1974

Application Of The Theory Of Markets To Provincial Finance: A Theoretical And Econometric Analysis Of Alberta Budgetary Realization Process

Henri-paul Rousseau

APPLICATION OF THE THEORY OF MARKETS TO PROVINCIAL FINANCE: A THEORETICAL AND ECONOMETRIC ANALYSIS OF ALBERTA BUDGETARY REALIZATION PROCESS

By

Henri-Paul Rousseau

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Faculty of Graduate Studies
The University of Western Ontario
London, Canada

 JUNE 1974

ABSTRACT

A microeconomic stock-flow model of notional and constrained excess demands is specified and applied to monthly data of planned and actual transactions of the budget of the Government of Alberta, in order to test the empirical implications of the economic literature on disequilibrium. The stock-flow nature of the model and the uniqueness of the data set permit a direct test of the presence of individual rationing effects, spillover effects, incorrect expectations effects, stock-adjustment effects, and cash-balances effects. The structure of the model is estimated by consistent econometric techniques. Regression analysis helps us to identify the significant relationships which are then employed to build a full recursive simulation model. Overall, the results indicate that we cannot reject the hypotheses of the above-mentioned effects. Their relative importance is different in each transaction but their role on the dynamics of the budgetary realization process cannot be neglected as shown in the simulation experiments presented in the thesis.

ACKNOWLEDGEMENT

While writing this dissertation I was helped by the very useful comments and generous encouragement of Peter Howitt who, as Chairman of my Thesis Committee, gave me prompt criticisms at all stages. His efficient organization and coordination greatly facilitated the realization of the project. I am also indebted to Joel Fried not only for his personal assistance at the early stages of the thesis but also for his generous support and useful advice at each important stage of this research. I also want to thank Thomas Courchene for his very important advice on the thesis. To all three, members of my Thesis Committee, I wish to express my sincere gratitude. In writing the Appendix to Chapter Five I have had the good fortune to benefit from the advice of Robin Carter.

This thesis would not have been possible without the generous collaboration of the personnel of the Treasury of the Government of Alberta. I particularly want to thank Mr. R.A. Splane and Mr. Al Kalke who provided the data set and answered to my numerous questions concerning the institutional and administrative details of the budgetary realization process of the Alberta Government.

In formulating many of the ideas of this dissertation I benefit from many conversations with my colleagues and friends Gérard Bélanger, Jacques Bruneau and Leonard Good. The computations were done during the Summer of 1973 at l'Université du Québec à Montréal where I appreciated the technical assistance of Françoise Grégoire and of Mr. Jean Dreyer from the Centre d'Informatique. I also want to thank Professor Marcel G. Dagenais, of the Université de Montréal, who provided me with the original computer program for Tobit Maximum Likelihood and who gave me useful comments on the Appendix to Chapter Five.

My research was supported by an Ontario-Quebec fellowship during 1972-73 and the Canada Council paid for the typing of the manuscript. Finally, I want to thank Mrs. Marielle Dionne who did an excellent job typing a difficult manuscript.

TABLE OF CONTENTS

Page

CHAPTER SEVEN - SIMULATION

CHAPTER EIGHT

Page

LIST OF CHARTS

Page

LIST OF FIGURES

LIST OF TABLES

Page

CHAPTER ONE

INTRODUCTION

Recent developments in monetary theory focus on the importance of exchange as an economic activity and on the role of money in a market economy. These analyses treat both centralized and decentralized trading arrangements.[1] Simultaneously this same literature investigates the influence of trading at non-equilibrium prices for individual transactions as well as for the working of the entire economy by introducing the concepts of notional demand and effective demand.[2] This literature is only in its infancy but already it has raised important theoretical and empirical questions concerning our understanding of monetary phenomena. Three of these questions are:

1) How do individual transactors react to unrealized planned transactions in a given market? Do they change only their money holdings? Or do they modify their plans in other markets?

2) If they modify their plans, do they change them simultaneously or non-simultaneously?

3) What is the role of stocks in the disequilibrium adjustment process?

---

[1] On centralized trading arrangements and the role of money, see Frank Hahn (1971), and J. Neihans (1971).

On decentralized trading arrangements, see R. Clower (1971) and J.M. Ostroy (1973).

[2] See R. Clower (1965), R. Barro & H. Grossman (1971), H. Grossman (1971), D. Tucker (1971) and Axel Leijonhufvud (1968), (1973).

At an empirical level, this essentially means that given a set of data on planned and actual transactions how can we explain the difference between these actual and planned transactions?

The purpose of the thesis is to provide an answer to these questions, both at a theoretical and empirical level. It is thus a study of how economic plans are realized at the microeconomic level. The micro unit studied is the Treasury of the Province of Alberta.

The main thrust of the thesis is to develop and test a theory of disequilibrium adjustment. It is important to stress this objective, from the outset since if the objective was merely to build a forecasting model of Alberta's budgetary cash flow one might opt for a different approach. Hence our objective is not to explain as accurately as possible the cash flow of the Alberta Government, which might entail the use of a cash management model instead of the model we use. Rather, it is to extend the existing theory of economic disequilibrium and to use the Alberta's budgetary process as a test of this theory. Nonetheless, the results of the simulation of Alberta's budgetary process will still be of considerable interest and we should devote some time to an analysis of the forecasting implications of our model for Alberta's budgetary process.

In Chapter Two we address the problem of the realization of economic plans. Basically, we demonstrate that the realization of economic plans is necessarily related to the fundamental question of how microeconomic decisions are coordinated in a market economy. Three basic approaches to the problem of plan realization are reviewed.

Firstly, in the neo-classical world of exchange, realization of plans is not a problem for the perfect coordination of economic activity is assumed by some deus ex-machina named the Walrasian auctioneer. Secondly, in a world of incomplete information about future prices and other parameters, plans are realized only if expectations are fully realized. Finally, in a world where the coordination of economic activity is assumed to be solved by independent and decentralized markets, actual and planned transactions are usually different due to the existence of trading at false prices.

In Chapter Three, the difference between planned and actual transactions is classified into two: Incorrect effects expectations and market rationing. This analysis is aided by resorting to the use of conceptual market experiments. We then present a microeconomic model which derives the precise nature of the relation between planned transactions and actual transactions. The model assumes that the transactor makes his original transactions plans over T periods on the basis of expectations which are held with certainty. At each period the transactions are carried out in a given order (which defines the sequence of transactions), and this ordering is assumed to be constant over the planning horizon. As the transactor tries to realize his original plans, i.e., notional excess demands, he is forced to revise these plans, either because his expectations about prices are not fulfilled or because he encounters quantity constraints on what he can buy or sell. He is then forced to select another set of plans for the subsequent transactions in the current and subsequent periods. Thus we obtain the constrained excess demands by including these quantity constraints in the maximization problem. These constrained excess demands are thus second-best transactions. Using Bellman's principle of optimality it is then shown that the original plans and the revised ones are generated by the same function evaluated at different values of the independent variables. Finally, a linear approximation by a Taylor expansion of the constrained excess demand yields an equation relating the difference between actual and planned transactions to nine different factors. These factors are:

1) The effect of individual rationing on each transaction.

2) The effect of an unrealized transaction, i, on transaction j in the same period. This effect is called a spillover effect.

3) Lagged spillover effect.

4) 5) 6) The effect of current unrealized expectations about prices, interest rates and autonomous changes in stocks on each transaction.

7) The effect of the difference between the planned stockholding and the actual stockholding on flow transactions. This is called the stock adjustment effect.

8) The effect of unrealized beginning of the period cash on each transaction.

9) A residual factor.

Thus our theoretical framework contains two types of empirical hypotheses. On the one hand, the model generates empirical implications (the above nine factors) to be tested for a given sequence of transactions. On the other hand, the sequence of transactions (the order in which transactions are carried out) itself is open to empirical verification. This is why Chapter Three presents the theoretical model underlying the first set of hypotheses and provides a set of ad-hoc guide-lines to decide on the sequence of transactions.

We conclude this chapter by discussing some limitations of the theoretical model and by relating it to the literature on disequilibrium.

Chapter Four provides a brief description of the institutional factors underlying the budgetary realization process in Alberta. This includes a presentation of the Department of Treasury data as well as of the accounting framework underlying the data set. Basically this data set contains monthly observations on planned and actual transactions, recorded on a cash basis, from September 1969 to March 1973 for <u>all</u> types of transactions of the budget. These transactions imply flow variables (revenues, expenditures, financial and monetary transactions) and stock variables (stock of cash, stock of debt, etc.). Thus the data set contains information on all transactions of the budget and therefore provides the necessary stock and flow variables in terms of both planned and actual values. In this sense, then, it is an ideal type of data set to test our theoretical model. Nonetheless, the data set does also have some shortcomings and these too are described in Chapter Four along with a discussion of how we circumvent some of the effects.

Our empirical results are reported in Chapter Five. In Section 5.1, we apply the ad-hoc guide-lines presented in Chapter Three, in order to discover what is the likely expected sequence of transactions. In Section 5.2, we outline the nature of the equations to be estimated and discuss the principles underlying their specification as well as the estimation methods. An analysis of the nature of the residuals demonstrates the necessity of choosing between two different assumptions concerning the structure of the realization process: One implying homoscedasticity and the other, heteroscedasticity. In order to discriminate between these two models, a test for homoscedasticity, proposed by Goldfeld and Quandt,[1] is carried out. In the same section, we analyze the problem of limited dependent variables raised by the nature of the observations on borrowing transactions. Our discussion of this problem leads us to conclude that the appropriate estimation technique is Tobin's Maximum Likelihood method. In an Appendix to Chapter Five we describe Tobin's Maximum Likelihood method and the Goldfeld-Quandt test for homoscedasticity.

In Section 5.3, the empirical results are presented. These results are generally consistent with the theory of planned and actual behavior outlined in chapters two and three in the sense that the difference between actual and planned transactions is explained by the variables accounting for rationing, spillover effects and incorrect expectations effects. Indeed, our model explains the realization process of the major components of the budget on a monthly basis. Current Expenditures are disaggregated into Expenditures on Education,

---

[1]S.M. Goldfeld and R.E. Quandt, "Some Tests for Homoscedasticity, Journal of the American Statistical Association, 60, pp. 539-547, 1965.

Expenditures on Health and Hospital Services and finally Expenditures on Other Goods and Services. Apart from Current Expenditures on Education which could not be explained by our theory, the other two conform to the dictates of our theory of the budget realization. It should be noted that, whenever necessary, the effects of seasonal factors and of possible bias have been included in the estimated equation in order to get a more efficient test of our theory.

Capital Expenditures are found to respond positively to variations in Total Budgetary Revenue and to unrealized Capital Expenditures in the past all of which is consistent with stock adjustment mechanism.

As far as Provincial Borrowing is concerned, the use of the Tobit model permits us to identify the beginning-of-month cash and the beginning-of-month stock of Loans and Advances as the explanatory variables. Moreover, an examination of the implications of the estimated equation shows that the model discriminates very well between non-borrowing observations and borrowing observations.

The unrealized dollar value of Loans and Advances was found to be mainly explained by the unrealized dollar value of Borrowing and beginning-of-month cash, indicating that Borrowing is less flexible than lending and that lending depends on cash.

The interaction between the stock and flow variables in explaining borrowing and lending activity presents an interesting sequence of adjustment. Indeed current borrowing affects current lending so that the beginning-of-month stock of Loans and Advances in the next period is different than expected which in turn means that the next month borrowing is different than expected. It is a cumulative stock-flow adjustment mechanism. This result is not only consistent with our theory but it also represents the first direct test of the role of stock adjustment in flow transactions, for the difference between desired stock and the actual stock is an observed variable in our data set. This direct test of the role of stock adjustment in flow transactions is also carried out for the excess demand for securities and it is shown to be significant. Moreover the excess demand for Special Investment Fund Securities is also found to be explained by the exchange rate between the U.S. and Canadian dollars and the interest rate on three to five years Canadian bonds. Finally, it is also affected by unexpected events such as the move from a fixed to a floating exchange rate in 1970, the change in U.S. financial and commercial policies in 1971, and the effect of the Federal election in 1972, as captured by dummy variables.

Our last transaction is the End-of-Month Cash which is an identity for the End-of-Month Cash is always equal to the flow transactions and the Beginning-of-Month Cash.

In a last section, a skeleton of the obtained model is presented and gives us the basis for testing different sequences of adjustment. As we said earlier, the sequence of transactions is itself an empirical question. In Chapter Six, we begin by presenting the strategy used to find the "most likely sequence" of transactions. The application of this research strategy to our data set, gives us the "most likely sequence". The sequence which results is: Total Budgetary Revenue, Current Expenditures on Education, Current Expenditures on Other Goods and Services, Capital Expenditures, Provincial Borrowing, Loans and Advances, Special Investment Funds Transactions and Cash Operations. This results in a complete recursive system of equations with all the significant exogenous variables and all the significant and non-significant transactions variables implied by the sequence. Using that system of equations, each empirical hypothesis obtained from the theoretical model is considered in each equation in order to evaluate the extent to which our theory has been tested. In doing this, we stress the uniqueness of our empirical results and evaluate their weaknesses.

Chapter Seven presents the results of the simulation analysis in order to shed more light on the cash flow of the Government of Alberta. By presenting the dynamic as well as the change in the dynamic multipliers for each endogenous transaction we are able to analyze the intertemporal implications of the model and to get a better understanding of the economic behavior behind the Alberta's Budgetary Realization Process.

The concluding chapter presents a summary of the major results of this study and outlines suggestions for further theoretical and empirical research in the general area of the theory of planned and actual behavior in disequilibrium situations.

CHAPTER TWO

INTRODUCTION TO THE THEORY OF PLANNED AND ACTUAL BEHAVIOR

Introduction

Our objective is to derive a model that will explain the difference between planned and actual transactions in a market economy. The purpose of this introduction is to show how this problem is intrinsically related to the fundamental question of how economic decisions are coordinated in a market economy. In order to accomplish this task, we will review the different approaches to the problem of the realization of economic plans. In Section 2.1, the neo-classical world of exchange will be described briefly and it will be shown that in such a world the problem of the realization of plans is not an important issue because the underlying organization of exchange simply rules out non-coordination. Section 2.2 presents a brief summary of what we shall call the Realization Function Approach as presented by Franco Modigliani and Kalman J. Cohen in their unfortunately neglected book.[1] In Section 2.3, we will see how their analysis can be used to extend recent work in the area of monetary theory relating to disequilibrium dynamic.

---

[1] Franco Modigliani and Kalman J. Cohen, The Role of Anticipations and Plans in Economic Behavior and Their Use in Economic Analysis and Forecasting, Bureau of Economic and Business Research, University of Illinois, Urbana, 1961.

Section 2.1 The Neo-Classical World of Exchange

Consider a perfectly competitive market where a unique and stable equilibrium exists, say at point E in Figure 2.1. In order to see the effect of an autonomous change in demand, we conduct the following conceptual market experiment.[1] Suppose DD shifts to D^1D^1 so that a new equilibrium is reached at E^1 in Figure 2.1. This is a market experiment in the sense that the independent variables are the tastes of the consumers, the distribution of endowments of stocks (which underly the demand curve) and the technology of production (which underlies the supply curve). The dependent variables are the price and quantity.

Given the market equilibrium price we turn to a conceptual individual experiment[2] to derive the individual demand curve. It is an individual experiment in the sense that the dependent variable is the quantity demanded by each individual and the independent variables are market prices, tastes and endowments. By varying the price of one commodity and keeping everything else constant we can derive such a demand curve with all its usual properties. Given individual demand and supply curves we find the market demand and supply curves and the properties of equilibrium.

If the system goes out of equilibrium it will return to equi-

---

[1]Don Patinkin, Money, Interest and Prices, 1965, Harper and Row, 1965, pp. 11-12.

[2]Ibid., pp. 11-12.

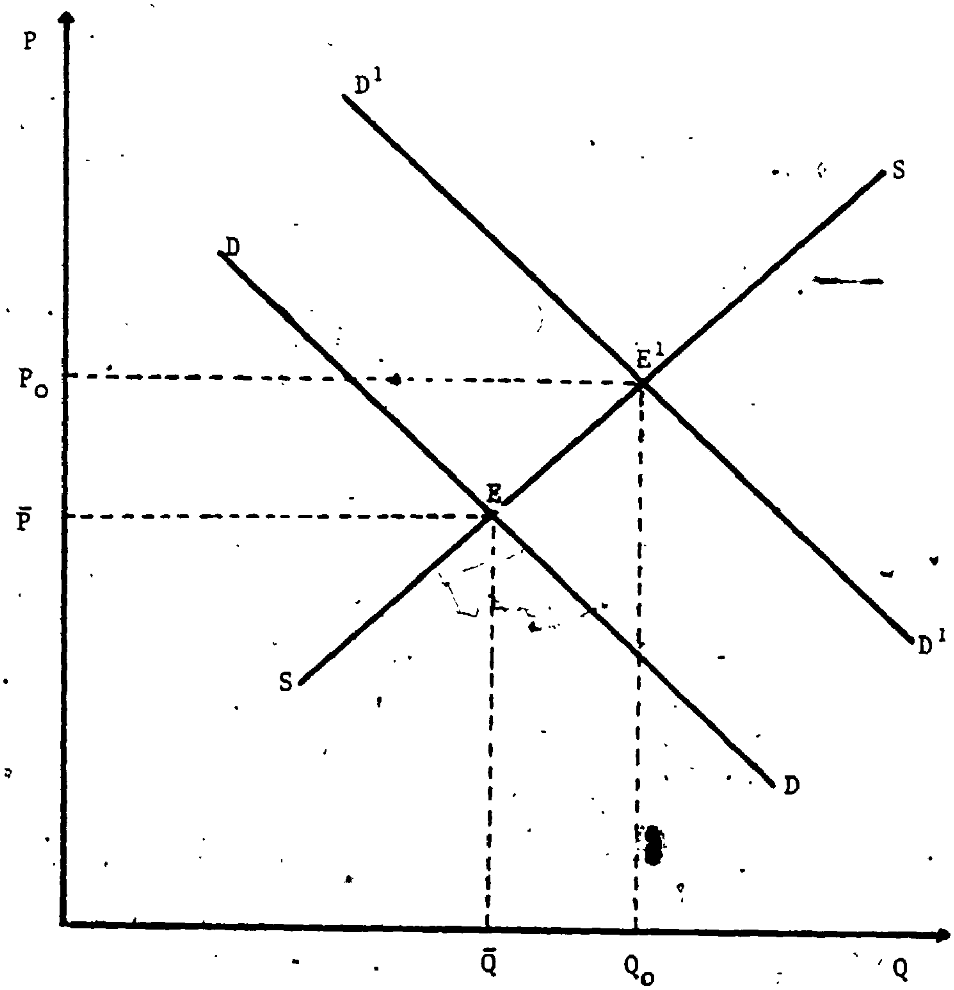


Figure 2.1

Neo-Classical Supply
and Demand Curves

librium according to the laws of supply and demand which can be summarized by the following dynamic adjustment process:

$$\frac{dP}{dt} = k\,(D-S)$$

where

D = demand
S = supply
$k > 0$

That is, an excess demand situation results in an increase in price and an excess supply situation, a decrease in price. This is the most basic expression of the law of supply and demand in a perfectly competitive market.[1]

This neo-classical theory is applied to a world where there exist three major activities: consumption, production and exchange. The assumptions underlying the consumption and production decisions are usually made explicit but those underlying the exchange process are much less explicit. The implicit "neo-classical" technology of exchange is best understood by recognizing the role of the theory of tâtonnement underlying the dynamics of any market.

Suppose that the demand curve shifts in one market, then at $P=\bar{P}$, where $\bar{P}$ is the equilibrium price, the demand is now greater than the supply, therefore $\bar{P}$ is no longer an equilibrium money price and relative prices are no longer equilibrium prices. How will the new

---

[1] An interesting exposition of this law of demand and supply is to be found in A. Leijonhufvud, "Notes on the Theory of Markets", Intermountain Economic Review, Fall 1970, Vol. I, No. 1, pp. 1-13.

equilibrium price, P_0, be reached? As Clower[1] and Arrow[2] have pointed out, in a perfectly competitive market everybody is price taker. Therefore the question arises: Who will determine the equilibrium price? The Neo-Classical Walrasian Theory answers this question in two ways: by the explicit tâtonnement theory or by the implicit version of it.

In the explicit version of tâtonnement theory, it is assumed that there exists an auctioneer who provides information and exchange services costlessly. Each market participant knows the prices and qualities of the goods and places orders to the auctioneer who registers each demand and supply order. When the orders are inconsistent the auctioneer changes the prices and communicates the new prices to each market participant who submits new orders according to these new prices. Each stage of the tâtonnement process corresponds to a new set of individual experiments. When orders are consistent in each market the prevailing market prices are equilibrium prices and exchange takes place.[3]

The implicit version of the tâtonnement process argues that the assumption of price taking does not mean that nobody fixes the current

---

[1] R. Clower, "Some Theory of an Ignorant Monopolist", Economic Journal, December 1959.

[2] K.J. Arrow, "Toward a Theory of Price Adjustment", The Allocation of Resources, M. Abramovitz, ed. Stanford, 1959.

[3] Note here that another version of this theory is the recontract assumption but the underlying postulates are the same, namely the cost of information and of transactions is zero so that it is rational for traders to recontract.

price. Consider as an example a firm in a perfectly competitive situation. If the firm tries to fix a price higher than the equilibrium price in the market, then, the number of firms being very large, all demanders will be able to buy the commodity from other suppliers at a lower price. Therefore the firm will fix a price equal to the market equilibrium price in order to maximize profit. But if the current price in the market is not the equilibrium price, who will fix the current price and according to what rules? What are the costs of changing the price? These questions are left unanswered in the model and we must rely on the explicit neo-walrasian tâtonnement process.

One might argue that while there is no auctioneer in a perfectly competitive situation, the above argument is not valid for the case of monopoly, monopsony and other imperfect market structures. Let us consider the case of a monopoly. As Clower states it: "the first thing which strikes one here is the perfect contrast with the competitive situation: for the problem of current price setting is already solved while the problem of determining market equilibrium is essentially untouched,"[1] for it is assumed that the monopolist has perfect information about the demand of the market. If, however, the market demand is, as it should be, a planned demand, it could be that the monopolist's plans in terms of price and quantity are not consistent with the demanders' plans. What will be the rules used to change

[1] R. Clower, "Competition, Monopoly and the Theory of Price", Pakistan Economic Journal, p. 223.

prices? Who will make the plans consistent? The model does not answer these questions.[1]

We can then say that: "The main difficulty in the past has been for monetary theorists to emancipate themselves from preconceptions carried over from conventional value theory, the whole of which rests on an essentially Walrasian conception of exchange as a virtual process in which the trading plans of a set of individuals are costlessly coordinated by a central authority whose only explicit function is to determine a vector of exchange rates that will permit individuals to carry out at least in principle a series of mutually consistent and beneficial transactions."[2]

Hence the major implications of the neo-classical technology of exchange concern a) the way in which transactions are carried out, and b) the role of money in such a world. We deal with each of these in turn:

A. The Exchange Process

In the neo-classical world, exchange is not considered as an economic activity. Value theory studies the use and allocation of resources in production and consumption. It does not analyze the

---

[1]For an essay on the dynamics of prices in a monopolistic situation see R.J. Barro, "Theory of Monopolistic Price Adjustment", Review of Economic Studies, 39, January 1972; and also R. Clower, "Some Theory of an Ignorant Monopolist", Economic Journal, December 1959.

