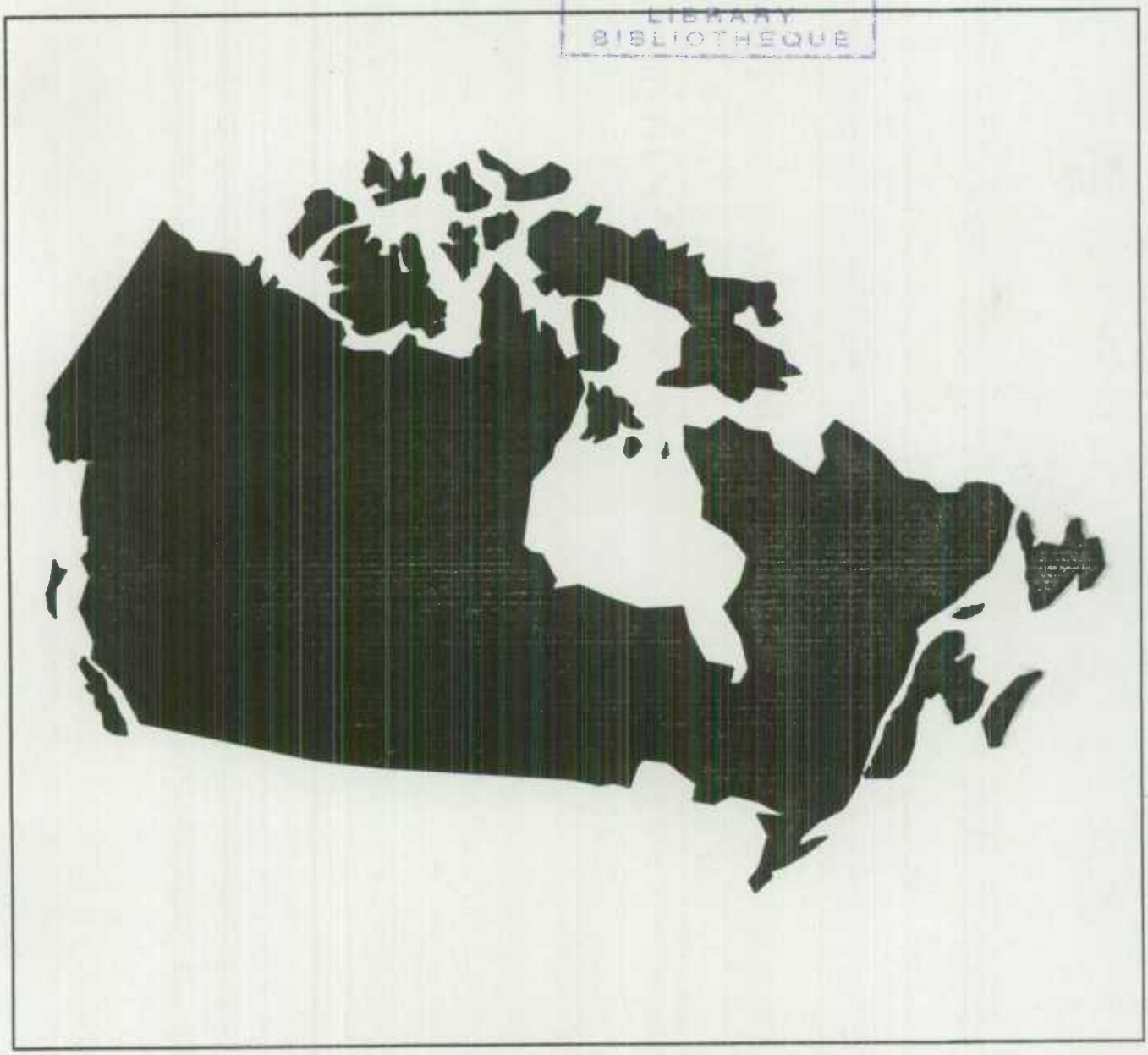
Income and Expenditure Accounts Division

PROVINCIAL DEFLATION DEVELOPMENT PROJECT

Background Paper



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PROVINCIAL DEFLATION DEVELOPMENT PROJECT

Income and Expenditure Accounts Division

Statistics Canada

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TABLE OF CONTENTS

PROVINCIAL DEFLATION PROJECT *

PREAMBLE

A project to develop constant dollar estimates of provincial gross domestic product has been discussed at federal/provincial meetings of the Provincial Economic Accounts Committee. The present study was initiated by the Government of Ontario, who entered into a contract with Statistics Canada to undertake the work for their province. Before the availability of such estimates from Statistics Canada, the Conference Board and some provinces had been filling the gaps with their own estimates. With the impetus provided by Ontario, and the requirement to have a consistent system across all provinces, estimates have now been developed for all the provinces and territories[1].

Members of the Income and Expenditure Accounts Division who have worked on the current project include: Karen Ashman, Rémi Fournelle, Gylliane Gervais, Katharine Kemp, Deborah MacDonald, Michel Pascal, Philippe Rhul, Edith Sederis, Veronica Utovac, Michel Vallières, Lois Whitmore, Karen Wilson.

The provincial and territorial estimates of final domestic demand at 1981 prices, presented in this report, are published in the Provincial Economic Accounts, annual Estimates, 1984-1988, Catalogue 13-213. Preliminary estimates, published four months after the reference year, are available in the Provincial Economic Accounts, Preliminary Estimates, 1989, Catalogue 13-213P. All these data are also available on CANSIM, diskettes and computer printouts.

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* This report was prepared by Katharine Kemp, Income and Expenditure Accounts Division, Statistics Canada.

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[1] An earlier development project to produce provincial constant dollars was undertaken for the period 1961-1978 and the results for the Personal Expenditure components were presented at a Federal-Provincial meeting of the Provincial Economic Accounts Committee, January 18-19, 1978. A paper was distributed, Sources and methods for the deflation of provincial consumer expenditure, by A. Baldwin and H. Messinger, then of the Gross National Product Division. The present study has drawn on the previous results and methodology for the earlier years of the seventies.

The Final Domestic Demand estimates at constant prices will be rebased from a 1981 time and weight base with the release of the next Provincial Economic Accounts early in 1991. Historical patterns and real growth rates will not be effected prior to 1986, although the series will be linked to the new 1986 time base and expressed in 1986 dollars. The data from the period 1986 forward will be revised to reflect more recent output and expenditure patterns and published growth rates will be affected by these changes. All rebased series will have new CANSIM identifiers, which will be announced when the rebased series are released.

INTRODUCTION

Reasons for interest in constant dollar estimates at the provincial level include the following:

- The provinces want to use provincial estimates in planning, forecasting and budgeting exercises for themselves. Several prepare their own provincial estimates, but with a more consistent approach developed through the work of Statistics Canada, more standardized interprovincial comparisons and analysis will be possible and the provinces will be able to compare their results with those of Statistics Canada.

- Regional economic modellers want regional factors and relationships as much as possible for inclusion in their econometric models so that structural analysis will be relevant on a regional basis.

- Analytical uses, for example, industrial composition of production, comparisons of regional growth rates, investment output ratios, variations in growth rates of government spending on goods and services, and investment trends. Some of these are shown in the 'results' section below with illustrative charts.

These kinds of requirements can be met by comparisons of provincial constant dollar aggregates and growth rates, removing the varying provincial impact of inflation.

COVERAGE

Constant dollar estimates and implicit price indexes for components of Final Domestic Demand (FDD) only are included in the present study - personal expenditure, government current expenditure on goods and services, and investment; estimates to complete the estimation of the Gross Domestic Product, that is, including inventories in the investment category and interprovincial trade components will be part of future development work.

The present estimates cover the period 1971-1988, with 1981 = 100 based implicit price indexes and constant dollars in 1981 prices.

Estimates for ten provinces, Yukon and Northwest Territories are available from 1977 to date. For the period 1971-1976 estimates are available for ten provinces and the combined North. The estimates are annual as are the current dollar series.

RESULTS AND ANALYSIS

Some key findings have been selected and presented in chart form. These include:

- growth rates of final domestic demand (FDD), by province
- provincial shares of FDD
- growth rates of investment as a proportion of FDD
- growth rates of residential construction
- growth rates of government expenditure compared with FDD
- relative price movements (among provinces)

The charts highlight several factors that emerge from the provincial constant dollar estimates. They show, for example,

- annual growth rates for 1981-1988 for Final Domestic Demand in 1981 prices have varied from -5.0% in the Northwest Territories to 4.8% in Ontario. The Canada average was 3.3%. (See Chart 1)

- for 1988 compared with the six year average for the period 1981-1988, all provinces (except Manitoba) and Yukon and Northwest Territories experienced growth rates above the average. (see Table 1).

- in comparing provincial shares of Final Domestic Demand for 1981 and 1988, Ontario has posted the largest relative gain while the Prairies, B.C., Yukon and Northwest Territories have recorded declines. (Chart 2 and 3).

- considerable volatility is shown among the components of Final Domestic Demand, especially in investment, and trends among provinces over the eighties have varied extensively.

- price movements as illustrated through the implicit price indexes of Final Domestic Demand are much less variable than the trends of constant dollars, both over time and among provinces. Trends in constant dollars reflect both the current dollar movements and the implicit price indexes.

Table 1

Final Domestic Demand, 1981 Constant Dollars

Growth Rates

	1981-1988	1988
Canada (published)	3.3*	6.2*
Nfld	3.4	5.3
PEI	4.1	6.5
N.S	3.4	5.2
N.B.	3.4	6.2
Que.	3.7	5.3
Ont.	4.8	6.6
Man.	3.0	2.6
Sask.	1.5	2.5
Alta.	0.2	8.2
B.C.	1.6	7.5
Yukon	1.1	5.2
NWT	-5.0	11.6

* Based on estimates published in June 1989, and adjusted to the concept for FDD for the provinces.

