A FEASIBILITY STUDY
FOR
ASSESSING THE MACROECONOMIC IMPACT OF ALTERNATIVE GOVERNMENT POLICIES DESIGNED TO AFFECT THE RATE OF DIFFUSION AND IMPLEMENTATION OF NEW INFORMATION TECHNOLOGY

Prepared for the
Department of Communications

E. L. Ruddick

December 6, 1979

Informetrica LIMITED • Ottawa, Canada • Effective Economic Research

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Project Proposal

This is a proposal to conduct a feasibility study for assessing the medium-term macroeconomic impact on the Canadian economy of alternative government policies designed to affect the rate of diffusion and implementation of information technology.

Background

While it is recognized that the "information revolution" and the diffusion and implementation of new information technologies will have a profound impact on many sectors of the Canadian economy, there has been, to date, no effort to rigorously quantify these impacts in a macroeconomic framework. Such technologies will have direct impacts on the employment and productivity of several industries. But the question remains, what is the desirable and most advantageous rate at which to implement such technologies? The government could offer various incentives in the form of grants, tax credits or assistance in the transfer of technologies, but what would be the macroeconomic impact of such moves? What would be the spill-over or secondary impacts of such policies? And, most importantly - making certain assumptions about the level and type of assistance required to meet certain threshold rates of diffusion - what are the advantages - again from the macro viewpoint - of proceeding more or less rapidly in implementing the technology?

An additional benefit of such quantitative analysis of the policy alternatives is the ability to give some perspective to different levels of effort by the government in terms of impact on the Gross National Product, employment, and personal income, to select only a few indicators of economic activity. Use of a detailed econometric model in such a macroeconomic analysis allows the adoption of new technology to be directed towards specific industries - for example manufacturing industries in the case of CAD/CAM or service industries for EFTS.

Informetrica Limited has considerable and unique experience in the analysis of the macroeconomic impact of particular government policies or industry decisions on the economy. Through the National Forecast Service, Informetrica Limited provides long-term detailed forecasts using The Informetrica Model (TIM). An overview of this model and its unique capabilities are found in Appendix C. It is a large econometric model which makes use of the 1971 input-output tables to distribute demand by 63 industries. This model (and Informetrica Limited's earlier model, based on the CANDIDE model) has been used for impact studies to analyse, for example, the effect of specific government policy proposals or private investment decisions and to assess the effects of changes in productivity on the macroeconomy. (A list of such studies is attached in Appendix B.)

Project Tasks

This project may be conveniently divided into seven consecutive tasks:

(i) Review of literature and interviews with experts

While the research team has some familiarity with the "information revolution" and new information technologies, this step is necessary to familiarize the team with the most recent developments and concerns of the industry. It would involve a review of the technical literature and interviews with experts at the Department of Communications; Industry, Trade and Commerce and in the industry, to identify what can reasonably be expected to be the major fields of application of this new information technology over the next 5-10 years. This would include, for instance, the scope for diffusion of process control, CAD/CAM, management applications, POS and EFTS in the various sectors of the economy. It is anticipated that the Department of Communications would assist in identifying the experts in government and industry who should be interviewed in this task.

(ii) Assessment of potential impact of the new technology

This task is concerned with assessing the impact or potential impact of the expected changes on productivity and employment requirements of the affected industries, and in identifying the factors which may be expected to affect the rate of implementation of the new technology. This step would include the inputs of a "technologist" familiar with the "information industry", and would also include reference to studies of these questions in the context of the U.S. economy (e.g. study by MIT).

(iii) Development of alternative scenarios

From the information acquired in (i) and (ii), the research team would develop a set of alternative scenarios for the diffusion and implementation of the new technology based on alternative government actions. An important element of the scenarios would be the amount of resources the government would be prepared to allocate (e.g. in the form of tax credits, grants or assistance to technology transfers) to encourage the diffusion of the technology. The alternative scenarios would most likely focus on different rates of diffusion of the technology, with the implementation of the technology centred in specific industries (e.g. services or manufacturing). These scenarios would reflect some of the most important areas of concern of government and industry officials which lend themselves to an analysis of this nature.

(iv) Develop the methodology to assess the macroeconomic impact of the alternative scenarios

At this stage a methodology would be developed to assess the medium term macroeconomic impact of the alternative scenarios set out in task (iii). As the purpose of the impact analysis is to assess the effect of the various scenarios on such economic variables as Gross National Product, inflation, employment and other macroeconomic variables, this task would reflect the methodology required to implement these scenarios using The Informetrica Model (TIM). As an overview to the methodological considerations, there are at least two ways to implement such scenarios using TIM. The first is to accept the structure of the model and its industry definitions, and to adjust existing

variables to reflect the particular assumptions of the scenario. For example, adjust certain government expenditure or tax variables, or make adjustments to employment levels in particular industries. This technique reflects a "conventional" approach to macroeconomic impact analysis, and the research team (see below) has extensive experience in this type of analysis. A second approach would be to create an entirely new industry which would reflect the demands and supplies of the new technology. This would involve a modification to the Input-Output table used in the model where the coefficients for this "industry" reflect the available information and assumptions on the implementation of the new technology. The research team includes professionals who are highly qualified in the construction of econometric models and who can assess and detail the methodology for this second approach.

(v) Perform some preliminary simulations to test the feasibility of the methodology

This task is designed to test the approach outlined in task (iv), using the National Forecast Service model, TIM. These simulations would not be detailed scenarios of alternative government policies, but would rather reflect reasonable (but not very precise) assumptions concerning certain alternate government actions to indicate the results of such simulations, and to assess whether these results are reasonable. Approximately three or four simulations would be run, reflecting the impact of, for example, government grants, declining growth in employment in certain industries, rapid investment by industries in the new

technologies. Such scenarios would, of necessity, be illustrative of the techniques only and would not accurately reflect the alternative scenarios suggested in tasks (iii) and (iv).

(vi) Preparation of Final Report

The output of this Project will take the form of a final report which will include a discussion of the findings of tasks (i) and (ii) (with a bibliography and list of those persons interviewed); a second section devoted to the alternative scenarios selected, and the methodology for assessing the impact of each scenario; and a third section which presents the results of the preliminary simulations. The second section will detail the rationale for the selection of the particular scenarios with a view to the issues of the 'information revolution' and the ability to undertake a macro-economic analysis of such issues. It will also include a lengthy discussion of the nature of the assumptions (e.g. tax credit, productivity gains in specific industry). The methodology portion will detail the specific nature of the adjustments required. For example, which particular variable or coefficient would be altered, and why.

(vii) Presentation of Final Report

The research team is prepared to present and discuss the final report with members of the Department of Communications and others involved in the industry-government dialogue on the 'information revolution'.

It is anticipated that a meeting with officials of the Department of Communications would follow the completion of tasks (i) and (ii), and that this meeting would serve as a checkpoint for the Department on the progress of the Project.

Research Team

The research team for the project will be headed by Ms. Elizabeth Ruddick. Ms. Ruddick (Advisor) has extensive experience in analysis of the macroeconomic impacts of government policy and private investment projects. As well, she is familiar with the concept of the information economy, and with the 'information revolution' as the result of a project carried out for the Department of Communications on consumer demand for entertainment services (with a view to the introduction of PAY-TV).

Mr. M.C. McCracken (President of Informetrica Limited) will assist in the presentation and development of the details of the alternative scenarios in the final report. Mr. McCracken, aside from his considerable experience in macroeconomic and policy analysis, is also familiar with the supplying and user industries of information technology and worked extensively on a project by Informetrica Limited for the CRTC to develop a model of the Cable TV Industry in Canada. In his "reviewer" role in this current project, this past experience, and exposure to many of the issues and views of the industry will be invaluable.

Mr. Carl Sonnen will assist in the development of the details of the alternative scenarios and the methodology used to assess the impact of these scenarios.

Mr. Paul Jacobson will participate in developing the particular methodology to assess the impact of the scenarios. His experience developing TIM, his previous experience in modelling, and his work on the model of the Cable TV Industry

will be important contributions to this study. In particular he will be able to assess the feasibility of altering the existing Input-Output table to meet the requirements of certain scenarios (see discussion of task (iv) under "Project Tasks" above).

It is our plan to include a qualified technologist on the research team, to provide inputs to tasks (i) and (ii), and in particular to assist in identifying the potential impact of expected changes on the productivity of the affected industries. The selection of this member of the team would be subject to the approval of the Scientific Authority administering the contract. The research team may also include other professionals of Informetrica Limited as required.

Vitae of the research team appear in Appendix A.