[2]R. Clower, "Theoretical Foundations of Monetary Policy", in Monetary Theory and Monetary Policy in the 1970, ed. C. Clayton & J.C. Gilbert, R. Sedgwich, Oxford University Press, 1971, p. 16.

resource allocation problem in the exchange process.[1] There is no need for it because the auctioneer provides the exchange services costlessly. The price of exchange services is zero because it is implicitly assumed that the supply of these services is always larger than the demand for them at any non-zero price. Since the costs of exchange and cost of bargaining are zero and since the auctioneer fixes the current prices, it is rational for the traders to recontract until an equilibrium is reached, and to make transactions only in equilibrium. The theory of planned behavior obtained by conceptual individual experiments is an adequate theory in such a world because it is precisely the planned behavior which determines, by tâtonnement, the actual price vector which is the equilibrium price vector. Prices are not determined by actual transactions but by virtual transactions coordinated by the auctioneer. The allocation of resources is considered the major problem in this economy not the coordination of economic activities between actual transactors.

In brief, in the tâtonnement process, the auctioneer ensures that prices can act as signals and incentives to coordinate economic activity in an optimal manner when decision making is decentralized.[2] Thus, with respect to value theory, the presence of an auctioneer is the sine qua non for the system to reach the equilibrium solution.

---

[1]J. Hirshleifer, "Exchange Theory: The Missing Chapter", Western Economic Journal, 6, 1973, pp. 129-146.

[2]Axel Leijonhufvud, On Keynesian Economics and The Economics of Keynes, Oxford University Press, 1968, pp. 390-394.

without any coordination problem. The determination of prices and quantities is thus independent of an actual exchange process.

B. The Role of Money in the Neo-Classical World

The necessary and sufficient condition that ensures the perfect realization of plans in the neo-classical model, also precludes the necessity of the use of any commodity as a means of payment. This condition is the nature of the underlying technology of exchange. In other words, the proposition concerning the perfect realization of plans has as a corollary that money is not useful in the model. An intuitive demonstration of this corollary is the following: the familiar budget constraint asserts that "no transactor consciously plans to purchase units of any commodity without at the same time planning to finance the purchase either from profit receipts or from the sale of units of some other commodity."[1] This logic implies that any goods may be traded directly for any other goods, which is to say that all commodities are perfect substitutes as a means of payments.[2] This is so because the full value of any goods can be instantly realized.

Thus the familiar budget constraint implies that all goods are sources of effective demands; consequently, there is no need for money as a medium of exchange. To complete the demonstration we only

---

[1] R. Clower, "The Keynesian Counter-revolution: A Theoretical Appraisal", in Reading in Monetary Theory, R. Clower (ed.), Penguin, p. 285.

[2] R. Clower, Foundations of Monetary Policy, op. cit., p. 16.

need to say that this familiar budget constraint can be written under the condition that there are no transaction costs. A sufficient condition for this is the presence of an auctioneer who is coordinating exchange at zero costs.

This corollary can be further illustrated by considering Patinkin's model[1] as representative of the neo-classical model. Here, money is unique because it is the only good that has the required characteristic of being liquid. But in Patinkin's parable liquidity refers to the transactor's ability to give money to the auctioneer when he calls on him. If he is not liquid, he may suffer some embarrassement, but he will not suffer from not being able to carry out the transaction for which payment is required since all transactions have been finalized on Monday on the basis of virtual earning powers. His virtual earning power ensures that if he was not able to back up his demands with immediate actual means of payment he will be able to do so sometime before the week was over. In Patinkin's parable, then, money is not required to give market expression to notional demands and thus make them effective demands. The auctioneer takes care of that.

In such a world, the search costs associated with the necessity of double coincidence of wants and of timing of transactions are reduced to zero; transaction costs are zero. There is no need for the institution of money for "money is a cipher in such a world as this for its only apparent function is to serve as a store of value -

---

[1]D. Patinkin, Money, Interest and Prices, Harper and Row, 1965.

a function that would appear to be better served by assets that have a positive income yield."[1]

In brief, in the neo-classical world of exchange, the coordination of economic activities is exogeneously assumed by an auctioneer. Thus the realization or the non-realization of plans is irrelevant to the system. In such a world, actual transactions will always be planned transactions because planned transactions (the relevant ones) are only effected at equilibrium prices.

If the neo-classical model does not explain how plans are realized, recent developments in economic theory do provide some preliminary answers to this question. One of these developments is the analysis of F. Modigliani and K.J. Cohen on The Role of Anticipation and Plans in Economic Behaviour and their Use in Economic Analysis and Forecasting.[2] In the next section, we shall briefly review their contribution in order to illustrate how the realization of plans is related to the coordination of economic activity. We will see that their analysis is a step toward a theory of planned and actual behavior.

2.2 The Realization Function Approach

In the early fifties, econometricians and forecasters had recognized the importance and usefulness of ex ante data in forecasting

---

[1] R. Clower, ed., Reading in Monetary Theory, Penguin, p. 20.

[2] Bureau of Economic and Business Research, University of Illinois, URBANA, 1961. It is important to note that an extensive econometric literature exists on the subject as reported in Modigliani and Cohen on pages 158-166.

and econometric research. In this sense, the existence of ex ante data permits the development of many hypotheses concerning the question of how the realization of plans is effected. However, the theoretical framework underlying these empirical results[1] was by and large a weak one, until the publication of the work of Modigliani and Cohen.

Indeed, "One of the major goals of their project has been a systematic exploration of the possible uses of statistical data bearing on anticipations and plans of firms both for the purpose of increasing our understanding of economic behavior in general and of decision-making by firms in particular and for the purpose of increasing our ability to forecast general economic activity or components thereof."[2] While it is not possible in this thesis to discuss the full extent of the Modigliani-Cohen contribution, we will present the crux of their approach as it relates to our particular focus.

We begin with the decision-making process used by the authors. This decision-making process is applied to a competitive firm and involves four different steps which they represent by a series of four equations. The first three equations constitute the structural model. The reduced form of this model gives the fourth equation called the general behavior function. Given ex ante data, it is then possible to forecast the value of the actual behavior. The extent to which the

---

[1]Modigliani and Cohen, ibid., various references quoted in the text.

[2]Modigliani and Cohen, op. cit., p. 9.

actual course of action deviates from the decision expressed by the general behavior function is measured by the realization function. This is why we call their model the Realization Function Approach. It seems appropriate to devote some time to explain these four steps.

(i) The Decision Function: The Decision Function of the firm consists of deciding on an optimal next move in a multi-period decision-making process. "The next move which is chosen can be regarded as the solution of a constrained maximization problem, it is some function of the initial conditions and the anticipated future constraints. Now the anticipated constraints for any future period depend only upon the anticipated initial conditions at the start of that period and the anticipated behavior of the environment during that period."[1]

(ii) The Enforcement Function: "Inasmuch as the anticipated and the actual environmental behavior may differ, the anticipated and the actual constraints set may not be the same...therefore we cannot say that the move actually made necessarily coincides with the decided move."[2] They assume "that no replanning occurs within the 'week' and that decisions made on Monday are carried out in a routine fashion whenever possible and adjusted in a routine way whenever they are not feasible."[3] The enforcement function specifies the move actually made by the firm both when the decided move is feasible and when it

[1]Ibid., p. 97.

[2]Ibid., p. 98.

[3]Ibid., p. 98.

is not. The arguments of the Enforcement Function are:

a) The decision of the t th week.

b) The initial conditions.

c) The anticipated relevant environmental behavior during the t th week.

d) The actual relevant environmental behavior during the t th week.[1]

(iii) The Anticipation Function: Interpreting initial conditions in a broad way to include not only current conditions but also past history, the firms' anticipations of future environmental behavior can be expressed as some function of the initial conditions.[2]

(iv) The Behavior Function: By appropriate substitution, the firms' t th period behavior is expressed in terms of the initial conditions and the relevant environmental behavior during the t th period. The resulting equation is called the general behavior function. This behavior function of the firm during any period, is in fact a reduced form model of the structural model expressed by the first three functions.[3]

(v) The Realization Function: The authors then show that the availability of information on decisions and underlying plans enables

---

[1] Ibid., p. 98.

[2] Ibid., p. 100.

[3] Ibid., p. 100.

them to forecast correctly the value of the actual behavior. However, if anticipations are disappointed, the planned decision will differ from the actual behavior. The Realization Function is thus defined as a measure of "the extent to which the actual course of action deviates from the decision, i.e., decisions fail to be realized, as a result of errors of anticipations."[1]

In brief, the decision of the firm during any decision period involves three distinct steps:

"a) the initial conditions, acting through the anticipations function, determine the firm's anticipations (as held at the beginning of that period) of all relevant future environmental behavior.

b) the firm's anticipations of the relevant future environmental behavior and the initial conditions, acting through the decision function, determine the firm's decision for its next move.

c) the decided next move, the anticipated and actual environmental behavior during the next period and initial conditions, acting through the enforcement function, determine the firm's actual move during the next period."[2]

Modigliani and Cohen obtained their results by recognizing the empirical fact that information in a market economy is costly and

---

[1] Ibid., p. 118.

[2] Ibid., [illegible]01.

that economic agents need to plan over many periods. It is one step away from the neo-classical world of exchange, namely, that the underlying system of communication is not characterized by an auctioneer who provides information about current and future prices in a costless way. This analysis shows that the problem of the realization of plans is related to the more fundamental problem of the coordination of economic activity.

However, there is a missing piece in the model, namely, the process of exchange, as illustrated by the ambiguity of the enforcement function. The basic postulate of the approach is that it relies "on the classical approach of general equilibrium analysis."[1] This postulate is used in the assumption that "no replanning occurs within the week and that decisions made on Monday are carried out in a routine fashion whenever possible and adjusted in a routine way whenever they are not feasible."[2] In other words, there is no replanning but adjustment can be made during the week. The ambiguity of this assumption illustrates the need for a theory of planned and actual behavior that shows the role of the exchange process (i.e. the rules under which exchange is effected) in the realization of plans. A step toward such a theory is achieved by the recent approach to monetary phenomena where disequilibrium situations are possible. This approach is the subject of our next section.

---

[1] *Ibid.*, p. 85.

[2] A. Alchian, "Information Costs, Pricing and Resource Unemployment" in E.S. Phelps et al., *Microeconomic Foundations of Employment and Inflation Theory*, Norton, 1970.

2.3 The Money and Exchange Approach

The recent literature on Money, Exchange and Disequilibrium argues that the actual process of exchange is not characterized by a central authority who coordinates the economic activity by providing information and exchange services costlessly. Therefore, the neoclassical world of exchange does not represent a satisfactory conceptual framework to analyse the monetary phenomena in a decentralized market economy. Given all the anomalies of the Walrasian paradigm, the Money and Exchange Approach tries to answer the following questions:

(1) What is the effect of information costs on the price adjustment mechanism in any market? How can information costs explain the unemployment of resources? The starting point for this in the literature is Alchian's article on "Information Costs, Pricing and Resource Unemployment."[1]

(2) How does the absence of an auctioneer establish the need for the institution of organized exchange and the use of money as a medium of exchange?

(3) How does a market disequilibrium situation affect the decision-making process of market participants?

More generally, "the central issue in macroeconomic theory is the extent to which the economy, or at least its market sectors, may

---

[1] A. Alchian, "Information Costs, Pricing and Resource Unemployment" in E.S. Phelps et al., Microeconomic Foundations of Employment and Inflation Theory, Norton, 1970.

properly be regarded as a self-regulating system. The social problem to which the issue of the system's self-regulatory capabilities pertains we may term the coordination of economic activities. The reference is to coordination of desired sales and purchases at the market level; full coordination for our purposes means simply that existing markets clear; it does not mean efficient allocation."[1]

Without reviewing the existing literature on the topic let us summarize the argument: Arman Alchian's analysis[2] establishes that in a world of information costs, it will be optimal, in some cases, to have price inflexibility as an information economizing device. Consequently, prices will not adjust instantaneously to clear the market and there will be trade at false prices. "A given market fails to clear when the aggregate sum of the quantities that all buyers wish to buy in that market do not equal the aggregate sum of the quantities that all sellers wish to sell in that market, in which case, some potential buyers or sellers are not able to buy or sell as much as they wish."[3]

Under the possibility of market disequilibrium we must distinguish between two concepts of demand. "An individual's unconstrained (notional) demand for a commodity is a schedule or function that

---

[1] Axel Leijonhuvud, "Effective Demand Failures", Swedish Journal of Economics, 1973, p. 20 and p. 39.

[2] Alchian, op. cit.

[3] D. Tucker, "Macro-economic Models and the Demand for Money under Market Disequilibrium," Journal of Money, Credit and Banking, Feb. 1971, p. 61.

specifies the quantity he will purchase, providing he is able to buy or sell the quantity he wishes of every commodity at today's prices, subject only to a budget constraint. His effective demand specifies the quantity he actually attempts to obtain by making an explicit offer in the market place."[1] This is so because under market disequilibrium, transactors on the long side of the market will encounter quantity constraints. They will be unable to sell or buy as much as they wish. This will make them revise their original planned expenditures and offers. Therefore, the relevant market demand in a given market is the effective demand curve which is a function of the same variables as the notional demand curve but it includes the difference between expected and actual transaction quantities. Only when expected and actual transaction quantities are the same will notional and effective demands coincide. This last statement has been called the "dual-decision hypothesis."[2]

The dual-decision hypothesis is an attempt to specify the consequences of non-price rationing on actual market behavior. If the dual-decision hypothesis is accepted, there will be some spill-over effects, in the sense that a quantity constraint in one market will affect the quantity transacted in another market.

---

[1]Ibid., p. 62.

[2]R. Clower, "The Keynesian Counter-Revolution: A Theoretical Appraisal" in Readings in Monetary Theory, ed. by R.W. Clower, p. 287.

Two major points of disequilibrium analysis are thus:

1. How can information costs explain disequilibrium phenomena such as price stability, queuing, mass inventory holding and non-price rationing? Related questions are: When is it economically optimal to change price, inventory, speed-up delivery, etc...? These questions refer to the rules of exchange in a given market.

2. What are the consequences on the economic behavior of market participants who encounter non-price rationing, queuing, surplus, in a money-using system? What is the role of money in such a situation? Consider for example an individual encountering a constraint on the amount of labour he is able to supply at a given wage rate, he has the choice among at least three alternatives:

a) He can revise his consumption plan by the exact amount of the constraint imposed on his excess supply of labour.

b) He can decrease his cash holdings by the same amount of his constraint and hence execute his consumption plans. In this case his cash holding will play the role of a buffer stock.

c) He can decrease his end-of-period money holding and revises his consumption plans, i.e., some combinations of a) and b).

All these questions concern the dynamic monetary adjustments of market participants in a world of information costs and under a specific institutional exchange process. On these questions there has been little work done, for "to formulate an explicit formal model that accurately portrays the dynamics either of individual or market behavior in a monetary economy is obviously an extremely difficult task."[1] However, Clower added that "we might learn a good deal about the dynamics of observable process of monetary adjustment and about related possibilities for economic control, if we had access to information of the sort that would be provided by a continuous cross-section sample of a representative selection of transactors whose asset holdings, sales, purchases, and income and expenditures were recorded in detail on a monthly or quarterly basis."[2]

Conclusion

We have argued that the problem of explaining the difference between planned and actual behavior is essentially one aspect of the problem of the coordination of economic activity. Indeed we have seen that in a world of perfect coordination as in the Walrasian system of exchange, actual and relevant planned behavior are always equal. Moreover, in a world of imperfect coordination actual and planned behavior are equal only if all anticipations are realized. Finally in a world of information costs and costs of exchange, where the coordination is assumed by independent markets, actual and planned

---

[1] R. Clower, "Theoretical Foundation of Monetary Policy", in Monetary Theory and Monetary Policy in the 1970's, G. Clayton, V.C. Gilbert and R. Sedwick ed., Oxford University Press, 1971, p. 21.

[2] Ibid., p. 28.

behavior would usually be different due to the existence of trading at false prices.

The objective of the next chapter is to present a theoretical model that formally includes the effects of unrealized anticipations, unrealized transactions, and market rationing on actual behavior.

CHAPTER THREE

THEORETICAL FRAMEWORK

Introduction

This chapter presents a theoretical framework which permits us to identify the role of incorrect expectations and of market rationing in explaining the difference between planned transactions and actual transactions. Section 3.1 specifies the problem to be studied by explaining the role of expectations and the role of market rationing using a specific conceptual market experiment. Section 3.2 presents a microeconomic model of a typical transactor operating under a given technology of exchange in a monetary economy. This model derives the nature of the relation between planned and actual transactions. In section 3.3 we analyse the major theoretical and empirical implications of the model. In section 3.4, the theory outlined in 3.3 is briefly related to the disequilibrium analysis and the limitations of the model are sketched.

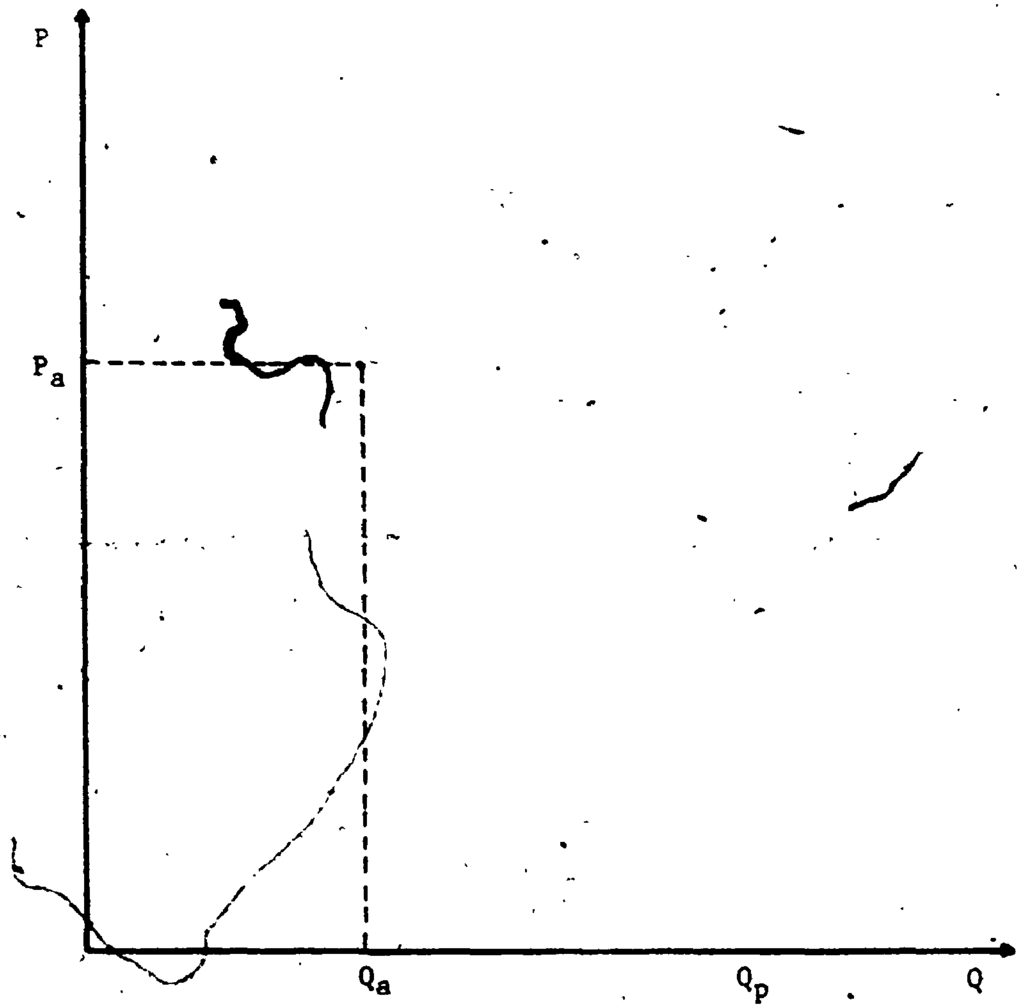


Figure 3.1

Observations of Actual
and Planned Quantities

Section 3.1 Planned and Actual Transactions: The Role of Expectations and of Market Rationing

Suppose we observe the following variable in a given market:

i) The actual quantity traded: Q_a

ii) The prevailing market price: P_a

iii) The quantity that was planned to be offered by the suppliers: Q_p

A graphical representation of these observations is provided in Figure 3.1. It is assumed, for example, that the planned quantity, Q_p, is greater than the actual quantity traded, Q_a. We postulate that the planned supply is some function of expected prices and that it is conditional on the realization of the planned transactions on all other markets. For example, producers plan to supply Q_p because they expect the prices to be at a certain level and anticipate to be able to buy the necessary inputs to produce Q_p. In other words, Q_p is a quantity on the "notional" supply curve. Now consider the following cases:

CASE ONE:

Let us assume that expectations concerning prices and transactions on all other markets were realized. This precludes any possible shift in the "notional" supply curve due to wrong expectations about prices in other markets or due to the effect of rationing in other markets on this market. Since Q_p is on the notional supply curve,

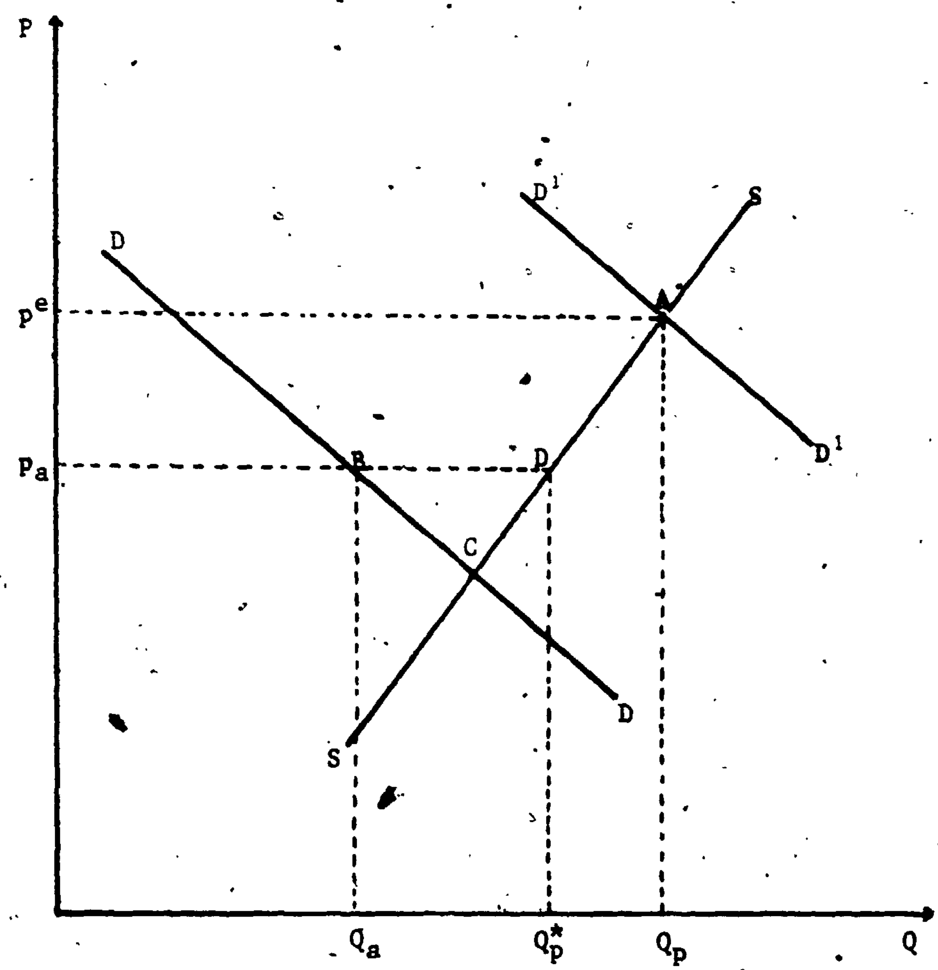


Figure 3.2 Case One

then the expected price p^e is also on the notional supply curve SS which we have drawn in figure 3.2. Corresponding to the notional supply Q_p is the expected price p^e, i.e., the demand curve was expected to be D^1D^1. But the actual demand curve was DD. Hence market transactions will result in quantity Q_a being supplied at price P_a, i.e., the price of the goods is fixed at a non-equilibrium level and the demand side of the market dominates.