FINAL DOMESTIC DEMAND
CONSTANT DOLLARS

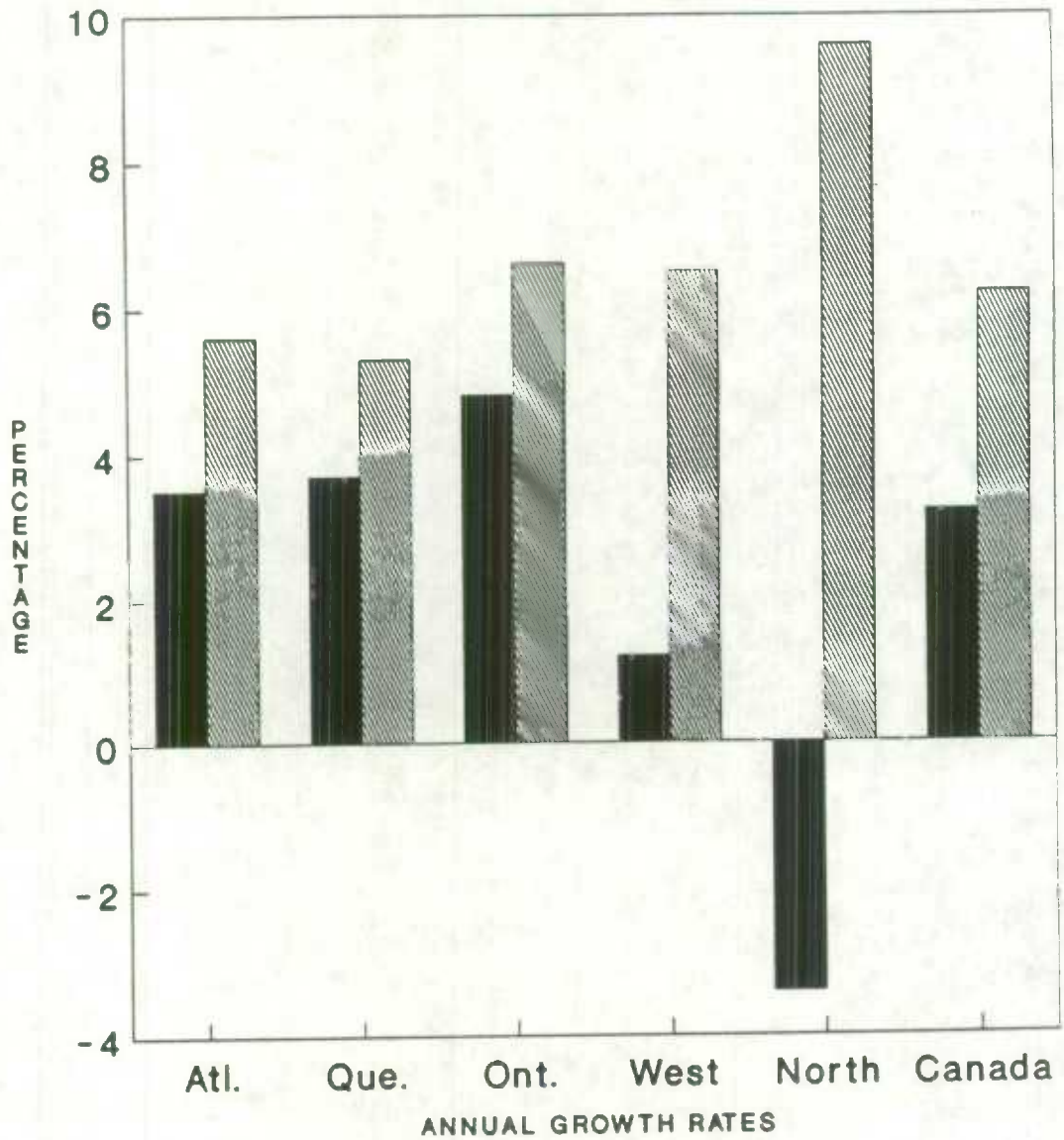

CHART 1

REGIONAL SHARES, 1981
FINAL DOMESTIC DEMAND

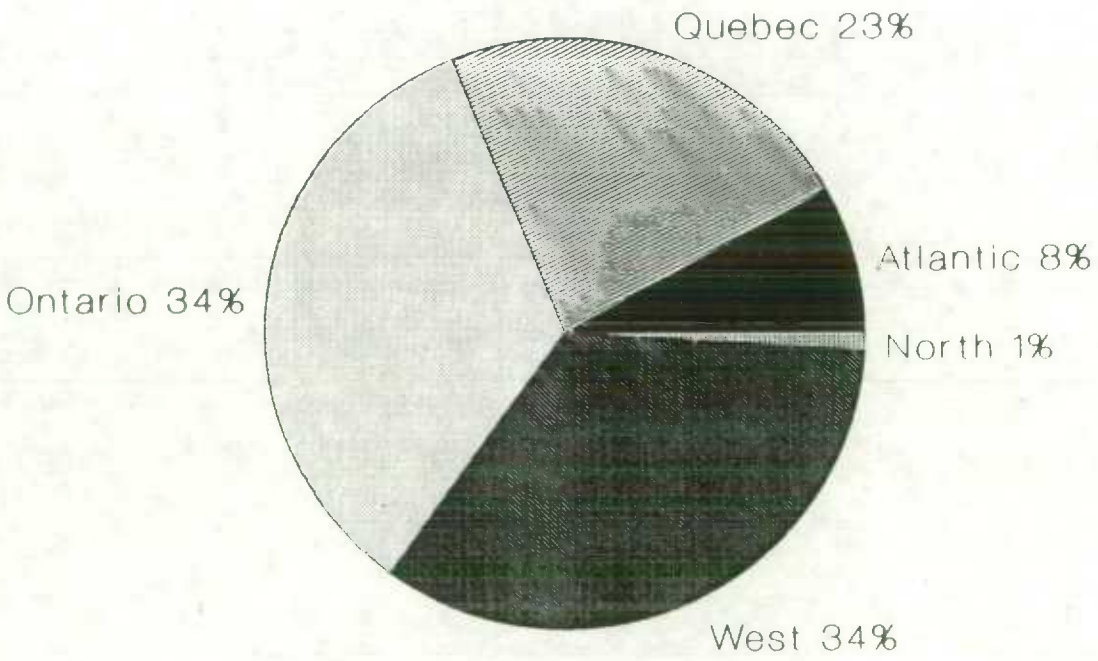

CHART 2

REGIONAL SHARES, 1988
FINAL DOMESTIC DEMAND

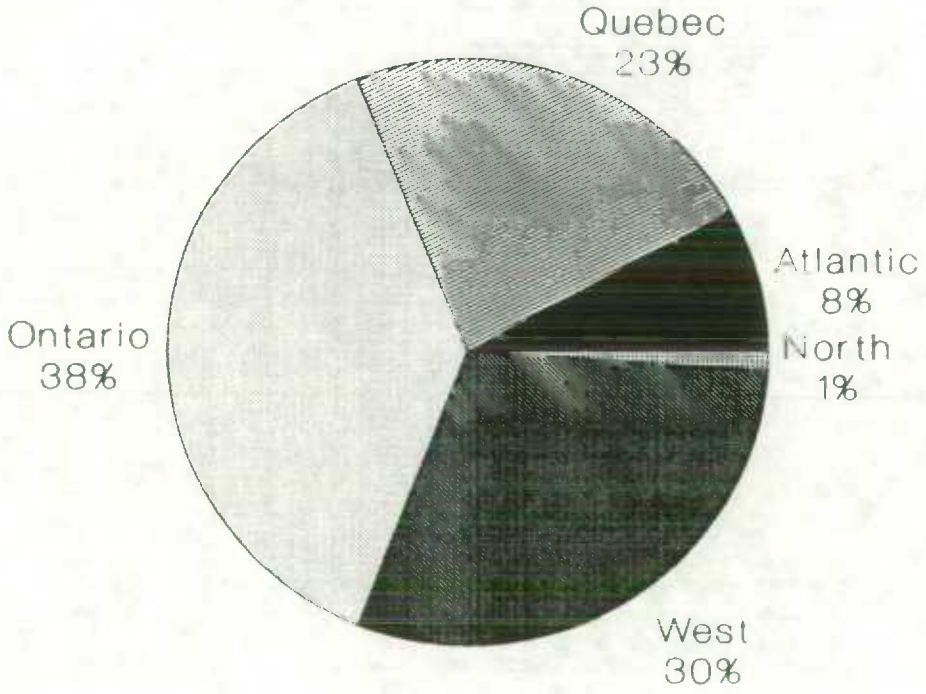

CHART 3

ANNUAL GROWTH RATES
CANADA

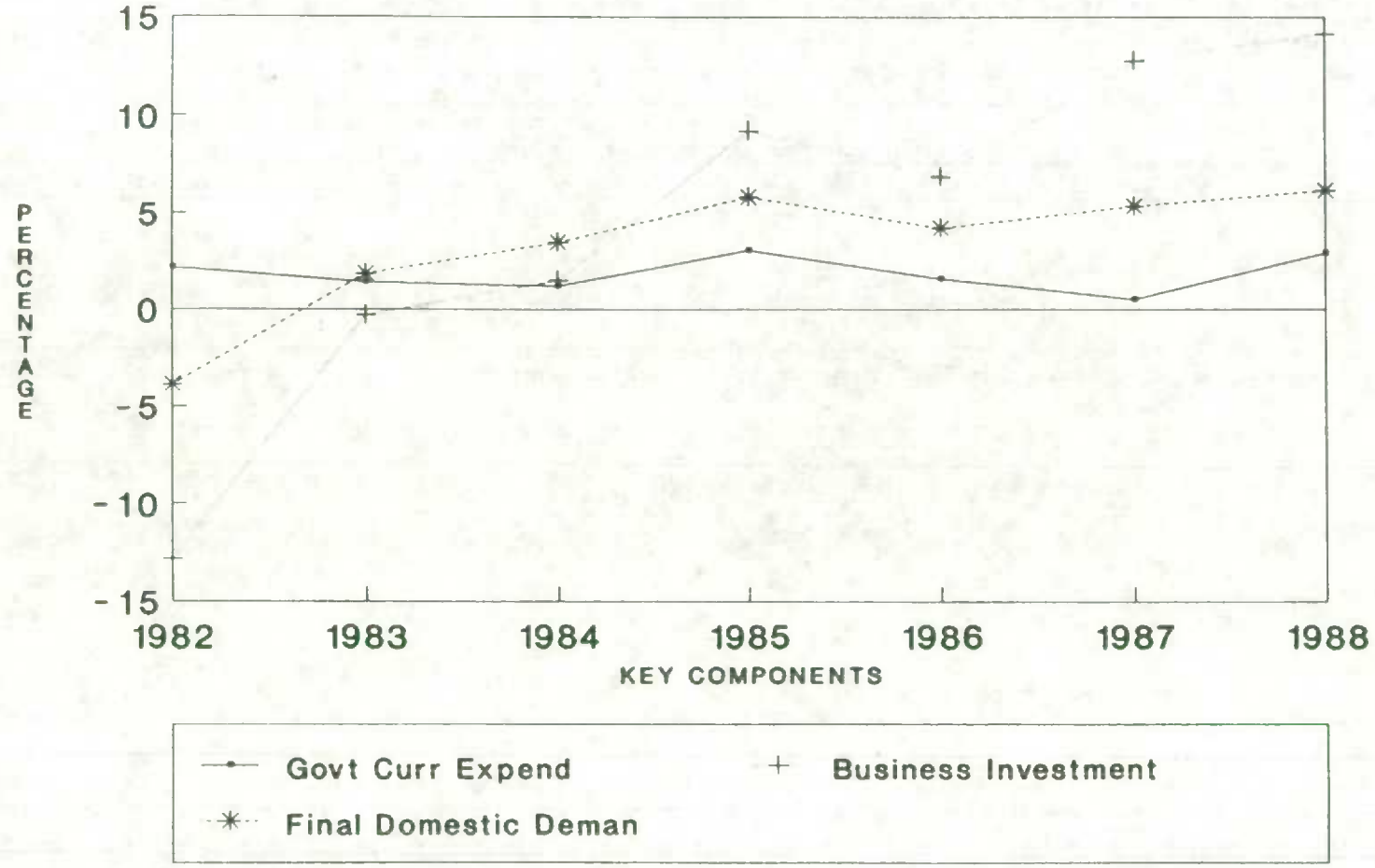

CHART 4

