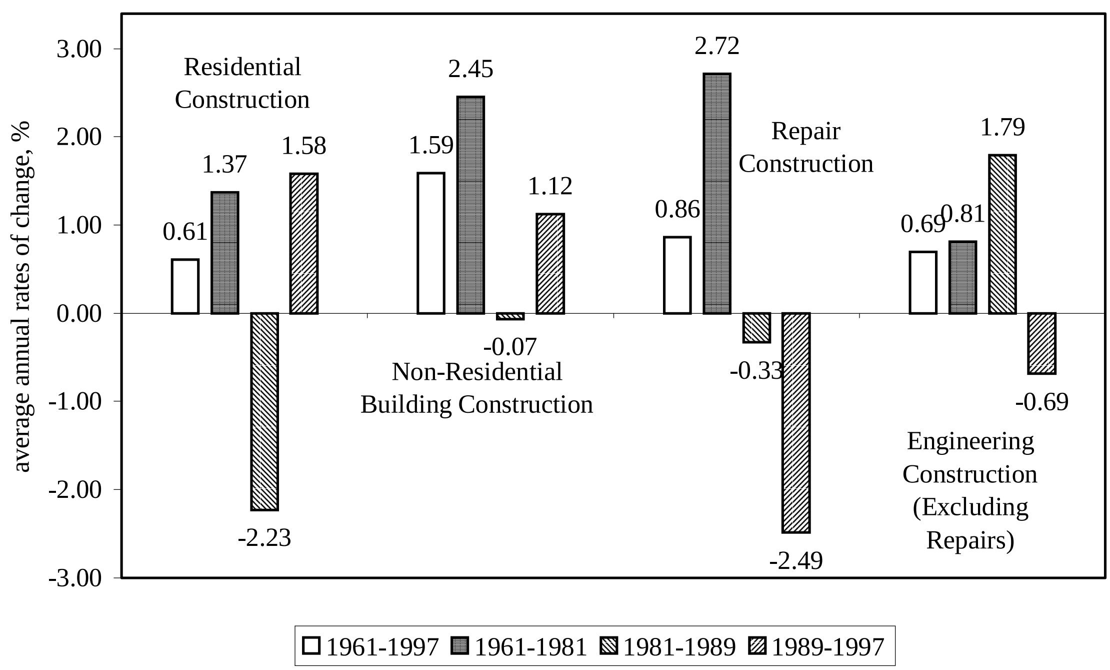
Chart 5

ut per Hour Trends in the Business and Construction Sectors, selected pe

a) Business Sector and Total Construction

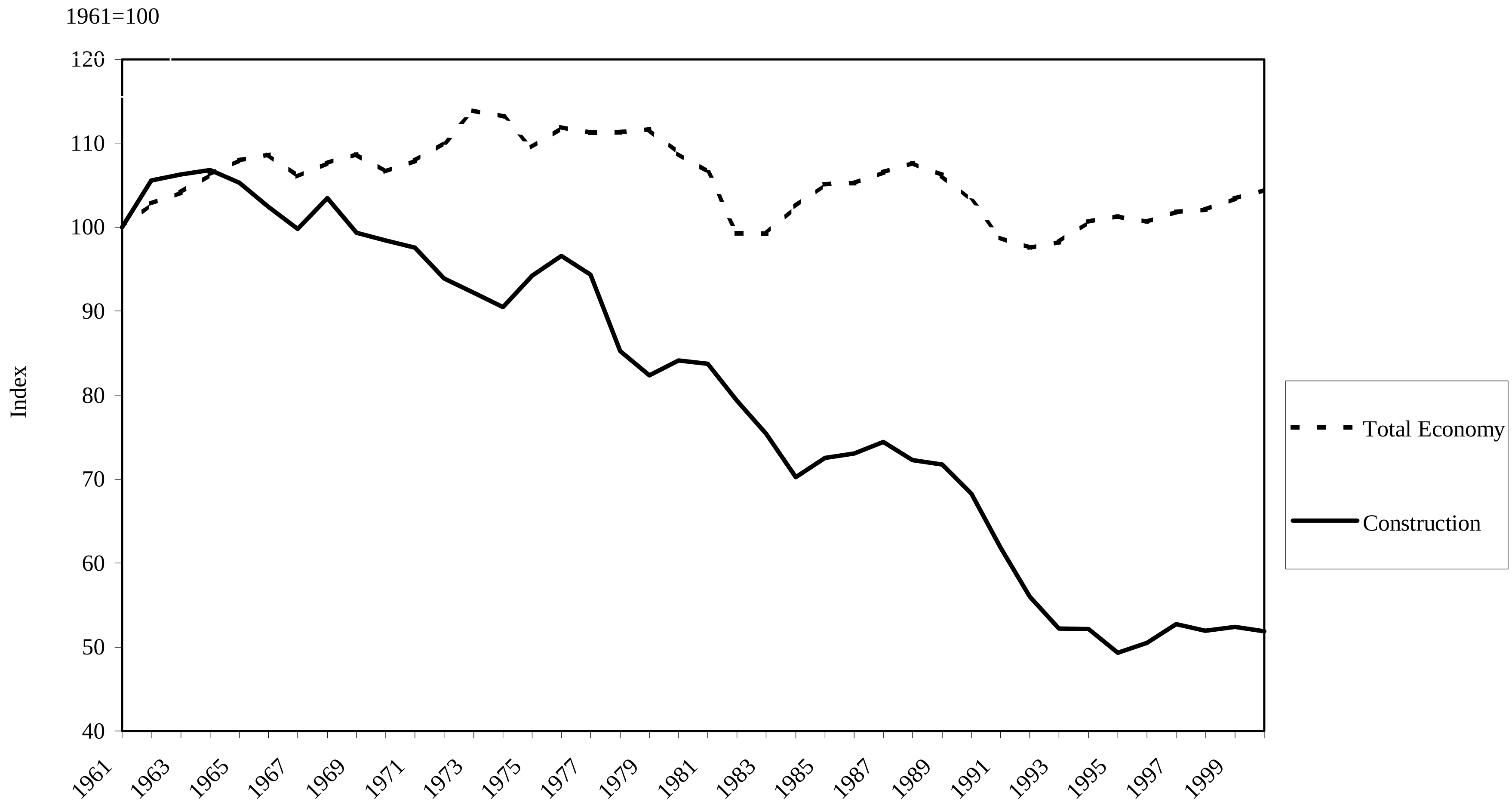


b) Components of Total Construction



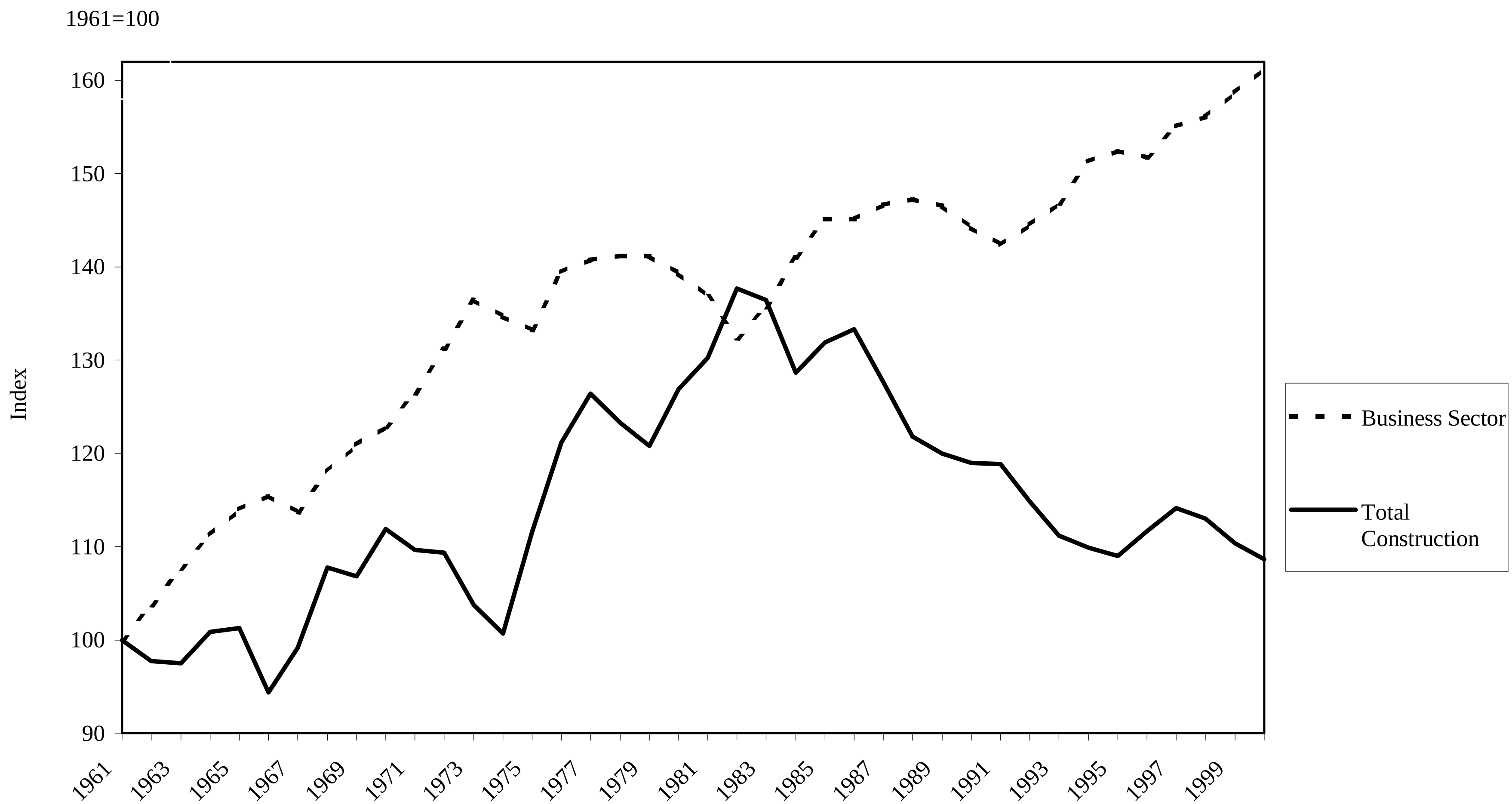
Source: Aggregate Productivity Measures, May 2001, Statistics Canada

Chart 6: Capital Productivity in the Total Economy and Construction Sector, 1961-2000



Source: Capital Stock Data, Aggregate Productivity Measures, Statistics Canada

Chart 7: Total Factor Productivity in the Business and Construction Sectors, 1961 - 2000