Timing of the Project

The final report for the Project would be delivered to the Department of Communications ten weeks after the approval of the contract and beginning of work on the Project. Tasks (i) and (ii) would be completed, and the meeting with the Department representatives on the progress of the contract would take place one month after the start-up date. (It is anticipated that the Department of Communications would assist the research team in identifying the experts in government and industry who would be interviewed in task (i).)

Project Costs

The estimated man-days and costs for the Project follow. Costs would be billed on a monthly basis for work provided to date, and are billed as per the attached fee schedule (see end of this section). The per diem fees include provision for overhead (e.g. typing, library services, etc.) and as a result no additional charges would be made for those services. Any travel expenses would be billed as incurred and are not included in the estimate below.

This project requires use of the National Forecast Service Model TIM (See Project Tasks, task (v)). An access fee of $4,000 is included in this estimate, as the Department of Communications is not currently a member of the National Forecast Service. If the Department subscribes to this Service within ninety days of signing the contract for this proposal, the access fee will be applied against their subscription.

Estimated man-days and costs

(i)	**Review of Literature and Interviews**		
	Elizabeth Ruddick	5 days @ $400/day	$2,000
	Economist	3 days @ $175/day	525
(ii)	**Assess Impact of Potential Change**		
	Elizabeth Ruddick	4 days @ $400/day	1,600
	"Technologist"	5 days @ $300/day	1,500
		Subtotal (i) and (ii)	$5,625
(iii)	**Develop Alternative Scenarios**		
	Elizabeth Ruddick	5 days @ $400/day	$2,000
	Carl Sonnen	1 day @ $450/day	450
	M.C. McCracken	1 day @ $500/day	500
(iv)	**Develop Methodology**		
	Elizabeth Ruddick	3 days @ $400/day	$1,200
	Carl Sonnen	1 day @ $450/day	450
	M.C. McCracken	1 day @ $500/day	500
	Paul Jacobson	2 days @ $350/day	700
(v)	**Preliminary Simulations**		
	Access Fee		$4,000
	Computer Costs		2,000
	Elizabeth Ruddick	6 days @ $400/day	2,400
	Carl Sonnen	1 day @ $450/day	450
	Paul Jacobson	2 days @ $350/day	700
(vi)	**Preparation of Final Report**		
	Elizabeth Ruddick	5 days @ $400/day	$2,000
(vii)	**Presentation of Final Report**		
	M.C. McCracken	1 day @ $500/day	$ 500
		Subtotal tasks (iii)-(vii)	$17,850
		Total Estimated Cost	$23,475

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FEE SCHEDULE - CONTRACT SERVICES

This supersedes all previous fee schedules and is applicable from July 1, 1979 to December 31, 1979.

Contract services may be provided on the basis of a fixed-price, cost-based, or time and materials contract. For time and materials contracts the fee structure is as follows:

Personnel

Senior Advisors	$400-$600 per day
Advisors/Project Leaders	$325-$400 per day
Senior Economists	$225-$325 per day
Economists/Analysts	$150-$225 per day
Research Staff	$100-$250 per day

These charges include provision for normal overhead (typing, databases, library services, etc.).

Computer Usage

Batch Remote-Job-Entry

All computer charges from computer utilities (including communications cost, surcharges for programs, forms, etc.) plus a 10% surcharge to defray accounting and other overhead items.

Timesharing

All computer charges from computer utilities as above, plus a 20% surcharge to defray accounting and other overhead items.

Mini Computer	Plotter System
$30 per hour	$50 per hour

Fixed Charges for Model Access (Not applicable to National Forecast Service subscribers)

For use with contract services requiring Informetrica models.

NFS Annual Model	$4,000 per month

Other Direct Expenses

Includes charges for travel and substantial costs for: printing or copying, long-distance calls, or other expenses incurred for a particular client.

Payment Terms: Net 15 days from invoice, based on time and materials used in previous month, 2% per month on outstanding balance.

In addition to the prices specified or referred to herein, the amount of any present or future sales, use, excise, or other similar tax applicable to the sales of services will be paid by the client.

Company Background

Informetrica Limited is a federally chartered (1972) corporation, all of whose owners, directors and principal officers are residents of Ottawa, Ontario.

Informetrica Limited possesses unique capabilities in economic research and analysis. Through the National Forecast Service, Informetrica Limited provides long-term detailed forecasts using The Informetrica Model (TIM). This is a large macroeconomic model, which makes use of the 1971 input-output tables to distribute demand by 63 industries. The model is also used for impact studies to analyse, for example, the effects of specific government policy proposals on private investment decisions and to assess the effects of changes in productivity on the macroeconomy. Through Contract Research, Informetrica provides specific services to clients, which range from economic impact studies, industry or corporate modelling, to more specific project analysis, drawing on the expertise of all professional staff in economics, statistics and systems analysis. Informetrica Limited has developed and maintained proprietary software to support its own operations and those of its clients and has used the personal expertise developed by this to undertake several major projects. The available software systems include DATABANK, MASSAGER, SIMSYS and MOSAIC programs.

APPENDIX A

M. Elizabeth Ruddick

Education: B. Comm. (Economics Major) McGill University (1971)

M.A. Economics, University of British Columbia (1972)

Post Graduate Study, London School of Economics, 1975-76. Research Area: Industrial Pricing in International Trade Under Fixed and Flexible Exchange Regimes.

Experience:

Informetrica Limited (1976 -) - Advisor

- Impact studies of energy policy, energy investments, transfer programs
- Macroeconomic dimensions of energy investment
- Use of relative prices and inflation in capital budgeting
- Price escalation methodology
- Energy demand modelling
- Long term forecasts with the CANDIDE model
- Spatial cost of living indexes
- Consumer demand for entertainment services

Department of Regional Economic Expansion - Economist - Responsible for complete documentation of CANDIDE-R econometric model, and analysis of its use in simulating regional and national impact of large scale autonomous investments (1975).

Economic Council of Canada - Economist - Primary responsibility for Chapter 5 "Energy Developments in the 1970's and Early 1980's" in Eleventh Annual Review. Economic Targets and Social Indicators (Information Canada: Ottawa 1974). Responsible for research on foreign impacts on Canadian prices under fixed and flexible exchange rates (1973-1975).

Languages:

English and French - fluent

Michael C. McCracken

Education: B.A. Economics, Rice University (1961)

M.A. Economics, Southern Methodist University (1964)

All requirements except dissertation for Ph.D., Southern Methodist University (1965)

Experience:

Informetrica Limited (1972-) - President, Senior Advisor

- Development of a large econometric model of Canada and its application to forecasting and policy simulation
- Application of quantitative techniques for corporate planning
- Examination of policy options for federal and provincial governments in fields of macroeconomics and energy
- Consulting studies for governments and businesses

Economic Council of Canada (1970-72) - CANDIDE Project Manager; (1965-67) - Econometrician

Office of Economic Research, United States Government (1969-70) - Development of quantitative techniques for economic research - Model-building for various countries

U.S. Army, Captain, Military Intelligence (1967-69) Research on U.S.S.R. and other economies

Teaching - Principles of Economics, International Trade, Mathematics for Economists, Quantitative Methods for Economic Research

Selected Publications

- "A Computer System for Econometric Research", Social Science Information, Vol. VI, No.5, October, 1967, pp. 151-158
- "Data Administration in an Information System" Conference on Government Information Systems (Economic Council of Canada, Ottawa, 1968)
- (With C.A. Sonnen) "A System for Large Econometric Models: Management, Estimation and Simulation", Proceedings of the ACM Annual Conference, August 1972, Boston (New York: Association for Computing Machinery, 1972, pp. 964-73)
- (With N.E. Wale) "Prices, Income and Saving, and Interest Rates" The Economy to 1980: Staff Papers (Economic Council of Canada, Ottawa, 1972)
- An Overview of CANDIDE Model 1.0, CANDIDE Project Paper No.1 (Economic Council of Canada, Ottawa, 1973)

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Carl A. Sonnen

Education: B.S.F.S. Foreign Service, Georgetown University (1959)

Requirements except dissertation for Ph.D., (Economics), American University (1970)

Experience:

Informetrica Limited (1972-) - Chief, Consulting Services, Senior Advisor (Secretary/Treasurer)

- Design and development of software implemented imformation systems with particular applicability to econometric research and reporting problems
- Application of quantitative research techniques for corporate and project planning and monitoring
- Examination of policy options for government with special reference to microeconomics and inter-provincial economic linkages
- Consulting studies for business with special emphasis on commodity demand and input costs

Economic Council of Canada (1971-72) - CANDIDE Project, systems development and implementation

Office of Economic Research, United States Government (1962-71)

- In-depth research and forecasts of economic conditions in Latin America
- Development of quantitative techniques for economic research

Teaching - Professional Development Seminars sponsored by Informetrica Limited on applicability of economics to corporate and government planning, and the development and use of econometric models

Selected Publications

- (With M.C. McCracken) "A System for Large Econometric Models: Management, Estimation and Simulation", Proceedings of the ACM Annual Conference, August 1972, Boston (New York: Association for Computing Machinery, 1972), pp. 964-73)
- "Canadian Unity and Some Elements of Long-Term Economic Prospects", (various issues of the Toronto Star, 1978)

Paul M. Jacobson

Education: M.A. Economics, Queen's University (1973)

B.A. Economics, McMaster University (1971)

Experience:

Informetrica Limited (1973 -) - Chief, Infrastructure Group, National Forecast Service

- Responsible for model and database development as well as other aspects of the research capital of the firm. Requires detailed knowledge of following branches of economics: consumption, investment, foreign trade, labour supply and demand, fiscal and monetary theory.

