The Role of Information Activities in Canadian Manufacturing Technology

FIRST INTERIM REPORT

Data Development

Economic Analysis Division
Telecommunications Economics Branch
JULY 1978

1

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I INTRODUCTION

Objectives

The firms which comprise the private business sector of the economy are not exclusively involved with the process of production. A good portion of the work engaged in by many firms includes such non-production activities as marketing, research and development, management and administration. These activities, pertaining to the gathering, processing and distribution of information internal to the firm, have an influence on output and consequently on the profits of the firm.

The question arises of course whether or not the high cost of these information activities outweighs, at the margin, the benefit they bring to profit. This and the related question of the productivity of information activities generally have not been posed at the micro level of the firm, although some investigation has been made of this issue for the economy as a whole. The method of the macroeconomic investigation of the issue invariably consists of partitioning economic output between information activities and non-information activities, following which the size and growth of the information sector can be noted and the productivity of information (the ratio of GNP to information inputs) calculated and subjected to critical commentary.[1]

The fundamental problem with the highly aggregative approach remarked on above is that the nature of information so defined becomes so broad, arbitrary and non-homogeneous as to make it very difficult to draw any specific conclusions from the studies. Activities related to outputs under the commodity title "information" are of such extreme diversity (eg. education and resource exploration) that any economist would be loath to postulate an aggregate production function for this sector. It is because of such concerns over the heterogeneity of information activities and outputs that we have adopted an approach more in consonance with

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[1] M. Porat, The Information Economy, U.S. Office of Commerce, OT 77-12 (1977)

micro-economic thought in which productivity and other economic questions can be more precisely specified. This leads us back to the business firm and the role played by its information related activities.

The opposition of information activities to non-information activities at the aggregate level can be justified if the same distinction is valid in consumption and in production. Addressing only the production side, the case for studying the information sector as a distinct part of the economy is strengthened if there is evidence to show that the production technology does indeed distinguish between information and non-information activities, and that goods within the aggregate are more closely substitutable between themselves than with those outside the aggregate. This issue can be posed in terms of the neo-classical production function for the firm or the industry, and then tested. In the present study we estimate a production function for the Canadian manufacturing industry and apply certain statistical tests for separability of the function. This test is in terms of the hypothesis that the production function is best explained by the separation of inputs described above. The existence of such separability will support the view that the production technology inputs information activities separately from the inputs that go directly into the production process. The aggregation of national activities into information and into non-information aggregates then gains in validity.

But it is not only as a test of the information sector concept that we undertake this research. More importantly, we wish to achieve a better understanding of the role of information activities in production. The results of this study will be an early step in this direction, and only a small one at that. The other objective of the study is to examine the impact of price changes in information capital on the distribution of employment among information and non-information workers. Finally, a re-examination of the productivity question will also be made.

Theoretical Background

The technology of a firm or industry can be described by a production function or equivalently, by a cost function. The production function relates the maximum output obtainable under a fixed technology for given quantities of inputs; the cost function relates the least cost bundle of inputs to the total cost of producing a given quantity of output. Here we are referring to a single output and by technology we denote the technical constraints which rule the quantity of inputs and the proportions in which they can be used to produce a given output.

In actual fact we do not estimate the production function (cost function) directly but instead we estimate the factor demand equations. There are derived from the production or cost function via the first order efficiency conditions. These conditions represent the efficient application of inputs to the production of a given output, at prices determined exogenously to the firm. The assumption here is that the firm is a price taker in all factor and good markets.

The hypothesis which is to be tested concerns the structure of manufacturing technology in Canada. The firm's value added market output is seen to be the result of the cooperative effort of the primary inputs represented by a variety of activities carried out by labour and by capital services. Conceptually, there is no difficulty in accepting that productive activities stand in a different relation to the firm's output than do administrative activities.