Source: Aggregate Productivity Measures, July 2001, Statistics Canada

Chart 8
CPI and Housing Prices in Canada, 1981 - 2000

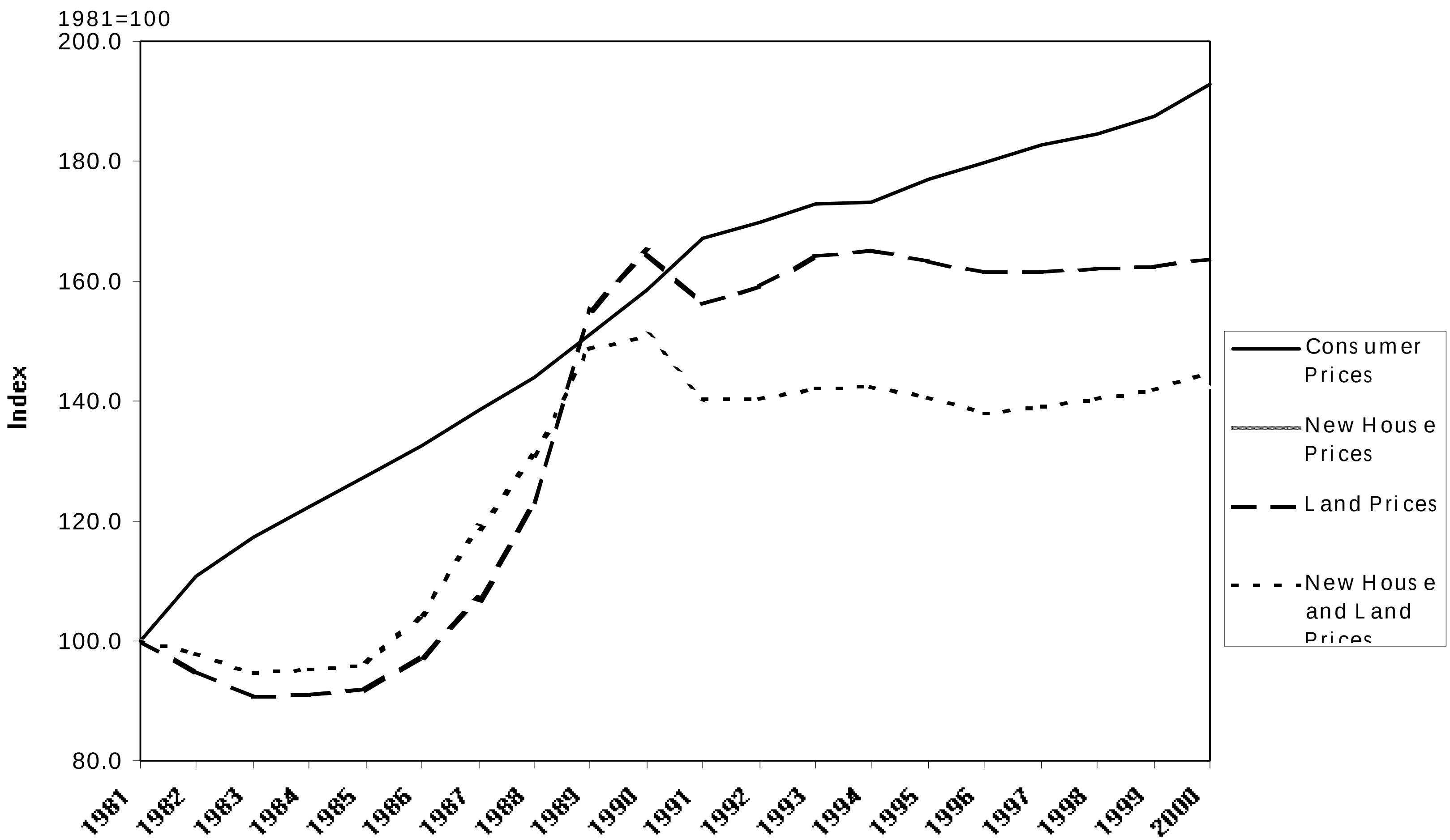


Chart 9
Unit Labour Costs in the Business Sector, Total Construction, and Residential Construction, 1961-2000