- Responsible for product development and management of Evergreen Data Services.

- Teaching at Professional Development Seminar level: Introduction to MASSAGER/DATABANK, Introduction to Quantitative Methods.

Consulting Projects:

A simulation model of a cable TV firm and the CATV industry utilizing cross-sectional and time-series data

Development of a technique for sub-provincial forecasts consistent with CANDIDE forecasts to provide inputs to pollution control requirements in Southern Ontario.

Management of a project to classify, load and retrieve CANSIM data for a wide variety of user-specific research queries

Development of software to provide company and industry financial reports for a government agency

Preparation of operational plans and budgets for a large-scale, energy-related government survey

Development of major extensions to Informetrica Limited proprietary software products such as Mosaic, Databank and Massager

APPENDIX B

Macroeconomic Impact Studies by Informetrica Limited Using The Informetrica Model or the National Forecast Service CANDIDE-type Model

--- Macroeconomic Impact of Increased Government Transfers

--- Macroeconomic Impact Study of a Major Frontier Energy Investment Project

--- Macroeconomic Impact of Immigration

--- Macroeconomic Effects of the Construction of a Natural Gas Pipeline

--- Macroeconomic Impact of Rapid Increases in the Domestic Price of Crude Oil

APPENDIX C

THE INFORMETRICA MODEL

AN OVERVIEW

P. Jacobson
October 29, 1979.

The Informetrica Model Project - An Overview

I. Introduction

This report provides an overview of the Informetrica Model. The two-year project to develop a new forecasting model was the result of two major stimuli. First, after six years of experience, principally through the National Forecast Service, in the use and enhancement of the CANDIDE family of models, some major requirements for and exciting possibilities of a restructured and re-estimated model were seen. An additional stimulus to the redevelopment project has been dramatic increases in the costs of the tuning and maintenance of the existing NFS model brought about by major revisions to the prime data sources used for such purposes.

For the project, four major goals were defined:

1) to produce a revised model with a disaggregation and articulation of linkages suited to the needs of our client base,

2) to produce a model which could better articulate policy impacts and provide reduced forecasting error,

3) to put into place sufficient model maintenance and development capital to ensure that ongoing work on the model could proceed at an appropriate pace and cost,

4) to ensure the optimum utilization of existing intellectual capital based on the CANDIDE models.

Like its predecessor models, the Informetrica Model is based on the structure of the National Accounts data as being the only totally consistent structured approach. Considerable restructuring to suit revised views of model linkages has been undertaken. However, care has been taken to focus on improvements only where data consistency and reliability warranted it.

The commitment to a development project of this size is part of Informetrica's strategy, as a centre of expertise in forecasting and analysis, of ensuring the continued high quality of its tools.

This document is intended to review Informetrica's Model more from a user's point of view than from that of a model builder. In focussing on the more general linkages and points of interest, it will serve as an introductory framework for more detailed documentation of specific sectors. Naturally, the general organization and much detail must be similar to the overviews of the three versions of the CANDIDE model to which the Informetrica Model owes an undoubted intellectual debt. The relevant documents covering these models are:

M.C. McCracken, An Overview of CANDIDE 1.0; CANDIDE Project Paper No.1, Economic Council of Canada, 1973.

R.G. Bodkin & S.M. Tanny (editors), CANDIDE Model 1.1 (2 vols.), Economic Council of Canada, 1975.

H.E.L. Waslander, CANDIDE Model 1.2 (mimeograph) Economic Council of Canada, July 1975

In particular, the more general introduction of the concepts of any model, as presented in "An Overview of CANDIDE 1.0", will be omitted here. To introduce users, familiar with the CANDIDE family of models, this overview will focus particularly on the differences between the Informetrica Model and its predecessors. Because of resource and size considerations, full equation reports will not be available at this time. However, Appendix A to this report lists some sample results. The detailed model code and mnemonic table are in a separate volume, TIM, Model Book.

II. Model Structure

All major macroeconomic models provide elaboration of these seven basic model sectors:

1) final demand (expenditure by sector of end use),

2) industry output,

3) labour supply and demand,

4) returns to factors and industry domestic output,

5) final demand prices,

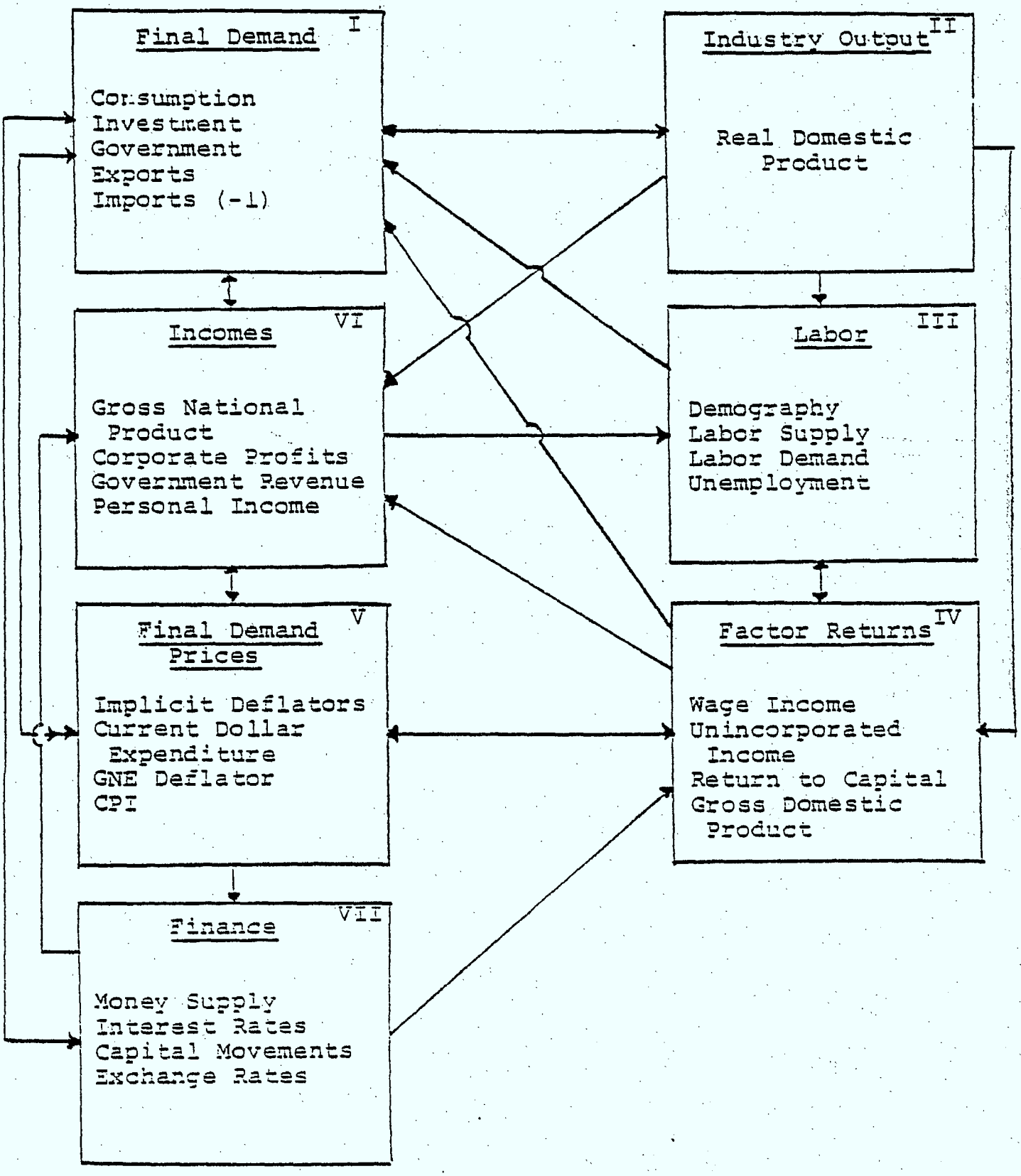
6) incomes (sectoral and aggregate),

7) financial variables and capital flows.