ANNUAL GROWTH RATES
ATLANTIC CANADA

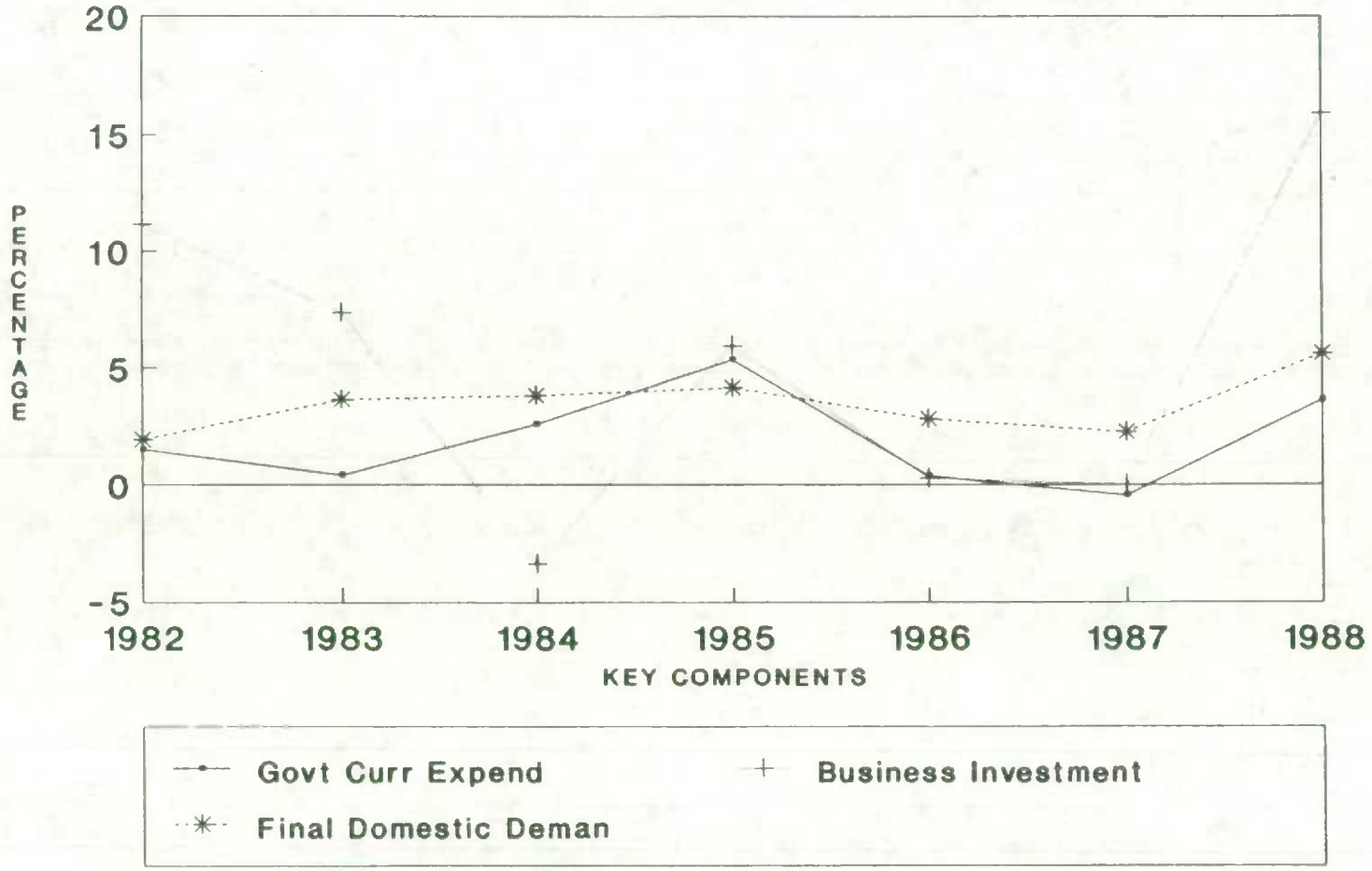

CHART 5

ANNUAL GROWTH RATES
QUEBEC

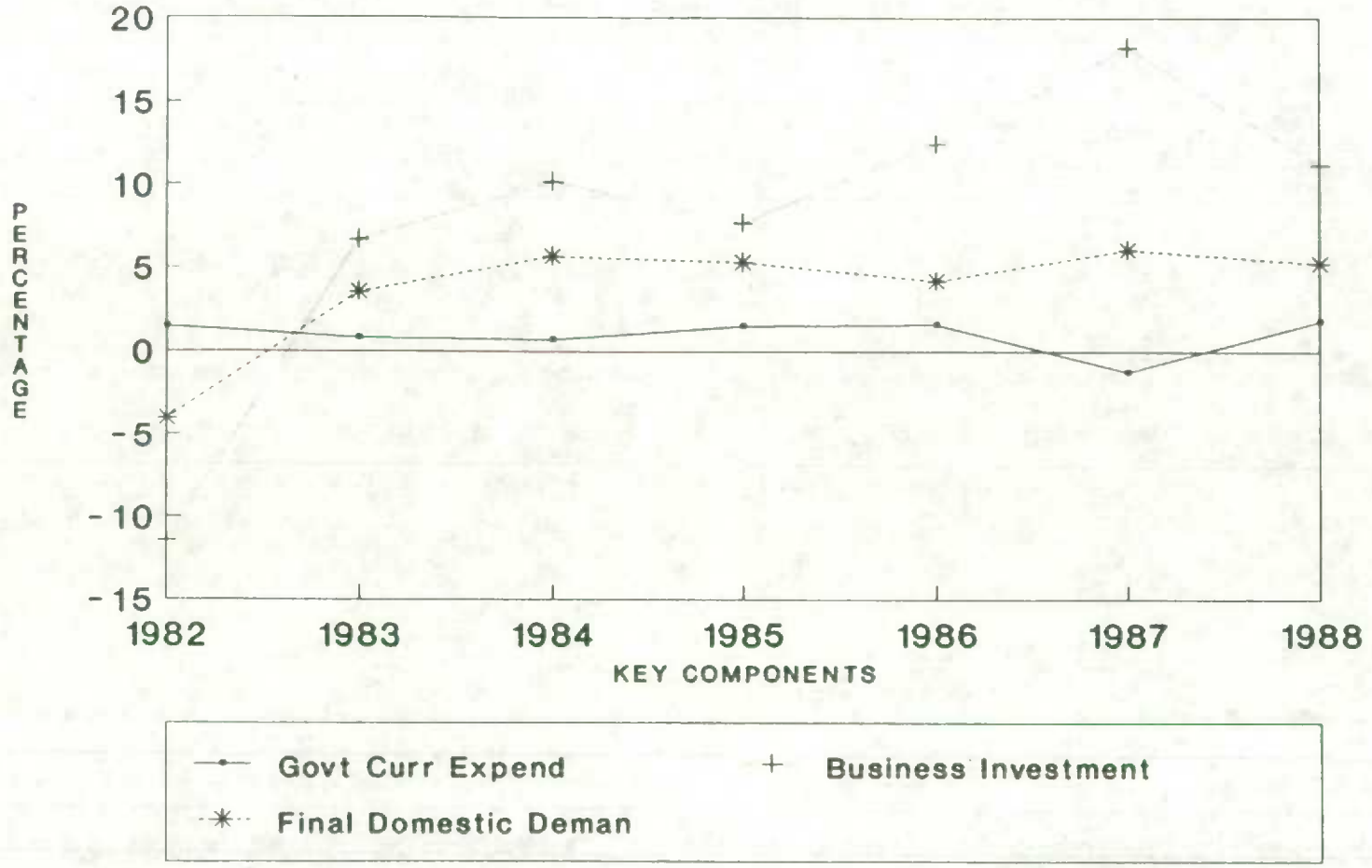

CHART 6

ANNUAL GROWTH RATES
ONTARIO

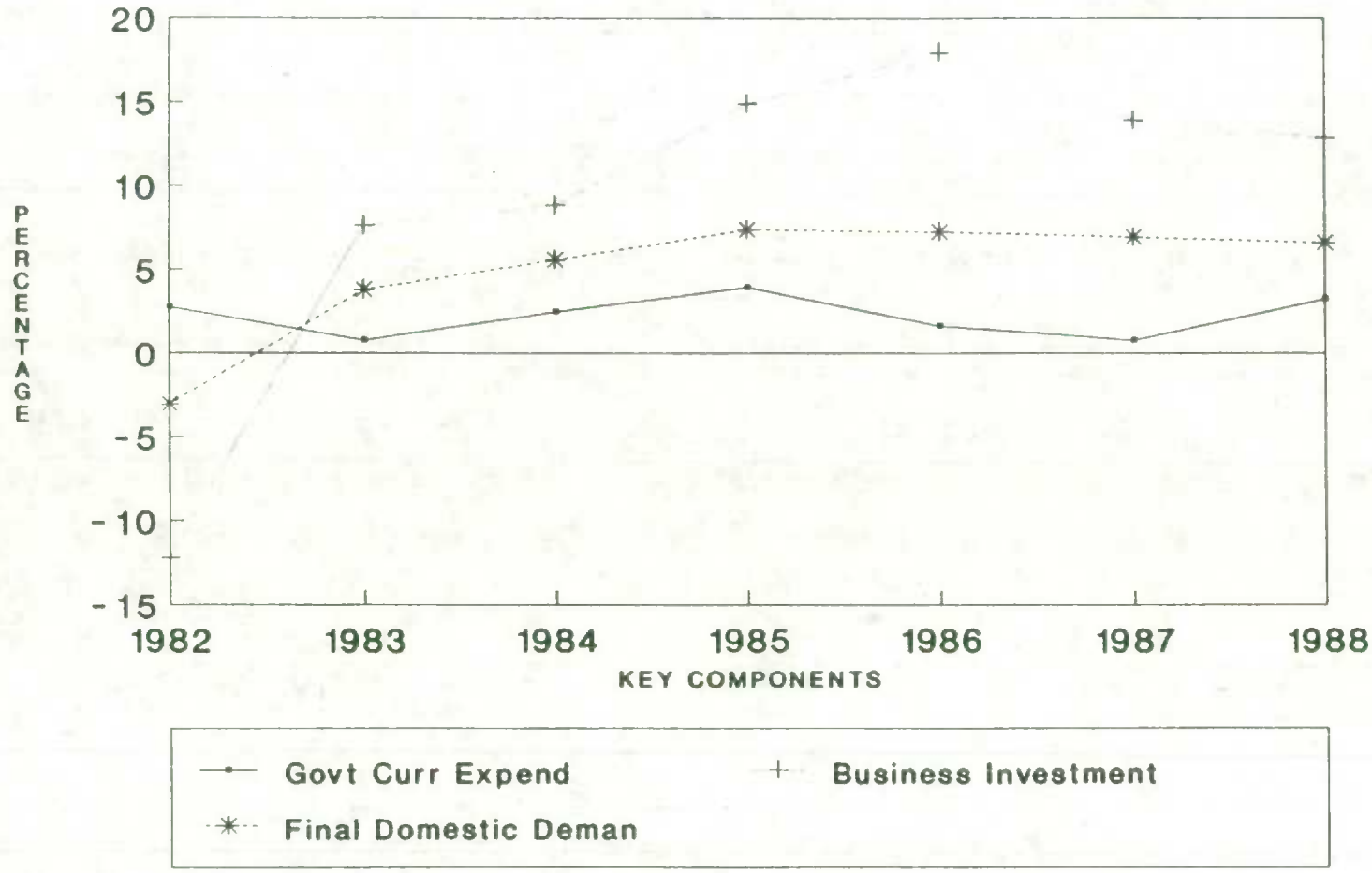

CHART 7

ANNUAL GROWTH RATES
WESTERN CANADA

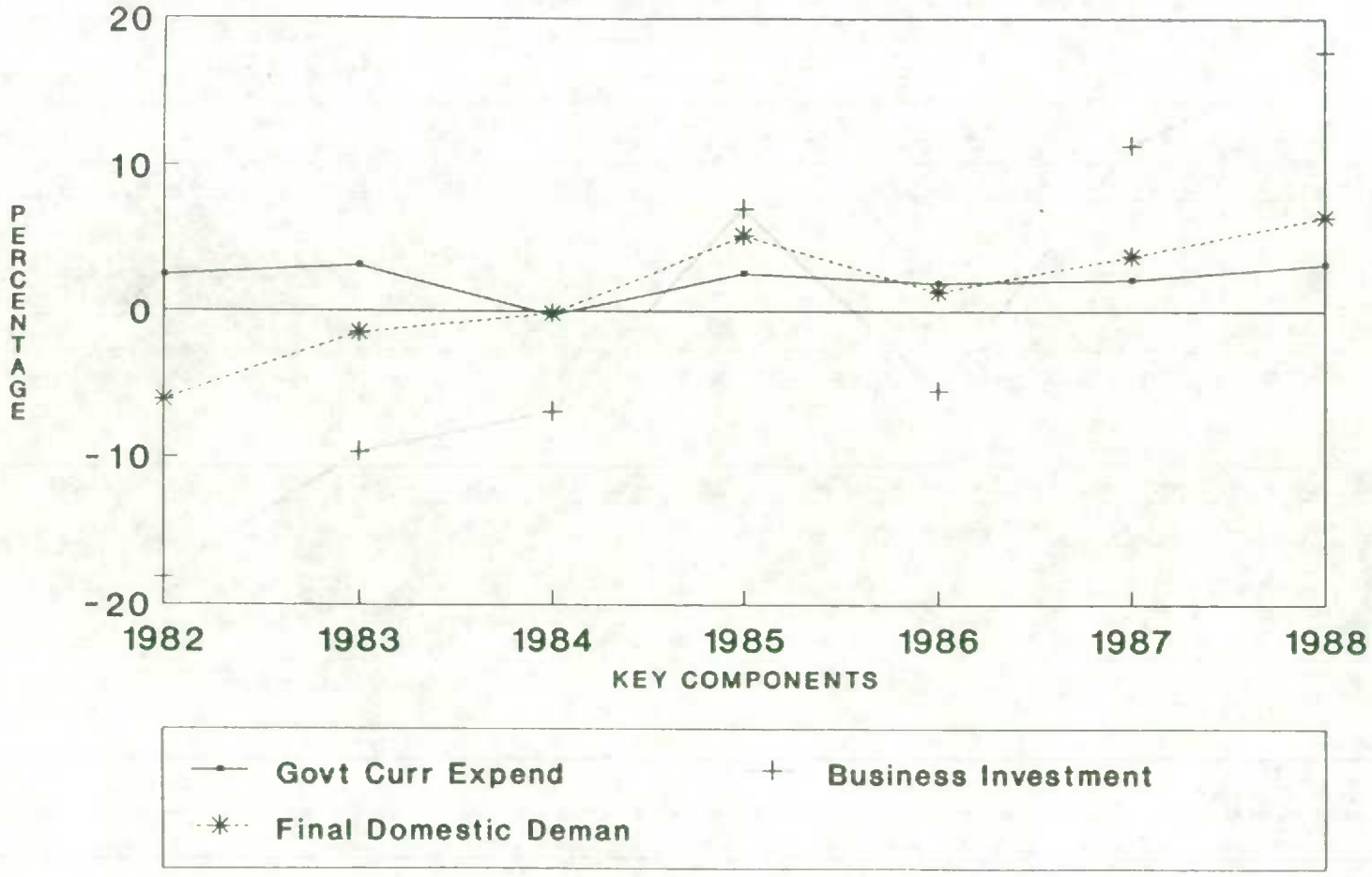

CHART 8

FINAL DOMESTIC DEMAND