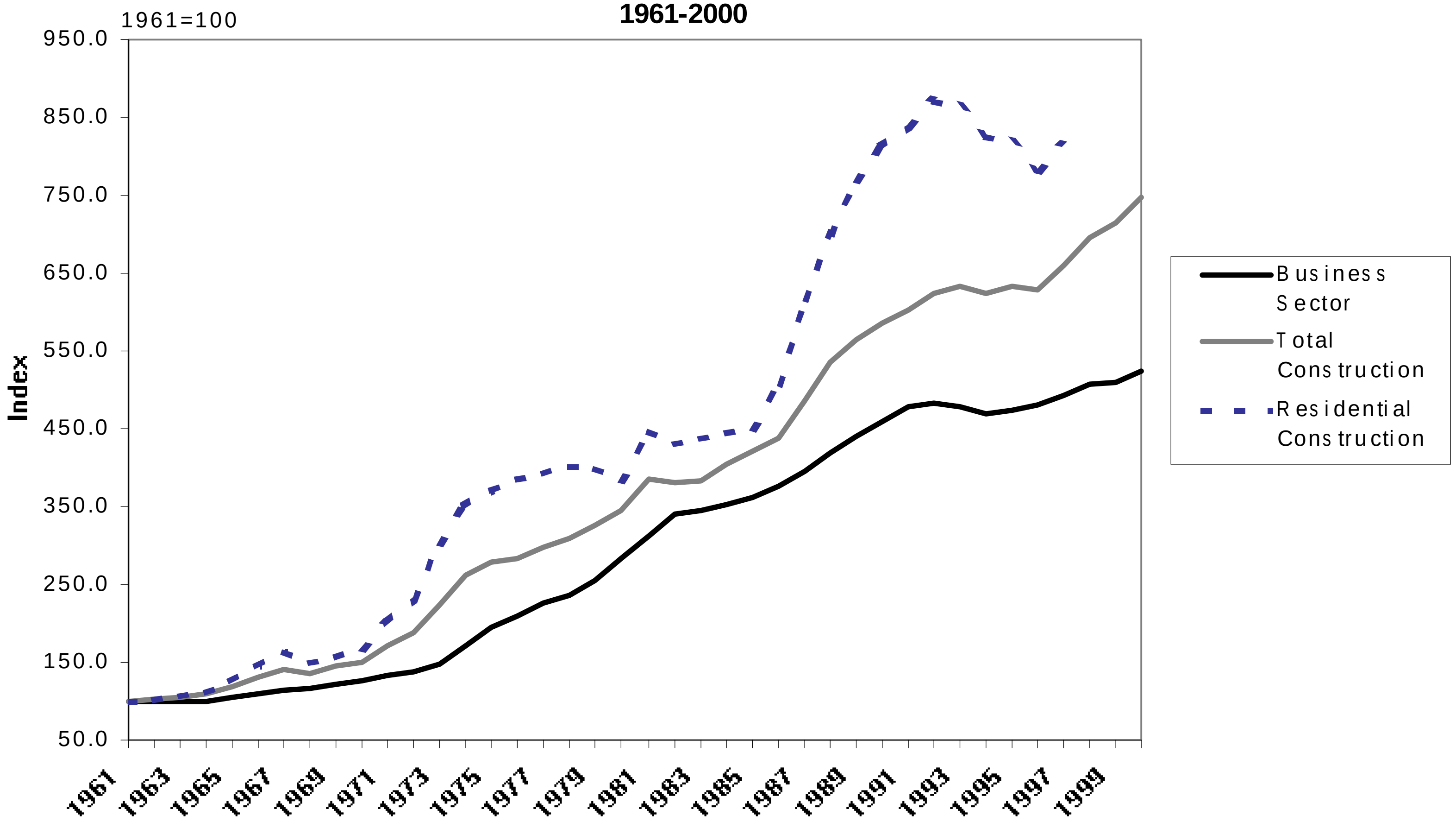


Chart 10
Housing Prices and Personal Income in Canada, 1981 - 2000

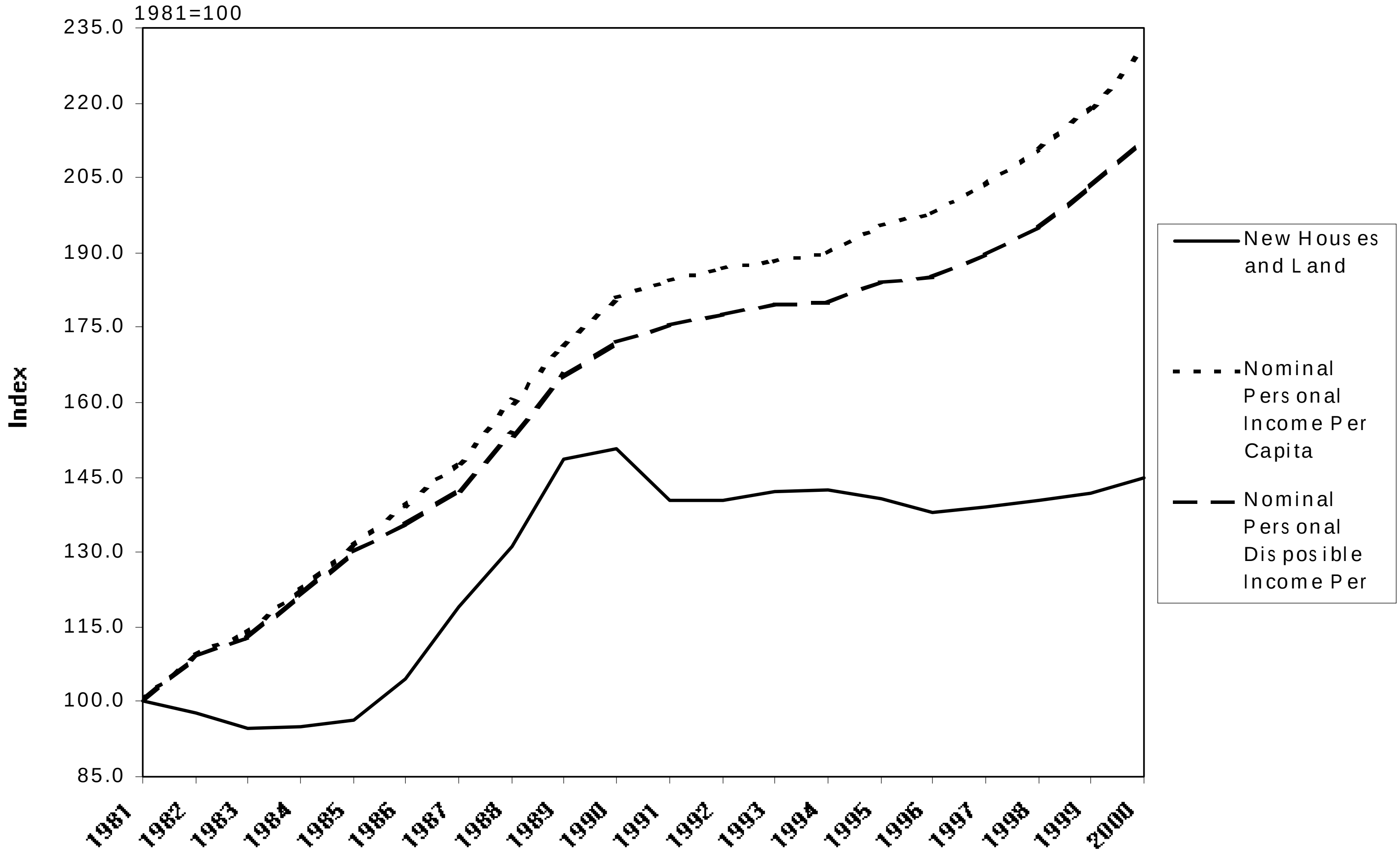


Chart 11
Trends in the Capital-Labour Ratio and Labour Productivity in the Construction Industry, 1976 - 2000