The administrative work, or in our terminology, the information activities, have applications other than the current production of the physical output. By definition, production is the exclusive concern of the production activities. Because we are using the value added concept, the activities which enter the analysis exclude intermediate materials and energy, and thus involve only the primary inputs, labour and capital services. The test for separability requires that the primary input be partitioned into information labour services (man-hours) H_i, non-information labour services H_n, information capital services K_i, and non-information capital services, K_n. However, because of severe data limitations it is impossible to break down the structures component of fixed capital formation into our two aggregates. The parts of a building housing office staff and machines together with the labour and machines on the shop floor cannot in any obvious way be assigned to information and non-information. This fact in the data likely reflects a basic real phenonemon whereby the proportions in which the two types of activities takes place inside the structure does not count for much, only the overall size of the building. This is a conjecture we endeavour to test prior to the fitting of the production function. If the test is affirmative for our conjecture, the result can be included as an *a priori* constraint in the subsequent estimation thereby saving us scarce degrees of freedom. Consequently, in the following discussion K_i, K_n refers only to the machinery and equipment component of capital and not to structures (the inventory component is excluded throughout). Structures will appear as a single factor denoted by S.

The process of production in manufacturing we perceive as being represented by the simple tree diagram shown below

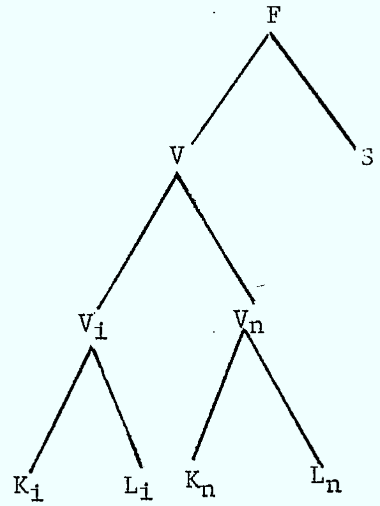

Figure I: The Production Tree

In this diagram, F is the production function relating inputs to value added output. V is a sub-production function nested within F along with S and its appearance serves to express the supposed separation of total activities from structures. The functional arrangement in this fashion suggests that the rate of substitution between the two activities, information and non-information, are independent of the size of the structure. How much of the floor space is devoted to the one activity or the other is irrelevant according to this specification.

The intermediate outputs denoted by V_i and V_n denote the contribution to final output of information activities and non-information activities respectively. This specification also alleges that the rate of substitution between capital and labour in the one activity is independent of the output level of the other activity. This diagram illustrates the type of production specification we are testing. A rejection of the test would suggest that the organization of the primary inputs into the information and non-information aggregates is spurious and does not mirror the real manufacturing process.

In order to carry out the tests described above it is necessary to specify a functional form which imposes no separability restrictions a priori. In this paper, we use the Transcendental Logarithmic Production Function (translog) to investigate the separability of information and non-information inputs into production in Canadian manufacturing. As well, we assume a fixed coefficient relationship between structures, 5, and the aggregate input function, V.

The Translog Function

The translog production function, with constant returns to scale (CRTS) and Hicks-neutral technical change (HNTC) imposed, can be written in the following form:

$$\ln V = \ln A + \ln \alpha_o + \sum_i \alpha_i \ln X_i + \tfrac{1}{2} \sum_i \sum_j \gamma^1_{ij} \ln X_i \ln X_j$$

where V is output, X_i are inputs, A is a technology index, the Greek letters are parameters, and $\gamma^1_{ij} = \gamma^1_{ji}$

let us define the function F, the aggregate input, through

$$\ln F = \ln V - \ln A$$

F can also be viewed as the production function corresponding to a zero rate of technical change.

We note that the logarithmic marginal productivity conditions on V and F, are identical and independent of A:

$$\frac{\partial \ln V}{\partial \ln X_i} = \frac{\partial \ln F}{\partial \ln X_i} = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln X_j$$

Hence we restrict our attention to the translog input function F.

A production function is well-behaved only if output increases monotonically with all inputs and if its isoquants are convex. The translog function does not satisfy these restrictions globally, due to its quadratic form.