CANADA and EASTERN PROVINCES

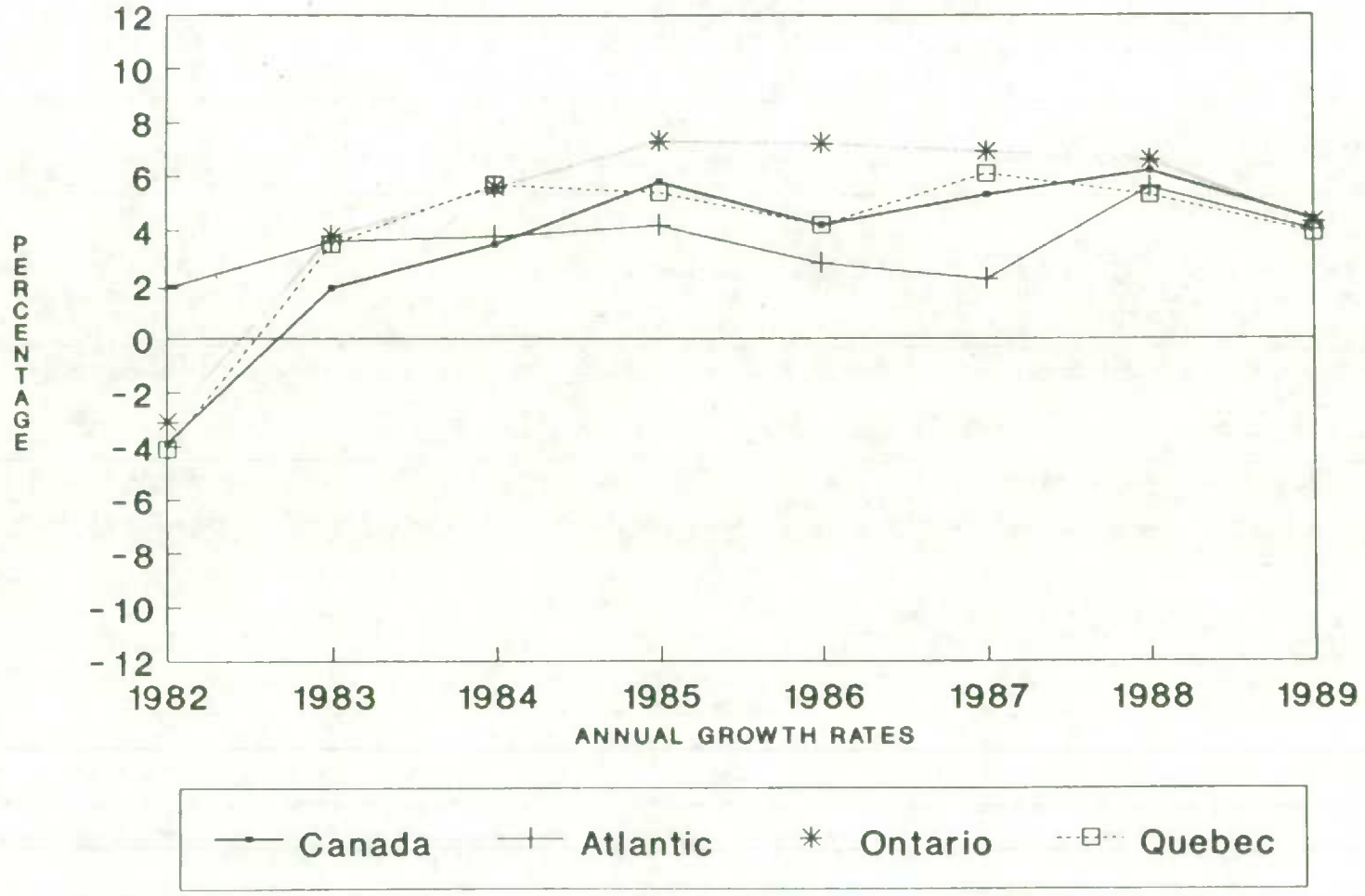

CHART 9

FINAL DOMESTIC DEMAND
CANADA, ONTARIO and the WEST

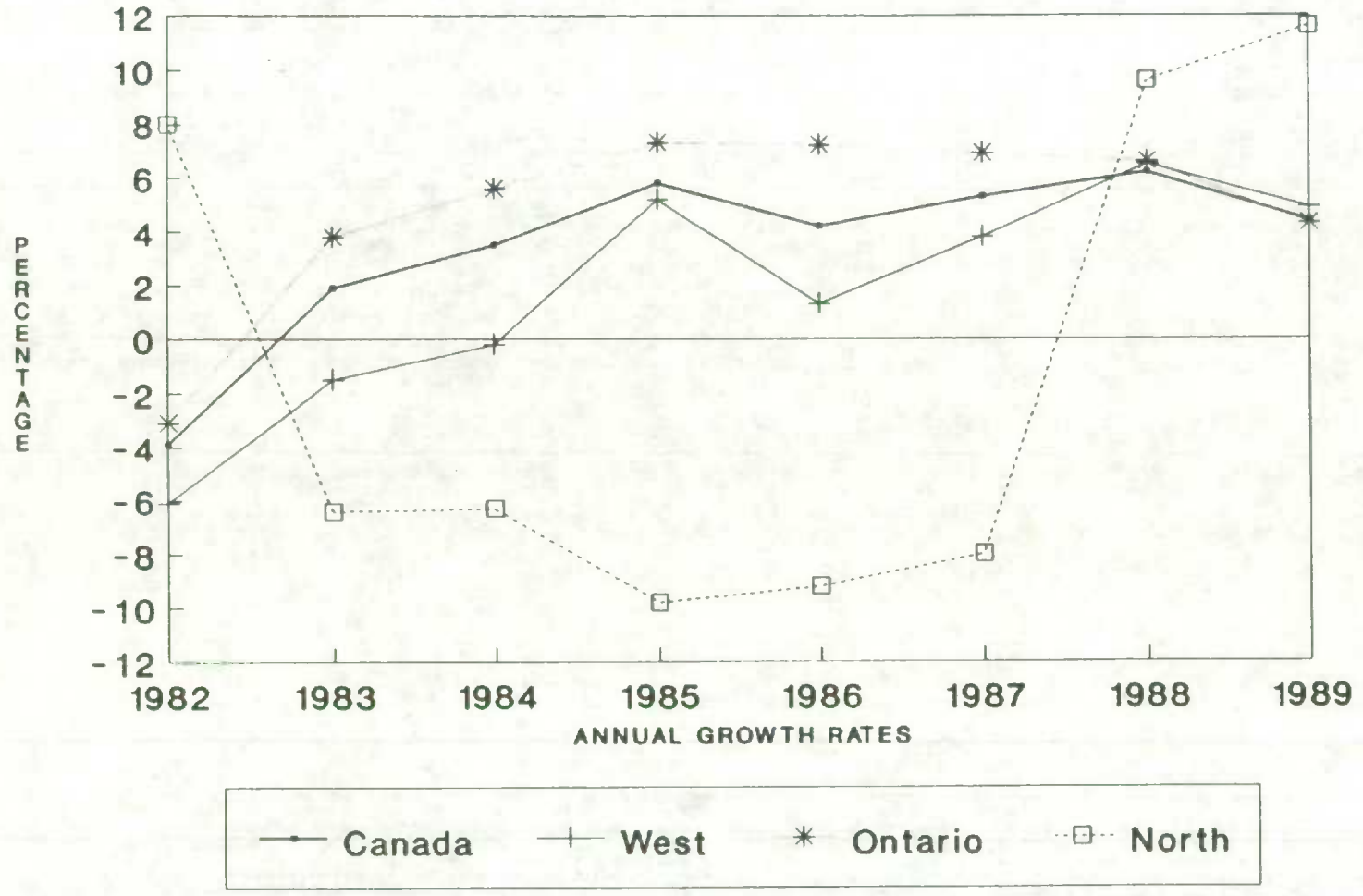

CHART 10

IMPLICIT PRICE INDEX
CANADA and EASTERN PROVINCES

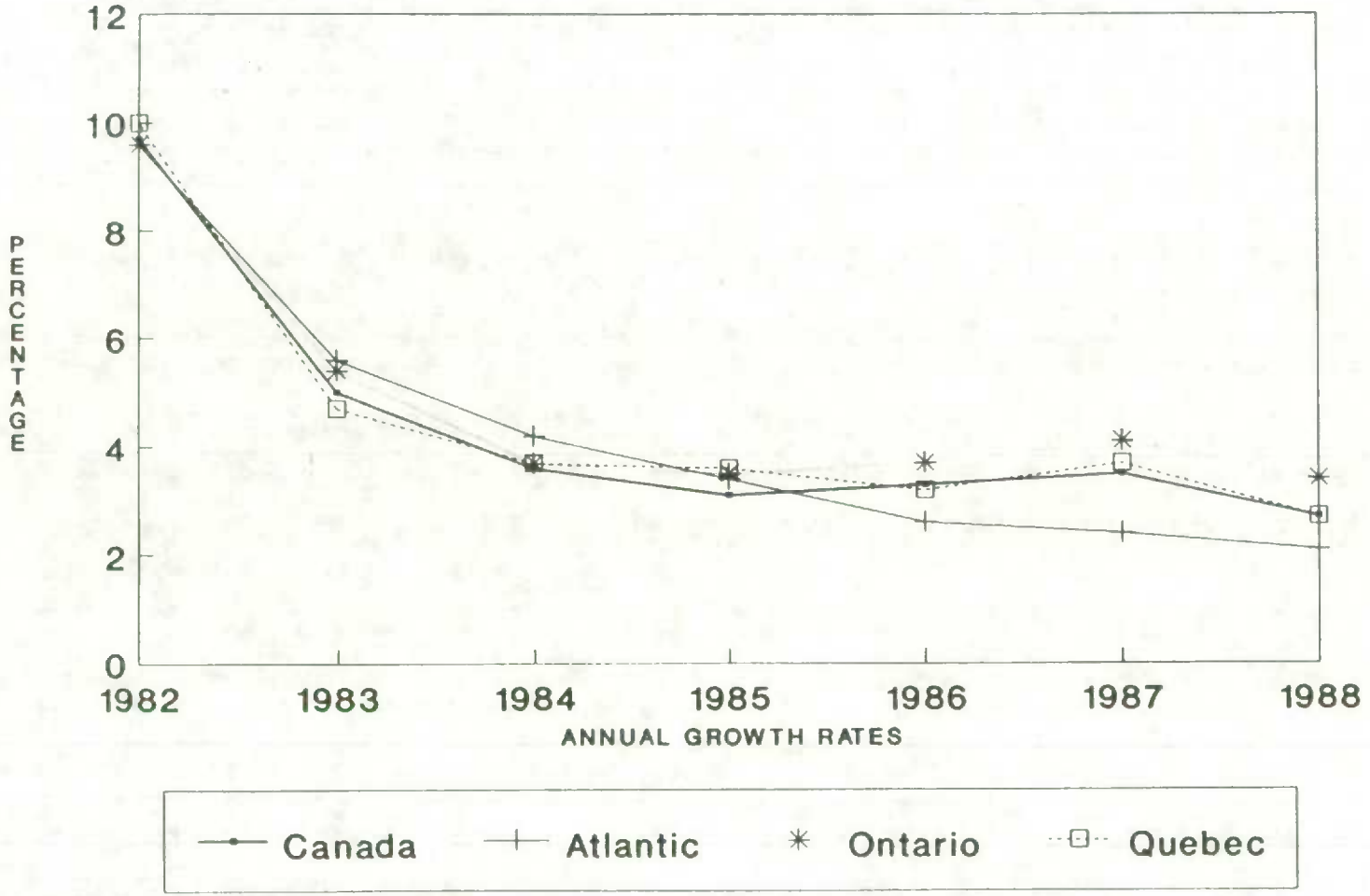

CHART 11

IMPLICIT PRICE INDEX
CANADA, ONTARIO and the WEST

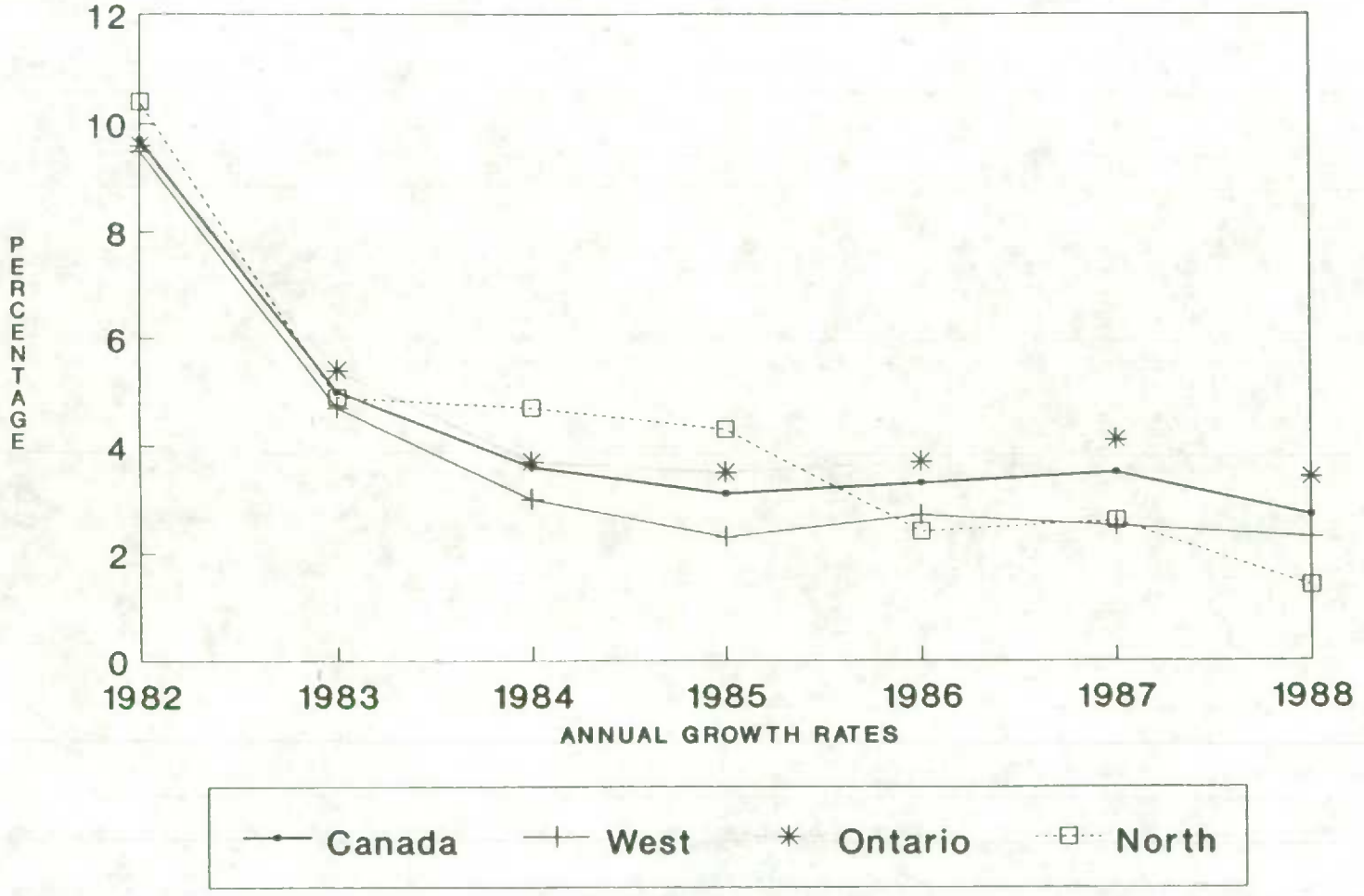

CHART 12

METHODS

The constant dollars and implicit price indexes, which have been calculated, are based on the current dollar Provincial Economic Accounts published by Statistics Canada[2] and revised annually and updated twice annually. An explanation of the methods of deriving the current dollar estimates can be found in the historical publication.