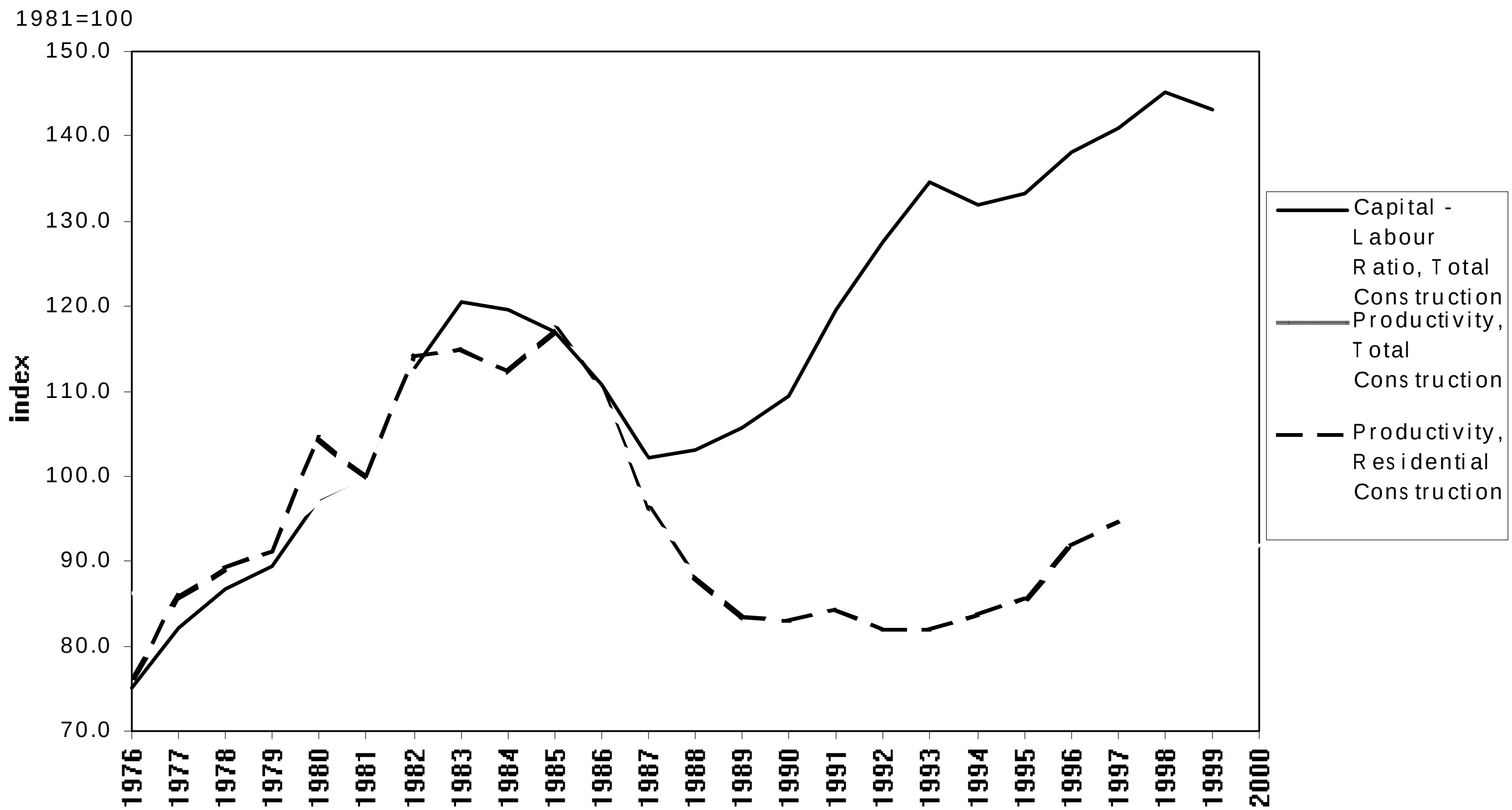


Chart 12
Trends in Attainment of a Post-Secondary Certificate or Diploma and Productivity in the Construction Industry, 1976-2000