Monotonicity requires that $\partial F/\partial X_i > 0$ $i = 1,...,n$.

Since X_i, $V > 0$ always, an equivalent set of conditions is

$$M_i = \frac{\partial \ln F}{\partial \ln X_i} = \frac{\partial F}{\partial X_i}\frac{X_i}{F} > 0 \quad i=1,...,n$$

Assuming price taking behaviour, a set of necessary conditions for efficient production is that $\frac{\partial F}{\partial X_i} = P_i$ where P_i is the price of the ith input relative to the price of aggregate input F.

The monotonicity conditions are then

$$M_i = \frac{\partial F}{\partial X_i}\frac{X_i}{F} = \frac{P_i X_i}{F} > 0$$

Given CRTS, $P_i X_i/F$ are the cost shares of the inputs in the total cost of all inputs.

It can be shown that the CRTS translog function does not assume separability (see Berndt and Christensen, "The Translog Function and the Substitution of Equipment, Structures and Labour in U.S. Manufacturing 1929-68" Journal of Econometrics I (1973) pp. 81-114).

Equating the cost shares and the logarithmic marginal products gives (in the 4 factor case):

$$M_1 = \alpha_1 + \gamma_{11} \ln X_1 + \gamma_{12} \ln X_2 + \gamma_{13} \ln X_3 + \gamma_{14} \ln X_4$$

$$M_2 = \alpha_2 + \gamma_{12} \ln X_1 + \gamma_{22} \ln X_2 + \gamma_{23} \ln X_3 + \gamma_{24} \ln X_4$$

$$M_3 = \alpha_3 + \gamma_{13} \ln X_1 + \gamma_{23} \ln X_2 + \gamma_{33} \ln X_3 + \gamma_{34} \ln X_4$$

$$M_4 = \alpha_4 + \gamma_{14} \ln X_1 + \gamma_{24} \ln X_2 + \gamma_{34} \ln X_3 + \gamma_{44} \ln X_4$$

We propose to estimate the parameters of the translog function F from these first order conditions.

By assuming CRTS the following restrictions on the parameters of the production function are imposed:

$$\sum_i \alpha_i = 1, \quad \sum_j \gamma_{ij} = 0$$

Thus of the 20 estimated parameters only 15 are free, and it impossible to express the parameters in one of the factor demand equations above interms of the parameters in the other three equations.

These equations can be rendered stochastic by including an addative shock u_i , i = 1, 2, 3, 4, on the right hand side, which thus signifies the random deviations from optimality each firm experiences. At the industry level prices and quantities for both inputs and outputs will be endogenous and an OLS estimators will be subject to simultaneity bias. To correct for this bias exogenous variable must be specified and the 2SLS estimation technique applied. But the 2SLS method assumes independence between equation disturbances, which cannot be assumed here owing to the relationships among the parameters. Hence 3SLS is called for, although another estimation problem remains. The estimates will depend on which equation in the set is dropped so a procedure, called "Iterative three Stage Least Squares (I3SLS)", should be adopted so as to correct for this source of bias.

In the next interim report we will describe the cost function approach to be adopted later in the course of this study.

II Data on Information/Non-Information Labour Services

Total Canadian Manufacturing

Introduction

To estimate the factor demand equations for total Canadian manufacturing, the following labour data are required: a) price index of information and non-information labour services for total Canadian manufacturing b) quantity index of information and non-information labour services for total Canadian manufacturing c) value of information and non-information labour services for total Canadian manufacturing

To develop these data requires the following annual time series (for 1947 to 1974)

a) Average hourly compensation for information and non-information workers, Canadian manufacturing

b) Total number of man-hours worked, information and non-information workers, Canadian manufacturing

c) Total wages and salaries, information and non-information workers, Canadian manufacturing

Definition of Information and Non-Information Occupations

Information occupations have been defined in DSTI/ICCP/78.4. The Standards Division of Statistics Canada has compiled a list of information occupations in terms of the 1971 Census occupational codes (Statistics Canada Catalogue 12-536) which conforms to this definition (see Appendix A). All occupations not listed in the Appendix are non-informational. According to the classification developed, in the 1971 Census, thirty-six percent of the Canadian manufacturing labour force were in information occupations.