Figure II.1 shows the basic linkages between these sectors. Sectors 1, 2 and 3 can be considered the 'real' side of the model. That is, this side of the model deals with real economic activity or transactions representing actual flows of goods and services and production factors. Sectors 4 and 5 are the key portions of the 'price' side of the model. That is, they define the prices and current values of the real economic activity defined in the previous sectors. Sector 6 provides the links between sector expenditures and incomes which comprise the heart of the GNE and GNP identities associated with the National Accounts framework. Sector 7 provides the interest rates, and other financial variables consistent with the money supply and the level of economic activity.

FIGURE II.1

INFORMETRICA MODEL - SECTORAL LINKAGES



A special sector, the Input-Output Sub-model, integrates the real and price sides of the model. It provides a bridge from final demand to industry output and from industry and foreign prices to domestic final demand prices.

Figure II.2 shows a more detailed summary of the model sectors and current block allocations.

1. Final Demand

Final demand or expenditure by end use is defined to be all expenditure by the four sectors of the economy which is not part of the economic inputs to any other phase of economic production. As a model sector, it can be considered analogous to the traditional Gross National Expenditure (GNE) identity of:

$$C + I + G + X - M = GNE$$

This identity is seen in the highest level aggregates shown in Table 6 of the annual National Accounts (13-201).

The final demand disaggregation in the Informetrica Model is summarized in Figure II.2. Personal sector expenditures are disaggregated into the detail of residential construction and of personal consumption. Final demand expenditure by the business sector is composed of investment in inventory, non-residential construction and machinery and equipment. Both current and capital expenditures are distinguished as final demand for the government sector. For some categories as many as four levels of government, federal, provincial, local and hospitals, are distinguished.

Figure II.2

Informetrica Model

Summary by Sector

	Categories (Approx.)	Blocks
I FINAL DEMAND		
1) Personal Consumption ($K) & Residential Construction	48	3, 16
2) Inventory Investment ($K)	8	17
3) Business Investment-MEK ($K)	40	6
4) Business Investment-COK ($K)	40	10
5) Exports ($K)	50(x2)	19,20,21
6) Imports ($K)	43(x2)	27,28,29
7) Government ($K)	23	35
II INDUSTRY OUTPUT		
1) Real Domestic Product	68	38
III LABOUR		
1) Population	32	52
2) Source Population	12	52
3) Labour Force	12	45
4) Employment	12	44
5) Hours Worked	12	44
IV FACTOR RETURNS		
1) Wage Bill	13	43
2) Unincorporated Income	9	43
3) Return to Capital	9	39
4) Inventory Valuation Adjustment	8	18
5) Capital Consumption Allowances	9	39
6) Gross Domestic Product	37	41
V INCOMES		
VI PRICES		
1) Consumption	48	4-5
2) Inventory	8	18
3) Exports	50	22-26
4) Imports	43	30-34
5) Business Investment - ME	40	8
6) Business Investment - CO	40	12
7) Government	20	36-37
8) Current Dollar Aggregates		1

	Categories (Approx.)	Blocks
VII INCOMES		
1) Government Revenue	60	46
2) Sector Income	50	47-48
VIII FINANCE		
1) Interest Rates	7	49
2) Chartered Banks Liabilities	4	49
3) Capital Flows	8	50

Some portion of the final demand expenditures by the three domestic sectors is produced by the foreign sector and imported by the domestic ones. Exports are final demand expenditure by the foreign sector on domestically produced goods.

The general theoretical thrust of the final demand sector of the Informetrica Model is Keynesian or neoclassic rather than monetarist. In other words, as in its predecessor models, there is no direct role in the model for monetary and financial stocks in the determination of final demand expenditures. However, there is some role for interest rates.

1.1 Consumption ($K-Block 3, $C-Block 5)

Consumption by the personal sector of goods and services is defined in the model in Block 3. The disaggregation, closely following that of the Annual National Accounts (13-201, Table 53), is equivalent to NFS-CANDIDE. Total consumption in constant dollars (CZK) is behaviorally disaggregated into 6 categories of durable goods expenditure (CDURTK), 6 categories of semi-durable goods expenditure (CHDRTK), 10 categories of non-durable goods expenditure (CNDRTK), and 26 categories of services expenditures (CSERTK). As in most macroeconomic models, the basic behavioral responses are found from prices and income. The distinguishing features of this sector are:

1) A special income concept, discretionary income (YDISK), is introduced into many of the equations. This income concept is defined as personal disposable income remaining after the purchase of key items such as food (CNF10K), and shelter (CSR10K, CSR20K, CNR40K, CNR50K, CNR60K). The general principle of its introduction is that many expenditure decisions are made given that a particular level of expenditures on necessities must be maintained.

2) To attempt to avoid complex adjustment mechanisms, the income, savings, consumption identity is ensured by defining discretionary savings as a residual given the endogenous definition of consumption and contractual savings.

3) Rather than use simple forecast rules based solely on population growth, additional service items such as laundry and dry cleaning (CSH50K) and other household services (CSH70K) have been endogenized as functions of relative price and demographic factors such as birth and marriage rates.

4) To improve the specification of the medical care related items, a specific population concept (HWIPOP) was used. This is a population index in which each age-sex cohort is weighted by the relative demands it places on the health care system.

5) As a general attempt to more appropriately structure the model, links have been built to other parts of the model. For example, travel expenses (CSA11K) is linked directly to the appropriate balance of payments item, travel payments (TRAVMC). In fact, the link is through an identity consistent with the data source methodology.

6) Rather than strictly follow the Houtthakker-Taylor consumption model, a more eclectic approach, aimed at more appropriate forecasts, has been tried. For example, consumption of gasoline and related oil products (CNT30K) has been tied to the energy model variable for motor gasoline consumption (MOTGAS). This variable is in turn responsive to both the relative price of such products, the price and stock of cars, household income and the number of cars per household.

1.2 Residential Construction (Block 16)

Residential construction is the investment category of the personal sector. This section of the model follows essentially the same pattern as the previous model. Expenditure on new and used construction are distinguished as functions of population, real income and appropriate stock variables.

The longer term properties of this block are the key concern. Ideally, the block should catch indicators of credit tightness and the impact of government programs. However, such factors have proven to be elusive during model development. The changing nature of government programs has proved particularly difficult.

1.3 Business Investment

Business investment is normally grouped into three categories:

1) inventory change, (Block 17)

2) non-residential construction, (Block 10)

3) investment in machinery and equipment, (Block 6).

In the current implementation of the Informetrica model, 40 categories in each of non-residential and machinery and equipment investment are distinguished. As with earlier models, the starting point of the estimation was the standard Jorgenson neoclassical model with the rental cost of capital defined as an investment price multiplied by the sum of the discount rate (industrial bond rate, RINDB) and the rate of replacement (the economic service life).

1) The standard specification is a function of output, existing stock and the price of output relative to the rental cost or price of capital.

2) Considerable emphasis has been placed on obtaining lag structures consistent with accepted economic theory.

3) To represent the time path of investment, a new variable, vintage of capital, is created for each investment category. Representing the average age of the stock of that investment good, it is used, rather than time, as a proxy for technical change. It can be considered as an age-weighted value of capital stock. The relative 'newness' of investment is represented by a more recent vintage of capital. This variable has been used in the Industry output adjustment equations, in the employment and in the capital consumption allowance equations.

1.4 Government Final Demand Expenditure

Government final demand expenditure is composed of current expenditures on goods and services and capital expenditures. Where possible, at least two levels of government (Federal and other) have been distinguished. However, in many cases, four levels of government, federal, provincial, local and hospitals are defined. Following its predecessor models, the Informetrica Model follows the practice of endogenously explaining the various expenditure items as functions of demographic trends and the general level of economic activity as representing a requirement for social infrastructure. Some principal features of this sector are:

1) Transfer payments have been further disaggregated with respect to both level and function. This allows the separate definition of government balances for each level of government and hence a more consistent articulation of the impact of the policies of one government level on the activities and balances of another level. In the current release, government balances (GBALP, GBALM, GBALH) have been defined.

2) Rather than constant dollar Gross National Expenditure (GNEXPK) as a principal explanatory variable as in previous models, a new concept, GNENET, private GNE less government expenditure, is introduced. This avoids the inconsistency and feedback problems associated with the previous approach.