However, at the price P_a, the quantity that the suppliers were willing to offer was Q_p^*, not Q_a, thus we can allocate the difference between Q_p, the notional supply and Q_a, the actual supply into two separate effects. The difference between Q_p and Q_p^* is due to incorrect expectations concerning the actual market prices. The remaining difference, i.e., Q_p^* minus Q_a is called market rationing. In this case, the difference between the planned and the actual transaction is the sum of two terms, the first one being market rationing and the second one being the change in the quantity supplied, due to wrong expectations:

$$[Q_p - Q_a] = [Q_p - Q_p^*] + [Q_p^* - Q_a]$$

CASE TWO:

Consider the case where expectations concerning prices in other markets were realized but where the expected transactions in other markets were not realized and were such that the notional supply curve shifted to the left. Also, assume that there were wrong expectations concerning the market price and that the actual price was a

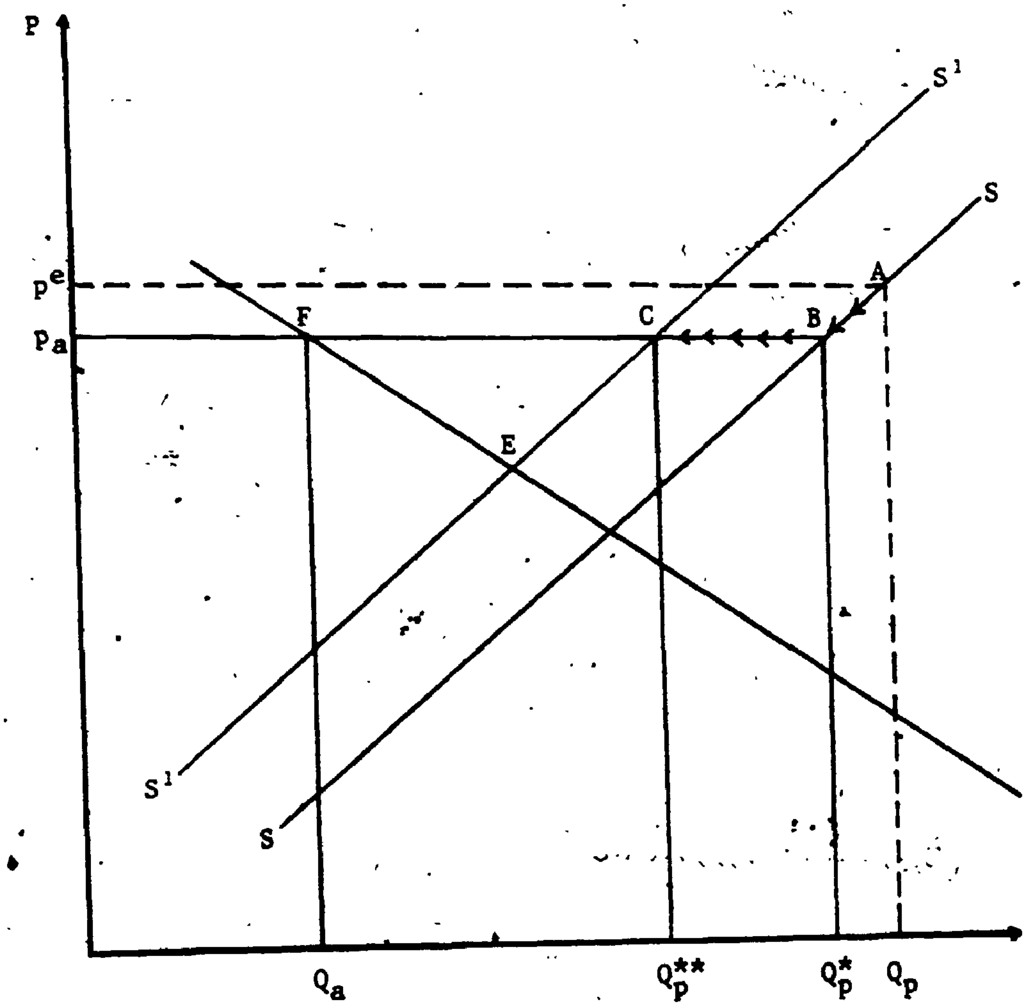


Figure 3.3 Case Two

non-equilibrium price.

This is illustrated in Figure 3.3 where suppliers expected to transact at point A by supplying Q_p at the expected price p^e. But because the actual price is different from the expected price, suppliers revise downward their notional supply and move along their notional supply curve from point A to point B. Due to the non-realization of a transaction in another market, (for example, a shortage of inputs), the notional supply curve shifts inward to the left from SS to S^1S^1 so that they change their quantity to be supplied from Q^*_p to Q^{**}_p moving from B to C. The actual transaction occurs at F where Q_a is less than Q^{**}_p by the amount of market rationing.

This last case shows that the difference between planned and actual transactions may be explained by three components:

i) The effect of incorrect expectations, $Q_p - Q^*_p$.

ii) The effect of the non-realization of transactions in other markets, usually called <u>spillover effects</u>,[1] $Q^*_p - Q^{**}_p$.

iii) The amount of <u>rationing</u> in the market considered, $Q^{**}_p - Q_a$.

The next section presents a microeconomic model which derives the precise nature of the relation between planned transactions and actual transactions.

---

[1]H.I. Grossman, "Money, Interest and Prices in Market Disequilibrium", Journal of Political Economy, 70, Sept./Oct. 1971, pp. 943-961.

3.2 A Microeconomic Model

3.2.1 Introduction

The starting point of the literature on the difference between notional and effective demands is Patinkin's work on disequilibrium, published in 1952.[1] This argument is simply that if transactions occur at non-equilibrium prices, there will be unsatisfied buyers or sellers. "For example, suppose that the array of prices is such that the amount demanded exceeds the amount supplied of both shoes and clothing. Then, the pressure on the price of, say, shoes comes from two sources; first, the buyers who have not succeeded in obtaining all the shoes they wish to purchase at the given prices; second, the buyers who have not succeeded in spending all they intended to (at the given prices) on clothing, and who redirect part of this unspent income to the shoe market."[2] Patinkin calls the second factor a spillover and mentions that notional demands curves take into account only the first of these factors.

However, as mentioned by H.I. Grossman,[3] Patinkin did not provide an analysis of the determination of the size of the spillover or of its effects. Paraphrasing Clower[4] we can say that Patinkin's

---

[1]D. Patinkin, "The Limitations of Samuelson's 'Correspondence Principle' ", Metroeconomica, 4, August 1952, pp. 37-43.

[2]Ibid., pp. 37-43.

[3]H.I. Grossman, "Money, Interest and Prices in Market Disequilibrium", Journal of Political Economy, 70, Sept./Oct. 1971, p. 948.

[4]R. Clower, "The Keynesian Counter Revolution: A Theoretical Appraisal", in Reading in Monetary Theory, R. Clower (ed.), Penguin, 1965, p. 282.

approach to this problem is not consistent with the established preference analysis because it permits transactors to revise their sale and purchase plans before the market prices have varied in response to the pressure of excess demand somewhere else in the economy. "Secondly, the supposition that price movements in one market are governed by excess demand conditions in all markets is logically equivalent to the supposition that individual traders respond not merely to absolute level of prevailing prices but also to the current rates of change of prices. This implies some basic changes in established preference analysis to allow prices as seen by transactors to differ from current market prices."[1]

Given these limitations, Clower proposes the dual-decision process in order to provide "a framework for analyzing individual behavior in one market when in another market actual quantities transacted differ from the notional demands."[2]

This dual-decision process has been generalized by H.I. Grossman. In his model, there are three commodities, goods, debt holdings and money holdings. The model supposes that if the transactor regards himself as constrained in the goods market, then he will revise his plans of debt holding and money holding. If he is constrained in the financial market, he will revise his plans of goods and money holding.

There is at least one important limitation to this generalization.

---

[1] R. Clower, op. cit., p. 282.

[2] H.I. Grossman, op. cit. p. 949.

The model assumes "that the individual always demands - that is to say, strives to achieve - the quantity which, given his perceived constraints in other markets, he calculates to be optimal, although this optimal quantity may exceed his perceived constraints in its own market."[1] The ambiguity of this assumption reflects itself in the necessity for Grossman to assume that the individual "bases his appraisal of the quantity constraints upon the actual current value of the actual transaction."[2] There is no ambiguity in this assumption as such, and indeed it is probably a realistic assumption. However, given the unexplained technology of exchange in the model, the assumption implies, "a simultaneous determination of the actual transactions carried out in (all) markets by each individual." Grossman's analysis makes it clear that logic would imply a recursive process involving a sequence of individual and market experiments. Thus there are limitations in Grossman's model, but these limitations are the result of a more extensive analysis of the dual-decision process, and they do demonstrate the need for a microeconomic model of plan realization under a given technology of exchange involving a recursive process. The objective of the next section is to present such a model.

3.2.2 A Microeconomic Model

a) The technology of exchange and the sequence of transactions

We assume that there exists (n+1) commodities consisting of m

---

[1] H.I. Grossman, op. cit., p. 951.

[2] H.I. Grossman, op. cit., p. 951.

financial assets, (n-m) goods and one (1) money commodity. The relevant planning horizon consists of T time periods. Each transactor possesses an initial endowment of one or more of the commodities at each time period. He knows with certainty his endowment of goods for the T periods. His endowment of financial assets (or liabilities) and money consists in the stockholding carried over from previous periods.

Let us define M_t as the beginning of period money holding and $X^o_{t,i}$ as the endowment of the i_{th} commodity. Call $B_{t,j}$ the value of the stockholding of the j^{th} financial asset (i.e. $B_{t,j} = P_{t,j} \cdot X^o_{t,j}$.

The problem facing this transactor is to acquire via exchange the optimal bundle of commodities given the following technology of exchange. The economy is composed of n shops, one for each commodity. At each shop, there is a shopkeeper who fixes the actual market price for each commodity at each period and who organizes exchange between the seller and the buyer earning a profit on the difference between the selling and buying prices. He follows some rules of exchange which do not need to be specified in detail, except that he is the one who performs the non-price rationing during each period both between sellers and buyers and among the market participants on the rationed side of the market. It is also assumed that the shopkeepers have committed themselves to post the price of each commodity in front of their individual shops. In other words, there is a price list at each shop.[1]

---

[1]A similar technology of exchange can be found in P. Howitt, Studies in The Theory of Monetary Dynamics, Ph. D. Dissertation, Northwestern University, June 1973, chap. 2, pp. 30-35.

Given this simple technology of exchange, the decision-making process of the transactor is as follows. At the beginning of the planning horizon, the individual does not know the actual and future "posted prices" for each commodity, but he forms expectations of the price of each commodity for each period and holds these single-valued expectations with certainty. Call the matrix of expected prices P^e. On the basis of these expectations, he maximizes his utility subject to his perceived constraints. The solution to this maximization problem is the set of notional excess demands for each commodity for each time period, $X^n_{t,i}$. This plan is notional in the sense that it is based on the assumptions that the prices will be as expected and that all planned transactions will be realized.

Given this plan, the transactor begins to carry out transactions following a sequence of transactions. The sequence of transactions is defined as the order in which the transactions occur. In other words, under the described technology of exchange, the transactor is assumed to visit one shop at a time in any period. In theory, the economic interpretation of the sequence of transactions can be either of the following.

The simplest case is to assume that the institutional trading arrangements of the economy impose the sequence of transactions on each transactor. For example, suppose each shopkeeper has different business hours during the trading period. Hence the sequencing of transactions is exogeneously given in this case.

A more interesting case consists in assuming that there is a transaction cost for each transaction. Given the structure of the transactions' costs, the transactors determine the optimum number of transactions in each market by minimizing these costs of transactions. The commodities are then ordered according to the number of transactions. The first commodity in this order will be traded more frequently than any other; and it will be possible to adjust the size of the transactions on this commodity more frequently than any other. But the last one in this order will be traded less frequently and it will be possible to adjust the size of the transaction on that commodity less frequently than any other. Commodities are then reordered: the less frequently traded one being the first commodity in the sequence. However, the mere fact that there are more occasions to adjust the size of the transaction for a given commodity, does not say anything about the costs of adjustment. Therefore, another way to explain the sequence of transaction is to postulate that the transactor expects that he will encounter quantity constraints and that he orders the transaction according to the following criterion:

> Transaction A is to be ordered before transaction B if transaction B is more flexible than transaction A.

To identify the degree of flexibility of each transaction he might use the following definition:

> Transaction A is said to be more flexible than transaction B if and only if it is cheaper to alter the actual size of transaction A given a difference between the actual and estimated transaction of B, than it is to alter the actual size of tran-

saction B given a difference (of the same value) between the actual and the estimated transaction of A.

In fact this definition and criterion would permit the identification of a sequence of adjustment simply by measuring the cost of adjustment for each transaction. However, a satisfactory explanation of how the sequence of transactions is determined would imply the construction of a model which is outside of the present study. The preceding discussion will serve as a guide-line to determine the most likely sequence of transactions to be assumed in the empirical research. As far as our theoretical model is concerned the preceding discussion aims to explain the meaning of the sequence of the transaction. In the present model, the sequence of transaction is assumed to be exogenously determined and to be the same for each period. After we have described the budgetary process for Alberta, we shall impose a sequence of transactions on the various budgetary items, this sequence being largely determined according to the principle outlined above.

b) <u>The model</u>

The transactor is thus assumed to carry out exchange by following a given sequence of transactions.

At the first shop, the transactor learns from the shopkeeper the prevailing "posted prices" for each commodity for the current period. Given his notional demand curves $\chi^n_{t,i}$, he substitutes the actual prices $(P_{1,1} \ldots P_{1,i} \ldots P_{1,m})$ for the expected prices $(P_{1,1}{}^e \ldots P_{1,i}{}^e \ldots P_{1,m}{}^e)$ and gets a set of excess demands, which we call

<u>revised notional demands</u> $X^{*n}_{t,i}$ because they have the same functional form as the notional excess demand but are evaluated at the vector P_1 instead of $P_1{}^e$.

At that point, the transactor expresses his revised notional demand, $X^{*n}_{1,1}$ to the shopkeeper of the first shop; but he learns from him that he can transact only $\bar{X}_{1,1} \leq X^{*n}_{1,1}$. He transacts $\bar{X}_{1,1}$ exchanging $P_{1,1}\,\bar{X}_{1,1}$ of money for $\bar{X}_{1,1}$ and then revises his plans for all other goods subject to the additional constraint that $X_{1,1} = \bar{X}_{1,1}$. This gives a set of <u>constrained excess demands</u> $X^c_{t,i}$. At the second shop, he wants to transact $X^c_{1,2}$ but he learns from the shopkeeper that the maximum he can transact is $\bar{X}_{1,2} \leq X^c_{1,2}$. He transacts $\bar{X}_{1,2}$ and again he revises his excess demands for all goods for each period. That is, he maximizes his utility subject to his "cash constraints":

$$M_t \geq \sum_{\alpha=1}^{i} P_{t,\alpha}\, X_{t,\alpha} \qquad (1)$$

$$i = 1,\ldots n$$
$$t = 1,\ldots T$$

where $X_{t,i} = (X'_{t,i} - X^o_{t,i})$

and $X'_{t,i}$ is the gross demand

and $X^o_{t,i}$ is the endowment

and to the additional constraints that the vector of prices for the first period is P_1 and that $X_{1,1} = \bar{X}_{1,1}$ and $X_{1,2} = \bar{X}_{1,2}$. This gives another set of constrained excess demands. He then goes to the third shop and so on up to the n^{th} shop in the first period. In the second period, he begins to carry out transactions following the same sequence of transactions. This realization of plans via the process of exchange goes on to the period T and in period T + 1 a new transaction plan is formed.

As expressed in equation (1), the rules of exchange in this "pure money economy"[1] impose on the transactor the following constraint: Each buying transaction must be financed out of cash and each selling transaction must give rise to an increase in cash. Therefore at each buying transaction the money holding at any period must be greater than or equal to the value of the sum of the net excess demands carried out up to that transaction plus the value of the net excess demand of the transaction considered.

In brief our transactor goes through a multistage decision-making process where the first stage gives the notional excess demands and where the stage (t,i) gives a set of constrained excess demands.

The notional excess demands are obtained by solving the following maximization problem:

$$\text{Max. } U = U\,(X_{1,1} + X^{o}_{1,1},\ X_{1,2} + X^{o}_{1,2}, \ldots,\ X_{1,n} + X^{o}_{1,n}, \ldots,$$
$$X_{t,i} + X^{o}_{t,i}, \ldots,\ X_{T,n} + X^{o}_{T,n}) \qquad (2)$$

Subject to

$$M_t \geq \sum_{\alpha=1}^{i} P^{e}_{t,\alpha}\, X_{t,\alpha} \qquad (3)$$

$$i = r, \ldots n$$
$$t = 1, \ldots T$$

[1] R. Clower, "A Reconsideration of the Micro-Foundation of Monetary Theory", Western Economic Journal, Dec. '67, pp. 1-9.

$$M_t = M_{t-1} - \sum_{v=1}^{n-m} P^e_{t-1,v}\,\chi_{t-1,v} - \sum_{j=n-m+1}^{n} P^e_{t-1,j}\,\chi_{t-1,j} + \sum_{j=n-m+1}^{n} r^e_{t-1,j}\,B^e_{t-1,j} + \sum_{j=n-m+1}^{n} \delta^e_{t-1,j}\,B^e_{t-1,j} \qquad (4)$$

$$j = 1,\ldots T$$

$$B_{t,j} = B_{t-1} + P^e_{t-1,j}\,\chi_{t-1,j} - \delta_{t-1,j}\,B_{t-1,j} \qquad (5)$$

$$j = n-m+1,\ldots n$$

$$t = 1,\ldots T$$

$$B_{1,j} = \bar{B}_{1,j} \qquad j = n-m+1,\ldots n$$

$$M_1 = \bar{M}_1$$

The utility is a function of the quantity of each commodity transacted in each period. The set of commodities includes all the flow commodities and the stock commodities. $\chi_{t,i}$ is a typical element of this set. It is equal to the difference between the quantity transacted and the endowment. The subscript (i) refers to the order in the sequence of transactions varying from 1 to n. $B_{t,j}$ is the value of the asset holding (or liability holding) at the beginning of period t. The subscript (j) varies from 1 to m and (v) varies from 1 to n-m. $P_{t,i}$ is the price of the i^{th} commodity in period t. $r_{t,j}$ is the rate of return on asset j in period t. $\delta_{t,j}$ is the exogenous rate of repayment if j refers to an asset or the exogenous rate of redemption if j refers to a liability.

Inequality (3) states that all transactions must be financed out of cash so that money is the only medium of exchange. Equation (4) defines the stock of money at the beginning of period t as the stock of money in the previous period less the total of all excess demands (including financial assets or liability transactions in the previous period) plus the net return on all financial assets and liabilities in the previous period plus the sum of all payments of financial assets and redemption of financial liabilities in the previous period.

Equation (5) identifies the stock holding of any financial asset or liability at the beginning of the period as the stock holding in the previous period plus the net change in the stock holding coming from the excess demand in the previous period, and the repayment on redemption in the previous period.

Equation (6) gives the initial value of the money holding and of each financial asset or liability. The choice variables are $X_{t,i}$'s which in turn determine M_t and $B_{t,j}$ given $B_{o,j}$'s and M_o and the exogenous redemption and repayment rates $\delta_{t,j}$'s, the exogenous prices and interest rates. All exogenous variables are expected.

The constrained excess demands in period t and before transaction i, are obtained by solving the following maximization problem.