The purpose of this paper is to present and explain the methods used to develop the constant dollar estimates and implicit price indexes, by province and territory, for the three components of Final Domestic Demand: Personal Expenditure, Government Current Expenditure on Goods and Services, and Investment.

General method used to create Implicit Price Indexes (IPIs)

Annual constant dollar series have been created by province and territory for 1971-1981 and 1981-1988 for the published levels of aggregation. The 1971-1981 constant dollars incorporate 1971 weights, and are expressed in prices of 1971 while the 1981-1988 constant dollars employ 1981 weights and are expressed in 1981 prices. Each aggregation is the sum of the constant dollars for the individual items included. Constant dollar series for each item are in general created by deflating each series in current dollars at the most detailed levels using individual fixed-weighted price indexes. In some important cases, other methods are used to create constant dollar series and deflators. These are described in the relevant sections below.

These two series of constant dollars for the published aggregates are then "linked" at 1981 using the following formula:

$$(\$K_{81}\ 1981/\$K_{71}\ 1981) * \$K_{71}\ (1971\text{-}1980)$$

This procedure creates a continuous series of constant dollars in 1981 prices for the years 1971-1988.

The implicit price indexes based on 1981 = 100 are then derived by dividing the current dollar published aggregates by the linked constant dollars in 1981 prices for the same aggregates.

Further general comments concerning the approach taken are:

In most cases, deflation at the provincial level has been based on provincial price indexes, or other provincial measures of constant dollar trends; usually these match the national methods used. The details by section below identify where differences occur from these approaches.

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[2] Published in **Provincial Economic Accounts**, Catalogue 13-213S (historical issue, 1961-1986) and 13-213 and 13-213P, annually.

National deflators have been used for example, in the Machinery and Equipment component with provincial weighting of purchases by industry; provincial price indexes are not available for Machinery and Equipment. This approach is considered acceptable because markets tend to be national in scope for machinery and equipment purchases (although with varying tax and transportation margins) and also because purchasing industries are often concentrated in specific regions (e.g. fishing, sawmills, specific manufacturing industries); the provincial weighting diagrams provide the regional dimension.

Estimates are clearly weaker for individual provinces than for Canada as a whole; in particular, the quality of the constant dollars is dependent on the allocation of current dollar estimates by province; a Table on page 28 and accompanying description provides a qualitative assessment of the overall reliability of the various components.

Where possible, appropriate price indexes have been used as deflators; in some cases, constant dollar series are estimated using employment or other quantity measures and the price index is derived implicitly. These are more fully described in the context of the appropriate sector deflation methods.

Detailed methods used by sector:

As far as individual deflation methods are concerned, in general the approach has been to mimic national methods: The following sections dealing with the personal, government and investment sectors describe the procedures in more detail.

Personal Expenditure on Goods and Services

Published categories	1981 share of FDD	No. of items deflated
Durables	8.0	28
Semi durables	6.3	17
Non-durables	16.9	14
Services	24.7	71
Total	55.9	130

The methods used to calculate constant dollar provincial and territorial amounts and implicit price indexes in the personal sector are discussed separately for the **Goods** (three categories) and **Services** categories.

Most **Goods** are deflated using price series from the Consumer Price Index. These price indexes are available provincially and territorially (although these aggregations are weighted city price indexes, and ignore non-urban areas).

Deflators which are derived from CPI price indexes incorporate four weight bases and two time bases, as illustrated by the Table below. Each deflator is linked at the time of a new weight base, to create a continuous series of price movements over the two periods 1971-1981 and 1981 to 1988. In accordance with the procedures used in the national deflation process for these items, the linking is done at the first quarter after the introduction of the new weight base[3], although the provincial and territorial deflators are calculated annually.

The procedure used to create deflators for the Goods and Services items in the Personal Expenditure sector where more than one CPI is incorporated is more complicated than where one CPI item price index is the deflator. In situations where more than one CPI is included in the deflator for a Personal Expenditure item, the weights within the deflator must be adjusted to reflect the changing weight bases, linking in the changes so that the change in weights will not affect the index movement.

Time Period	**Time base**	**Weight Base (CPI Basket)**
1971	1971=100	1967
.		
.		
1974		1974
.		
.		
1978		1978
.		
.		
1981	1981=100	
1982		1982
.		
.		
1986		1986

The deflators are linked at each new basket in order to create a continuous time series on the time base 1971=100 and 1981=100. These procedures conform to the methods used nationally at the time of the historical revision (published in 1986).

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[3] The CPI methods are different; a lag of several years is customary in the incorporation of new baskets because of CPI revision policies which are different from those of the Incomes and Expenditure Accounts.

For items not using CPIs as deflators, various methods are used; for example, where constant dollar series are created from employment numbers, and the price derived implicitly, different weight bases are not required; 1981 and 1971 current dollar series are projected with the employment trends to create constant dollar series.

Examples of **Goods** that do not use CPIs as deflators are electricity and natural gas; both use a quantity measure to project constant dollars and the price is derived implicitly.

Deflators for the **Services** component are created using a wider variety of methods, due to the characteristics of the items included and the difficulty of measuring their price movements. Some are based on CPIs in the same way as described for the Goods, but many are not.

The deflation procedures employed for the following series in services are similar to those used for the goods category and rely entirely or in part on the consumer price indexes.

Water charges (2 series)
Rents and other lodging (4 series)
Domestic Services
Child care in the home
Child care outside the home
Laundry and dry-cleaning
Property insurance, cost of service
Pet Care
Furniture and appliance rental
Medical care, dental care and the like (in part)
Other health care
Commissions of tour operators
Automobile insurance, cost of service
Urban transit
Railway Transit
Inter-city and rural bus transit
Air transport (from 1971 to 1983)
Water transport
Taxi
Moving and storage
Telecommunications
Postal services
Lotteries (in part)
Pari-Mutuel betting (in part)
Other recreational services
Hairstyling for men and women
Other personal care
Meals outside the home

Service portion of alcoholic beverages
Accommodation
Board
Miscellaneous household services
Cable television and pay television
Political parties
Parking
Driving lessons and tests
Motor vehicle renting and leasing
Movie theatres and drive-ins
Photography

The national deflator, which may or may not rely on the CPI, was employed for 15 series: air transport, postal services, welfare and religious organizations (2 series) and the group of financial services consisting of 11 series. Attempts were made to develop provincial deflators for these series but results were deemed unsatisfactory.

A variety of methods are incorporated in the deflation of the remaining series in services. The deflator for universities and trade unions is a weighted one incorporating expenditure categories such as depreciation, office supplies, rent and energy. Identical expenditure weights for all regions were multiplied by appropriate price indexes. The price of the wage component here is implicit, the wage bill having been divided by employment in one case, and union membership in the other. A constant dollar series is constructed for private schools using a combination of student enrolment and number of teachers. The deflation of special care facilities and hospital care and the like parallels the national method: an implicit price is derived by province using hospital current expenditure (less depreciation) and hours worked in hospitals, and then applied to both series. A constant dollar series is constructed for funerals and burials on the basis of the number of deaths. The new fixed-weighted index of average hourly earnings in business services was used for life insurance.

Canada level deflators (adjusted for the effect of provincial sales taxes) have been incorporated for the period 1971-1974 if the provincial deflators were considered to be unreliable. This was before provincial CPI indexes became available (although some price series are available for the entire 1971-1988 period). For this period some of the earlier work done on provincial deflation (mentioned in footnote [1] on page 1) has been incorporated.

Government Current Expenditure on Goods and Services

Published categories	1981 share of FDD	No. of items deflated
Total	19.6	13

The two major categories of expenditure are **wages** and **non-wages**.

The wage portion contains seven series which are deflated using employment data series by province as constant dollar projectors. That is, an average salary in 1981 is multiplied by the number of employees each year to create a constant dollar series for 1981 to 1988: a 1971 average salary is used to create the 1971 to 1981 series. These two are linked at 1981 and the price is derived implicitly, by dividing the current dollar estimate (provincial labour Income including Supplementary Labour Income) by the corresponding constant dollar series based on employment.

Adjustments must be made to these employment series so that they will conform to the concepts and definitions of the System of National Accounts, and to make the current dollar series and constant dollar series correspond to the same concepts and methods.

The series for which this approach is used are:

Federal government labour income
Salaries of civilians working in the Department of National Defence
Military pay and allowances
Provincial government labour income
Local government labour income
Education labour income
Hospital labour income

The non-salary portion includes defence capital, depreciation, expenses on Medicare and a residual amount. The residual includes amounts for defence, hospitals and total government current expenditure.

For these items, representing approximately 38% of government current expenditure on goods and services (7.5% of FDD) in 1981 for Canada, a variety of deflation methods are employed. Constant dollars for depreciation are derived from Statistics Canada estimates, and implicit price indexes are calculated by dividing current dollars by constant dollars. A national index is applied to each province. Defence capital (construction investment), a very small amount, is deflated using the implicit price index for Government gross fixed capital formation. Medicare expenditures are deflated provincially using an index based on provincial payment schedules for physicians' services. The index, weighted by province, is calculated monthly by the Department of National Health and Welfare.

The Residual current dollars includes defence, hospital and other government components. Each of these has a deflator built from fixed-weighted price indexes for a range of materials and supplies, weighted in 1981 dollars for the period 1981-1988 and in 1971 dollars for the period 1971-1981. For defence, the weights are equal between an index for government residual expenditures, and government machinery and equipment; hospital residual expenditures are deflated using price indexes comprising Consumer Price Indexes or industrial price Indexes, constructed to cover major operating expenditures, such as medical and surgical supplies, drugs, other supplies and expenses and building maintenance and repairs; government residual expenditures which cover items such as telecommunications, energy, office supplies, transportation, and advertising are basically deflated the same way, with a combination of consumer and industrial price indexes. The weights for hospital and government residuals come from the Input/output matrices.

Investment in fixed capital

Published categories	1981 share of FDD	No. of series deflated
Government	2.7	5
Construction	2.3	4
Machinery and Equipment	0.4	1
Business	21.8	49
Residential	5.9	5
Non-Residential	7.7	4
Machinery and Equipment	8.2	40
Total Investment	24.5	54

The provincial and territorial estimates in constant dollars and the derivation of implicit price indexes follows the national methods very closely in the investment sector. Sectoring between the business and government portions was also undertaken by province.