3) To provide a link between government programs and administrative costs, separate proxies (FAV, MAV, PAV) for the activities of each level of government have been developed from major items of revenue, transfers and capital formation.

4) Where possible price relatives (e.g. GHWCOP/PGNE) have been introduced to measure reaction to increasing costs.

5) Among the specific demographic variables used such as school enrolment (ELSEC) is a new concept HWIPOP. This is an age-sex weighted population index based on the relative demand placed on the health-care system by various population cohorts.

6) To assist in the development of simulation scenarios, several previously exogenous items have been endogenized using the concept of a relatively stable exogenous rate applied to an endogenous base. The base used could be as general as GNE or as specific as activity in a particular industry. For example, federal subsidies have been disaggregated into four components. Each is defined by a rate applied to an appropriate base. For example, agricultural subsidies are driven by a rate applied to agricultural RDP (lagged one period).

1.5 Foreign Trade Sub-Model

The foreign trade portion of the Informetrica Model is the portion of final demand most distinguished in disaggregation from previous models. For each of two directions of trade (U.S. and R.O.W.), 49 export categories and 42 import categories are distinguished. Figure II.1.5 summarizes the disaggregation available. The general specification of the equations in this section of the model includes as specific as possible a measure of foreign activity, relative prices and some measure of domestic capacity. Principal features of the implementation include:

1) As well as the major efforts of data collection, specification and estimation, this increased disaggregation necessitated a major disaggregation of the Statistics Canada input/output final demand conversion (E) matrix by Informetrica.

2) Most impact prices are linked via the exchange rate to exogenous foreign prices.

3) In the current release of the model, all export prices are linked to exogenous foreign price variables. The TIM input/output system produces export price estimates consistent with domestic industry selling prices. A link between selected export prices and their domestic equivalents is under test.

FIGURE II.1.5

TRADE SUB-MODEL DISAGGREGATION

	No. of Commodity Categories	No. of Behavioral Equations
Exports		
1-LIVE ANIMALS	1	2
2-FOOD, BEVERAGES	5	10
3-CRUDE MATERIALS	14	28
4-FABRICATED MATERIALS	15	29
5-END PRODUCTS	7	14
6-SPECIAL TRANSACTIONS	2	4
SERVICES	6	10
TOTAL	50	97
Imports		
1-LIVE ANIMALS	1	2
2-FOOD, BEVERAGES	4	8
3-CRUDE MATERIALS	8	16
4-FABRICATED MATERIALS	12	23
5-END PRODUCTS	11	22
6-SPECIAL TRANSACTIONS	1	2
SERVICES	6	11
TOTAL	43	84

4) To achieve better long-run production, supply variables such as capital stock and labor costs have been introduced.

This sector of the model is currently undergoing intensive testing to evaluate the time profile and magnitude of the response to relative price changes such as would occur with changes in the exchange rate.

2. Industry Output

As with most macro models, industry outputs (RDP) are a key concept integrating expenditure and economic activity. The disaggregated industry outputs are used in the determination of imports, exports, inventories, business investment, employment, and other areas in which industrially specified indicators of economic activity are required. Additionally, the industry outputs are used in the determination of the factor incomes (return to capital and wages). These factor incomes are used, in turn, in the determination of current dollar industry output (GDP) and the corresponding prices of industry activity.

As with all models of the CANDIDE family, a modified input/output system is used to provide the bridge from final demand expenditure to industry output and from industry and import prices to final demand prices. The basic approach in output determination is defined by four steps.

1) Translate final demand expenditure using the E converter matrix into domestic requirements.

2) Translate the requirements into requirements for industry output using the market-share matrix D.

3) Using the requirements matrix "B" which determines input requirements for a unit of output and D, translate the final demand output requirement, given inter-industry requirements into output levels.

4) Because the output levels are only approximate, adjustment equations are used to match the published RDP data.

The distinguishing features of the Informetrica Model implementation of this approach are:

1) Rather than use two externally calculated inverse matrices for the determination of output and price estimates, the basic I/O matrices are used to calculate an iterative solution each year. As well as some savings in storage requirements, this approach provides the necessary condition for the use of time-varying input output/tables. When warranted, and an appropriate projection can be defined, their introduction will be considered.

2) The solution algorithm uses two basic input/output derived matrices. These are:

   a) DE - conversion of 219 final demand categories into 82 industry requirements. Block 62, the YD variables, shows the results of these calculations. They represent simply an industry view of the sum of final demand (C+I+G+X-M).

b) DB - 82 industry requirements are converted into 82 industry outputs. Block 59, the YR variables, shows the I/O estimates of RDP. Block 61 lists the industry equivalent of gross output.

3) The considerable disaggregation of the DE matrix was done by Informetrica to appropriately utilize the disaggregation available in the foreign trade sub-model. For example, in the predecessor models, manufacturing exports (MANFXK) was converted with one mix of industry requirements. Yet this category contains such diverse items as textiles, chemicals, aircraft, and petroleum and coal products. Thus, it was not possible to easily impact, through the export linkage, the chemicals industry only. Because of the increased disaggregations, this is now possible in a more consistent fashion.

4) In the adjustment equations for RDP, complex lag responses have been avoided to ensure a more consistent model response to impacts (Block 38).

5) Some additional disaggregation of the DB matrix was performed to isolate the impact on final demand of royalties on natural resources. The use of the Input/Output system in the determination of final demand prices will be discussed below.

3. Labour Demand and Supply

The outputs of the labour sector are the labor force, employment by industry and unemployment. As an indicator of the state of the economy, the unemployment rate (URATE) enters many parts of the model. Employment by industry is used in determining the factor income of labour, a key concept in the development of industry prices. Industry-specific employment also influences the participation of particular cohorts in the labor force.

3.1 Labor Demand (Block 44)

As with most models, industry-specific employment requirements are determined primarily by the corresponding industry output and capital stock. Both the level of employment and the hours required are distinguished. The distinguishing feature of the implementation are:

1) The disaggregation used is equivalent to that available in the Labour Force Survey, the only source consistent with the measures of labour compensation.

2) The equations are estimated as productivity functions with the vintage of capital replacing time as a proxy for technical change. This links employment to the time path of investment, not just the level of capital stock.

3.2 Labor Supply

The supply of labor is defined by two components, source population and participation rates. The participation rates, disaggregated on a age-sex basis, define the portion of the source population employed or looking for work. Following the practice of the predecessor models, the Informetrica Model treats the historically stable participation rate of prime age (25-54) males as exogenous. The general model used relates a participation rate to some measure of labor market tightness, real income and demographic variables (appropriate to the group in question), such as the marriage rate, fertility or school enrolment.

Particular features of interest

1) Instead of five participation rates, twelve are defined. For each of male and female, participation rates are distinguished for the 15-19, 20-24, 25-54, 55-64, 65-69, 70 and over age groups.

2) Fertility trends have been introduced where appropriate.

3) A composite income variable reflecting the unemployment insurance program was used for most categories.

4) Old age security programs are found to have a negative impact on the participation rate of older age groups.

3.3 Demography (Block 52)

As a conceptually separate sub-model, anterior to the other sectors, a demographic submodel is used by the Informetrica Model to provide estimates of population and other demographic variables. This portion of the model is anterior to the rest because there is no current feedback of economic influences on demographic variables. The key portion of this sector calculates the current level of an age-sex specific population cohort by ageing with an appropriate survival rate, the lagged value of the cohort and a portion of the previous cohort. Source population cohorts are defined as population cohorts adjusted to fit the labor force definitions.

Principal features of this sector include:

1) Sixteen age-specific categories are defined for each of male and female. Two cohorts, age 0 to 4 years and age 65 and over, were disaggregated to separate out children less than one year of age (PF0000, PM0000), and people over 70 (PF7000, PM7000). This was done because of the their very different survival patterns.

2) Exogenous survival rates have been introduced to allow for changing mortality assumptions.

3) Net immigration, currently exogenous, is allocated to the cohorts on the basis of the average age-sex composition over the period 1961-1971.

4. Factor Returns, Industry Gross Domestic Product and Prices

The determination of returns to the factors of production and of industry Gross Domestic Product (GDP) represents a major point of departure from the approach followed in NFS CANDIDE. In the predecessor models, industry deflators, defining the current dollar value of industry output, were derived on a markup basis from aggregate measures of unit labor and in a few cases from unit capital costs. In contrast, the Informetrica Model in Block 41 derives GDP measures based on the summation of factor incomes. In fact, for the major aggregate industries, GDP is defined as the summation of the factor returns to capital (returns to capital, e.g. MARC - manufacturing return to capital), to labor (wage bill, e.g. MAWA - manufacturing labor compensation), and unincorporated income. The details of these items and their industrial disaggregation will be discussed below.