At t = k and i = ℓ, the problem is to maximize:

$$U = U(\bar{X}_{1,1} + X^o_{1,1}, \ldots, \bar{X}_{k-1,n} + X^o_{k-1,n}, \ldots, \bar{X}_{k,1} + \bar{X}^o_{k,1}, \ldots, \bar{X}_{k,\ell-1} + X^o_{k,\ell-1}, \ldots, X_{k,\ell} + X^o_{k,\ell}, \ldots, X_{k,n} + X^o_{k,n}, \ldots, X_{t,i} + X^o_{t,i}, \ldots, X_{T,n} + X^o_{T,n}) \quad (7)$$

Subject to

$$M_k \geq \sum_{\alpha=1}^{\ell-1} P_{k,\alpha} \bar{X}_{k,\alpha} + \sum_{\beta=1}^{i} P_{k,\beta} X_{k,\beta} \tag{8}$$

$$i = \ell,\ \ell + 1, \ldots n$$

$$M_t \geq \sum_{\alpha=1}^{i} P^e_{t,\alpha} X_{t,\alpha} \tag{9}$$

$$i = 1, \ldots n$$
$$t = k+1, \ldots T$$

$$M_{k+1} = M_k - \sum_{i=1}^{\ell-1} P_{k,i} \bar{X}_{k,i} - \sum_{i=\ell-1}^{n} P_{k,i} X_{k,i} +$$

$$\sum_{j=n-m+1}^{n} r_{k,j} B_{k,j} + \sum_{j=n-m+1}^{n} \delta_{k,j} B_{k,j} \tag{10}$$

$$M_t = M_{t-1} - \sum_{i=1}^{n} P^e_{t-1,i} X_{t-1,i} + \sum_{j=n-m+1}^{n} r^e_{t-1,j} B_{t-1,j}$$

$$\sum_{j=n-m+1}^{n} \delta^e_{t-1,j} B_{t-1,j} \tag{11}$$

$$t = k + 2, \ldots T$$

$$B_{k+1,j} = B_{k,j} + P_{k,j} X_{k,j} - \delta_{k,j} B_{k,j} \tag{12}$$

$$j = n-m+1, \ldots n$$

$$B_{t,j} = B_{t-1,j} + P_{t-1,j} X_{t-1,j} - \delta_{t-1,j} B_{t-1,j} \tag{13}$$

$$j = n-m+1, \ldots n$$
$$t = k+2, \ldots T$$

$$B_{k,j} = \bar{B}_{k,j} \qquad j = n-m+1, \ldots n \tag{14}$$

$$M_k = \bar{M}_k \tag{15}$$

where P_t is a 1 x n vector of actual prices

$P^e_{t+1}, \ldots P^e_T$, are vectors of expected prices

r_t is a 1 x m vector of actual interest rates

$r^e_{t+1}, \ldots r^e_T$ are 1 x m vectors of expected interest rates

δ_t is a 1 x m vector of repayment and redemption rates

$\delta^e_{t+1}, \ldots \delta^e_T$ are 1 x m vectors of expected repayment and redemption rates

and $\bar{B}_{k,j}$ and $\bar{M}_k$ are the beginning of period stocks.

This maximization problem has the same structure as the one for notional excess demands except that:

i) all excess demands for the k-1 periods are known and fixed as shown in the utility function.

ii) the excess demand on the ℓ-1 transactions in period k are known and fixed as shown in the utility function and the cash constraint expressed by equation (8).

iii) the prices, the interest rates and the redemption and repayment rates for period k are known and fixed while the prices and rates for the subsequent period are expected prices and expected rates. This is why we have two expressions for the cash constraint, two expressions for the definition of the stock of money and the stock of financial assets or liabilities.

iv) the stocks at the beginning of period k are known and fixed as expressed by the initial condition (14) and (15).

Assuming that all the necessary and sufficient conditions for a maximum are respected, this gives the constrained demands in period k before transaction ℓ. The general form of the constrained demand in period t before the i^{th} transaction is thus:

$$X^c_{t,i} = X_{t,i}\,(P_t,\ P^e_{t+1},\ P^e_T;\ \ r_t,\ r^e_{t+1},\ldots r^e_T;$$

$$\delta_t,\ \delta^e_{t+1},\ldots\delta^e_T;\ \ \bar{M}_t,\ \bar{X}_{t(i)}) \qquad (16)$$

$\bar{X}_{t(i)}$ is a t by n matrix identifying past transactions, that is

$$\bar{X}_{t(i)} = \begin{bmatrix} \bar{X}_{1,1}, & \ldots\ldots\ldots\ldots\ldots & \bar{X}_{1,n} \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \bar{X}_{t-1}, & \ldots\ldots\ldots\ldots\ldots & \bar{X}_{t-1,m} \\ \bar{X}_{t,1}, & \ldots\ \bar{X}_{t,i-1},\ 0\ \ldots\ 0\ \ldots & 0 \end{bmatrix}$$

Note that the last row of $\bar{X}_{t(i)}$ includes only the i-1 transactions since $\bar{X}_{t(i)}$ is defined here for the constrained demand $X^c_{t,i}$. Thus there exists a different $\bar{X}_{t(i)}$ matrix for each constrained excess demand.

Now using the following optimality principle we will be able to relate the constrained demands to the notional demands.

Let us first state this principle:

<u>PRINCIPLE</u>: BELLMAN Principle of Optimality

"An optimal sequence of decisions in a multistage decision process problem has the property that whatever the initial stage, state and decisions are, the remaining decisions must constitute an optimal sequence of decisions for the remaining problem, with the stage and state resulting from the first decision considered as initial conditions."[1]

The implications of this optimality principle can be expressed in the following way. The initial stage, state and decisions may be represented by

$$\emptyset = (P^e_t, P^e_{t+1}, \ldots P^e_T;\ r^e_t, r^e_{t+1}, \ldots r^e_T;\ \delta^e_{t+1}, \ldots$$

$$\delta^e_T, \ldots B^n_t, M^n_t, \chi^n_{t(i)})$$

this gives the optimal notional excess demands, $\chi^n_{t,i}$ for $t = 1 \ldots T$ and for $i = 1 \ldots n$. It is an optimal sequence of decisions relating $\chi^n_{t,i}$ to $\emptyset$ by a function $\chi_{t,i}$. Thus the function $\chi_{t,i}$ is the optimal performance function.[2] According to the principle of optimality, if the function $\chi_{t,i}$ is the optimal performance function for the problem defined by $\emptyset$, it must constitute an optimal sequence of decisions for the remaining problem defined by $\emptyset$, evaluated at

$$\emptyset = (P_t, P^e_{t+1}, \ldots P^e_T;\ r_t, r^e_{t+1}, \ldots r^e_T;\ \delta_t, \delta^e_{t+1}, \delta^e_T;$$

$$\bar{B}_t;\ \bar{M}_t;\ \bar{X}_{t(i)})$$

Thus the function $\chi_{t,i}$ expressed in (16) is the optimal performance function so that the notional excess demands can be written as

---

[1] Dreyfus, S.E., Dynamic Programming and the Calculus of Variations, New York, Academic Press Inc., 1965, p. 8.

[2] Michael P. Intriligator, Mathematical Optimization and Economic Theory, Prentice-Hall, Englewood Cliffs, N.J., 1971, p. 328.

$$\chi^n_{t,i} = \chi_{t,i}(P^e_t, P^e_{t+1}, \ldots P^e_T; \; r^e_t, \ldots r^e_T; \; \delta^e_t, \ldots \delta^e_T;$$

$$M^n_t; \; B^n_t; \; \chi^n_{t(i)}) \qquad (17)$$

where

$$\chi^n_{t(i)} = \begin{bmatrix} \chi^n_{1,1}, & \ldots\ldots\ldots\ldots\ldots\ldots & \chi^n_{1,n} \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \chi^n_{t-1}, & \ldots\ldots\ldots\ldots\ldots\ldots & \chi^n_{t-1,n} \\ \chi^n_{t,1}, & \ldots \; \chi^n_{t,i-1}, 0 \ldots 0 \ldots & 0 \end{bmatrix}$$

In other words, the notional excess demands for commodity i in period t has the same functional form as its corresponding constrained excess demand except that:

i) the notional excess demand is evaluated at expected prices and expected rates for all periods.

ii) the notional stock holding of money and of financial assets or liabilities are substituted for the actual ones.

iii) Notional excess demands, χ^n_t, representing the transactions that are supposed to take place before $\chi^n_{t,i}$ is substituted for the actual ones, $\bar{\chi}_t$.

Now let us approximate $\chi^c_{t,i}$ by a Taylor series expansion around the point defined by

$$P_t = P^e_t, \; \bar{\chi}_t = \chi^n_t, \; \bar{M}_t = M^n_t, \; B_t = B^n_t, \; r_t = r^e_t, \text{ and } \delta_t = \delta^e_t$$

Define the following:

$\alpha_{i,\ell} = \delta X^c_{t,i}/\delta \bar{X}_{t,\ell}$ as the spillover coefficient of the current ℓ^{th} transaction on the i^{th} transaction.

$\ell = 1,\ldots i-1$, since the sequence of transactions is from 1 to $\ell-1$ before the 1^{th} transaction.

$\ell^c_{i,\ell} = \delta X^s_{t,i}/\delta \bar{X}_{s,\ell}$ as the spillover coefficient of the 1^{th} transaction carried out in period s, (s < t), on the i^{th} current transaction; $\ell = 1\ldots n$ and $s = 1\ldots t-1$.

$b_{i,\ell} = \frac{\partial X^c_{t,i}}{\partial P_{t,\ell}}$ as the coefficient of expectations about price of commodity ℓ on commodity i.

$\gamma_i = \frac{\partial X^c_{t,i}}{\partial \bar{M}}$ as the beginning of period cash coefficient on commodity i.

$z_{i,j} = \frac{\partial X^c_{t,i}}{\partial B_{t,j}}$ as the coefficient of the beginning of period stock holding of financial asset or liability j on the i^{th} transaction.

$f_{i,j} = \frac{\partial X^c_{t,i}}{\partial r_{t,j}}$ as the coefficient of expectations about the interest rate j on transaction i.

$g_{i,j} = \frac{\partial X^c_{t,i}}{\partial \delta_{t,j}}$ as the coefficient of expectations about the repayment rates j on transaction i.

$R_{t,i}$ = the residual of the Taylor expansion. This Taylor expansion gives:

$$X^c_{t,i} - X^n_{t,i} = \sum_{\ell=1}^{i-1} \alpha_{i,\ell}[\bar{X}_{t,\ell} - X^n_{t,\ell}] + \sum_{s=1}^{t-1} \sum_{\ell=1}^{n} \ell_{i,\ell}[\bar{X}_{s,\ell} - X^n_{s,\ell}]$$

$$+ \sum_{\ell=1}^{n} b_{i,\ell}[P_{t,\ell} - P^e_{t,\ell}] + \sum_{j=1}^{m} f_{i,j}[r_{t,j} - r^e_{t,j}]$$

$$+ \sum_{j=1}^{m} g_{i,j}[\delta_{t,j} - \delta^e_{t,j}] + \sum_{j=1}^{m} z_{i,j}[\bar{B}_{t,j} - B^n_{t,j}]$$

$$+ \gamma_i[\bar{M}_t - M^n_t] + R_{t,i} \qquad (18)$$

In section 3.1 we identified that the difference between actual and planned transactions was the sum of these three terms:

$$(\bar{X}_{t,i} - X^n_{t,i}) = (\bar{X}_{t,i} - X^c_{t,i}) + (X^c_{t,i} - X^{*n}_{t,i}) + (X^{*n}_{t,i} - X^n_{t,i}) \qquad (19)$$

Equation (18) explains the last two terms of equation (19).

Assuming that the direct rationing effect can be estimated by

$$(\bar{X}_{t,i} - X^c_{t,i}) = (k_i + e_{t,i}) \qquad (20)$$

Where k_i is the mean value of the rationing effect over the period for the i^{th} transaction and $e_{t,i}$ is a random variable with mean zero and constant variance.

We can write the equation to be estimated as:

$$\bar{X}_{t,i}-X^{n}_{t,i} = k_i + \sum_{\ell=1}^{i-1} \alpha_{i,\ell}[\bar{X}_{t,\ell} - X^{n}_{t,\ell}] + \sum_{s=1}^{t-1}\sum_{\ell=1}^{n} \ell_{i,\ell}[\bar{X}_{s,\ell} - X^{n}_{s,\ell}]$$

$$+ \sum_{j=1}^{n} b_{i,\ell}[P_{t,\ell} - P^{e}_{t,\ell}] + \sum_{j=1}^{m} f_{i,j}[r_{t,j} - r^{e}_{t,j}]$$

$$+ \sum_{j=1}^{m} g_{i,j}[\delta_{t,j} - \delta^{e}_{t,j}] + \sum_{j=1}^{m} z_{i,j}[\bar{B}_{t,j} - B^{n}_{t,j}]$$

$$+ \gamma_i[\bar{M}_t - M^{n}_t] + \mu_{t,i} \tag{21}$$

Where $\mu_{t,i} = R_{u,i} + e_{t,i}$ (22)

Equation (21) means that the difference between actual transactions and notional excess demands as linearly approximated by a Taylor expansion is equal to the sum of nine different factors:

1) direct rationing effect,
2) current spillover effect,
3) lagged spillover effect,
4) current unrealized expectation about prices,
5) current unrealized expectation about interest rates,
6) current unrealized expectation about repayment or redemption rates of liabilities or assets,
7) stock adjustment effect,
8) beginning-of-period cash effect,
9) a residual factor.

In the next section we analyse the theoretical and empirical implications of the model.[4]

3.3 Theoretical and Empirical Implications of the Model

This section presents an analysis of each of the nine factors explaining the difference between actual and planned transactions.

a) Direct Rationing Effect

In equation (20) we specified that the market rationing can be estimated by $(\bar{X}_{t,i} - X^c_{t,i}) = \bar{X}k_i + e_{t,i})$. If $X^c_{t,i}$ is an excess demand, and if we assume that the transactor is never forced to buy more than he wants, thus $(\bar{X}_{t,i} - X^c_{t,i}) < 0$ for all $t=1...T$. If $X^c_{t,i}$ is an excess supply and if we assume that the transactor is never forced to sell more than he wants, thus $(\bar{X}_{t,i} - X^c_{t,i}) < 0$ for all $t=1...T$.

Therefore under the assumptions that the transactor never buys or sells more than he wants, we have the following restrictions: $k_i<0$ for all $i=1...n$.

<u>Unless we have some a priori indications that the transactor</u> was forced to buy or sell more than he wants, we expect k_i to be negative or zero.

b) Current Spillover Effects

The question here is why do we expect to encounter current spillover effects. As shown in the theory, current realized transactions enter in the utility function and in the current cash constraint.

There are two forces at play here: The fact that these realized transactions enter in the utility function indicates that the transactor cares about the composition of the bundle of commodities that he will end up with, and the fact that they are included in the current cash constraint indicates that the non-realization of a current transaction changes the current cash position before the transactions are considered. The sign of the spillover coefficient will therefore depend on the net effect of tastes (complementary or substitute) and cash considerations. The proposition to be tested here is the following one:

PROPOSITION I

When planned transactions in one market are not realized in period t, transactions in at least one other market will be revised in period t. The measure of this simultaneous reaction is the spillover coefficient $\alpha_{i,\ell}$.

Test: If $\alpha_{i,\ell} = 0$ for all i and ℓ, it means that there is no spillover effect.

c) Lagged Spillover Effect

Lagged realized transactions enter in the utility function only, since the beginning of the period cash includes the effect of all the past non-realizations. Therefore the sign of the spillover coefficient on lagged non-realizations depends on taste considerations only.

PROPOSITION II

When planned transactions in one market are not realized in period s, transactions in at least another market will be revised in any subsequent period.

Test: If $\iota^{s}_{i,\ell} = 0$ for all i and s and ℓ, then there is no lagged spillover effects.

d) Current unrealized expectations about prices

The proposition is simply that wrong expectations about prices are equivalent to changes in prices and therefore imply a change in the quantity demanded or supplied.

PROPOSITION III

When expectations about prices are not realized in period t, the transactions in at least one market will be revised in period t; the measure of this reaction is the coefficient $b_{i,\ell}$.

Test: If $b_{i,\ell} = 0$ for all i and ℓ, it means that wrong expectations about prices do not affect current transactions.

e) Current unrealized expectations about interest rates

If interest rates are different than expected in any period, the payment of interest on liabilities will be different than expected the interest revenue on assets will be different than expected. Thus cash will be different than expected. Wrong expectations about interest rates also means that the market prices of financial assets or liabilities will be different than expected and this will affect the optimal portfolio composition. The sign of the coefficient will depend on cash and portfolio considerations.

PROPOSITION IV

When expectations about interest es in one market are not realized in period t, transactions in at least another market will be revised in the current period.

Test: If $f_{i,j} = 0$ for all i and j, then wrong expectations about interest rates do not affect current transactions.

f) Current unrealized expectations about repayment or redemption rates

If the repayment rates and the redemption rates are not realized, the stockholding of assets or liabilities will not be realized and the beginning of the period cash will not be realized. This will affect the cash position and portfolio composition and therefore induces some changes in other transactions.

PROPOSITION V

When expectations about repayment and redemption rates are not realized in one market in period t, transactions in at least another market will be revised in period t.

Test: If $g_{i,j} = 0$ for all i and j, then wrong expectations about repayment or redemption rates do not affect current transactions.

g) Stock Adjustment Effect

PROPOSITION VI

When the beginning of period stock holding is not as expected, transactions in at least another market will be revised in period t.

Test: If $z_{i,j} = 0$ for all i and j, it means that there is no stock adjustment effect.

h) Beginning of Period Cash Effect

PROPOSITION VII

When the beginning of period cash is different than the planned holding, transactions in at least one other market will be revised in the same period.

Test: If $\gamma_i = 0$ for all i, there is no cash effect.

The following identity holds:

IDENTITY

If all transactions are reported on a cash basis, the difference between the actual change in cash and the planned change in cash is identically equal to the sum of the differences between actual and planned transactions of all excess demands.

Let us now discuss how our theory can be related to the existing literature on disequilibrium and explain the limitations of the model.

3.4 Relation to the Disequilibrium Literature and Limitations of the Model

The above model can be considered as an extension of Clower-Grossman analysis of the dual-decision process dealing explicitly with asset holding phenomena and incorrect expectations. Recent discussions[1] on the effects of non-equilibrium transactions stress the important distinction between pure flow model and stock flow model in order to analyse the role of stocks "as 'buffers' between physical inflows and outflows and between financial income and expenditure flows. Stocks of liquid assets - of cash balances, in particular - allow expenditures to be maintained when receipts fall off; indeed, they are maintained by traders exactly for the purpose of meeting such contingencies."[2] However, as noted by R. Clower "in this type of model, current transactions exercise an influence only after a certain time delay."[3]

In the pure flow model, "if the transactor fails to realize his

---

[1] A. Leijonhufvud, "Effective Demand Failures," Swedish Economic Journal, pp. 33-40.

[2] Op. cit., p. 38.

[3] R. Clower, "The Keynesian Counter-Resolution: A Theoretical Appraisal," in Reading in Monetary Theory, R. Clower (ed.), p. 284.

desired sales due to excess supply in those markets, he will not have the wherewithal to realize his desired purchases."[1] In stock-flow model, however, the stock permits inter-temporal adjustments. This is one of the relevant questions raised by our theoretical model: Will there be any spillover effects when the transactors have sufficient stocks that can be used as buffers? In order to answer this question, we must rely on a data set which permits the construction of such empirical test, that is, we need data on the full budget of the transactor.

This issue about the role of the buffer stock can even be raised as an objection. Indeed, "it may appear to some people that the entire analysis is based on an implausible behavioral hypothesis..... one that should be changed. One of the primary functions of an individual's money balance, of course, is to serve as a buffer stock and to absorb the impact of unexpected emergencies. Thus, it might be argued, there is no reason to expect an individual to revise his effective demands for other commodities when he encounters a quantity constraints in one market; his money balance will absorb the impact. Thus, any analysis based on the presumption that they do revise their effective demand must be weak at best."[2]

There are many responses to this position. Tucker argues that it is a special case, "whereas allowing for revision of all demands

---

[1]A. Leijonhufvud, op. cit., p. 35.

[2]D. Tucker, "Macroeconomic Models and the Demand for Money under Market Disequilibrium", J.M.C.B., Feb. 71, p. 80.

is a less restrictive and more general assumption."[1] Our response is this. In pure flow models, the only plausible assumption is that plans will have to be revised. In stock-flow models, it remains an empirical question. However, one thing is certain, in order to test for the presence of current spillover effects, we must use a stock-flow model. In this sense our model is correctly formulated.

However, there are some theoretical and empirical limitations to the present model. For example, it implicitly assumes that the transactor is afflicted with a Cournot-like myopia in the sense that he always expects the rationing to be absent in the next period. The transactor does not form expectations about rationing. However, "the effective demands of many of the individuals who encounter or who expect to encounter a quantity constraint in some market will differ from their unconstrained demands. The demand functions that determine the effective demands of each such individual will include the relevant quantity limitation (actual or anticipated) as one of the explanatory variables, and the inclusion of this quantity limit explicitly in the demand function is the crucial element that distinguishes the demand functions that apply under market disequilibrium from the demand functions that are appropriate under the assumption of continuous market clearing."[2]

Another important limitation of the model is that the sequence of transactions is assumed to be exogenous in the model. However, to make

---

[1] D. Tucker, op. cit., pp. 80-81.

[2] D. Tucker, op. cit., pp. 63-64.

the sequence of transactions endogenous is a very difficult task because it is related to many other unsolved issues. For example, in deciding this sequence, the transactor must take into consideration whether the commodity exchanged is in excess demand or in excess supply. For, if all excess demand commodities are traded first, cash will be decreasing rapidly and it is possible to run out of cash before any excess supply transactions take place. This problem is much more complicated when actual (or expected) rationing is included in the analysis. Indeed, it is no longer certain that the planned sequence will be the same as the actual one. All these problems indicate the theoretical limitations of our model but they also indicate how this approach to monetary phenomena is a fructuous one.

The major empirical limitation of the model is that it requires a very sophisticated set of data in the sense that we need data on all types of transactions and on expected exogenous variables.

CONCLUSION

The difference between planned and actual transactions, was shown to be explained by the effect of incorrect expectations and of market rationing. In Section 3.2 we have presented a microeconomic model which derives the precise nature of the relation between planned transactions and actual transactions. The model is stock-flow in nature and permits us to formulate propositions in Section 3.3 that can be tested. In a last section our theoretical framework is related to relevant issues in the disequilibrium literature and the major limitations of our model are identified. One of these limitations is that our model requires a very special set of data. The objective of the next chapter is to present our data set in order to determine its strengths and weaknesses for the testing of our hypotheses.