Business Residential Construction contains three components:

New construction
Alterations and improvements
Transfer costs

The residential construction component is a sector for which the Canada constant dollar sum is aggregated from the provinces and territories. In this sector the provincial current dollars are based on administrative records (building permits) and other reasonably reliable regional data sources. For new residential construction, current and constant dollars (1971 prices and 1981 prices) for business and government are separated by province. The constant dollars in 1971 prices are linked to the constant dollars in 1981 prices to scale the 1971 constant dollars up to the level of the 1981 dollars in 1981, while preserving the growth rates of the published 1971 constant dollar series in the 1970s.

The New construction portion includes work-put-in-place, mobile homes, conversions, cottages and supplementary costs.

Work put in place consists of four dwelling types (singles, semi-detached, row and apartments) for which data are available in current dollars by province from 1971-1988. Deflators are the same for singles, semis and row units and are available regionally. Apartments are separately deflated by region. Current and constant dollars are summed by province and by type in 1971 and 1981 constant dollars. Implicit prices are calculated by dividing the linked constant dollar series from 1971-1988 into the current dollars.

Current dollars for mobiles, conversions, cottages and supplementary costs are available by province from 1981 forward on CANSIM; for the 1970s, current dollar amounts for these components were calculated as a residual after subtracting work-put-in-place, alterations and improvements and real estate commissions from the provincial totals of business residential construction. These items were deflated provincially with a Canada level implicit price index for the same components. Provincial constant dollars for mobiles, cottages and supplementary costs were derived using these Canada implicit deflators.

Government Residential construction is deflated using the new construction portion of Business residential construction. It is not shown separately in Government Gross Fixed Capital Formation because the amounts are negligible.

Non-residential construction consists of two components;

buildings
engineering

The building portion was deflated with a Canada level deflator for the period 1971 to 1981, while for the 1980s regional deflators were available and were used provincially to create the constant dollars. As this was also the Canada methodology for the 1980s, provincial and territorial constant dollar amounts were summed to arrive at the Canada total. Current dollar data are available to distribute non-residential building construction between business and government, by province, for the period from 1982 forward. For the 1970s, government non-residential building construction was estimated using the institutional portion of non-residential building. Business non-residential building construction was allocated using the sum of commercial and industrial buildings.

The engineering portion is deflated in three parts (and separately for government and business). These are Railways, Highways and Other engineering. The current dollars are largely derived from **Construction in Canada** information (with some unpublished detail and ratios used to separate the North from B.C. and to develop estimates for PEI and NFLD in some years.)

For railways, all expenditure is defined as part of the business sector, and the Canada implicit price index is used to deflate the provincial current dollars, for both 1971=100 and 1981=100.

Highway current dollars by province were derived from **Construction in Canada** and the government portion was estimated and removed to sector the expenditure between business and government. Bridges are deflated separately.

Highway price indexes are available by province, both on 1971=100 and 1981=100 bases. (PEI and North are deflated with Nova Scotia and B.C. respectively). Business and Government use the same deflators. For bridges, a Canada deflator is used. Constant dollars are summed for these components and implicit price indexes obtained.

Other Engineering current dollars by province are based on **Construction in Canada** with some further estimates required to match the deflation methods or allocate expenditures for geographical or other subdivisions not normally available. Exploration and Development Drilling required data from different sources to supplement the Construction in Canada data.

A residual component of "Other" Engineering by province was calculated by subtracting identified items of expenditure from the Engineering construction total. Archival material was required for back years; unpublished data was necessary to separate smaller provinces.

Canada level price indexes are used to deflate provincial Other Engineering components.

Interest during construction is a component of Electric power construction that required special treatment. The current dollars are obtained from a Capital Expenditures survey. An amount is calculated by province according to the relative importance in current dollars. Components excluding interest during construction are deflated separately with different deflators than the including interest components.

In general the construction of the provincial and territorial **Machinery and Equipment** implicit price indexes (separated into business and government) closely follows the Canada method. Canada price indexes (adjusted for the effect of provincial sales taxes) are used as deflators and the regional dimension is provided by the provincial weighting diagrams, reflecting different mixes of machinery and equipment purchases by province and territory. Price indexes with 1971 weights were used as deflators for the period 1971-1981, while 1981 weights were used for the period 1981-1988. The current dollar distributions of machinery purchases are adjusted for use in the National Accounts to match the appropriate concepts.

Computers were given special treatment as a result of their increasing importance and unusual price movement. The current dollars for computers for Canada were subtracted from the Machinery and Equipment expenditure totals. To distribute the national value for computers by province, the distribution of machinery and equipment purchases of the Finance, Insurance and Real Estate industry was employed as the allocator in the Business sector; total government expenditure on Machinery and Equipment for computers by province was the government provincial allocator. Using the Canada level deflator, these current dollars were deflated separately and the constant dollars derived were added back to the machinery and equipment totals excluding computers. This was done to reflect the growing importance of computers over the 1980s.

METHODOLOGICAL ISSUES

Two major technical issues considered are discussed in more detail in the Appendix to this paper. They are: the method used to aggregate the provincial and territorial constant dollar totals to the published Canada totals; and, the treatment of adjusting entries.

1. Aggregation of provincial and territorial constant dollars in accordance with Canada totals

In cases where national deflators have been used with provincial weighting, (as is the case for the Machinery and Equipment deflators by province) and where the method for deriving Canada deflators is based on summing the provincial constant dollars, (as is the case for residential construction) discrepancies between the sum of provinces and territories and Canada totals should not exist; in cases where separate provincial deflators, or provincial constant dollar projectors are employed, discrepancies are expected to occur and a consistent approach was required to present the results. Following consultation with the provincial and territorial governments the approach decided upon was that for purposes of publication, these discrepancies would be allocated among the provinces and territories at the levels of published aggregates. One published GDP for Canada was the desirable outcome. In addition, as a general rule the estimates for Canada as a whole are more reliable than those of the individual provinces, and for this reason, constraining provincial sums to Canada totals improves the provincial series. Further discussion of this issue is included in the **Technical Appendix** to this paper. At more

detailed levels of aggregation and for analytical purposes the differences between the sums of provinces and territories and Canada published totals will be viewed as a means of evaluating the overall provincial deflation procedures. The discrepancies between the national totals and the sums of provinces and territories, while they will not be published, will be available to users on request.

2. Adjusting entries.

Analogous to the Canada methods, adjusting entries are calculated in the years before the base year (1981) to preserve the growth rates of aggregates where components and totals are arithmetically rebased independently. When this rebasing is carried out the components no longer sum to the aggregate, and the adjusting entry is added to the sum of the components so that the components do add. In the case of the provincial deflation, adjusting entries are required in two dimensions: the sum of the provincial components to the national total and the sum of the provincial components to the provincial totals. An example of the way this calculation works is provided in the Technical Appendix to this paper.

QUALITY ASSESSMENT

In the provincial accounts, as with other component parts of the System of National Accounts, many data sources are used in constructing the estimates and it is difficult to assign a precise measure of error to specific series. The allocation of current dollars among provinces and territories is dependent on statistical information, itself subject to varying reliability.

In the estimates of Final Domestic Demand, the reliability of the constant dollar series is a function of the reliability of the current dollar estimates as well as the price component, and the reliability can vary among the three estimates for a given series[4].

Table 2, shown on page 28, summarizes the assessment of the quality of the estimates in the main components of the Provincial accounts, for the three types of estimates - current, constant and price. The basis of the estimated quality is described as follows: the current dollar estimates are taken from the previously mentioned publication, the deflators (price component) are ranked with a "1" if a Consumer Price Index (or combination of CPI's) is directly appropriate, or if other conceptually, geographically, and item specific price indexes are available. Lower rankings are assigned where proxy indicators have been created, for example using employment series as projectors for the constant dollar series or where price indexes for other than the specific items have been used, for example, labour and material indexes for some components of Engineering construction where output price indexes would be preferable. Given that the quality of the constant dollars is dependent on the other two series, the rankings given to the constant dollar series are also derived indirectly.

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[4] For more discussion of the reliability of the provincial current dollar estimates, see Provincial Economic Accounts, historical issue, 1961-1986, Catalogue 13-213S.

Table 2

Quality assessment of provincial and territorial estimates

	Rankings		
	current dollars	price	constant dollars
Component of Final Domestic Demand			
Personal expenditure on:			
Goods	1	1	1
Services	2	2	3
Government Current Expenditure on Goods and Services	1	3	3
Government Investment on:			
Construction	1	2	2
Machinery and Equipment	2	2	2
Business Investment on:			
Residential Construction	1	1	1
Non-Residential Construction	1	2	2
Machinery and Equipment	2	2	2

FUTURE DEVELOPMENT

This project represents a major development in the availability of GDP estimates for individual provinces and territories. Further work remains to be done in specified areas such as the improvement of particular series of lower quality or where national deflators or volume measures are used as proxy for provincial ones.

Some deflators are not available at the provincial level as yet. For example the alterations and improvements component of residential construction has been deflated with the Canada implicit price but provincial deflators could be developed. Provincial deflators should also be constructed for personal expenditure on financial services.

Developmental work will continue to improve these indicators at the provincial level.

TECHNICAL APPENDIX

1. Summation of Provincial and Territorial constant dollar totals compared with Canada published totals.

2. Adjusting entries

1. Summation of provincial constant dollars compared with Canada published totals.

An important issue is that differences occur between the 'sum of provinces' derived from deflating Final Domestic Demand (FDD) components at the provincial and territorial level and the Canada published totals in constant dollars for the same components.

In two situations, the sum of the provinces and the Canada totals will be the same: these are where Canada deflators are used with provincial weighting diagrams to deflate current dollars, as is the case with the Machinery and Equipment component, and in cases where the Canada totals are built using provincial/regional deflators initially and are therefore obtained as a result of summing the provincial constant dollar amounts. This occurs, for example, with new residential construction.

The approach of aggregating the provinces and territories to calculate Canada constant dollars would be preferable to the alternative of deriving the Canada totals directly at the national level. For purposes of this study, a constraint exists that published totals exist in current and constant dollars for Canada as well as provincial current dollars. The approach adopted for the study reflects these existing published data and revision policy for the National and Provincial Gross Domestic Product.