Sources of Labour Data

There are three main sources from which annual time series of information/non-information labour data may be developed.

i) Employment Earnings and Hours

The first is the monthly Survey of Employment, Earnings and Hours. This survey covers larger companies only, that is, companies having 20 or more employees in any month of the year. It is estimated that in 1972 90.6 percent of manufacturing employees were covered by the survey.

Employees are classified by this survey either as wage earners or salaried employees. This classification is defined by occupation, however, rather than by the method of payment. Wage earners are those employees engaged in actual production and related operations, including maintenance, warehouse and delivery staffs, security staff, routemen, driver-salesmen, sales clerks in retail stores, waitresses, and working foremen performing functions similar to those of the employees whom they supervise, etc. Wage-earners may be paid a fixed monthly amount or on the basis of hours worked. The survey covers all wage-earners regardless of the method of payment. Salaried employees constitute executive, administrative, supervisory, technical and professional personnel, commission agents, and travelling salesmen directly responsible to the administration, as well as general office, clerical and related workers in the office and plant. In addition, working directors of incorporated businesses are included in this category.

Since the survey is based on an employee concept, working owners or partners in unincorporated businesses, the self-employed, and persons providing services to an establishment on the basis of a contract for services are excluded. The importance of this exclusion to the results and a possible rectification of the problem requires further attention.

Relevant data available from the survey include number of employees (total, salaried and wage earners), average weekly earnings (total, salaried and wage earners), and average weekly hours and average hourly earnings of hourly-rated wage earners.

These data can be useful for our study if the survey classification of manufacturing workers into salaried employees and wage earners corresponds closely enough to our desired breakdown into information and non-information workers. The main discrepancy between the two classifications (other than the incomplete coverage of the survey), concerns the inclusion of sales people in the salaried group, as sales persons are not information workers, according to our definition. This would seem to indicate that the survey should overstate the ratio of information to non-information workers. However, for our 1971 benchmark year, results of the Survey of Employment, Earnings and Hours show that thirty-one percent of workers are "informational", compared to thirty-six percent reported in the Census. Differences in the two figures are, of course, due at least partially to differences in reference periods and to inclusion in the Census of unemployed persons (who were classified by their last job). Another shortcoming of this particular survey is that it does not report hours worked or paid for salaried employees. This information must be obtained from other sources, or estimated.

ii) Census of Manufacturing

The Census of Manufactures is an annual mail survey covering Canada's manufacturing industries. In the Census, data are collected on the following employee groups:

(a) Production and related workers - Manufacturing activities

In addition to those engaged in production and assembling activities, they include those employed in storing, inspecting, handling, packing, warehousing, etc. They also include employees engaged in maintenance, repair, janitorial and watchman services and line supervisors (working foremen) engaged in similar work to that of the employees they supervise.

(b) Production and related workers - Non-manufacturing activities

Such employees include those in manufacturing establishments engaged in activities such as construction undertaken for the use of these establishments, some outside piece-workers employed in certain industries, logging employees who are reported as part of a sawmilling establishment and any other production workers who are not engaged in manufacturing-type operations.

(c) Administrative and office employees

This category includes all executive and supervisory officials such as presidents, vice-presidents, comptrollers, secretaries, treasurers, etc., together with managers, professional, technical and research employees, superintendents and factory supervisors above the line supervisor or working foreman level, and clerical staffs. Also included are employees in activities such as advertising, credit collections, purchasing, personnel, legal, medical, etc. It should be noted that prior to 1961 this category also included working owners and partners. Also included in this category are employees located at head offices or auxiliary units separately located from the establishment.