APPENDIX TO CHAPTER THREE

Glossary of Symbols

n = number of commodities

m = number of financial assets or liabilities

T = number of time periods

i = index of the n commodities, indicating the sequence of transactions, running from 1 to n

j = index of the m financial assets or liabilities, running from 1 to m

v = index of the n-m goods, running from 1 to n-m

t = index of the time period, running from 1 to T

$X^{o}_{t,i}$ = endowment of the i^{th} commodity in the t^{th} period

$X'_{t,i}$ = quantity of the i^{th} commodity planned to be transacted in the t^{th} period

$X_{t,i}$ = excess demand of the i^{th} commodity in the t^{th} period

where

$X^{n}_{t,i}$ = notional excess demand of the i^{th} commodity in the t^{th} period

$X^{*n}_{t,i}$ = revised notional excess demand of the i^{th} commodity in the t^{th} period

$X^{c}_{t,i}$ = constrained excess demand of the i^{th}

$\bar{X}_{t,i}$ = actual quantity of the i^{th} commodity, transacted in t^{th} period

$P^{e}_{t,i}$ = expected price of the i^{th} commodity, in the t^{th} period

$P_{t,i}$ = actual price of the i^{th} commodity in the t^{th} period

M_t = beginning of period t, money holding

M_t^n = notional beginning of period t, money holding

$\bar{M}_t$ = actual beginning of period t, money holding

$B_{t,j}$ = beginning of period t, holding of the j^{th} asset or liability

$B_{t,j}^m$ = notional beginning of period t, holding of the j^{th} asset or liability

$\bar{B}_{t,j}$ = actual beginning of period t, holding of the j^{th} asset or liability

$r_{t,j}^e$ = expected rate of interest in period t, on the j^{th} asset or liability

$r_{t,j}$ = actual rate of interest in period t, on the j^{th} asset or liability

$\delta_{t,j}^e$ = expected repayment or redemption rate on the j^{th} asset or liability in the t^{th} period

$\delta_{t,j}$ = actual repayment or redemption rate on the j^{th} asset or liability in the t^{th} period

$\alpha_{i,l}$ = spillover coefficient of the current l^{th} transaction on the i^{th} transaction

$l = 1, \ldots, i-1$

$\ell_{i,l}^s$ = spillover coefficient on the l^{th} transaction carried out in period s $(s < t)$, on the i^{th} current transaction

$l = 1, \ldots, m$

$s = 1, \ldots, t-1$

$\beta_{i,l}$ = coefficient of expectations about price of commodity l on commodity i

γ_i = beginning of period cash coefficient on commodity i

$z_{i,j}$ = coefficient of the beginning of period stock holding of the j^{th} financial asset or liability on the i^{th} transaction

$f_{i,j}$ = coefficient of expectation about the interest rate j on transaction i

$g_{i,j}$ = coefficient of expectation about the repayment or redemption rate on the j^{th} asset or liability on transaction i

$R_{t,i}$ = the residual of the Taylor expansion

$e_{t,i}$ = the residual of the assumed rationing equation

$\mu_{t,i}$ = the residual of the estimated equation.

CHAPTER FOUR

THE DATA

Introduction

The purpose of this chapter is to describe the institutional framework behind the budgetary realization process of the Province of Alberta. In a first section, a brief financial history of the Provincial Government will be provided. Section 4.2 presents a description of the Department of Treasury. In section 4.3 the accounting system underlying the data set will be analysed in order to describe the data set in detail. The uniqueness of these data for the study of disequilibrium will be stressed and the shortcomings will be mentioned. In this section we will also indicate how we aim to cope with a few of these shortcomings. In the last section, the application of Theil's mean square error of forecast to the data set will serve as an introduction to the next chapter on the empirical results.

Section 4.1 A Brief Financial History of the Government of Alberta

The striking fact about Alberta's provincial finances is that this province had an annual surplus on the income account from 1937 to 1972.[1] The years before 1945 were years of relatively large surpluses. This allowed the provincial government to initiate what has been called the 1945 Debt Reorganization Program. From 1908 to 1945 the net funded debt increased almost each year but from 1945 to 1969 it decreased each year - from $140,805,449.21 in 1945 to $29,152,119.65 in 1959 and to $10,993,108.32 in 1968. In fact, over the period 19[illegible] to 1968, there were no new bond or treasury bill issues. These large income-account surpluses not only permitted a substantial reduction of the outstanding debt but also helped to finance the necessary capital expenditures over the period. Moreover after the Debt Reorganization Program, there was some money left over which was used to acquire financial assets. The purchase of interest earning assets was facilitated by the creation of the Alberta Special Investment Fund (S.I.F.). The securities purchased by the S.I.F. are mainly medium-term Canadian government debt instruments. For example, the portfolio composition of the S.I.F. on March 31, 1971 was the following one:[2]

Government of Canada, direct and guaranteed	$53,594,531.88
Provincial, direct and guaranteed	$57,060,401.40
Municipal Bonds	$18,481,636.74
Municipal Hospital Districts Bonds	$ 1,381,226.47
School Districts and Divisions Bonds	$20,703,604.34

[1] <u>Public Accounts of the Province of Alberta</u>, 1972, Edmonton, p. 79.

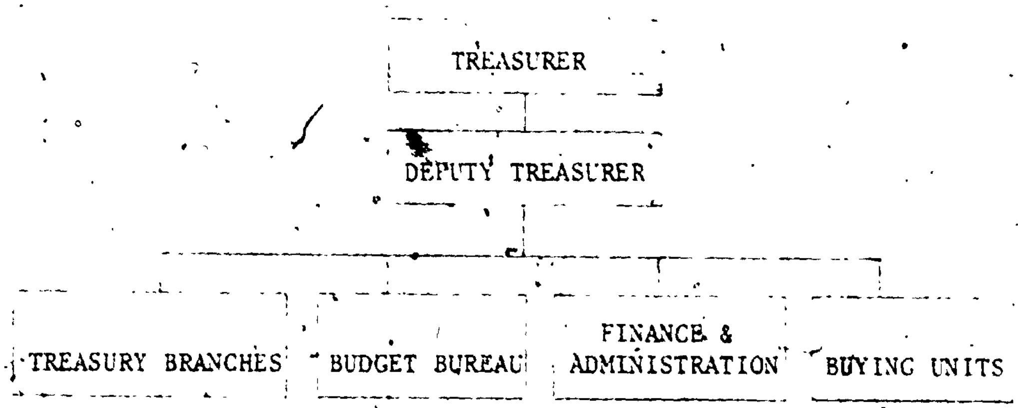
[2] <u>Public Accounts</u>, 1972, pp. 76-77.

The assets of the S.I.F. thus consist of securities which can be sold or bought in secondary financial markets.

These historical notes permit us to identify the Government of Alberta as a surplus unit. However, this fact does not preclude any borrowing as we will see later but does give a better understanding of certain financial transactions.

4.2 The Department of Treasury

It is important to know that the Treasury Department is organized according to the following structure:



The functions of the Treasury Branches division are administrative and technical. These branches represent the Treasury in the different cities and localities of the province.

The functions of the Buying Units division are to decide where to buy or sell, and to find the optimum prices for the goods and services. Goods and services are usually bought (sold) by tender.

All interested sellers (buyers) make an offer (a bid) and the one with the lowest (highest) price for the quality and quantity needed receives the contract. This is how the prices on goods and services (which account for the largest part of non-wage expenditures) are determined.

The Budget Bureau prepares the budget speech of the year and the monthly forecasts. Each department submits to the Budget Bureau an estimate of its revenues and expenditures for the forthcoming year along with a forecast of how the annual figures will be received or spent over the twelve months of the year. These estimates are then compared with the past month-to-year ratio and adjustments are made when necessary. The Budget Bureau works in close collaboration with the Finance and Administration division to manage both debt and cash and to oversee the overall budgetary realization process.

The Finance and Administration Division is in charge of the cash and debt management and operates, in collaboration with the Treasury Branches, the day-to-day transactions. These transactions include money market transactions, bank operations, treasury bills, auctions, loans, etc.

4.3 The Accounting Framework and the Characteristics of the Data Set

The two major sources of data are the monthly Summary of Receipts and Expenditures and the Consolidated Revenue Funds: Statements of Cash Transaction and the End-of-Month Cash Position. Both sources record transactions on a cash basis for each month of the year. These sources of data exist for the estimated as well as for the actual transactions. The estimated figures are calculated at the end of each fiscal year, that is, at the end of March, and include the estimates of the monthly transactions for each type of operation for the next twelve months. They represent the notional transaction plans on a monthly basis and they are generally consistent with the annual budget figures prepaired by the Budget Bureau. The actual version of these financial statements is formulated at the end of each month. The last monthly statement contains all the monthly transactions which occurred during the previous twelve months. These monthly statements too are generally consistent with the public accounts of the province.

These sources of data include a detailed breakdown of all transactions classified by sources and uses of funds. However, for the purpose of our study the data are organized according to a more aggregate accounting framework. Specifically, transactions are classified as budgetary, non budgetary, borrowing and cash transactions. For each month over the period September 1969 to February 1973, actual and estimated transactions were aggregated in the following way:

ACCOUNTING FRAMEWORK

Budgetary Transactions[1]

		ACTUAL	ESTIMATE
1)	Total Budgetary Revenue	+	+
2)	Current Expenditure on Education	-	-
3)	Current Expenditure on Health	-	-
4)	Other Current Expenditures	-	-
5)	Capital Expenditures	-	-
	Budgetary Surplus	+/-	+/-

Non-Budgetary Transactions

		ACTUAL	ESTIMATE
6)	Loans and Advances	-	-
7)	Repayments of Loans and Advances	+	+
8)	~~Net~~ Purchase of Special Investment Fund Securities (Purchases-Sales)	-	-
9)	Redemptions of S.I.F. Securities	+	+
	Non-Budgetary Surplus	+/-	+/-

Debt Operations

		ACTUAL	ESTIMATE
10)	Total Provincial Borrowing	+	+
11)	Debt Redemption	-	-
	Net change in debt	+/-	+/-

Cash Operations

12) Change in cash = Budgetary Surplus - Non-Budgetary Surplus - Net change in debt

---

[1]The sign - or + identifies the transaction as an excess demand (use of cash) or excess supply (sources of cash) transaction.

The above accounting framework records the flow transactions. We add to this the stock variables, i.e., the end-of-month stock of debt, the end-of-month stock of loans and advances, the end-of-month stock of S.I.F. securities and the end-of-month cash and we get:

i) 9 endogenous flows: Total Budgetary Revenue, current expenditures on education, current expenditures on health, current expenditures on other goods and services, capital expenditures, loans and advances, total borrowing, S.I.F. net purchase or sales, and the change in cash.

ii) 4 endogenous stocks: End-of-month cash, end-of-month stock of debt, end-of-month stock of loans and advances, end-of-month stock of S.I.F. securities.

iii) 3 autonomous changes in stock: Debt redemptions, repayment of loans and advances, redemptions of S.I.F. securities.

This data set is rather unique because it presents information about the planned transactions for each type of transactions included in the budget. Transactions are recorded for a short time horizon, i.e. one month. The budget includes pure-flow commodities (e.g. current expenditures) and stock-flow commodities (e.g. financial assets). In brief, this data set corresponds closely to what Clower identified as an ideal sample in the sense that it describes the monetary adjustment of a "transactor whose asset holdings, sales, purchases and income and expenditures [are] recorded in detail on a monthly...basis."[1]

However, the present data set also has its shortcomings. The first major shortcoming is that the Government of Alberta is not what can be called "micro-unit" in the traditional sense. It is a provincial government. However, if we define a micro-unit as an economic entity which is a price-taker and does not have the power of issuing money, then the Alberta Government might be considered as approximating a micro-unit. In any case, our results will be a test of the theory as applied to a specific provincial government.

The other shortcomings of our data set relate to the lack of data on the expected values of exogenous variables such as prices, interest rates and the redemption or repayment rates. The first consequence of this lack of data is that it precludes us from estimating notional excess demands directly. The second consequence is that we will have to postulate some heuristic rules about how the forecast of exogenous variables is made in order to get proxy variables for these expectations. We chose these heuristic rules after several discussions with the members of the Budget Bureau and the Finance and Administration section of the Treasury Department. The reader will find, in Appendix A, the exact rules used. But it appears useful for us to indicate here the general principles underlying these rules. For variables such as interest rates and exchange rates, the average of

[1] R. Clower "Foundations of Monetary Policy" in G. Clayton, J.C. Gilbert and R. Sedw-ck, Monetary Theory and Policy in the 1970's, Oxford University Press, 1971, p. 28.

the previous year rates were used as a proxy for the expected rates for the next year. For repayments, we used the planned amounts instead of the planned rates. In the case of debt redemption rates, there was no need to generate any expected rates for there was no difference between the actual and estimated debt redemption transactions. For all other prices, the lack of data on a monthly basis (the non-existence of prices in some cases) precludes any use of expected variables. Keeping in mind all these shortcomings we now attempt to summarize some essential characteristics of the data set by applying Theil's mean square error of forecast to the expected and actual values of the various budget categories. In addition to being of interest in their own right these mean square error statistics will provide a useful guide for the regression analysis that follows in the next chapter.

4.4 The Mean Square Error of Forecast

The objective of this section is to identify the major sources of forecasting error in the monthly transactions of the Alberta Treasury. In order to accomplish this task we will utilize the following expression of the mean square error of forecast:[1]

$$\frac{1}{N}\sum_{t=1}^{N}(E_t - A_t)^2 = (\bar{E}_t - \bar{A}_t)^2 + (S_E - S_A)^2 + 2(1 - r)S_E S_A$$

---

[1] Henri Theil, Applied Economic Forecasting, Chicago Rand M[illegible]y 1966, Chapter 1.

where

E_t is the estimated figure in period t and A_t is the actual in period t.

$\bar{E}$ and $\bar{A}$ are the respective means of E and A; S_E and S_A are their respective standard errors; and r is the simple correlation coefficient between E and A.

The first element $(\bar{E} - \bar{A})^2$ would be zero if and only if, on the average, the actual and estimated figures were equal. This element indicates the importance of the bias contained in the overall error in the estimated transaction. For instance, where $\bar{E} > \bar{A}$, budget estimates of the transaction contain, on average, an overestimation of the actual percentage changes.

The second element $(S_E - S_A)^2$ would be zero if and only if the standard error of the actual and estimated transaction were equal. Since E is a function of the anticipated level of economic activity and A is a function of the actual level, the greater the difference between S_E and S_A the greater is the error in the anticipations of forecasts. The estimate may be too sensitive to these anticipations ($S_E > S_A$) or not sensitive enough ($S_E < S_A$). This type of error is due to the forecaster's difficulties in ascertaining the pattern of cyclical fluctuations in economic activity.

The third term gives the error due to the lack of positive correlation between the actual and the estimated transaction.

If we divide each term of equation (1) by the mean square error and multiply by 100 we get:

$$100 = M1 + M2 + M3 \qquad (2)$$

where

M1 is the percentage of the mean square error explained by the bias in the estimates.

M2 is the percentage of errors of variation in the budgetary estimates.

M3 is the percentage of lack of covariation between actual and estimated values.

Tables 4.1 and 4.2 show the results of the mean square error of forecast applied to the figure on transaction as expressed in level and percentage change.

We now consider the major findings of this exercise.

Total Budgetary Revenue:

Total Budgetary Revenues (TBR) are underestimated both in percentage changes and level value. The systematic component, M1, explains 9.9% of the mean square error of forecast in the case of percentage change variables and 8.9% in the case of the absolute values. The major sources of error is to be found in the last component, M3, meaning that there was a difference in the timing. This is true for both level value and percentage change value variables.

TABLE 4.1

MEAN SQUARE ERROR OF ESTIMATE

(1969.9 - 1973.2)

Budgetary Variables*	$\bar{E}$	$\bar{A}$	S_E	S_A	r	M1	M2	M3	MSE
TBR	84506	87270	13954	17353	.8630	8.9	13.5	77.5	85,609,533
CEE	25249	21501	23382	22254	.9423	18.63	1.68	79.67	75,367,472
CEO	38785	40660	13919	14760	.7839	7.23	1.45	91.32	48,619,449
CEHS	2785	2982	1464	1248	.4796	1.9	2.3	95.7	2,042,578
CEHH	15269	16933	6212	5187	.8150	17.5	6.6	75.7	15,822,262
CET	82401	81841	28446	26077	.9448	.37	6.4	93.2	87,810,810
KET	15356	13439	6512	7241	.6869	10.8	1.6	87.5	34,026,750
LIA	2089	1953	1433	2365	.2852	.3	15.1	84.5	6,165,333
SIFP	69	314	42	632	-.1348	12.8	74.4	12.7	468,945
SIFS	737	1532	2162	3152	.0211	4.2	6.5	89.2	15,048,214
REDL + REDSIF	2302	2571	4608	4592	.9542	3.6	.01	96.0	20,100,277
PBS	4155	6187	13128	14049	.5040	2.1	.45	97.3	196,620,190
BMC	13737	58676	60291	30038	.5488	44.20	20.0	35.77	45,762,200

*The definitions of the variables are given in Appendix A of the thesis.

TABLE 4.2

MEAN SQUARE ERROR OF ESTIMATE IN PERCENTAGE CHANGES*

(1969.9 - 1973.2)

Budgetary Variables	$\bar{E}$	$\bar{A}$	S_E	S_A	r	M1	M2	M3	MSE
TBR	-.0035	.0348	.22	.29	.93	9.92	28.59	61.48	.01
CEE	2.75	1.939	4.85	3.79	.90	11.94	20.29	67.77	5.63
CEO	.0937	.1083	.53	.54	.92	.55	.52	98.03	.04
CEHS	-.006	-.0490	.43	.39	.43	1.55	.86	97.59	.20
CEHH	.168	.2913	1.39	1.37	.98	17.36	.58	82.06	.09
CET	.079	.086	.47	.46	.97	.41	.64	98.94	.01
KET	1.427	.7704	5.17	2.30	.85	3.52	68.18	29.29	12.26
LIA	21.89	3.363	90.55	10.48	.26	4.21	78.66	17.13	8152.08
SIFP	2.6	9.84	8.13	38.82	-.03	3.18	57.25	39.56	1644.60
SIFS	2.05	1.91	15.17	6.99	-.07	+.006	22.80	77.19	293.73
REDL + REDSIF	1.52	2.05	4.64	4.76	.90	6.12	0.33	93.55	4.58
PBS	-.2923	-.0869	.46	.82	.17	5.23	16.42	78.35	.81
BMC	-1.33	-.1643	4.28	1.02	-.003	6.58	51.01	42.40	20.76

*In the percentage changes case,

$$E = \frac{\text{Estimate (+) - Actual (t-1)}}{\text{Actual (t-1)}} \times 100$$

and

$$A = \frac{\text{Actual (t) - Actual (t-1)}}{\text{Actual (t-1)}} \times 100$$

Thus $\bar{E}$, $\bar{A}$, S_E, S_A are the mean and standard deviation of the estimated and actual percentage changes. Note that the two percentage changes are comparable for they are calculated on the same basis, (Actual (t-1)).

Current Expenditures:

While total current expenditures on goods and services (CET) are overestimated for the case of absolute value variables, M1 accounts for less than 1.0% of the mean square error of forecast. However, in the case of percentage change, total expenditures are underestimated, but again M1 accounts for less than 1.0% of the mean square error. Both the percentage change and the absolute value variables show that these errors are dominated by the M3 errors. Current expenditures on health services (CEHS) and hospital services (CEHH) and current expenditures on other goods and services (CEO) are underestimated but current expenditures on education (CEE) are overestimated. For all expenditures M3 is the largest component of the error. The fact that the errors are cancelled out in the aggregate, suggests that current expenditures should be disaggregated. However, even if the first component of the M.S.E. for current expenditures on hospital services (CEHH) is greater than the one for current expenditures on hospital services (CEHS), we decided to aggregate these two expenditures because they are made in the same "market". Henceforth (CEH) will be the sum of (CEHS) and (CEHH).

Capital Expenditures:

Both the level and the percentage change indicate that Capital Expenditures (KET) are overestimated; M1 explaining 3.52% of the error in percentage change and 10.8% of the error in level value. In percentage change M2 accounts for 67.0% of the error while it accounts for only 1.6% in the case of level value variables.

2 OF/DE 3

Loans and Advances:

Both the percentage change and the level value variables indicate an overestimation in Loans and Advances (LIA), M1 accounting for 47.0% in Table 4.2 and for less than 1.0% in Table 4.1. M2 accounts for 78.0% in the case of percentage change and for only 15.0% in the case of level value variables. However, M3 is equal to 84.0% in the former case and to 17.0% in the later case.

Special Investment Fund Transactions:

The purchases of SIF securities is systematically underestimated in both tables. The variance is also underestimated in both cases. The correlation coefficient is even negative in both tables. This indicates that the forecasting method employed leaves a great deal to be desired. The sale of SIF securities is underestimated in absolute value but overestimated in percentage change. However, even if these two variables seem to obey to different patterns we aggregate them in order to get a single excess demand variables as required by our theoretical framework. Henceforth (SIFX) will be the difference between (SIFP) and (SIFS).

Repayments of Loans and Advances and SIF Redemptions:

Repayments of Loans and Advances (REPL) and SIF redemptions or repayments (RESIF) exhibit a relatively low mean square error. This confirms the fact that these transactions are not a major source of error and that given the rates, repayments and redemptions, these flows should be as expected.

Provincial Borrowing:

Provincial Borrowing (PBS) in level value indicates an under-estimation of borrowing. The largest component of the mean square error is M3, indicating that the timing of borrowing is not as expected. Debt redemption transactions were not included for there was no error of forecast in this transaction.

Beginning-of-month cash:

The actual beginning-of-month cash is systematically greater than the planned one, with M1 accounting for 44.0% in absolute value and for 6.0% in the case of the percentage change variable. The variance of the estimated cash holdings is greater than the variance for actual beginning-of-month cash holding. Note that this figure has the largest proportion of error concentrated in M1 in the table, suggesting that at this level of analysis, it may well be serving as a buffer item in the adjustment process.

Conclusion

In this chapter we presented data relating to the micro-unit (the Alberta Treasury) that will be utilized in order to test our theoretical model. From the above analysis we can say that the Alberta Government has been historically a surplus unit and that the Treasury Department which looks after the cash management system is close enough to a microeconomic unit for our research. The uniqueness of our data set was explained and its shortcoming mentioned. In the last section we applied Theil's version of the mean square error of forecast to our data set. With this information on forecasting errors we can now attempt to utilize these data to test our theoretical model.

CHAPTER FIVE

REGRESSION ANALYSIS

Introduction

The primary objective of our econometric analysis is to test the theory outlined in chapter four and, we reiterate, not to explain as accurately as possible the cash flow of the Alberta Government which might well be better explained by utilizing a cash management approach. Our model contains two types of hypotheses. On the one hand, the model generates empirical implications to be tested assuming a given sequence of transactions. On the other hand, the sequence of transactions is itself open to empirical investigation and within limits we should investigate the appropriateness of our a priori sequencing. The theoretical framework underlying the first set of hypotheses was explained in the previous chapter and a set of ad-hoc guide-lines was developed to decide upon the sequence of transactions. Using these guide-lines the first section of this chapter generates the expected sequence. Section 5.2 outlines the nature of the equations and discusses the principles underlying their specification and their estimation. Section 5.3 presents the results of the econometric analysis. Each equation is discussed separately. Section 5.4 shows what these empirical results suggest as the sequence of transactions.

5.1 The Sequence of Transactions

In order to give a better understanding of our hypothesis concerning the sequence of transactions, we present a brief description of the transactions and their corresponding market. Basically, we can identify three major classes of markets:

1) The goods and services markets where total budgetary revenues, current expenditures on education, health and other goods and services are carried out.