Where national deflators are used to deflate provincial current dollars, we have the following relationships:

$$\sum_{i=1}^{n} \$K_i^c = \sum_{i=1}^{n} (\$C_i^c / P_i^c)$$

$$= \sum_{i=1}^{n} [(\$C_i^{nfld} + \$C_i^{pei} + \$C_i^{ns} + \ldots \$C_i^{nwt} / P_i^c)$$

Where $\$C_i^c$ = current dollars for Canada for item i

P_i^c = Canada deflator for item i

$\$K_i^c$ = Canada constant dollars for item i

n is the number of items in a linked aggregation

And $(\$C_i^{nfld} + \$C_i^{pei} + \$C_i^{ns} + \ldots + \$C_i^{nwt}) = \$C_i^c$

In other situations, where provincial deflators are used, or where constant dollar projectors are based on quantity measures such as employment, volume of natural gas, differences can be expected between the "sum of provinces" and "Canada" totals.

The differences are close to zero in the base year (1981 in this case) and tend to become wider as the time series moves away from the base period in either direction.

In order to arrive at the published Canada FDD for the historical period for which the deflation project is being presented in this paper (1971-1988), the approach is to adjust the provincial sums to equal the Canada totals at the level of published aggregates. Below this level, detailed estimates will be available on request showing the discrepancies that emerge from the calculations. Using this approach, there will be only one Canada FDD series, while for analytical purposes, the unconstrained components will be available.

"Forcing" the published totals to be equal in this way imposes certain constraints on the deflation methods used in this study. Generally speaking, the Canada estimates are considered more reliable than the provincial ones. Many surveys from which the current dollars are taken are designed primarily to provide good Canada estimates, with the regional dimension as a secondary objective. Thus, constraining the provincial summation to the Canada totals can be viewed as strengthening the provincial estimates. Also, in most instances, the national deflation methods have been used for the provinces. This approach has not precluded using provincial deflators where available and where they are considered to be of good quality (as is the case for most Goods and many Services in the Personal Expenditure categories (drawing on provincial Consumer Price Index information). However, it has limited the extent to which improvements in sources or methods have been introduced in particular provinces. Individual provincial methods could have the effect of increasing the difference between sum of provinces and Canada totals. For the historical period, the options are limited as the Canada totals are already published.

Developmental work within the usual revision cycles and for future years can incorporate improved methods for individual provinces. Such improvements will be reflected in the Canada estimates as well.

2. Adjusting entries

In the case of adjusting entries, the concern is that in time periods before the base period, rebasing of the components and adding them does not yield the same result as rebasing the total. This occurs because of the shift in relative spending patterns which is reflected when the price base is changed. The difference between the sum of the rebased components and the rebased aggregate is shown as an adjusting entry. Its purpose is to preserve the growth rates of previously published aggregates. Adjusting entries can be seen for example in the revised historical estimates of Gross Domestic Product[5]. In the case of calculating provincial constant dollar estimates, the adjusting entries are required in two dimensions: between the sum of provinces in total, Canada in total and between the sum for each component for all provinces and the Canada total. The interaction between these two series of adjusting entries provides a further adjusting entry to balance the system.

Tables 3 and 4 show the entries in algebraic form.

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[5] See National Income and Expenditure Accounts, Annual estimates, 1926-1986, cat. no. 13-531, June, 1988, Table 3.

Table 3

An example of adjusting entries, using unlinked data

	Prov 1 Prov 2.....Prov 12	ΣProv	Regional Adjusting Entry	Canada
Comp. 1				
Comp. 2	$X_{i,j}^{U}$	$\sum_{j} X_{i,j}^{U}$	0	Y_i^U
Comp. 3				
.....				
Sum	$\sum_{i} X_{i,j}^{U}$	$\sum_{i,j} X_{i,j}^{U}$	0	$\sum_{i} Y_i^U$
Adjustment	0	0	0	0
Total	$X_{T,j}^{U}$	$X_{T,T}^{U}$	0	Y_T^U

Table 4

An example of adjusting entries, using linked data

	Prov 1 Prov 2.....Prov 12	ΣProv	Regional Adjusting Entry	Canada
Comp. 1				
Comp. 2	$X_{i,j}^{L}$	$\sum_{j} X_{i,j}^{L}$	A_i^{Can}	Y_i^L
Comp. 3				
.....				
Sum	$\sum_{i} X_{i,j}^{L}$	$\sum_{i,j} X_{i,j}^{L}$	$\sum_{i} A_i^{Can}$	$\sum_{i} Y_i^L$
Adjustment	A_j	$\sum_{j} A_j$	ϵ	A_T^{Can}
Total	$X_{T,j}^{L}$	$\sum_{j} X_{T,j}^{L}$	A_T^{*Can}	Y_T^L

Where:

$X^{U}_{i,j}$ = unlinked component i, province j

$X^{L}_{i,j}$ = linked component i, province j

$X^{U}_{T,j}, X^{L}_{T,j}$ = unlinked and linked total province j

$X^{U}_{i,T}, X^{L}_{i,T}$ = unlinked and linked component i, total province

X^{U}_{TT} = unlinked total provinces, total components

Y^{U}_{i}, Y^{L}_{i} = unlinked and linked component i, Canada

Y^{U}_{T}, Y^{L}_{T} = unlinked and linked total, Canada

A_T^{Can} = adjusting entry, Canada, published NIEA

A_i^{Can} = adjusting entry, component i Canada total less provincial totals

A_T^{*Can} = adjusting entry, linked Canada total less sum of linked provincial totals

A_j = adjusting entry within the province

$L_{i,j}$ = linking factor 1981 $K (yr 1981)/ 1971 $K (yr 1981)

$$\epsilon = A_T^{Can} - \sum_j A_j = A_T^{*Can} - \sum_i A_i^{Can}$$

For the unlinked data, additivity is preserved between the sum of components and the aggregate by province and territory and for Canada:

$$\sum_{I} X^{U}_{I,j} = X^{U}_{T,j} \quad , \quad \sum_{I} Y^{U}_{I} = Y^{U}_{T} \quad ;$$

and between the sum of provinces and territories for the components and the Canada total:

$$\sum_{j} X^{U}_{I,j} = Y^{U}_{I}$$

the later identity is explained in the Appendix, item 1.
Hence the relationship

$$\sum_{I,j} X^{U}_{I,j} = Y^{U}_{T}$$

applies and no adjustment is required for the unlinked data.

The following relationship apply to the linked data:

PEA	Canada
$X_{i,j}^{L} = X_{i,j}^{U} \times L_{i,j}$	$Y_i^{L} = Y_i^{U} \times L_i^{Can}$
$X_{T,j}^{L} = X_{T,j}^{U} \times L_{T,j}$	$Y_T^{L} = Y_T^{U} \times L_T^{Can}$
$X_{T,j}^{L} = \sum_i X_{i,j}^{L} + A_j$	$Y_T^{L} = \sum_i Y_i^{L} + A_T^{Can}$
$Y_i^{L} = \sum_j X_{i,j}^{L} + A_i^{Can}$	
$Y_T^{L} = \sum_j X_{T,j}^{L} + A_T^{*Can}$	

We have:

$$\sum_j X_{T,j}^{L} + A_T^{*Can} = \sum_{i,j} X_{i,j}^{L} + \sum_i A_i^{Can} + A_T^{Can}$$ that is:

$$\sum_j X_{T,j}^{L} - \sum_{i,j} X_{i,j}^{L} = \sum_i A_i^{Can} + A_T^{Can} - A_T^{*Can}$$

and

$$\sum_j X_{T,j}^{L} = \sum_{i,j} X_{i,j}^{L} + \sum_j A_j$$

that is:

$$\sum_j X_{T,j}^{L} - \sum_{i,j} X_{i,j}^{L} = \sum_j A_j$$

finally:

$$\sum_j A_j \quad + \quad A_T^{*Can} \quad = \quad \sum_i A_i^{Can} \quad + \quad A_T^{Can}$$

sum of adjusting entries for each province	+	amount added to sum of linked province totals to get linked Canada total	=	sum of amount added to province linked total for each component i to get linked Canada total for each component i	+	published NIEA adjusting entry

and $$A_T^{Can} - \sum_j A_j = \epsilon = A_T^{*Can} - \sum_I A_I^{Can}$$

the difference between the sum of the within province and published NIEA adjusting entry equals the difference between the amount added to the linked provincial totals to arrive at the linked Canada total and the sum of the amounts added to the provincial linked totals for each component to arrive at the Canada linked total for each component.

This is demonstrated in Table 5 following, using the example of data for Final Domestic Demand and its component parts in 1977, expressed in prices of 1981.

TABLE 5. AN EXAMPLE OF ADJUSTING ENTRIES, LINKED DATA FOR 1977 IN 1981 PRICES

CATEGORY	NFLD	PEI	NS	NB	QUE	ONT	MAN	SASK	ALTA	B.C.	YUK	NWT	REGIONAL ADJENT	CANADA
Personal expenditure on consumer goods and services	3298	751	5365	4121	43859	66086	7223	6162	15776	21002	203	307	46	174199
Durable goods	395	107	716	612	6407	9045	1044	1057	2541	3089	32	26	-6	25065
Semi-durable goods	344	88	619	464	4884	7375	804	719	1904	2274	17	38	29	19559
Non-durable goods	1200	283	1892	1513	15503	21351	2294	1997	4217	6546	74	124	-131	56863
Services	1364	278	2154	1536	17161	28652	3081	2396	7120	9226	82	123	115	73288
Adjusting entry	-5	-5	-16	-4	-96	-337	0	-7	-6	-133	-2	-4	39	-576
Government current expenditure on goods and services	919	382	2668	1658	16484	23591	2855	2338	5054	6700	140	409	152	63350
Government investment in fixed capital	253	36	253	357	2539	2531	370	502	1155	1187	38	94	10	9325
Construction	270	39	270	347	2368	2298	347	401	1083	1028	36	90	32	8609
Machinery & equipment	16	1	32	25	226	351	36	91	103	162	3	8	0	1054
Adjusting entry	-33	-4	-49	-15	-55	-118	-13	10	-31	-3	-1	-4	-22	-338
Business investment in fixed capital	760	139	1235	1255	11845	16793	2082	2454	9266	6730	68	590	370	53587
Residential construction	288	72	528	382	4829	7162	761	847	2746	2736	15	36	-31	20371
Non-Residential construction	278	36	437	429	4504	5081	723	749	4434	2356	29	471	165	19692
Machinery & equipment	190	42	334	478	3315	5697	731	942	2344	1796	24	80	70	16043
Adjusting entry	4	-11	-64	-34	-803	-1147	-133	-84	-258	-158	0	3	166	-2519
Adjusting Entry	-9	-3	-8	-7	-99	-918	-27	-135	-195	-288	4	11	-272	-1946
Final Domestic Demand	**5221**	**1305**	**9513**	**7384**	**74628**	**108083**	**12503**	**11321**	**31056**	**35331**	**453**	**1411**	**306**	**298515**