4.1 Labor Income - Block 43

Factor returns to labor or labor compensation are defined in the model for the 12 industrial sector detail consistent with the framework of the National Accounts and the Labor Force Survey. This compensation measure includes supplementary labor income. As well as being a part of GDP, the industry wage bills are used as measures of labor cost in the determination of unincorporated income and in other equations. The general model used assumes a positive reaction of the wage bill to changes in the CPI, output per man and hours per man.

Some principal features of the sector include:

1) For industries, such as manufacturing or construction, where substantial labor concentration exists, a wage bargaining model is used. Employees are assumed to try to capture a portion of the factor returns to capital per man.

2) Return to capital per employed worker is used as a measure of profitability.

3) In manufacturing, the change in the capital/labor ratio, as a measure of capital intensity, enters with a positive sign.

4) For service industries, a modified Phillips curve model, using the reciprocal of the unemployment rate, is used.

5) Since the first release of TIM, 10 equations for supplementary labor income (SLI) have been introduced. These are tied specifically to the Canada and Quebec pension plan variables and to the Unemployment Insurance variables.

6) To help ensure the appropriate linkage between government wages appearing as part of final demand (GFWASC) and government labor income (ADWA), this latter equation is simply estimated as an adjustment equation to the detailed government wage items. This allows more sophisticated behavioral specifications of the wage bill deflators.

7) Similarly, in TIM, the public portion of CSWA, the Community, Business and Personal wage bill, have been separated out into health and education components to link more appropriately to government expenditure.

4.2 Unincorporated Income

Unincorporated business income is defined for the eight industries in which it is important. The general specification uses other factor returns; usually return to capital and the wage bill. In some cases, TIME is required for adjusting purposes. The notable exception is net income of farm operators from farm products (AGUNY) which is estimated as a function of the agriculture GDP, (AGYG), wage bill (AGWA) and capital consumption allowances (AGCCA).

4.3 Return to Capital (Block 39)

In the Informetrica Model, a new concept, return to capital, is introduced. This is the portion of industry gross domestic product which does not accrue to other factors (i.e. labour). It is often defined as other operating surplus. As well as forming part of GDP, it is used as a measure of industry profitability in the determination of wages and unincorporated income. The basic model used is that payments to capital should, on average, cover capital costs.

Principal features of this sector are:

1) Return to Capital is defined for nine sectors.

   Fishing and trapping (FSRC); mining (MIRC); manufacturing (MARC); construction (CORC); utilities (UTRC); Transportation, storage and communication (TSRC); trade (TRRC); Finance (FIRC) and Services (CSRC).

2) The basic model uses the inverse of the capital/output ratio and the cost of capital.

3) Cyclical fluctuations in the return to capital are postulated as depending on capacity utilization and for manufacturing, foreign price conditions.

4.4 Industry Gross Domestic Product (Block 41)

Industry Gross Domestic Product (GDP) is the current dollar equivalent to Real Domestic Product (RDP). Industry price deflators, the ratios of the two series, are used in the input/output prices model to create estimates of final demand prices. They provide the valuation of output and activity.

In NFS-CANDIDE, GDP deflators for the aggregate industries were defined by a markup equation applied to unit labour and/or unit capital cost indexes. The detail within manufacturing was simply estimated as time trend adjustment equations applied to the aggregate manufacturing deflator (MAP). Instead of following this cost approach, the Informetrica Model defines GDP for the aggregate industries as the sum of industry specific factor returns. For most industries, return to capital, unincorporated business income and wages are defined. This approach allows a much "richer" specification of the effects of investment, employment, price changes, etc. on industry prices.

Estimates of GDP on an industry basis within manufacturing are based on a relatively rich specification utilizing the disaggregation of RDP and capital stock data as well as specific foreign trade detail. However, at the current time, because of the lack of consistent disaggregated series for return to capital and wages, the GDP equations adjust to average shares of aggregate manufacturing data.

5. Final Demand Prices

Following the practice of most macro-economic models, the Informetrica Model uses a model based on the aggregation of factor costs to develop estimates of all final demand prices. As well as defining current dollar final demand from constant dollar flows, the final demand price deflators are used in the demand equations. Through the CPI, they are used in the wage equations. As mentioned above, the Informetrica Model uses the input/output matrices to create estimates of final demand deflators which are weighted combinations of industry prices, import prices and indirect taxes. The major features of the implementation are:

1) Additional disaggregation of the DB matrix to allow the separation of government royalties from the price effects of finance, insurance and real estate. Further, oil and gas royalties have been separately distinguished.

2) In the predecessor models, the effects of two industry tax deflators and one subsidy deflator were distributed across the price system using the base year industry allocation of taxes and subsidies. This meant that it was not possible to easily tax or subsidize a separate industry. Additionally, there were serious conceptual problems in the definition of the deflators used.

3) In the Informetrica Model, a special set of Industry price deflators (with mnemonics ending in PZ) have been defined to more appropriately capture the effects of indirect taxes and subsidies. Each industry-specific PZ reflects the positive effect of taxes and the negative effect of subsidies on the price structure of that industry. While still retaining the assumption of full pass-through, this approach will allow the application of new subsidies or taxes to an industry in any given year. This industry-specific approach assures an appropriate and internally consistent reaction in the final demand prices.

4) An intermediate level of industry price estimates, conceptually equivalent to Industry Selling Prices, are defined in Block 63 (the PX variables). For each industry, its PX is a weighted sum of its own price deflator (PZ) and those of other industries from which it purchases inputs.

5) Unlike the prodecessor models, the Informetrica Model incorporates moving import shares in the prices model. Therefore, the impact of import prices on domestic prices will vary with the relative amount of output substitution provided by these imports.

6) Input/Output estimates are created for export prices. At present these estimates are not used directly, although we expect to be able to explain some export prices as functions of these variables. In all cases, they are useful for the comparison of domestic and foreign prices on a consistent basis.

6. Incomes (Block 46, 47, 48)

This sector of the model creates estimates which correspond to many of the entries shown in the income accounts of the National Accounts. This general treatment is much the same as in NFS-CANDIDE and the other models of the CANDIDE family. Some of the more distinctive features are:

1) As with NFS-CANDIDE, dividend flows to Canadian (DIVCP) and to the foreign sector (DNR) are endogenously determined. The variables are linked to the stocks of foreign-owned assets defined in the capital flows portion of the model. DNR is also linked to dividend flows on a balance-of-payments basis.

2) Transfer payments have been disaggregated to a level necessary to further separate out the activities of the provincial, local, hospitals and pension funds. In most cases, these transfer payments have been endogenized using an appropriate rate and base.

3) Three major programs of transfer payments to the personal sector have been endogenized. These are old age pensions, family allowances, and unemployment insurance. Stochastic equations have been used to approximate the evolution of these programs.

4) For the UIC program, to arrive at the total of benefits paid (UIB), the number of benefit weeks paid (UIBWKS) and the average benefit (UIBBEN) are endogenously determined. Similarly,a stochastic rule was developed to endogenize the maximum contribution level (UIBCM) and the total level of contribution (TUI).

5) Local government revenue (LGTREV) has been separately distinguished.

6) Separate balances, (GBALM,GBALP,GBALH) have been defined in the current version. To achieve this, some items such as government interest expense, have been separately endogenized.

7. Financial Sector (Block 47)

Following the directions pointed to by earlier models, the Informetrica Model has introduced a more sophisticated, fully-specified financial model with appropriate links between monetary aggregate, government policy and interest rates. As well as links to the asset position of the Bank of Canada, the financial requirements of government and the cash requirements of business are also linked to the financial model. Some important features of the model include:

1) Asset demand equations are specified for savings deposits, term and notice deposits and currency.

2) An interest-responsive demand function for excess reserves is also introduced.

3) Given the supply of reserves (high-powered money) and the demand for excess reserves, the level of demand deposits is determined by the inversion of the standard money supply identity.

4) CANPCP, the Canadian commercial paper rate, is modelled as the key interest rate in the Informetrica Model. It was chosen as the rate most representative of market conditions. As such, it is endogenized as a function of the level of demand deposits relative to the level of GNE and an American interest rate.

8. Capital Flows and Exchange Rates

The capital flows sector of the Informetrica Model assumes a more critical role than in the predecessor models. The asset stocks are used to derive balance of payments income flows. The capital flows are used to derive the balance of payments position (BASBAL, OFSBAL). Some critical features of the implementation are:

1) A two-area breakdown, consistent with the foreign trade sector) has been adopted. This gives the model the facility to define area-specific payments balances.