(d) Sales and distribution workers

This category includes office personnel whose salaries are charged to selling expense, travelling salesmen, driver salesmen, truckdrivers and their helpers, etc. It may also include some sales employees who are reported as part of a manufacturing establishment but are not working at the establishment's location.

Ideally, category (c) would be used as a proxy for information workers. However, in the published tables, employee data are only available broken down by:

a) production and related workers - manufacturing activity

b) all other employees

Thus this source again "pollutes"information workers with non-information workers. For 1969 (the only year for which disaggregated data are published), the percentage distribution of other employees is as follows:

Administrative and office employees	69.8%
Production and related Workers - non-mfg.	1.9%
Sales and distribution employees	28.3%

Attempts to obtain reaggregated data have not been successful due to confidentiality problems at the individual industry level.

Putting aside for the moment the classification problem, the Census of Manufactures reports data on number of employees, wage and salaries paid (shown separately for the two groups above), and total man-hours paid for production and related workers in manufacturing activity. Breaks in the series occur in 1960 due to a change in the definition of a manufacturing establishment.

The "new" establishment definition is "the smallest unit which is a separate operating entity capable of reporting certain principal statistics". Prior to 1960, the Census of manufactures only covered manufacturing activities; since 1960 it also covers the non-manufacturing activities of manufacturing establishments. In particular, total employees and salaries and wages in the revised 1961 and subsequent data are not comparable with earlier statistics under the same headings.

iii) Productivity Section, Input-Output Division

The Productivity Section of the Input-Output Division of Statistics Canada uses data from a number of sources, including the two already described, to develop productivity measures. In particular, they derive measures of man-hours worked in manufacturing from Census of Manufactures data. The basic procedure followed is described in the publication Aggregate Productivity Measures (Cat. 14-201).

Although man-hours series were derived separately for production and related workers, and administrative and office employees, unfortunately for years before 1961 these series no longer exist.

Data Adjustment Procedure

Lack of disaggregated data sources led us to adopt the procedure described below to derive series of information/non-information labour services for the period 1947-1960. (In fact this procedure was used as a first approximation for the whole period 1947-1974).

A series of total man-hours worked for all employees in Canadian manufacturing compiled by the Productivity Division was obtained from CANSIM (D240066). This series was disaggregated into information and non-information man-hours on the basis of the ratio of administrative workers to production workers reported by the Census of Manufactures.

Similarly, a series of total labour compensation for all employees in Canadian manufacturing (D240426) compiled by the Productivity Division was disaggregated into information and non-information wages and salaries on the basis of the ratio of administrative wages and salaries to production workers wages and salaries reported by the Census of Manufactures.

Two series of compensation per man-hour for information and non-information workers were then derived by dividing the calculated compensation series by the calculated man-hours series.

Major Manufacturing Industries

Data requirements for the major manufacturing industries are the same as for total Canadian manufacturing, that is, data on quantity and prices of labour services are required broken down into information and non-information components. Of course, in this case separate data must be prepared for each major manufacturing industry (see Appendix B).

The time period for this exercise is also shorter, being from 1965 to 1974, in conformity with the capital series.

There are two main sources of data. The Census of Manufactures, discussed previously, yields the same data at the individual industry level as at the level of total Canadian manufacturing.

A second source of data on wages and salaries are the Input-Output tables. Where the two sources differ, the Census of Manufactures data should be reconciled with the Input-Output data for the capital data are being developed from the latter source.

Because of the shortened time period, problems due to establishment definitions do not arise. However, it may be necessary to make adjustments to obtain data on a uniform Standard Industrial Classification basis for the entire period. For example, Plastic Fabricators, N.E.S., were classified in Miscellaneous Manufacturing until 1970, and in the Rubber and Plastic Products Industries thereafter.

III Capital Data

3.1 Total Canadian Manufacturing

There are no data to permit the separation of information and non-information capital before 1961. Hence for the time series work we endeavour to test only whether structures are separable from labour and other capital inputs.