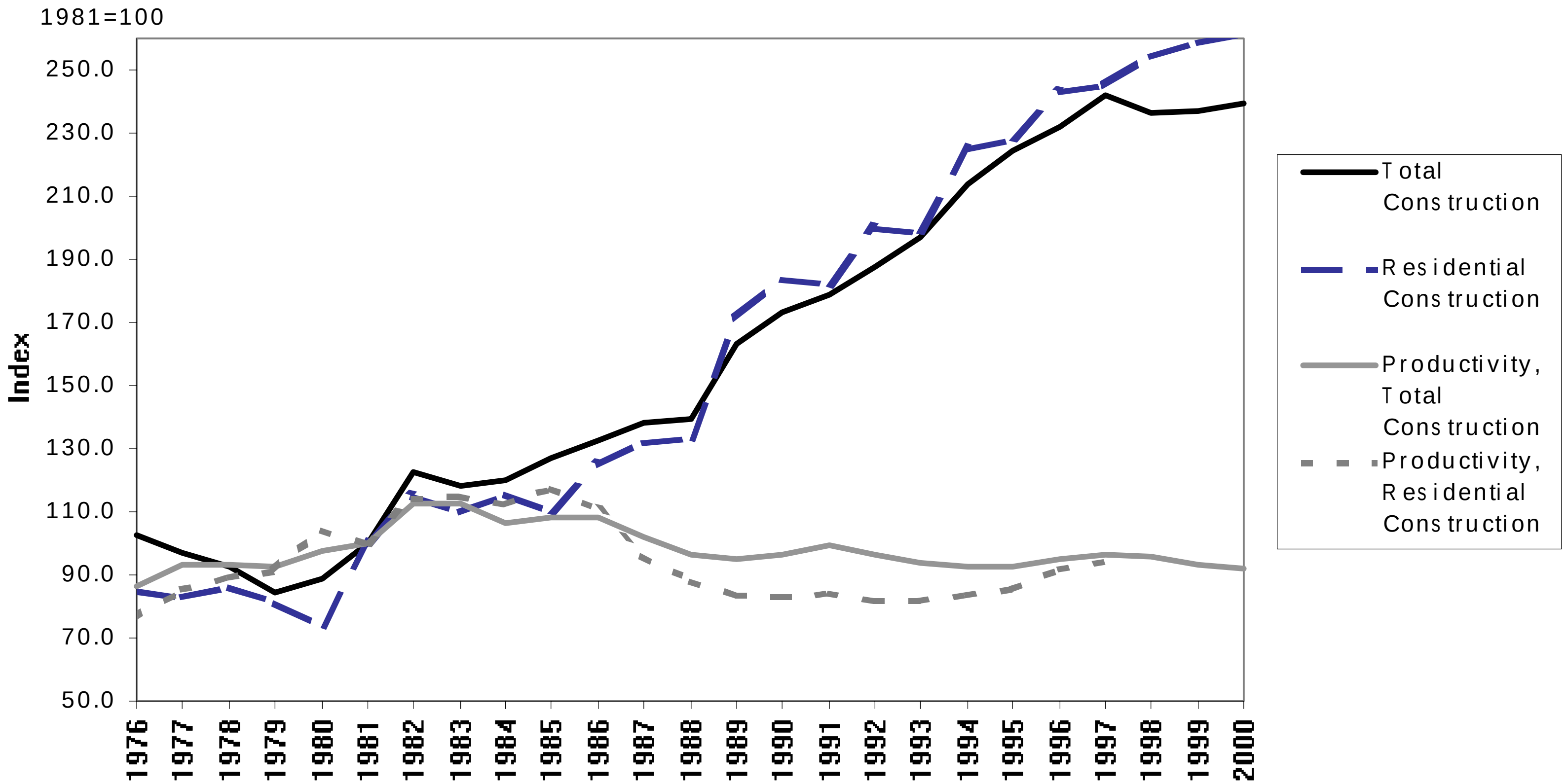
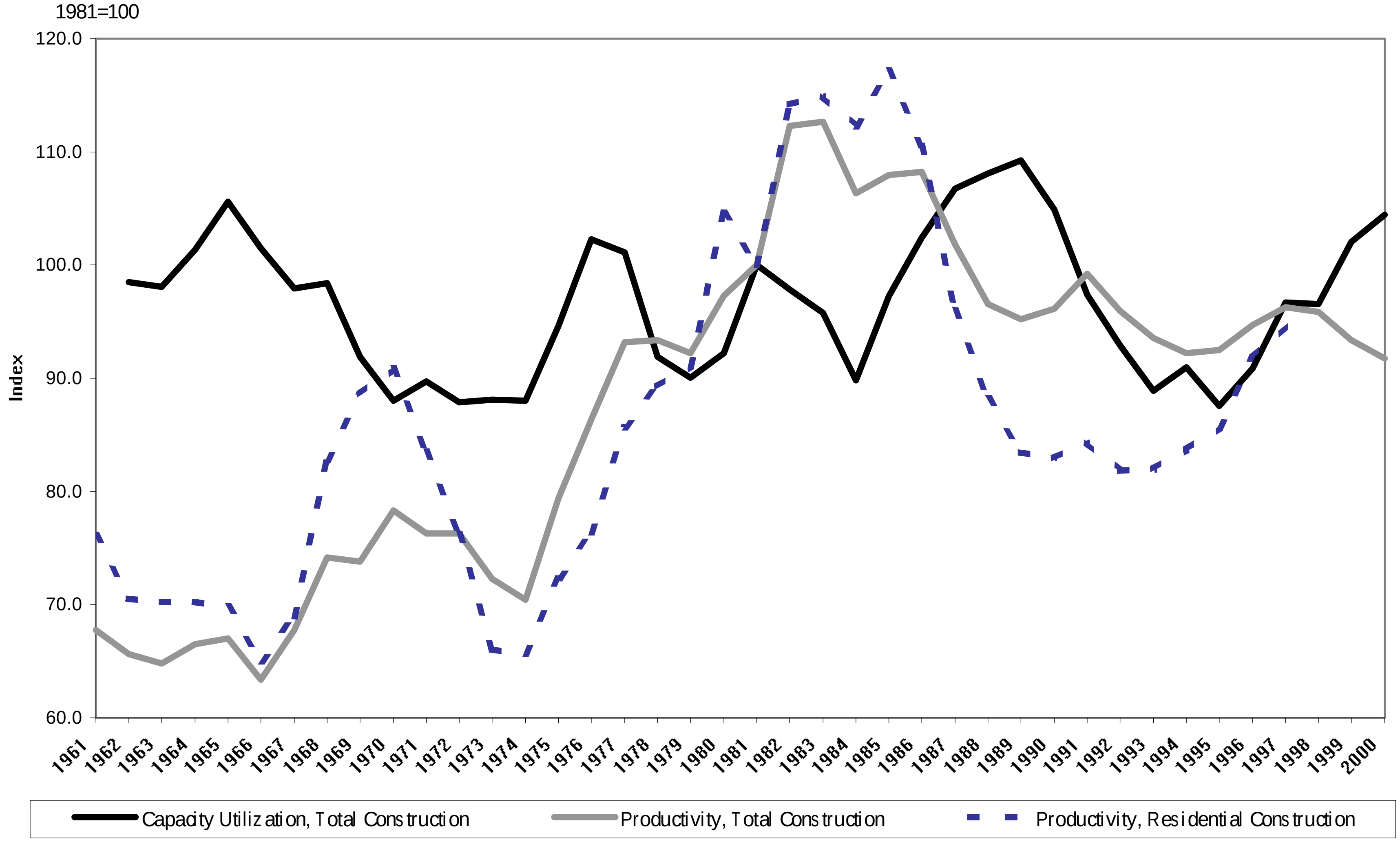


Chart 13
Capacity Utilization and Productivity in the Construction Industry 1961-2000



Source: Statistics Canada Aggregate Producivity Measures and Capacity Utilization data

Chart 14
Unemployment Rate & Productivity in the Construction Industry, 1976-2000