2) The capital goods market where capital expenditures are made.

3) The private financial markets and the public financial institutions where loans and advances, sales and purchases of S.I.F. securities, debt operations and cash management operations are executed.

Total budgetary revenues are composed of three major sources: Revenues from taxation, revenues from the Federal Government and revenues from the sales of royalties to the private resource exploiting sector. Revenues from taxation are not flexible at all for, when the budget speech is voted on, the tax rates are fixed. Hence, any difference between actual and estimated revenues must be due to errors in forecasting the tax bases. Revenues from the Federal Government and from the sales of royalties are determined by factors outside of the umbrella of our analysis. Therefore, total budgetary revenues are assumed to be less flexible than any other transactions and should come first in the sequence of transactions.

Current expenditures on education and health are both concerned with human capital. These expenditures are sometimes in the form of transfers to the household sector in order to increase or permit an effective demand for the services and sometimes provided to increase the supply of the services. Human capital or health capital is a highly illiquid form of wealth and the markets for both education and health are poorly organized as compared to the financial or capital goods markets. From the government's point of view, when a given program is enacted, it is difficult to change these resulting non-wage expenditures. To do so would mean the implementation of a new program, which is usually done at the beginning of the fiscal year. On the other hand, the wage component of current expenditures is subject to the rules of exchange in the labour market in the public sector. We therefore assume that current expenditures are more flexible than total budgetary revenue but less than any other transactions.

Capital expenditures are mainly expenditures on non-residential construction. This fact permits us to consider capital expenditures as a more flexible transaction than current expenditures for it is possible to change the expenditures program during the year if the construction industry permits the change. Another reason for considering capital expenditures as following the current income account transaction in our sequence is the administrative tradition that part of capital expenditures should be financed out of the current account surplus and the other part out of the non-budgetary surplus and borrowing.[1] Therefore it will be assumed that capital expenditures

---

[1]See A.W. Johnson and J.M. Andrews, Provincial and Municipal Governments and the Capital Market, working paper #4. The Royal Commission on Banking and Finance, Ottawa, 1962.

are adjusted after all current account transactions.

Provincial financial markets and the public financial institutions have been the object of many studies.[1] In general, it is concluded that the provincial bond market, the money market and the provincial and federal financial institutions represent a well-organized financial system. There is a presumption, however, that the money market and the secondary bond market form a better market than the primary bond market. Our concern is the ordering of the following transactions: a) Borrowing, b) Loans and advances, c) S.I.F. securities transactions, d) Cash operations. Cash transactions are, by nearly any standard, the most flexible since they are under the direct control of the Treasury Department and entail relatively small transaction costs. Similarly, S.I.F. transactions are highly flexible since they are conducted on a well-organized market, the secondary financial market, and they are not normally subject to legislation. Changes in S.I.F. transactions are assumed to be adjusted before cash operations but after all other transactions.

Loans and advances transactions are loans and advances to municipalities, regional school boards and public enterprises. The relationships between the treasury and these institutions are frequent and well-organized. Loans and advances do not involve large transaction

[1] A good description of the functioning of the provincial capital market is to be found in: A.W. Johnson and J.M. Andrews, Provincial and Municipal Governments and the Capital Markets, Working Paper #4, R.C.B.F. 1962, Ottawa, E.P. Neufeld, The Financial System of Canada, It's Growth and Development, Macmillan of Canada, Toronto 1972, Bank of Canada, "The Financing of Provincial and Municipal Governments and Their Enterprises", Bank of Canada Review, Oct. 1972, pp. 3-22.

costs and they can be adjusted in timing quite easily if the financial managers of the provincial treasury and the financial managers of the receiving institutions agree on the adjustment. Contrary to the lending operations, borrowing transactions on the long-term bond market imply transactions costs and negotiations between an investment dealer and the debt manager.[1]

In the money market where the Treasury Bill auctions are carried out, it is less expensive to conduct debt management operations but it still represents a less flexible transaction than the loans and advances.

In brief we assume that the lending operations of the provincial government are more flexible than the borrowing ones, so that borrowing comes before lending in the sequence of adjustment.

Thus the sequence of adjustment in the order given by our admittedly ad-hoc procedure yield, beginning with the least flexible: Total Budgetary Revenue, Current Expenditures on Education, Current Expenditures on Other Goods and Services, Current Expenditures on Health, Capital Expenditures, Borrowing, Loans and Advances, S.I.F. transactions and Cash Operations. This is one of the possible sequences of adjustment and it is part of our research to find the existing sequence of adjustment.

In order to explain how we shall subject our theory to empirical verification we conclude this section with a description of our research strategy. Simply stated, the strategy is to use single-

---

[1] See Johnson and Andrew, <u>op. cit</u>.

equation-estimation techniques to obtain an estimated equation for each endogenous transaction, retaining in the equaeion only the variables which are statistically significant. In the light of these results, alternative sequences of adjustment can be tested in order to build a complete recursive model that will be used to conduct some simulation experiments. The estimation of single equations is the object of the present chapter. The presentation and analysis of the recursive model is the subject of chapter six. Chapter seven provides the results of simulation experiments.

5.2 Specification of the Form of the Equation and the Estimation Methods

In selecting the estimation method we wish to ensure that the residuals have constant variance and are free of serial correlation. With the dependent variable being the difference between the actual and the estimated transaction, it is reasonable to assume that there will be no serial correlation. In any case, the Durbin-Watson test will permit us to identify the eventual presence of autocorrelation in most cases.[1] However, the possibility of heteroscedasticity requires us to make some specific assumptions about the structure of the realization process. The residual will in essence be the sum of the effect of unincluded variables due to the Taylor approximation

---

[1] As is well-known, the presence of lagged dependent variables suggest "that the Durbin-Watson statistic,..., is asymtotically biased toward the acceptance of the null hypothesis of independence or, equivalently that the power of this statistic is low in the presence of lagged values of the dependent variable", Henri Theil, Principles of Econometrics, John Wiley and Sons, Inc., 1971, p. 414.

and unincluded variables due to the fact that rationing is to be estimated by a constant term and a residual factor. One reasonable assumption is to say that the effect of excluded variables influencing the forecast but not the actual value of the dependent variable or vice versa is randomly distributed with constant variance so that we can apply ordinary least squares. Consequently ordinary least squares were applied to each equation.

An alternative to the above assumption is to say that the effect of excluded variables influencing the forecast but not the actual value (or vice versa) should be proportional to the size of the actual or the forecast. If so, then the resulting heteroscedasticity could be avoided and a more efficient estimated thereby obtained, if the residuals were deflated by say the average of the actual and the estimate values of the dependent variables. In other words, under this assumption we apply weighted least squares where the weight is the average of the forecast and the actual value. This average is a better deflator than either alone, in part because either the forecast or the actual could be zero while the other was positive and in part also because the actual and the forecast should enter the deflator with the same sign and the numerator with opposite sign. In other words, the deflation by the average of actual and forecast avoids the spurious correlation that would result if either one were used without the other.[1]

---

[1]The application of weighted least squares was suggested to me by reading: J. Helliwell and G. Glorieux, Realization of Aggregate and Sectoral Investment Forecast, Bank of Canada, June 1968, Ottawa, Mimeo.

However, the application of ordinary least squares and the application of weighted least squares represents not only two different econometric techniques but also two different hypotheses. One needs to discriminate between these two. In order to discriminate between the two models we use the test suggested by S.M. Goldfeld and R.E. Quandt.[1] The exact nature of this test is described in section B of the appendix to this chapter.

Consequently we apply ordinary least squares to each equation and then test for the presence of heteroscedasticity. If heteroscedasticity cannot be rejected, weighted least squares are used.

However, the use of ordinary least squares or weighted least squares requires that there are no zero observations in the dependent variable over the sample. This is not the case for one dependent variable, namely borrowing. As should be expected, provincial governments do not borrow at each month but rather they borrow infrequently in large amounts in order to minimize the transaction costs involved in the borrowing process. Therefore our data on borrowing presents a case of what we refer to as a "limited dependent variable" in the sense that the variable $(\bar{\chi}-\chi^{n})$ for borrowing has a zero value for 30 observations and a non-zero value for 12 observations. What is to be explained is why $(\bar{\chi}-\chi^{n})$ is zero for some observations and if it is not zero, why it takes on its particular value. The problems associated with the case of limited dependent variables are well-known

---

[1] S.M. Goldfeld and R.E. Quandt, "Some Tests for Homoscedasticity," Journal of the American Statistical Association, 60, pp. 540, 1965.

in the econometric lieterature.[1] The simplest approach is to use the dependent variable as the regressand in a conventional regression, recording zero for the period where the observation is zero. But since there will be many zero observations the linear regression model will be often empirically inappropriate.[2] There are at least two solutions to this problem: The twin linear probability function and Tobin's Maximum Likelihood estimate.[3] In the twin linear probability approach, the classical assumption of homoscedasticity is untenable as proved by Golberger.[4] A better method of estimation is the one suggested by J. Tobin.[5]

Indeed an alternative one-step procedure is the extension of the probit analysis, developed by Tobin. The basic principle underlying the Tobit model is the threshold principle of econometric behaviour, which can be expressed in the following way. "Let X and Y be two real variables and let ΔX and ΔY denote changes in the value of X and Y respectively. We then can say that X is e-threshold-sensistive to ΔY if and only if for $/\Delta Y/ \geq e$, X is functionally related to ΔY; and for $/\Delta Y/ < e$, ΔX and ΔY are independent. A change in the value of Y will,

---

[1] A. Golberger, Econometric Theory, John Wiley and Sons, Inc., New York, 1964, pp. 248-255.

[2] A. Golberger, ibid., pp. 251-252.

[3] A third one is to be found in M.G. Dagenais, "A Threshold Regression Model, Econometrica, Vol. 36, No. 2, April 1969,

[4] A. Golberger, ibid., p. 149.

[5] J. Tobin, "Estimation of Relationship for Limited Dependant Variables", Econometrica, 1958, pp. 24-36.

in other words, affect X only if the change is sufficiently large, i.e., only if it exceeds some positive threshold level."[1]

The econometric implication of this principle consists in assuming that the behaviour of the dependent variable is determined by

$$y_t = \begin{cases} 0 & \text{if } I_t < I_t^* \\ I_t - I_t^* & \text{if } I_t \geq I_t^* \end{cases}$$

where $I_t = X_t' B$

where X_t is a vector of independent variables and

B is a vector of regression coefficients

I_t^* is a disturbance term assumed to be normally distributed with zero mean and a constant variance σ^2.

The fact that y depends on I_t and I_t^* implies that I_t and the probabilities of y_t are function of the B's and σ. In Section A of the appendix to this chapter, we explain in greater detail the Tobin methods. We show how the maximum likelihood estimation method is used to estimate the B's and σ. While the appendix is based on the original Tobin paper, it also provides the missing steps in the derivation of certain results used in our econometric work. Specifically the expected value of y_t given I_t is derived. For a complete discussion of the method we refer the reader to the appendix.

As noted in chapter four, our data set does not provide all the information needed on exogenous variables like prices, interest rates

---

[1] N. C. Devletoglou, "Thresholds and Transaction Costs", Quarterly Journal of Economics, Vol. 85, No. I, Feb. 1971, p. 164.

and repayment or redemption rates. For this reason, the estimated equation will not take into account the possibility of bias in the forecast that this might generate nor does it take account for the effect of unpredicted seasonal patterns. With an ideal set of data any bias in the forecast of exogenous variables or any unpredicted seasonal pattern will reflect itself in the difference between the actual and estimated exogenous variable. However, in our case, we will use ad hoc methods to cope with these problems. To these methods we now turn.

As suggested by Theil[1] and as used by Helliwell and Glorieux[2] and as well by R. Agarwala, T. Burns and M. Duffy,[3] it is very likely that some transactions will be systematically overestimated while others will be underestimated in certain periods. If there is an overestimation ($X^n_{t,i} > \bar{X}_{t,i}$) or an underestimation ($X^n_{t,i} < \bar{X}_{t,i}$) in any period, then the estimated equation will not take into account this overestimation. In order to solve this problem, the following variable is included in the equation

$$(X^n - \bar{X}^n)$$

where $$\bar{X}^n = \hat{b}_0 + \hat{b}_1 (T)$$

where T is a trend term. In other words, $\bar{X}^n$ represents the "normal"

[1]H. Theil, Economic Forecast and Policy, 2nd ed., 1965, chap. 5.

[2]J. Helliwell and G. Glorieux, "Realization of aggregate and sectoral investment forecasts", June 1968, Bank of Canada, Ottawa, Mimeo.

[3]R. Agarwala, T. Burns, M. Duffy, "Forecasting Gross Private Fixed Investment Using Intentions Survey Data", The Manchester School, 1969, pp. 279-293.

forecast and $X^n - \bar{X}^n$ is the residual of the estimated normal forecast. Obviously the assumption that the normal forecast can be estimated by a TREND, is restrictive. The ideal situation would be to regress planned transactions on anticipated exogenous variables and to use the residual in the equation. However, this procedure is obviously impossible for it is precisely because we lack data that we are using this variable. The variable $(X^n - \bar{X}^n)$ being the residual of an equation estimated by least squares, it has a zero mean and it will not change the equation at the mean value.

In our model, planned and actual transactions are not seasonally adjusted and the difference $(\bar{X}_{t,i} - X^n_{t,i})$ will not be affected by seasonal factors only if both $\bar{X}_{t,i}$ and $X^n_{t,i}$ have the same seasonal patterns or if the included exogenous variables explain the difference in seasonality. But the seasonal pattern of the included exogenous variables cannot be expected to correct all the seasonality. Therefore dummy variables are used to take account of the seasonal factors not explained. The procedure used consists in using 11 monthly seasonals in the equation and to retain only the significant ones.

In summary, each equation is estimated by ordinary least squares including the variable $(X^n - \bar{X}^n)$ and seasonal factors and a test for the presence of heteroscedasticity is performed. If heteroscedasticity cannot be rejected, the equation is estimated by weighted least squares. In the next section, the empirical results of our research are presented.

5.3 Empirical Results

In this section, the estimated equation for the endogenous transactions will be presented. The transactions are:

1) Total Budgetary Revenue
2) Current Expenditures on Education
3) Current Expenditures on Other Goods and Services
4) Current Expenditures on Health
5) Capital Expenditures
6) Provincial Borrowing
7) Loans and Advances
8) Net Purchases of S.I.F. Securities
9) Cash Operations

Before we present the empirical results it is useful to give our notation.

5.3.1 Notation

The following symbols are used in the presentation of our results:

R^2 is the multiple correlation coefficient

$\bar{R}^2$ is the coefficient of determination

S.E.E. is the standard error of estimate in thousand of dollars

D.W. is the Durbin-Watson statistic

n is the number of observations

F is the F statistic

m is the number of variables on the right-hand side of the equation

G.Q. is the Goldfeld and Quand E statistic as described in the Appendix

k is the number of excluded observation in the test for heteroscedasticity

D.F. is the degree of freedom for the G.Q. statistic.

5.3.2 Estimated Equations

Let us present the obtained estimated equations.

a) Total Budgetary Revenue

The difference between the actual and the forecast Budgetary Revenue is assumed to be explained by the errors of forecast only, for it is assumed to be the first in the sequence of adjustment. Therefore Total Budgetary Revenue was not estimated since the errors depend only on exogenous factors. Thus, for the purpose of the model, Total Budgetary Revenue is assumed to be exogenous.

b) Current Expenditures on Education[1]

The difference between actual and estimated Current Expenditures on Education was found to be independent of all other transactions. The best equation obtained tends to show that CEED can be considered as autoregressive over the sample. This equation is:

OLSQ

(Oct. 69 - Feb. 73)

$$[CEED] = -2240.793 + 0.37150688\,[CEEDL]$$
$$(-1.734) \qquad (2.538)$$

R^2	= .377	D.W.	= 1.81
$\bar{R}^2$	= .142	F	= 6.446
S.E.E.	= 7348	G.Q.	= .71
n	= 41	k	= 3
m	= 2	D.F.	= 17

[1]The definition of variables is given in Appendix A of the thesis.

CEED is therefore explained by its lagged value and a constant term. This strange result can be explained in the following way. The mean square error of forecast for CEED, as shown in chapter four is the largest error of all current expenditures. This is due to the systematic overestimation for the period April 1971 to February 1972. Over that period, actual expenditures amounted to $225,849 while the estimate was $369,393. For some reason an intended program was cancelled during this year.

Due to this poor result, CEED will be assumed to be exogenous for simulation purposes.

c) Current Expenditures on Other Goods and Services

The results show that these expenditures serve as a buffer in the adjustment process in the sense that for each dollar not realized in CEED, CEOD will change by 50 cents. That is, if the actual current expenditures on education are lower than estimated, then actual expenditures on other goods and services will be greater than forecasted, indicating a strong spillover effect where the cash effect and the substitution effect are greater than any possible complement effect. CEOD also reacts to the beginning-of-month cash in a positive manner indicating that for each dollar not realized in cash, CEOD will be changed by 6 cents. The presence of a strongly significant negative constant term combined with the presence of a systematic bias as shown by the coefficient on RCEOE and the effect of seasonality, indicated that we cannot reject the presence of rationing in this transaction.

Finally, note that the G.Q. statistic indicates that the hypothesis of heteroscedasticity can be rejected and therefore only the least squares estimate is presented:

OLSQ

(Sept. 69 - Feb. 73)

$$[CEOD] = \underset{(-4.3537)}{-\ 6993.3647} \underset{(-4.060)}{-\ 0.50966} [CEED] + \underset{(2.954)}{0.06247} [BMCD]$$

$$+ \underset{(3.179)}{12534.325} [MAR] + \underset{(2.195)}{8454.789} [MAY]$$

$$+ \underset{(3.183)}{13246.1930} [JUNE] + \underset{(2.293)}{8670.0087} [JULY]$$

$$+ \underset{(2.372)}{8890.08715} [AUG] - \underset{(-3.77)}{0.35218} [RCEOE]$$

R^2	= .820	D.W.	= 1.781
$\bar{R}^2$	= .672	F	= 8.46
S.E.E.	= 675	G.Q.	= 2.44
n	= 42	k	= 1
m	= 9	D.F.	= 11

d) <u>Current Expenditures on Health</u>

Note that "on July 1, 1969, the Alberta Health Plan was terminated and the Alberta Health Care Insurance Plan commenced operations. During its early stages and having regard to the Federal Government regarding participation in the national medicare scheme, the New Plan was oriented chiefly towards medical coverage. With the experience gained and following a thorough study, the Minister of Health will introduce a New Plan."[1]

[1] Budget Speech of the Hon. A.D. Slborc, Province of Alberta, 1970, p. 8.

This institutional fact has two implications for our empirical results:

1) It is expected that the constant term can be positive due to the fact that the demand for health services under the new program forces the government to make a larger expenditure than it originally intended to. In terms of our economic model this would be a case of positive rationing.

2) As time passes, information about the demand for health can be obtained and a better forecast can be made. So that we expect a negative trend in the difference between actual expenditures and estimates.

In fact our results do show that the first implication cannot be rejected: the constant term is indeed positive. Secondly, the introduction of a trend variable does indicate that a certain learning process is present. Our results also show that [CEHD] responds to two stock variables: the beginning of the month stock of debt [BMDD] and the stock of loans and advances [BMSLD]. A greater than expected stock of debt implies an increase in [CEHD]. A greater than expected stock of loans and advances means a lower than expected level of expenditures. The fact that [CEHD] responds negatively to [BMSLD] indicates that loans and advances are substitutes for [CEHD]: this is not surprising for a large part of loans and advances are given to health institutions. Finally note that a dollar not realized in [CEOD] implies a negative change in the [CEHD], again suggesting a spillover effect.

OLSQ

(Nov. 69 - Feb. 73)

$$[CEHD] = 7412.17732 - .08636967\,[CEOD]$$
$$(5.2435) \qquad (-1.406)$$

$$+ .02903430\,[BMDD] - .129585\,[BMSLD]$$
$$(1.346) \qquad (1.3866)$$

$$+ 2672.1124\,[NOV] - 285.707507\,[TREND]$$
$$(1.492) \qquad (-4.3077)$$

R^2	= .849	D.W.	= 1.4293
$\bar{R}^2$	= .721	F	= 7.227
S.E.E.	= 3331.75	G.Q.	= 2.62
n	= 41	k	= 2
m	= 6	P.F.	= 14

e) Capital Expenditures

As expected, capital expenditures are functions of lagged capital expenditures in the last two periods indicating a stock adjustment pattern in the capital expenditures. Current and lagged revenues affect capital expenditures positively meaning that for one dollar less in current and lagged revenue, capital expenditures will be cut down by 12 and 14 cents respectively.

The significant negative constant term in the equation means that we cannot reject the hypothesis of rationing in this transaction. Finally, heretoscedasticity does hot occur in this case. The least squares estimate is:

OLSQ

(Nov. 69 - Feb. 73)

$$[KETD] = -\,3088.3088579 - .12264546\,[TBRD]$$
$$\qquad (-3.30) \qquad\qquad (1.56)$$

$$-\,.14229206\,[TBRDL] - .44912494\,[KETDL]$$
$$\qquad (1.87) \qquad\qquad (-2.996)$$

$$+\,.28517469\,[KETDLL]$$
$$\qquad (1.909)$$

R^2	= .713	D.W.	= 2.08
$\bar{R}^2$	= .508	F	= 9.046
S.E.E.	= 4087.94	G.Q.	= .76
n	= 40	k	= 1
m	= 5	D.F.	= 14

f) Borrowing

As we noted in the previous section, provincial borrowing presents a case of limited dependent variables and was estimated by TOBIT analysis, i.e., by a maximum likelihood estimation technique. As explained in section A of the appendix of the present chapter, the obtained equation is an estimation of the standardized index. The obtained equation for the standardized index is:

$$\frac{I}{\sigma} = 1.57968 - .00002199\,[BMCD] - .0002685\,[BMSLD]$$
$$\qquad (-2.98) \qquad (-3.04) \qquad\qquad (-3.4)$$

and $$\frac{1}{\sigma} = .0000475$$

The equation of the index is:

$$I = 33244.649 - 5.6158\,[BMSLD] - .4465549\,[BMCD]$$

For sufficient large value of the explanatory variables, then, as shown in the appendix to this chapter, I is the dependent variable [PBSD]. Therefore, provincial borrowing depends on two stock variables: the beginning of month cash and the beginning of month stock of loans and advances. If the [BMCD] is greater than expected, then the amount borrowed is less than the planned amount. If the beginning of month stock of loans and advances is greater than planned, then the amount borrowed is less than the planned amount. As we will see in the next equation, the flow of loans and advances depends on [PBSD] in the sense that if borrowing is greater than expeeted, then loans and advances will be greater than expected, so that the beginning of the month stock of loans and advances in the next period is greater than expected which implies a smaller amount to be borrowed. It is a cumulative stock-flow adjustment mechanism.