For estimation and testing, the following capital data are required:

i) the quantity of structures used in Canadian manufacturing for 1947-1974

ii) the quantity of machinery and equipment used in Canadian manufacturing, 1947-1974

iii) the rental price of structures

iv) the rental price of machinery and equipment

The real stock of structures and machinery and equipment for Canadian manufacturing are directly derivable from CANSIM matrix 3384 which contains series on the mid-year net capital stock of total Canadian manufacturing annually since 1926 in constant 1961 dollars. The data are broken down into four components: building construction, engineering construction, machinery and equipment and capital items charged to operating expenses (smaller types of equipment normally charged by respondents to the Capital Expenditures Survey to current accounts and having a serviceable life greater than one year). These four components were aggregated into two: structures - the sum of the first two, and machinery and equipment - the sum of the second two.

To go from real stock to service flows we assume that the quantity of capital services rendered by structures and M&E is proportional to the real stock of structures and M&E. Denote the stocks by K_s and K_m respectively. The quantities of service flows at time t, denoted Q_s,t and $Q_{m,t}$, are computed as

$$Q_{s,t} = ZK_{s,t} \qquad Q_{m,t} = ZK_{m,t}$$

where Z is a constant"quality of capital" index.

The replacement price of these two components is derived by dividing the current dollar gross fixed capital formation by the corresponding constant dollar gross fixed capital formation. The capital service price is then derived from the replacement price (in the no tax case) using the formula

$$p = (P(r + \delta) - \dot{p}$$

p is the rental price of capital

P is the replacement price of capital

r is the discount rate (interest rate)

δ is the depreciation rate

and $\dot{}$ denotes rate of change (representing capital gains)

For the first stage of the estimation, service prices calculated by Denny and Pinto were used. (M. Denny and C. Pinto). _The Canadian Manufacturing Sector" Capital Stocks, Service Prices and the Demand for Labour_. Department of Manpower and Immigration, August, 1976). These service prices do not include a capital gains term, on the assumption that realized capital gains did not affect the service price because they were unanticipated at the time decisions were made.

We note that the procedure adopted in the estimation may be an over-simplification, as we have assumed not only that the service flows rendered by structures and M + E are proportional to the real stock, but that they are in the same proportion. By contrast, for U.S. manufacturing, Berndt has used a Ƶ of .25 for machinery and equipment, and a Ƶ of .19 for structures. Our Ƶ was derived implicitly by subtracting the value of labour inputs from the value of output, to arrive at the aggregate value of capital services. The value of capital services was then further disaggregated among machinery and equipment, and structures, by the ratio of the product of the service price of machinery and equipment and the M + E real stock, to the product of the service price of structures and real stock in structures.

3.2 Major Manufacturing Industries

For the pooled time series-cross sectional work, series of information and non-information machinery and equipment capital stock and service prices, and the stock and service price of structures by manufacturing industry, are required. The data from which the M + E stock series are to be calculated consist of the annual estimates (from 1961 to 1974) of commodities purchased by each industry on capital account as machinery and equipment.

The first step was to separate the commodities into two groups: informational and non-informational. The criteria used was that any commodity which would be used solely or primarily by information workers was classified as informational. All other commodities were non-informational.* A list showing the breakdown of machinery and equipment commodities is attached as Appendix C.

Once the commodities were grouped, Divisia quantity and price indices for each group had to be constructed. For our purposes, it is desirable if these indices are based on purchasers' prices (that is, the total laid down cost of a commodity at the using establishment). This requires as input current values of commodities in purchasers prices and also purchase price deflators. Unfortunately, while the former series are available, the latter are not from the published data which are in producers prices.

What is available is shown below:

i) current values of each commodity purchased by each manufacturing industry on capital account in producers prices, and purchasers prices.

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* This criterion suggests a greater precision in the commodity separation than we were able to achieve in actual fact. Some capital goods and services were assigned to information activities even though we suspected that production workers also worked with the same commodities.

ii) values in constant 1961 dollars of each commodity purchased by each manufacturing industry on capital account in producers prices only.

iii) one price deflator per commodity, which is the ratio of current to constant dollar producers prices values.