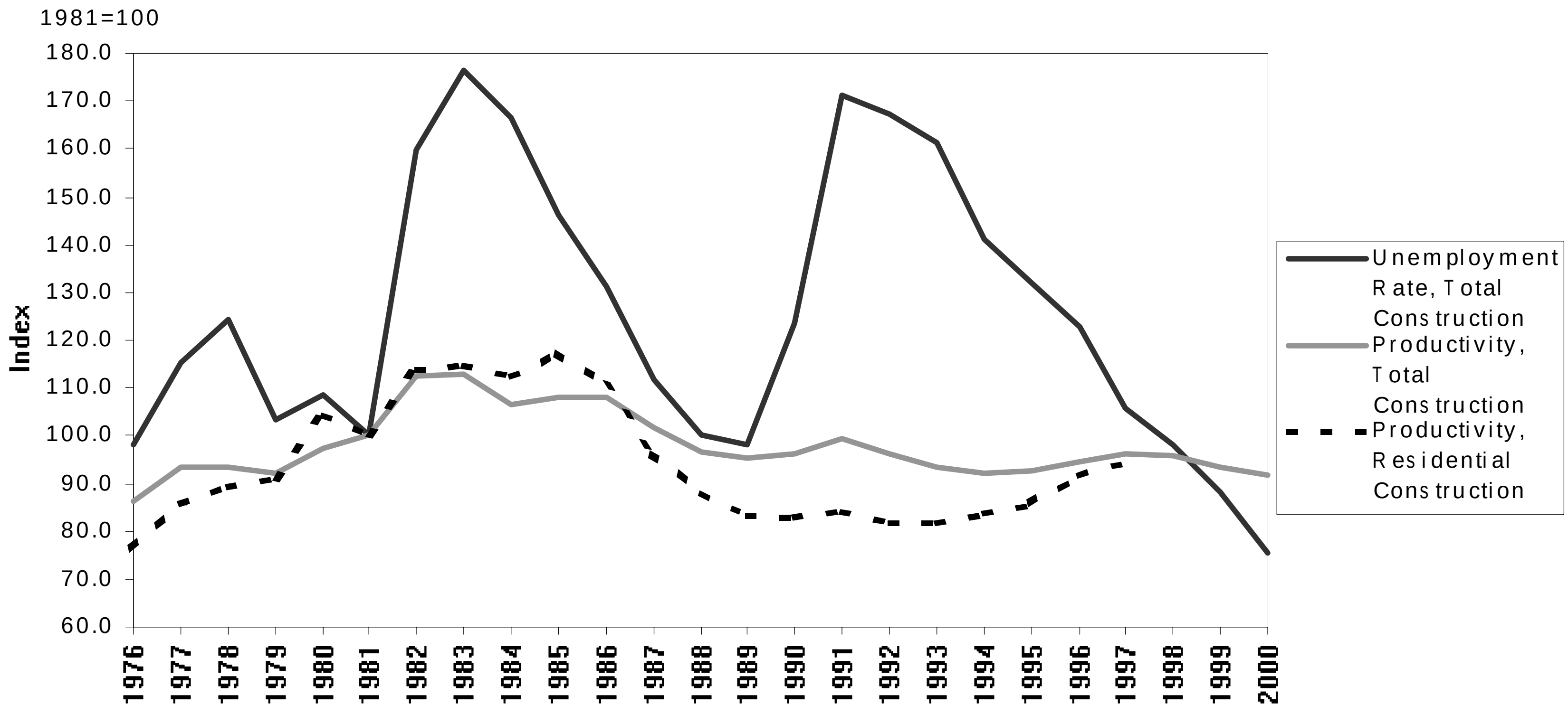
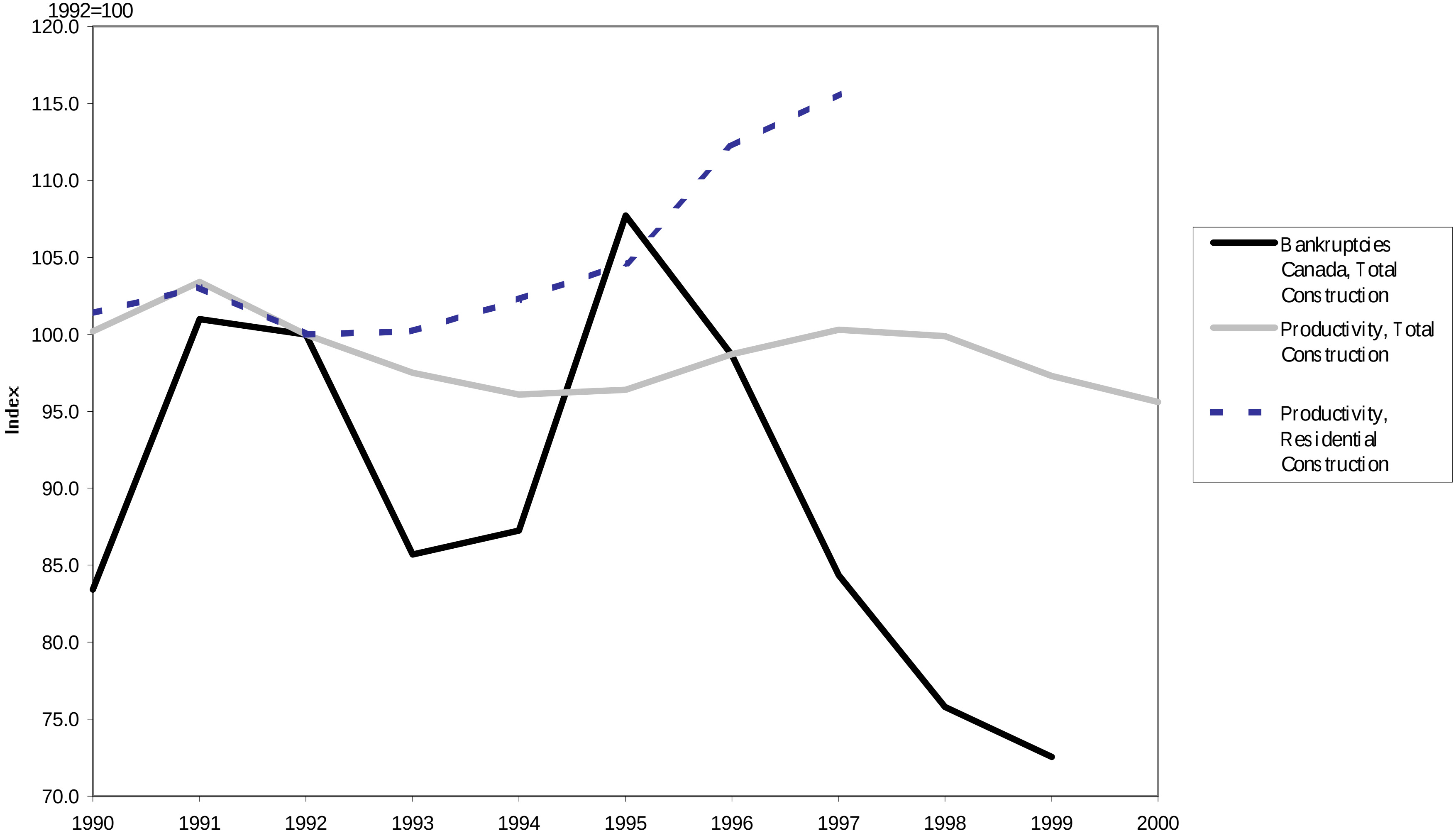
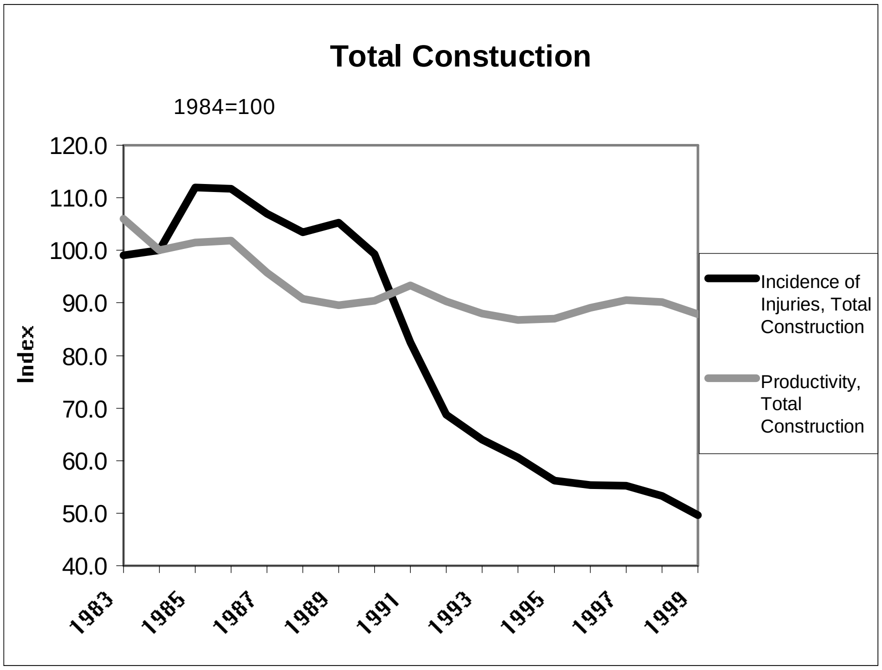