The presence of a significant constant term indicates that the hypothesis of rationing cannot be rejected. As explained in section A of the appendix, it is possible to estimate the mean probability that [PBSD] would be non-zero for the non-zero observations and the mean probability that [PBSD] would be non-zero for the zero observations. These mean probabilities are respectively .465 and .094, suggesting that the Tobit model discriminates pretty well between non-borrowing and borrowing observations. The results are compared favourably with those obtained in other studies.[1]

---

[1]See M. Dagenais "Application of a Threshold Regression Model to Household Purchase of Automobiles", Cahier no 7304, Département des Sciences Economiques, Université de Montréal, 1973, and the literature quoted in this paper.

g) Loans and Advances

Loans and Advances were found to be explained by the non-realization of beginning of month cash, by a constant term and by [RLIAE] which measures the effect of systematic bias. Indeed our results confirmed our hypothesis that borrowing transactions influence the lending transactions on a monthly basis.

For each dollar not realized in [PBSD], [LIAD] is changed by 5 cents while for each dollar non-realized in [BMCD], [LIAD] is changed by 1 cent. The presence of a negative constant term indicates that over the sample, the government was not able to lend as much as it wanted to. Note that the G.Q. statistic indicates that the hypothesis of heteroscedasticity cannot be rejected. Therefore both ordinary least squares and weighted least squares estimates are presented. Finally, the fact that borrowing transactions influence lending operations tend to confirm the hypothesis advanced by Neufeld that provincial government play a role as financial intermediaries.[1]

The obtained equations are:

OLSQ

(Sept. 69 - Feb. 73)

$$[LIAD] = -\underset{(-2.28)}{949.74281} + \underset{(2.424)}{.05575}\,[PBSD] + \underset{(2.517)}{.01558}\,[BMCD] - \underset{(-2.728)}{.68133}\,[RLIAE]$$

---

[1] E. Neufeld, The Financial System of Canada, It's Growth and Development, Macmillan, 1972.

$R^2 = .595$ D.W. = 2.105
$\bar{R}^2 = .355$ F = 6.96
S.E.E. = 1789.64 G.Q. = 8.397
n = 42 k = 1
m = 4 F.F. = 16

WLSQ

(Sept. 69 - Feb. 73)

$$[LIAD] = -\ 822.249 + .05568\ [PBSD]$$
$$(-2.011) \quad (2.417)$$
$$+\ .01346\ [BMCD] \quad .67375\ [RLIAE]$$
$$(2.028) \quad (-2.69)$$

$R^2 = .567$ D.W. = 2.151
$\bar{R}^2 = .321$ F = 5.999

h) Special Investment Fund Excess Demand

As noted in chapter three, the excess demand for financial securities is expected to be influenced by exogenous financial factors and other transactions. In fact [SIFXD] was found to be affected by the beginning of month stock of financial assets so that if the stock is greater than expected, the excess demand for financial assets will be lower than expected. Also if the interest rate on 3 to 5 years Canadian Bonds is greater than expected, the excess demand will be lower than expected. When the rate of interest is greater than expected, expectations are such that in the near future it will decrease so that the actual demand is revised downward. Similarly when the exchange rate between the U.S. and the Canadian dollar is greater than expected, the excess demand for financial asset is lower than expected. That is when the price of the U.S. dollar in Canadian money is greater than expected, [SIFXD] is revised downward. This can be seen as the effect of a change in the price of U.S. securities on [SIFXD] or as the effect of a change in the exchange rate on financial manager's expectations about Canadian interest rate. Finally, there is a need to include dummy variables in order to take into account the following unanticipated events:

1) The move from a fixed to a floating exchange rate on May 31 of 1970. A dummy which takes a value of 1 in June and July 1970 is included, DUM1.

2) The change in the U.S. commercial and financial policy introduced by President Nixon in late August 1971 is expected to influence [SIFXD]. Hence DUM2 takes a value of 1 in September 1971 and zero in all other periods.

3) The effect of the Federal election in October 1973 on the financial market. DUM3 which takes value of 1 in November 1972 and zero in all other periods is included. The estimated equation is:

OLSQ

(Nov. 69 - Feb. 73)

$$[SIFXD] = -.06599113\,[BMSIFD] + 480.08040027\,[FEXRD]$$
$$(-2.008) \qquad (3.719)$$

$$-\,1374.50686210\,[1R3A5D] + 7506.1222\,[DUM1]$$
$$(-3.43) \qquad (5.1379)$$

$$+\,6947.2975\,[DUM2] - 15631.8359\,[DUM3]$$
$$(3.432) \qquad (-7.71)$$

R^2	= .877	D.W.	= 2.56
$\bar{R}^2$	= .77	F	= 23.384
S.E.E.	= 1980.87	G.Q.	= .01
n	= 41	k	= 3
m	=	D.F.	= 13

i) Cash Operations

If the Cash Operations are defined as the difference between the actual change in cash and the estimated change in cash, then given that all transactions are recorded on a cash basis, it is identically true that the actual-estimated change in cash is equal to the sum of all other transactions expressed in difference.

Thus from the accounting framework the end of the month cash [EMCD] can be expressed as:

[EMCD] = [BMCD] + [TBRD] - [CEED] - [CEOD] - [CEHD] - [KETD]
+ [PBSD] - [LIAD] - [SIFXD] + [REDSIFD] + [REDLD]
- [REDDD]

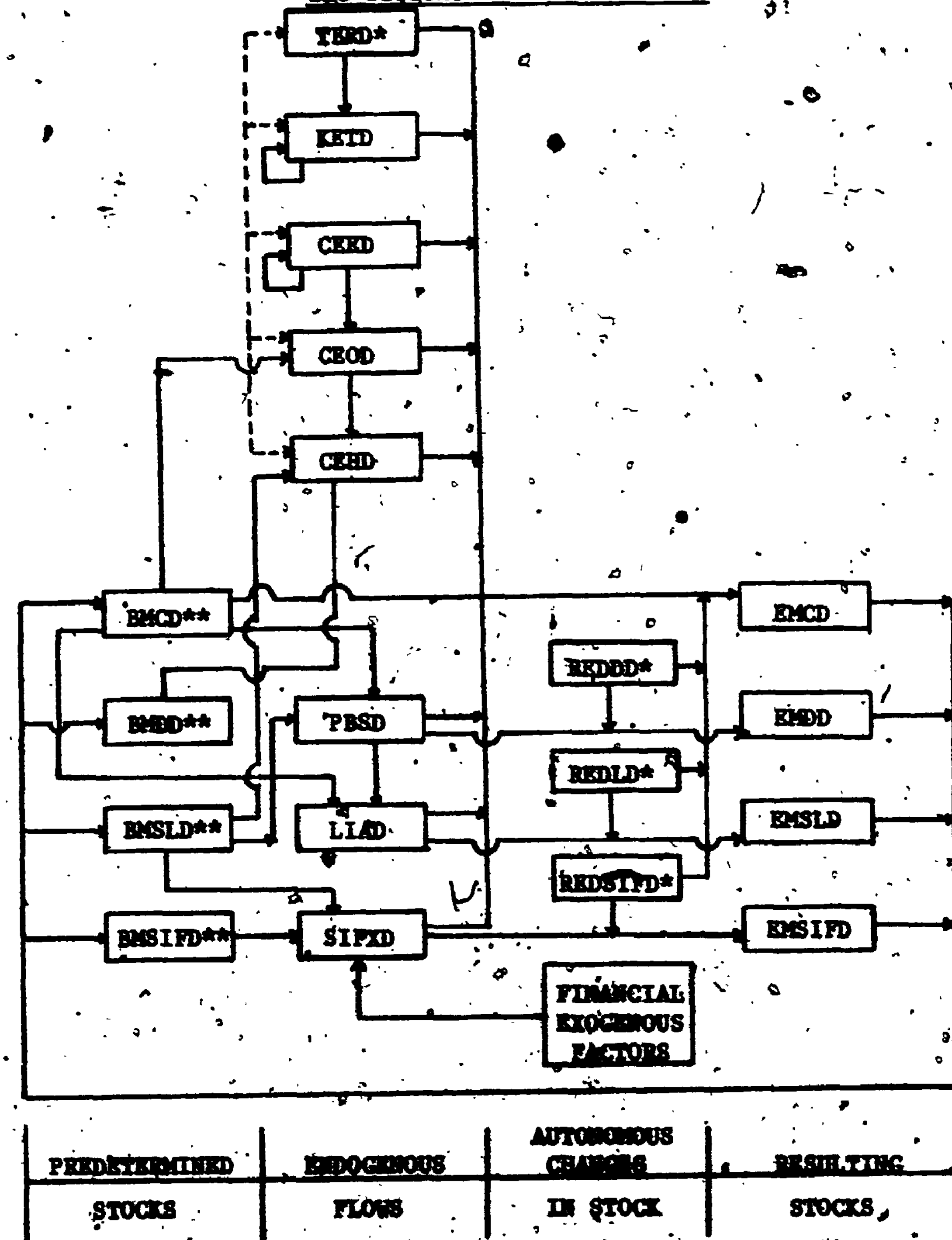
Hence, cash operations are obtained by an identity indicating that ceteris paribus a change in any other transaction will affect the end of month cash only.

5.4 The Model

The result of this estimation is a system of eight equations forming a recursive model of a sequence of the adjustment of stock and flow transactions. Chart V-1 indicates the major relationships. At the beginning of each month, the stocks are predetermined. During the month the endogenous flows transactions are carried out and the exogenous changes in stocks occur. At the end of the month the resulting stocks are obtained and they become the beginning of month stocks in the next period.

Chart V-1

The Sequence of Transactions[1]



*Exogenous Variables
**Predetermined Variables
Others: Endogenous Variables

[1]The definition of the variables is given in Appendix A.

The major stock-flow relationships are:

1) The beginning-of-month cash [BMCD] affects current expenditures on other goods and services [CEOD], provincial borrowing [PBSD], loans and advances [LIAD] and the end-of-month cash [EMCD].

2) The beginning-of-month stock of loans and advances [BMSLD] influences current expenditures on health services [CEHD], provincial borrowing [PBSD], and the end-of-month stock of loans and advances.

3) The beginning-of-month stock of financial assets determined the excess demand for financial assets and the end-of-month stock.

The inter-flow relationships are the following:

1) Current expenditures on education influence current expenditures on other goods and services which in turn affects current expenditures on health.

2) Total budgetary revenue affects capital expenditures.

3) Provincial borrowing influences loans and advances.

Conclusion

In this chapter, the empirical results for each equation were presented after a discussion of the econometric theory underlying the estimation. In each equation, we included only the significant variables. In fact, the model that we just presented fulfills two objectives: It provides a preliminary test of the theory outlined in chapter three and gives some empirical insights on the sequence of adjustments by presenting the significant stock-flow relationships and the interflows relations.

However, in order to test the theory and to carry out simulations experiments we need a <u>complete recursive model</u>. The sequence of adjustment described in Chart V-1 is not completely recursive and there are many recursive models that can be obtained from this if we include the non-significant variables in the sequence. One of these recursive models is the sequence suggested in section 5.1 of this chapter. Another is obtained by including capital expenditures before all the current expenditures, and then keep the same sequence for the other transactions. One objective of the next chapter will be to present the result of the tests for alternative sequences. Given the obtained sequence, we will then study the extent to which our theory has been tested by considering each of the nine empirical hypotheses in each equation. They will be done in the next chapter. Chapter seven will present the results of the simulation in order to shed some light on the cash flow of Alberta's Treasury.

APPENDIX TO CHAPTER FIVE

The present appendix aims to describe two of the econometric techniques used in the regression analysis. In Section A, we will present Tobin's Maximum Likelihood Method and in Section B, the Goldfeld and Quandt's test for homoscedasticity.

A) Tobin's Maximum Likelihood: Tobit Model[1]

Suppose that Y is a limited dependent variable, with a lower limit at zero (0). Let I_t be an index which is a linear combination of the independent variables $(X_1\ X_2 \ldots X_n)$. At any period t, the relationship is assumed to be

$$I_t = X_t'B \tag{1}$$

where I_t is a scalor,

X_t is a vector of independent variables in period t of dimension nX1

B is a nX1 vector of regression coefficients

Let I_t^* play the role of a disturbance term. It may be interpreted as critical values of the index in the sense that the behaviour of the dependent variable is determined by

$$y_t = \begin{cases} 0 & \text{if} \quad I_t < I_t^* \\ I_t - I_t^* & \text{if} \quad I_t \geq I_t^* \end{cases} \tag{2}$$

[1] This appendix relies on Golberger's presentation of the Tobit Model in: Econometric Theory, John Wiley and Sons Inc., New York, 1954, pp. 253-255 and Tobin's original paper "Estimation of Relationship for limited Dependant Variables", Econometrica, 1958, pp. 24-36.

We assume that I_t^* is normally distributed according to $N(0,\sigma^2)$. Each y_t is thus a function of the $X_t's$ (via I_t) and of I_t^*. From equations (1) and (2), the interpretation of I_t^* is clear. It means that given the explained behaviour, I_t, there will be a non-zero value for the dependent variable if and only if this explained behaviour results in an index which is not smaller than some critical value of the index. If the estimated index is smaller than this critical value, y_t and X_t will not be linearly related and y_t will be zero. In that sense, y_t is I_t^* - threshold - sensitive to the $X_t's$.

The following notation will be used:

If z is a random variable which is said to be normally distributed, then its density function is:

$$f(z) = \frac{1}{\sqrt{2\pi\sigma^2}} \cdot e^{-\frac{(z-\mu)^2}{2\sigma^2}}$$

where e is the base of the natural logarithms and μ and σ^2 are parameters.

If z is distributed N(0,1), we say that z has a standard normal distribution and its density function is:

$$f(z) = (2\pi)^{-\frac{1}{2}} e^{-\frac{1}{2} z^2}$$

The cumulative normal distribution obtained by integrating the density distribution is

$$F(z) = (2\pi\sigma^2)^{-\frac{1}{2}} \int^{z} e^{-(2\sigma^2)^{-1} (x-\mu)^2} dx$$

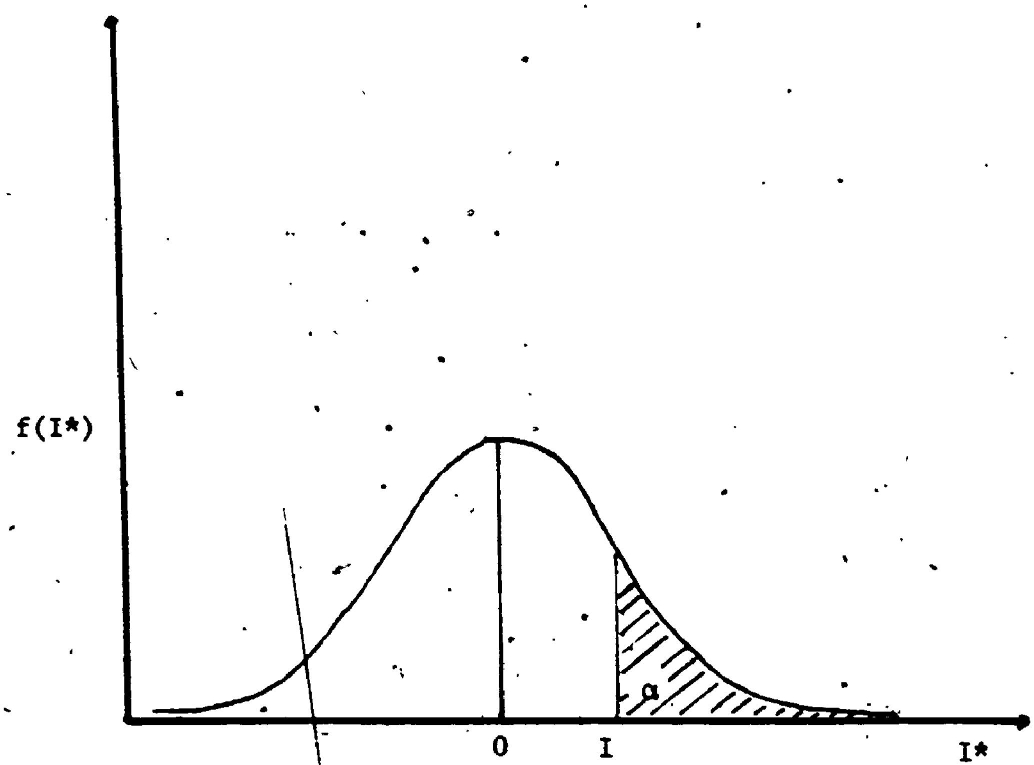


Figure 5.1 The Probability Density Function of I*

if z is distributed N(0,1), then

$$F(z) = (2\pi)^{-\frac{1}{2}} \int^{z} e^{-\frac{1}{2}x^2} dx$$

We wish to derive the distribution of Y given the distribution of I_t^*. Let us note that:

$$\text{Prob}\ \{y = 0|I\} = \text{Prob}\ \{I^* > I|I\} \tag{3}$$

The first result is obtained from equation (2) and can be interpreted graphically as in figure 5.1, that is:

$$\text{Prob}\ \{I^* > I|I\} = \alpha = 1 - F(I) \tag{4}$$

I^* being a $N(0,\sigma^2)$ we can standardize it to get:

$$\text{Prob}\ \{y = 0|I\} = 1 - F\frac{I}{\sigma} \tag{5}$$

Similarly,

$$\text{Prob}\ \{y > y^* \geq 0|I\} = \text{Prob}\ \{I^* < I - y^*|I\} \tag{6}$$

Graphically, this can be expressed as in figure 5.2, that is:

$$\text{Prob}\ \{I^* < I - y^*\ I\} = \gamma = F\{I-y^*\} \tag{7}$$

If we standardize I^* we get:

$$\text{Prob}\ \{y > y^* \geq 0|I\} = F\left(\frac{I - y^*}{\sigma}\right) \tag{8}$$

Thus I and the probabilities are functions of the B's. This suggests maximum likelihood estimation of the B's and of σ. Without loss of generality, suppose the sample to be ordered so that the first S observations have y = 0 and the remaining T-S have y > 0. Then the

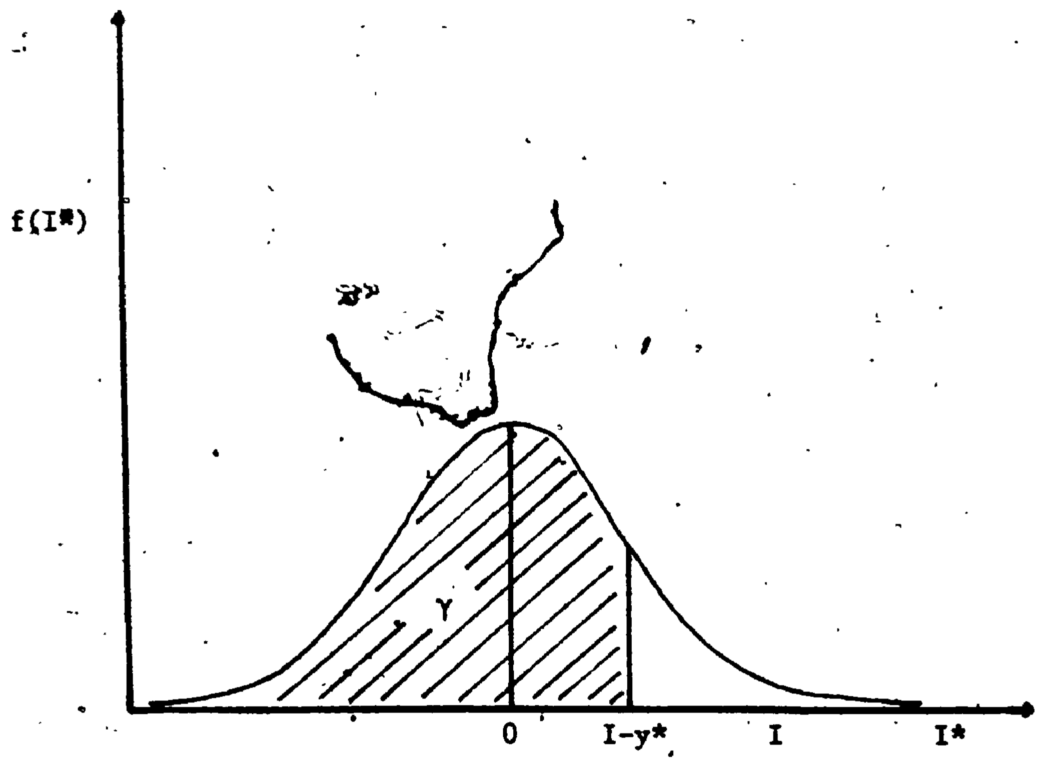


Figure 5.2 The Probability Density Function of I*

likelihood of the sample is:

$$L = \left[1 - \left(F \frac{I_1}{\sigma}\right)\right] \cdots\cdots \left[1 - \left(F \frac{I_S}{\sigma}\right)\right]$$

$$X \frac{1}{\sigma} f \left(\frac{I_{S+1} - y_{S+1}}{\sigma}\right) \cdots\cdots \frac{1}{\sigma} f \left(\frac{I_T - y_T}{\sigma}\right) \qquad (9)$$

where f(z) = value of the standard normal density function at z.

The logarithmic likelihood is

$$L = \sum_{t=1}^{S} \log \left[1 - \left(F \frac{I_t}{\sigma}\right)\right] - (T-S) \log \sigma$$

$$+ \sum_{t=S+1}^{T} \log f\left(\frac{I_t - y_t}{\sigma}\right) \qquad (10)$$

in which each term is a function of the B's and σ

$$F\left(\frac{I_t}{\sigma}\right) = (2\pi)^{-\frac{1}{2}} \int_{-\infty}^{X_t' B/\sigma} e^{-\frac{x^2}{2}} dx \qquad (11)$$

$$f\left(\frac{I_t - y_t}{\sigma}\right) = (2\pi)^{-\frac{1}{2}} e^{-\frac{1}{2}\left[\frac{X_t' B - y_t}{\sigma}\right]^2} \qquad (12)$$

Setting the derivatives of (10) with respect to B's and σ to zero gives the normal equations determining the maximum likelihood estimators, the $\hat{B}$'s and the $\hat{\sigma}$[1].

Methods for solving the nonlinear normal equations may be found in Tobin's paper. It is sufficient to say here that we use a version of the computer program used by Tobin[2] and this program generates

---

[1] A. Golberger, ibid., p. 254.