In producer's price tables, transportation changes, trade margins, and commodity taxes levied after producer's price stage are treated as separate commodity inputs into the purchasing industry. Therefore to derive information/non-information machinery and equipment investment series, these margins must be allocated between information and non-information machinery and equipment. The procedure to be followed is, as a first try, to allocate the margins in proportion to the relative value of the commodity group. The values obtained are to be compared to the current dollar purchasers price data, to determine whether the allocation introduces any bias into the data. If no significant bias is introduced, Divisia indices will be calculated using the producers prices data with the margins appropriately allocated. Otherwise, further adjustments to the data will be required.

The construction of the capital stock series from the fixed capital formation data is achieved through the standard method of declining balance. The base year stock is the accumulation of fixed capital formation over the lifetime of the capital goods less the loss due to wear and tear. Given the base year stock, the values for succeeding years are derived iteratively by adding the fixed capital formation in the current year to last year's stock net of depreciation.

The lifetime of machinery and equipment in Canada has been assumed by Statistics Canada to vary from 10 to 20 years. In our study a long M & E life robs us of observations to the detriment of statistical quality. There exists therefore a trade-off between degrees of freedom and an accurate estimate of the level of capital stocks. We take two steps to deal with this problem. Firstly we assume a lifetime of a decade, realising that this probably still understates the period over which M & E is employed. In order to preserve a reasonable number of observations, the 1961 - 1974 series which we shall obtain on fixed capital formation of information and non-information M & E, will be backcasted by five years. The backcast total M & E will be adjusted to the total M & E for the industries in each of those years. By aggregating investment in the manner stated over the 10 years, 1955 - 1965, we take 1965 as the year of the base capital stock in our calculation. This procedure then yields 9 x 20 = 180 observations.

The potential bias introduced by underestimating the size of the capital stock deserves to be examined. It has been observed elsewhere that the impact of the earlier vintage machines will be small in the movement of the stock figures. We assume by this observation that the choice of a short lifetime will principally affect the level of the stock and hardly at all affect the variation in the time series. Because the separability tests are in the form of equality constraints, we suspect that the bias produced in these tests are small. Subsequently we expect to demonstrate this proposition as well as attempt to deal with the more sizeable impact expected on the estimated values of the parameters.

The capital service prices for the two machinery and equipment groups will be derived from the replacement price of capital using the same formula as in the case of total manufacturing.

For structures, stock estimates are available directly from Statistics Canada Construction Division. Only service prices will have to be calculated.

Information Occupations

(1971 Census Occupational Classification)

Scientific and Professional

2111-2114, 2119

2131, 2133
2141-2159
2163
2181-2189
2311-2319
2331
2343,2349
3111, 3117, 3119
3152

Market Search
1141
1175
5131
5171-5177
5191

Educators

2711-2799

Communication Workers
3311-3314, 3319
3330 - 3339

3352-3359
3370
2351

Postal, Telecommunications
4172-4175

Information Machine Workers
3315
4141, 4143
8585
9511-9517

Clerical and Related

411, 4113
4131-4139
4151, 4155
4161, 4169
4171
4191-4199

Process Control and Supervisory

4110
4130
4150, 4153, 4159
4160
4170
4190
5130
5170
5190
6120
6130
6160
6190
7180

7510
7710
8110
8130
8150
8160
8210
8230
8290
8310
8330

8350
8370
8390
8510
8530
8540
8550
8570
8580
8590
8710
8730
8780
9110
9113
9130
9170
9190
9310
9510
9530
9550
9590
9910

All other occupations are non-informational.