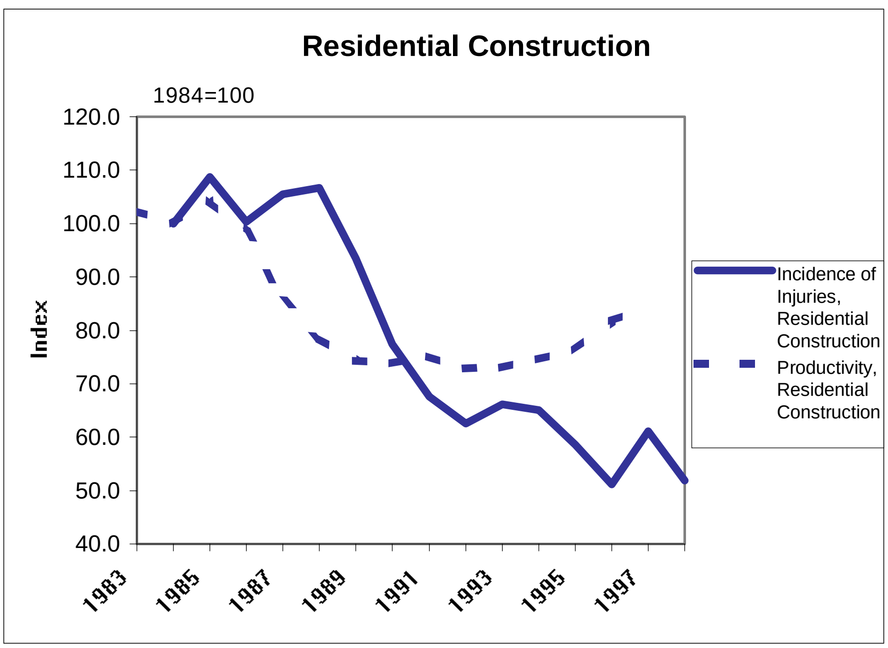
Chart 15
Bankruptcies and Productivity in the Construction Industry, 1990-2000



Source: Statistics Canada, Aggregate Productivity Measures and Bankruptcies by Industry

Chart 16: Incidence of Workplace Injuries and Productivity Growth in the Construction Sector, 1983-1999





Source: The Association of Workers Compensation Boards of Canada (AWCBC) for the National Work Injury Statistic
Statistics Canada, Labour Force Survey and Aggregate Productivity Measures

Chart 17: Union Density and Productivity in the Total Construction Industry, Canada, 1976 - 2000

Source: Statistics Canada, Historical CALURA series, Labour Force Survey, and Aggregate Productivity Measures