2) The capital flow equations have been estimated as interest responsive to obtain a link to monetary policy.

3) An endogenous exchange rate equation has been developed and is currently undergoing testing but all current forecasts are being run with an exogenous exchange rate.

III. Exogenous Variables

As with the preceding models, the Informetrica Model requires exogenous variables to define the assumptions for forecasting. Where these variables refer to the external (R.O.W.) sector, many have been chosen to be compatible with the Wharton Long-Term Model but are still general enough to use other models as a source. For the demographic sub-model, the exogenous variables are immigration and the fertility and survival rates. At the current juncture, all investment scrappage levels are exogenous. Some categories, with appropriately short service lives, will be endogenized at some point. Rather than have exogenous amounts for some government programs, exogenous rates are applied to appropriate bases. These rates become policy instruments which are easier to set and evaluate than the total dollar levels of the programs themselves.

IV. Model Support Capital

As part of the commitment to the new model, it was recognized that a capital-intensive approach to model development would assist in maintaining a high level of model support.

Probably the most time-consuming portion of model support is the database maintenance activity. A significant portion of the database required for the Informetrica Model is available in machine-readable form. Accounting models have been developed to convert this data into the organization and aggregation suited to the model.

One major accounting model was developed to support only the data series drawn from the Trade of Canada. This set of software ensures the consistency and timeliness of that portion of the database. Particular attention was paid to the requirement for consistency of aggregation.

The other major accounting model integrates the remainder of the database. This draws largely from CANSIM to create the required aggregates and to check for statistical discrepancies.

V. Current Model Performance Measurement

As part of the on-going model maintenance, changes to the model specification are continually being introduced. These changes are designed to improve the model performance in forecasting and policy simulations. In some cases the changes are made to cope with new legislation or new institutions on the Canadian economy. In other cases respecification may be required in areas where a structural change is evident or suspected.

The five criteria for accepting model changes are:

1) the theoretical specification of the equation,

2) the statistical properties of the estimated equation,

3) the effect on the sample-period performance of the model,

4) the ex-ante forecasting performance.

To establish an initial benchmark, the measures for a dynamic simulation of the period 1963-74 is included in Appendix B. We will be providing descriptions of the multipliers and policy simulation characteristics of TIM at a later date. In addition, the tabulation of forecasting performance will continue to be a regular part of the National Forecast Service.

APPENDIX A

SOME SAMPLE EQUATION RESULTS

TIM as of October, 1979

MOTGAS 3-80, MOTOR GASOLINE CONSUMPTION

MOTGAS=PCRTOT*(.05739+.001716*YDISK/HOHO
(4.57)

-.02300*PCRTOT/HOHO -.005339*CIT30P/YDISK
(-5.74) (-1.92)

-.0103*CDT10P/YDISK)
(5.25)

$\bar{R}^2$	=	.704	SEE =	.000275	RMSE =	.00023	COV = 1.117
DW	=	1.27	$\bar{Y}$ =	.0246	AAPE =	.767	F = 11.113
R^2n	=	.999	AAPEn =	.768	Est. Pd. =	1958-1975	

CDT11K 3-10, CONSUMPTION, AUTOMOBILES, NEW

CDT11K=HØHØ*(.70697=.098735*YDISP/HOHO
(9.28)

-.512087*CDT11P/YDISP
(-6.308)

-.1789*(CARSTK/HØHØ)<-1>

-.07152*(D51ON-D70-D71ON)
(6.216)

-.1549*CNT3OP/YDISP)
(-2.44)

$\bar{R}^2$ = .98262 SEE = .0136 RMSE = COV = 4.16

DW = 2.26 $\bar{Y}$ = .3288 AAPE = 2.96 F =249.7

R^2n = .9946 AAPEn = 2.96 Est. Pd. = 1953-1975

CDT11P 4.4, PRICE DEFLATOR - AUTOMOBILES NEW

CDT11P=AUTØEP*EXP(1.3157-0.5546*
(-3.899

ALOG(AUTOEP/AUTOEP<-1>)

-.0186*TIME-.04139*(1.0-D71ON))
(-13.9) (-4.4)

$\bar{R}^2$	=	.982	SEE =	.00929	RMSE =	.0077	COV = 215.3
DW	=	1.86	$\bar{Y}$ =	.0043	AAPE =	48.08	F = 225.46
R^2n	=	.978	AAPEn =	.605	Est. Pd. =	1962-1974	

CHP10P 4.13, PRICE DEFLATOR, JEWELRY, WATCHES

$$CHP10P = JEWLEP * EXP(-.7869 + .01131 * TIME \quad (6.6)$$

$$+ .03927 * (1.0 - D71Q1)) \quad (2.57)$$

$\bar{R}^2$	=	.82	SEE =	.016	RMSE =	.014	COV = 348.7
DW	=	2.08	$\bar{Y}$ =	.00459	AAPE =	64.2	F = 30.7
R^2n	=	.99	AAPEn =	1.2	Est. Pd. =	1961-1974	

M141MK 6.26 INVESTMENT, M&E, MACHINERY

M141MK=11.819+.0604*M14CMK -1
(9.39)

+(B*(D(MA14YG/M14RTM)))<-1,-5>

ALMON LAG - DEGREE 2

LAG		T
1.	.72516	4.22
2.	.7189	5.19
3.	.6433	3.74
4.	.4983	2.89
5.	.2838	2.43

$\bar{R}^2$	=	.9209	SEE =	3.94	RMSE =	3.549	COV = 9.89
DW	=	2.04	$\bar{Y}$ =	39.88	AAPE =	8.21	F = 78.6
R^2n	=	.9328	AAPEn =		Est. Pd. =	1954-1974	

M14ICK 10-25, INVESTMENT, NRC, MACHINERY

M14ICK=38.637-.4602*M14CCK<-1>
(-7.59)

+.09368*MA14Y+.09215*MA14Y<-1>
(-7.59)

$\bar{R}^2$	=	0.8747	SEE =	2.94	RMSE =	2.66	COV = 17.7
DW	=	1.92	$\bar{Y}$ =	16.5	AAPE =	14.5	F = 49.8
R^2n	=		AAPEn =		Est. Pd. =	1953-1974	

LUMUXK 20-2, EXPORTS, LUMBER U.S.

LUMUXK=EXP(-2.599+1.576*ALOG(USRESK+USNRCK)
(11.2)

-.3553*ALOG(LUMUXP/REXN/LUMDUS)
(-2.69)

-0.5571*ALOG(MA08Y/(M08CCK+M08CMK))<-1>)
(-3.57)

$\bar{R}^2$	=	.962	SEE =	.0418	RMSE =	0.035	COV = .649
DW	=	1.74	$\bar{Y}$ =	6.435	AAPE =	0.48	F = 93.45
R^2n	=	.966	AAPEn =	3.14	Est. Pd. =	1961-1975	

MAU5MK 28-56 IMPORTS, OTHER MANF. GOODS U.S.

MAU5MK=EXP(-6.202-1.3827*
(-4.185)

ALOG(MAS5MP/(MAWA/MAY))

+1.315*ALOG(YDISK))
(17.86)

$\bar{R}^2$ = .971	SEE = .0717	RMSE = .064	COV = 1.05
DW = 1.34	$\bar{Y}$ = 6.8	AAPE = .768	F =237.35
R^2n = .971	AAPEn = 5.196	Est. Pd. =	

GRC6SK 35-6, FEDERAL GOVERNMENT OTHER GOODS & SERVICES

GFC6SK=(CPCGSC/FPL6SP)+(GFWASK*

(.722+0.0807*(FAV/GFWASK))

(11.07)

$\bar{R}^2$	=	.884	SEE =	.043	RMSE =	.04	COV = 15.4
DW	=	.807	$\bar{Y}$ =	.2807	AAPE =	14.5	F = 122.5
R^2n	=	.947	AAPEn =	14.5	Est. Pd. =		

GPWASP=GPWASP -1 *(1.+(-0.206

+1.0176*Q(ECPI)
(7.74)

+0.242*(GFWASP/GPWASP)
(3.13)

$\bar{R}^2$	=	.837	SEE =	.0143	RMSE =	.012	COV = 20.9
DW	=	1.59	$\bar{Y}$ =	.068	AAPE =	17.1	F = 36.8
R^2n	=	.998	AAPEn =	.805	Est. Pd. =	1961-1975	

TSRC 39-8, TRANSPORTATION RETURN TO CAPITAL

TSRC=-835.6+10612.8*TSY/TSCK
(5.8)