BUSINESS GROSS FIXED CAPITAL FORMATION

Machinery and Equipment

Breakdown into Information and Non-Information Components

INFORMATION

17000	Carpets & Fabric Rugs, Mats, etc.
20500	Office Furniture & Visible Record Equipment
20600	Special Purpose Furniture
32900	Office Machines and Equipment
35700	TV, Radio, Record Players
35800	Telephone & Telegraph Line Apparatus & Equipment
49800	Lab & Scientific Equipment
50300	Photographic Equipment & Supplies
51200	Advertising Goods
52000	Phono Records & Artists Materials

NON-INFORMATION

12700	Tires & Tubes, N.E.S.
13000	Rubber Belts & Coated Fabrics
13200	Hose & Tubing, Mainly Rubber
14900	Nets & Netting
17400	Tarpaulins & other covers
19900	Containers, Closures & Wood Pallets
20200	Barrels and Kegs of Wood
23400	Printing Plates, Set Type Etc.
26300	Scrap & Waste Msterials NES
27300	Tanks
27400	Power Boilers
27700	Scaffolding Equip., Demountable
28200	Metal Basic Prod. & Range Boilers
28400	Metal Awnings, Ash Cans, Pails, etc.
28500	Kitchen Utensils

NON-INFORMATION

28600	Containers & Bottle Caps of Metal
29600	Cutting and Forming Tools
29700	Measuring, Edging, Mechanic's Tools
29800	Scissors, Razor Blades, Ind. Cutt
29900	Domestic Equipment, NES
30400	Cum. Appliances, Cook & Warming Food
30500	Custom Metal Working
31000	Fire Fight & Traffic Control Equip
31100	Taxi & Park Meters, Blocks & Ladders
31400	Tractors, Farm & Garden Type
31500	Other Agricultural Machinery
31600	Mechanical Power Trans. Equip.
31700	Pumps, Compressors & Blowers Etc.
31800	Conveyors,
31900	Ind. Trucks, Tractors, Trailers, etc.
32000	Fans, Aic circulators & air Units
32100	Pkg. Mach, Lub.
32200	Industrial Furnaces, Kilns & Ovens
32300	Mach. Ind. Specified & Special
32400	Power Driven Hand Tools
32500	Metal End Products, NES
32600	Refrig & Air Con. Eq. Ex. Household
32700	Scales & Balances
32800	Vending Machines
33000	Aircraft, All Types
33100	Aircraft Engines
33200	Specialized Aircraft Equipment
33300	Modifications, Conversions, Serv.
33400	Passenger Automobiles & Chassis
33500	Trucks, Chassis, Tractors, Com.
33600	Buses and Chassis
33700	Military Motor Veh., Motorcycles
33800	Mobile Homes

NON-INFORMATION

33900	Oth. Trailers & Semi-Trailers, Com.
34000	Bodies and Cabs for Trucks
34500	Locomotives, Cars & Tenders, Rdy. Ser
34600	Self-Propel Cars
34800	Ships & Boats, Military & Commercial
34900	Sub-Assemblies, Parts, Etc. Ships
35000	Ship Repairs
35100	Snowmobiles, & Misc. Non-Motor Veh.
35200	Pleasure & Sporting Craft
35300	Small Elec. Appliances, Domestic
35400	Space Heater, Heating Stoves, Etc.
35500	Refrig. Freezers & Comb. Domestic
35600	Gas Ranges & Elec. Stoves, Domestic
35900	Radio & TV Broadcasting & Trans. Eq.
36000	Radar Equip. & Related Devices
36500	Welding Machinery & Equipment
36600	Engines, Marine, Electric Turbines
36700	Transformers & Converters Ex. T&I
36800	Elec. Equip. Industrial, NES
39100	Glass Containers
49700	Aircraft & Nautical Instruments
49900	Misc. Measure & Control Instruments
50000	Medical & Related Instruments, etc.
50100	Ind. Military & Civil Def. Safety Eq.
50800	Sporting, Fishing & Hunting Equip.

THE ROLE OF INFORMATION ACTIVITIES
IN CANADIAN MANUFACTURING TECHNOLOGY.

DATE DUE
DATE DE RETOUR

DEC 1 1 2002			

LOWE-MARTIN No. 1137