+((B*(TSRCCO*TSCCØK+TSRCME*TSCMEK))
<-2,-4>)

ALMON, DEGREE 2

LAG	B	T
2.	.00147	1.32
3.	.000808	1.68
4.	.000316	.379

$\bar{R}^2$ = .983 SEE = 81.63 RMSE = 73.4 COV = 5.58

DW = 1.07 $\bar{Y}$ = 1462.5 AAPE = 3.65 F = 391.3

R^2n = AAPEn = Est. Pd. =

TRRC 39-12 TRADE, RETURN TO CAPITAL

```
TRRC=TRY*EXP(-3.4809-.35199*ALOG(TRINSK/TRY)
                    (-1.29)

    +(B*ALOG((TRRCCØ*TRCCØK+TRRCME*TRCMEK)/TRCK))
    <0,-2>

    -.8566*ALOG(TRWY/TRY))
     (-1.48)
```

ALMON, DEGREE 2

LAG	BETA	T
0	.3107	13.77
-1	.1381	13.77
-2	.0345	13.77

$\bar{R}^2$	= .922	SEE = .0432	RMSE = .038	COV = -2.755
DW	= 2.15	$\bar{Y}$ = -1.57	AAPE = 1.88	F = 76.083
R^2n	= .9912	AAPEn = 2.88	Est. Pd. = 1956-1975	

CSCMWA 43-36 WAGES AND SALARIES, COMMERCIAL

CSCMWA=CSCMWA<-1>*CSET1/CSET1<-1>*

(1.0+(.01705+.9352*Q(ECPI)
(6.66)

+.4338*Q(CSET1/CSET1)
(2.7)

+.2125*Q((CSRC.((CSBUSY-CSOTHY-CSHOTY))<-1>)
(2.37)

+.4036*Q((CSBUSY+CSOTHY)/CSET1)))
(2.35)

$\bar{R}^2$ = .858	SEE = .016	RMSE = .014	COV = 31.5
DW = .95	$\bar{Y}$ = .052	AAPE = 35.5	F = 32.7
R^2n = .999	AAPEn = 1.15	Est. Pd. = 1954-1975	

MAET 44.5 MANUFACTURING, TOTAL EMPLOYMENT

```
MAET=MAY*EXP(1.7547
     -.7760*ALØG((((MAVMEK*MACMEK+MAVCOK*MACCOK)/MACK)
      (-3.6)

     <0,-1>)*.5)-2763*ALOG(MAY/MACK<0,-1>)*.5))
                (-2.92)

     -.498*ALOG((MAY/MAET)<-1>)))
     (-3.78)
```

$\bar{R}^2$	=	.990	SEE = .0196	RMSE =	.017	COV =	- 0.951
DW	=	2.16	$\bar{Y}$ = 2.15	AAPE =	.709	F =	664.51
R^2n	=	.9793	AAPEn = 1.49	Est. Pd. =	1956-1975		

MP1519 45-1 PARTICIPATION RATE - MALES 15-19

MP1519=1.59-.0043*URATE<-1>
(-3.12)

-1.413*ELESEC/(PT0519)
(-6.65)

+.0669*((UIB+TEWA)/LBFORC)/CPID
(17.2)

-5.0314*(PM1519/PT1500)

$\bar{R}^2$ = .972 SEE = .0066 RMSE = .0057 COV = 1.56

DW = 1.49 $\bar{Y}$ = .422 AAPE = 1.097 F = 181.1

R^2n = AAPEn = Est. Pd. =

REMARKS:

PT0519 - Total POP 05-19 age group

PT1500 - Total POP 15 years and over.

Appendix B

Current Model Performance

Ex Post Dynamic Simulation[1] 1963 to 1974

Mnemonic	Description	RMSE [2]	AAPE [3]
GNEXPK	Gross National Expenditure ($71K)	1890.0	1.923
CZK	Total Consumption ($71K)	703.6	1.114
GCURRK	Government Current Expenditures ($71K)	563.2	3.213
GFICAK	Government Fixed Capital Formation ($71K)	198.2	4.983
IME	Investment in Machinery and Equipment ($71K)	246.2	3.780
INRC	Investment in Non-residential Construction ($71K)	282.4	3.681
IR	Business Expenditure on Residential Construction ($71K)	171.4	3.397
TEVPCK	Value of Physical Change in Inventories, Total Economy ($71K)	599.5	107.3
XPTTXK	Exports of Goods and Services ($71K)	608.0	2.341
TSRVXK	Exports, Total Services ($71K)	141.7	3.009
XGNAXK	Exports, Total Goods ($71K)	530.7	2.593
IMPTMK	Imports of Goods and Services ($71K)	580.9	2.300
TSRVMK	Imports, Total Services ($71K)	158.7	2.083
IGNAMK	Imports, Total Goods ($71K)	530.8	2.955
LBFORC	Total Labour Force	34.58	0.3668
TEET	Total Employment	143.0	1.636
UT	Total Unemployed	121.6	27.34
URATE	Unemployment Rate (%)	1.515	27.15
GOVEXP	Total Government Expenditure	612.8	2.355
GOVREV	Total Government Revenue	483.3	1.697
CP	Corporate Profits Before Taxes	644.7	7.482
YDC	Disposable Income	744.9	1.476
YD	Disposable Personal Income ($71K)	1043.0	1.692
TEWA	Total Wage Income	905.0	2.094
TEP	Implicit GDP Deflator	0.0094	0.7957
PI	Investment Implicit Deflator	0.01972	1.895
PGNE	Implicit Price Index of GNE	0.009657	0.8673
CPID	Implicit Deflator of Consumer Expenditure	0.009903	0.7970
GNPC	Gross National Product	1480.0	1.739
TEY	Real Domestic Product, Total Economy ($71K)	1771.0	2.105
MAY	RDP, Manufacturing ($71K)	578.9	2.883
MANDY	RDP, Manufacturing, Non-Durables ($71K)	206.9	1.896
MANDURY	RDP, Manufacturing, Durables ($71K)	390.4	4.005
RTRB3M	Average Yield for 3-month Treasury Bills	0.5153	10.03
RINDB	Average Yield for 10 Industrial Bonds	0.2697	3.006

1/ Based on the Informetrica Model, subsequent respecification work is likely to improve these measures.

2/ Root Mean Squared Error

3/ Average Absolute Percentage Error

Simulation Description V791019

Ex Post Dynamic Simulation 1963 to 1974
Final Demand Detail

			RMSE	AAPE
CZK	Total Consumption	$K	703.6	1.114
CDURTK	Durables		159.0	1.910
CHDRTK	Semi-durables		88.05	1.010
CNDRTK	Non-durables		204.4	0.8605
CSERTK	Services		496.1	1.990
IME	Investment in Mach. & Equip	$K	246.2	3.780
AGIMEK	Agriculture		61.18	6.747
FOIMEK	Forestry		12.85	18.21
FSIMEK	Fishing		6.937	10.62
MIIMEK	Mining		36.43	10.77
MAIMEK	Manufacturing		134.3	5.638
COIMEK	Construction		18.53	6.021
UTIMEK	Utilities		52.42	8.879
TSIMEK	Transportation, Stor		83.56	5.010
TRIMEK	Trade		24.79	5.499
FIIMEK	Finance, Insurance		9.401	7.364
CSIMEK	Community, Bus. Ser.		55.41	7.724
INRC	Investment in Non-Res. Const.	$K	282.4	3.681
AGICOK	Agriculture		16.80	5.100
FOICOK	Forestry		9.443	13.30
FSICOK	Fishing		-	-
MIICOK	Mining		75.77	5.415
MAICOK	Manufacturing		64.98	6.596
COICOK	Construction		6.326	23.52
UTICOK	Utilities		96.79	8.187
TSICOK	Transportation, Stor.		64.78	5.449
TRICOK	Trade		19.44	7.418
FIICOK	Finance, Insurance		50.34	7.887
CSICOK	Community, Bus. Ser.		84.70	12.06
XPTTXK	Exports, Goods & Services		608.0	2.341
SEC2XK	Section 2		79.98	3.430
SEC3XK	Section 3		93.57	2.879
SEC4XK	Section 4		193.8	2.691
SEC5XK	Section 5		355.4	5.445
NESEXK	Special Transactions		24.10	4.465
TSRVXK	Services		141.7	3.009
IMPTMK	Imports, Goods & Services		580.09	2.300
SEC2MK	Section 2		96.62	7.214
SEC3MK	Section 3		23.15	1.357
SEC4MK	Section 4		164.7	4.091
SEC5MK	Section 5		359.6	3.525
TSRVMK	Services		158.7	2.083