[2] The original program was given to us by Professor M. Dagenais of the Université de Montréal.

the $\hat{B}$'s and $\hat{\sigma}$ and their respective standard errors. The standard errors are obtained by using the obtained regression coefficients to evaluate the matrix of the second derivative at the point of maximum likelihood: "the negative inverse of that matrix gives large sample estimates of the variances and covariances of the estimates around the corresponding population parameters."[1] Given the variances of the estimated coefficients, it is possible to construct the usual test on these coefficients.

From our preceding discussion, it should be clear that the estimated equation gives the value of the estimated index $\hat{I}_t$ which is used to determine the conditional expectation of $\hat{y}_t$ given $\hat{I}_t$. Indeed, the expected value of y_t given I_t is:

$$E(y_t|I_t = 0.Pr(y=0) + \int_0^{\infty} yf\left(\frac{I-y}{\sigma}\right)dy \qquad (13)$$

Let $r = \left(\frac{I-y}{\sigma}\right)$ or $y = I-\sigma r$

and $dr = -\frac{1}{\sigma}dy$ or $dy = -\sigma dr$

if y varies between 0 and ∞, then r varies between I/σ and $-\infty$ for when $y = 0$, $r = \frac{I}{\sigma}$ and when $y = \infty$, $r = -\infty$.

Thus

$$\int_0^{-\infty} \frac{y}{\sigma} f\left(\frac{I-y}{\sigma}\right)dy = \int_{I/\sigma}^{-\infty} \left(\frac{I-\sigma r}{\sigma}\right) f(r)\ (-\sigma dr)$$

$$= \int_{I/\sigma}^{-\infty} -(I-\sigma r)\ [f(r)]\ dr$$

---

[1] J. Tobin, <u>ibid</u>., p. 28.

This can be written as

$$= \int_{-\infty}^{I|\sigma} (I-\sigma r)\ f(r)\ dr$$

$$\text{or} \quad = I\int_{-\infty}^{I|\sigma} f(r)\ dr + \sigma \int_{-\infty}^{I|\sigma} - r\ f(r)\ dr \qquad (14)$$

Since $$- rf(r) = f'(r) = \frac{df(r)}{dr}$$

by definition of the density function of the normal distribution, the second term is simply $\sigma f\left(\frac{I}{\sigma}\right)$ and the first term is $IF\left(\frac{I}{\sigma}\right)$ by definition of f(z) and F(z).

Therefore, the expected value of y given I is

$$E(y_t/I_t) = I_t\ F\left(\frac{I_t}{\sigma}\right) + \sigma f\left(\frac{I_t}{\sigma}\right) \qquad (15)$$

The estimated expectation is thus

$$\hat{y}_t = \hat{I}_t\ F\left(\frac{\hat{I}_t}{\hat{\sigma}}\right) + \hat{\sigma} f\left(\frac{\hat{I}_t}{\hat{\sigma}}\right) \qquad (16)$$

The difference between the expected value of y_t and the index is:

$$E(y_t)-I_t = \sigma f\left(\frac{I_t}{\sigma}\right) + I_t\left[F\left(\frac{I_t}{\sigma}\right) - 1\right] \qquad (17)$$

In the case of one independent variable the expected value of y_t given x_t is as presented in figure 5.3.

Since for sufficiently large values of I_t, the cumulative distribution is unity, $F\left(\frac{I}{\sigma}\right) = 1$, and the density function is zero,

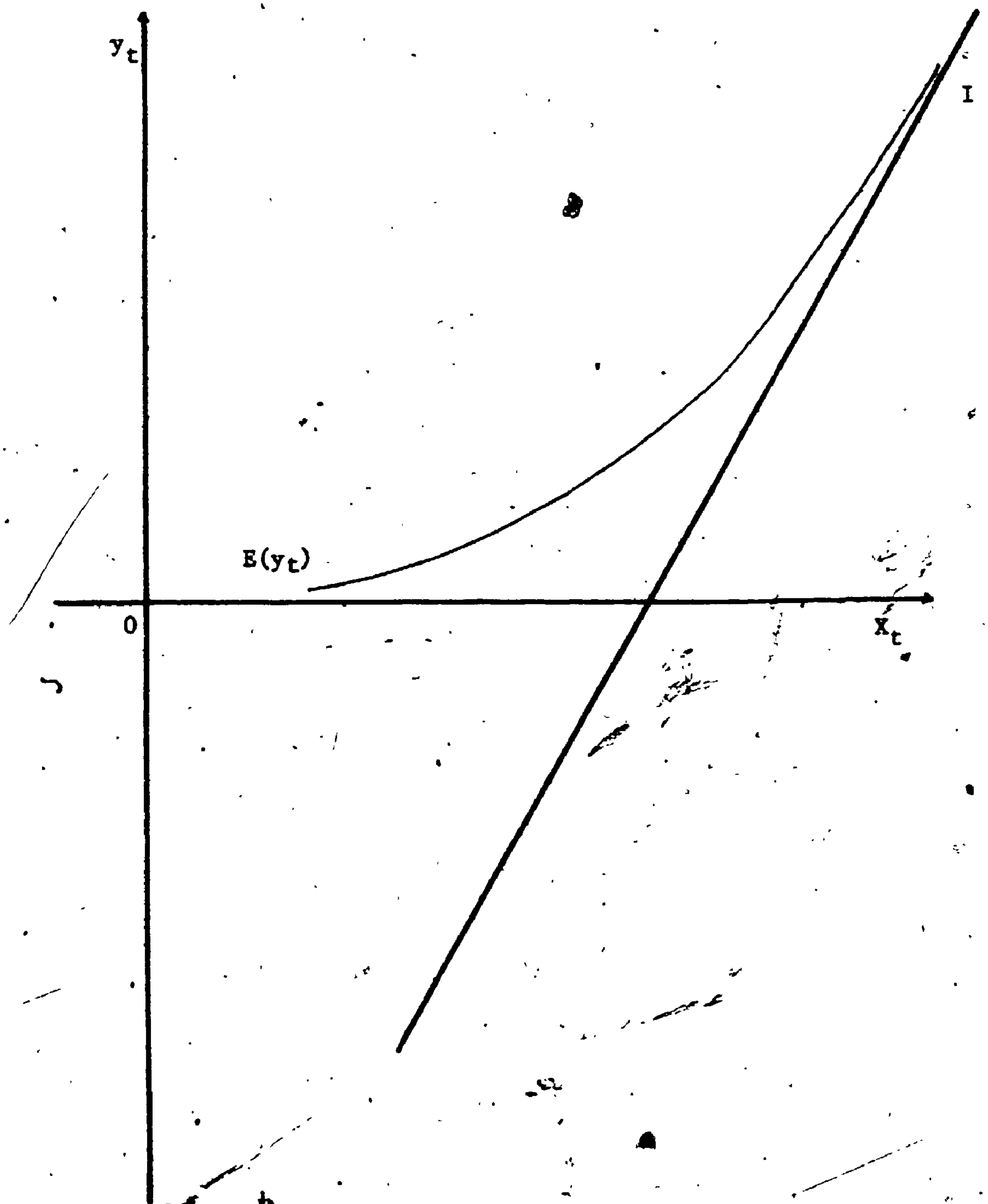


Figure 5.3

The Expected Value of y_t

$f\left(\frac{I}{\sigma}\right) \doteq 0$, we can say from equation (15) that the expected value of y_t is approximately equal to I_t. That is $y_t = I_t$ for large values of X'B.

Given the estimated value of I_t and σ it is possible to evaluate the empirical probability of y_t given the X's using

$$\text{Prob } \{y_t > 0|X\} = F\left(\frac{\hat{I}_t}{\sigma}\right) \tag{20}$$

where $\hat{I}_t$ is given by X'B.

If X_t are the independent variables corresponding to the non-zero observations in y_t, equation (20) gives the probability that y_t is greater than zero for a non-zero observation and if X_t corresponds to the zero observations in y_t, equation (20) gives the probability that y_t will be greater than zero for a zero observation. By evaluating the mean probability for each type of observations we can tell if the estimated index discriminates well between the two types of observations. The better is the discrimination implied by the estimated index, the larger the difference between the two mean probabilities.

B. Test for Homoscedasticity[1]

Suppose that we are in presence of two different models of the form

$$y = XB + \mu \quad (1)$$

$$\frac{y}{X_m} = \frac{X}{X_m} B + V \quad (2)$$

where X is a (nX m+1) matrice of observations on the independent variables

Y is a (nX1) vector of observations on the dependent variables

μ is a (nX1) vector of residuals

B is a (mX1) vector of coefficients to be estimated

and $[X/X_m]$ and $[Y/X_m]$ are matrices differing from X and Y only in that they contain the elements of X and Y divided by the variable X_m such that $\mu = X_m V$.

The objective is to estimate B and to accept one or the other (or possibly neither) model.

"On the assumption that the error terms are normally distributed a test can be constructed in the following manner:

a) Order the observations by the values of the variable X_m which is the potential deflator i.e. the new ordering is given in terms of the second subscript of X_m indexed so that $X_{mi} \leq X_{mj}$ if and only if $i<j$ and we then index the remaining variables so that the index values correspond with those of the X_{mi}.

---

[1] The present appendix is based on S.M. Goldfeld and R.E. Quandt, "Some Tests for Homoscedasticity", Journal of the American Statistical Association, Vol. 60, pp. 540, 1965; and on Henri Theil, Principles of Econometrics, John Wiley and Sons, Inc., 1971, pp. 196-199.

b) Given some choice of the number of central observations, k, to be omitted, we fit separate regressions (by least squares) to the first (n-k)/2 and the last (n-k)/2 observations, provided that (n-k)/2>m, the number of parameters to be estimated, and that the (n-k)/2 observations be distributed over at least (m) distinct points in the x-space.

c) Denoting by S_1 and S_2 the sum of squares of the residuals from the regressions based on the relatively small and relatively large value of X_m respectively, we form,

$$R = \frac{S_2}{S_1}$$

The quantity R clearly has the F- distribution with

$\frac{n-k-2m}{2}$, $\frac{n-k-2m}{2}$ degrees of freedom under the null hypothesis.

Under the alternative hypothesis the value of R will tend to be large since, if the ratio hypothesis is true, u = vXm and Var (u) = X_m^2 Var(v) = X_m^2 constant. Since the value of X_m^2 are larger for the second set of residuals than for the first, the corresponding sum of squares of residuals will tend to be larger."[1]

In Goldfeld and Quandt version of the test, a middle group of observations is omitted. "This lowers the degree of freedom on which the test is based and thereby reduced the power of the test. On the other hand, if the alternative hypothesis is true, the inclusion of the centrally located observations would cause [S_1] and [S_2] to be on average closer to each other than they would be if these observations were not included, and this effect works in the opposite direction. Some experimental studies suggest that the power of the test is improved by deleting a modest proportion of observations in the middle range."[2]

---

[1]Goldfeld and Quandt, ibid., pp. 540-541.

[2]H. Theil, ibid., p. 199.

CHAPTER SIX

TESTS OF THE THEORY

Introduction

In the previous chapter we presented the empirical results of our regression analysis. The objective of that analysis was to apply our theory to the data set described in chapter four in order to identify the statistically significant relationships for each dependent variable. This results in a model which is not completely recursive and from which many sequences of transactions may be tested. Up to now, the objective of the thesis has been to test the theory outlined in chapters two and three. This objective is not yet obtained and we must now identify the "most likely sequence of transactions" and explain the meaning of our results. Since the significant variables have been identified we are left with the inclusion of the non-significant variables in the sequence in order to get a complete recursive model. The procedure used to test alternative sequences of transactions was the following one:

1) In each equation, all the endogenous (transaction) variables which were significant in the estimated equation (in chapter five) were kept in the equation and any recursive sequence which would have implied the exclusion of that significant variable was rejected a priori. This restricts the number of alternative

recursive sequences to be tested.[1]

2) In each equation, all the exogenous and predetermined (non-transaction) variables which were significant in the estimated equation (in chapter five) were kept in the regression and no other exogenous variables were included.

3) Moreover as explained in chapter five, Total Budgetary Revenue [TBRD], and Current Expenditures on Education [CEED] were considered exogenous over the sample. Most transactions were estimated by ordinary least squares, however, Borrowing transactions [PBSD] were estimated by Tobit Maximum Likelihood Method. The end-of-month cash was determined as an identity.

4) We tested for the different recursive sequences by comparing the obtained $\bar{R}^2$ and the variances of the regression coefficients equation by equation across the possible sequences.

For example, the obtained equation for [CEOD] in the first sequence was compared with the obtained equation for [CEOD] in all other sequences. The result of this research strategy is

---

[1] These recursive sequences are:

a) [TBRD], [CEED], [CEOD], [CEHD], [KETD], [PBSD], [LIAD], [SIFXD], [EMCD].

b) [TBRD], [KETD], [CEED], [CEOD], [CEHD], [PBSD], [LIAD], [SIFXD], [EMCD].

c) [TBRD], [CEED], [CEOD], [CEHD], [PBSD], [LIAD], [KETD], [SIFXD], [EMCD].

d) [TBRD], [CEED], [CEOD], [CEHD], [PBSD], [LIAD], [SIFXD], [KETD], [EMCD].

to give as the most likely recursive sequence of transactions the sequence described in chapter five. That is:

[TBRD], [CEED], [CEOD], [CEHD], [KETD], [PBSD], [LIAD], [SIFXD], [EMCD].

In other words, if the sequence is recursive, this is the most likely sequence. But what about simultaneous sequences? We did not test for all possible simultaneous sequences but the ones we tested were worse than any recursive sequence. In brief, as far as the sequences of transactions is concerned, our tests indicate that sequence 1 is the "most likely sequence". This is not the last word on the sequence of transactions. The theoretical model did not include a complete discussion of the problem of the sequence of transaction because it is outside of the present study. For the same reason, our empirical research does not present a complete analysis of this problem. However, among the recursive sequences, sequence 1 is certainly the most probable one. The qualitative results of the obtained model are presented in Table VI-1, and the obtained coefficients of the sequence are given in Table VI-2. Appendix B presents that complete model which is used in the simulation experiments presented in chapter seven.

Using Tables VI-1 and VI-2, we will analyze the various hypotheses that were laid out in chapter four. Doing this, we hope to stress the unique nature of these tests.

TABLE VI-1

QUALITATIVE RESULTS OF THE SIMULATION MODEL(1)

HYPOTHESIS / VARIABLE	RATIONING	CURRENT SPILLOVER EFFECT								LAGGED SPILL-OVER EFFECT	PRICES EXPECTATION EFFECT	INTEREST RATES EXPECTATION EFFECT	CASH EFFECT	STOCK ADJUSTMENT EFFECT			REPAYMENT OR REDEMPTION RATES EFFECT			AD-HOC VARIABLES		
	DIRECT RATIONING EFFECT	TBRD	CEED	CEOD	CEHD	KETD	PBSD	LIAD	SIFXD				BMCD	BMBD	BMSLD	BMSIFD	REBD	RESLD	RESIFD	SEASONALS DUMMIES	BIAIS IN THE ESTIMATE	UNEXPECTED EVENTS
CEOD	−	+*	−										+							5 SEASONALS	RCEOE −	
CEHD	+	+*	+*	−										+	−					−1 SEASONAL		TREND −
KETD	−	+	−*	−*	−*					TBRDL, + KETDL, − KETDLL, +												
PBSD	−												−		−							
LIAD	−	−*	+*	−*	+*	+*	+						+								RLIAE −	
SIEXD	−*	−*	−*	−*	+*	+*	−*	+*			FEXRD −	ER3ASD −				−						DUM 1 DUM 2 DUM 3
EMCD		+1.	−1.	−1.	−1.	−1.	+1.	−1.					+1.				−1.	+1.	+1.			
EMBD							1.							1.			−1.					
EMSLD								1.							1.			−1.				
EMSIFD									1.							1.			−1.			

(1) A blank entry means that the two variables are not related

A entry with a minus sign (−) or a plus sign (+) means that the two variables are significantly related ; the sign indicates the nature of the effect.

A entry with a minus sign (−) or a plus sign (+) and a star (*) means that the two variables are not significantly related , the sign indicates the estimated effect.

TABLE VI-2

THE SEQUENCE OF TRANSACTIONS

	TBRD	CEED	CEOD	CEHD	KETD	PBSD	LIAD	SIFXD	BMCD	BMDD	BMSLD	EMSIFD	REDDD	REDLD	REDSIFD
CEOD	.08898	-.4842							.063						
CEHD	.0197	.0317	-.0749							.02903	-.1295				
KETD	.1268	-.0301	-.0244	-.0781											
PBSD	0.0	0.0	0.0	0.0	0.0				-.4465		-5.615				
LIAD	-.03129	+.01185	-.0829	+.0047	+.0673				+.0242						
SIFXD	-.041	-.0987	-.0544	.0790	.0298	.0131	.0991					-.08255			
EMCD	+1.	-1.	-1.	-1.	+1.	+1.	-1.	-1.	+1.				-1.	+1.	+1.
EMDD										1.			1.		
EMSLD											1.			1.	
EMSIFD												1.			1.

6.1 Test of the Theory

The present section aims to provide the theoretical meaning of our empirical results. This is not an easy objective because the empirical results generate many important side issues on which other authors have commented. However, at the risk of reopening some old controversies or opening new controversies, we will try to shed some light on these results. We will attempt to do this because we believe that given a theoretical framework, econometric research should be pushed to its limits. If in chapter five it was sufficient to say that y_t depends on the vector of X's, we think that in this chapter it is necessary to give our interpretation of these results in the light of our theoretical framework, referring to the existing literature on these problems. Our hope is that even if this analysis only raises important problems in the light of a different approach, it will have succeeded in improving our understanding of short-run monetary phenomena.

In chapter four we identified eight different factors explaining the difference between actual and planned transactions. Each of these factors corresponds to an empirical hypothesis that was tested. Let us go over these propositions one by one in each equation. There are six endogenous flow transactions in the model [CEOD], [CEHD], [KETD], [PBSD], [LIAD], [SIFXD] and one endogenous stock, [EMCD].

Proposition I: Direct Rationing Effect

In theory we expect the constant term to be negative or zero in each endogenous flow transaction. Our results indicate that out of the six flow transactions, four have a significant negative constant term, [CEOD], [KETD], [PBSD], and [LIAD], one has a non-significant negative constant term, [SIFXD], and one has a significant positive constant term, [CEHD]. It is interesting to note that for transactions that are conducted on the best organized markets, [financial markets], our constant term is not significantly different from zero as shown in row [SIFXD] and column [rationing] of Table VI-1. The only result not consistant with our theory is the positive constant term in [CEHD]. However, as we said in chapter five this can be rationalized by the fact that the medicare program imposed larger expenditures on the part of the Government than it first anticipated. However, one might raise some objections concerning the interpretation of the constant term in the equations. Indeed one might argue that since the residual includes the remainder of the Taylor expansion accounting for nonlinearities in the Taylor series, the constant term picks up these nonlinear effects and cannot be interpreted as a measure of individual rationing. Indeed this may be the case; however in that situation the constant term could not be restricted in sign and size. Under our interpretation, the constant term is expected to be negative or zero and this is what happens empirically except in one case, [CEHD]. Moreover, the value of the constant term for each transaction is

-7092.37	for	[CEOD]
7561.72	for	[CEHD]
-3055.73	for	[KETD]
-33244.64	for	[PBSD]
-1295.27	for	[LIAD]
-729.79	for	[SIFXD]

If we exclude [PBSD] and [CEHD], the size of the constant term decreases as we move from transactions at the beginning of the sequence to transactions that are at the end of the sequence. This suggests that the size of the individual rationing effect is smaller for transactions conducted on "well-organized markets" than for those carried on less-organized markets. It is not a proof of this hypothesis, but the opposite result would have been embarrassing. Thus the constant term is probably best understood as a measure of individual rationing than as a measure of nonlinearities in the equations. In any case, a more efficient estimate of the constant term might be obtained by taking into account the nonlinearities, but this is outside the scope of our study.

Proposition II: Current Spillover Effect

If we include the significant spillover effects only, our results indicate that there are spillover effects in four flow transactions, namely:

[CEED] on [CEOD],
[CEOD] on [CEHD],
[TARD] on [KETD],
[PBSD] on [LIAD].

This implies that there are two endogenous flow transactions which do not have significant spillover effect, namely: [PBSD], [SIFXD]. In the case of [PBSD], it is easy to understand that current flow transactions in other markets do not affect transactions in the "financial capital markets" because of the threshold nature of the decision process as shown by the use of the Tobit Model in chapter five. Indeed borrowing transactions represent a case where the effect of other transactions works through the stock of cash and stock of loans and advances. In the case of [SIFXD], none of the flow transactions seems to influence significantly the operation of the Special Investment Fund.

These significant results are strong enough to suggest that the hypothesis of current spillover effect cannot be rejected a priori and that in most cases it is a hypothesis worthy of consideration.

One amazing result is that current not-realized revenues have little effect on current flow transactions. Indeed it significantly affects capital expenditures, and even when we consider the non-significant effects, they are of small magnitude.

This empirical result is of primary importance and in order to suggest an economic meaningful interpretation we must rely on the literature on the respective roles of wealth and income in the consumption function.[1] There is an extensive growing literature on that

[1] R.W. Clower and M.B. Johnson, "Income, Wealth and the Theory of Consumption", ~~in~~ Value, Capital and Growth, Papers in honour of Sir John Hicks, Ed. J.N. Wolfe, Aldine, 1968, pp. 45-96; and R.J. Ball and P.S. Drake, "The Relationship Between Aggregate Consumption and Wealth", International Economic Review, Vol. 5, No. 1, (January 1964), p. 68.

topic and we do not intend to review it here.[1] However, we think that our empirical results must be interpreted in this context even if the micro-unit studied is not a household. Wealth can be viewed as a financial stock operating as an inter-temporal constraint, or as the present value of expected future income receipts discounted to the present; or to turn this latter relationship around, permanent income may be viewed as the current period return on wealth, where in this case wealth includes human wealth. In other words, wealth can be measured as a financial stock or as permanent income. Under both definitions of wealth, current income is just one component of total wealth. However, the causal relationship between current consumption and current income is different under both measures of wealth.

In the permanent income case, current and past income affect current consumption if they change permanent income by changing expected future income. In the case of wealth as a financial stock, a change in past and current income will affect current consumption because it will change the time path of wealth. Thus when all the components of financial wealth are included in the consumption function, current income should have a weaker effect on current consumption than when wealth is included as permanent income measured by current and past income.

Our theoretical framework includes both of these possible effects. Wealth as a financial stock is included by the effects of the begin-

---

[1] An excellent review is available in M.K. Evans, Macroeconomic Activity: Theory, Forecasting and Control, Harper and Row, 1969, Chapters 2 and 3.

ning of the month cash, and other financial assets or liabilities. Moreover current income is included directly by the current spillover effect of income and the past value of income is included by the lagged spillover effects. Since all these effects were tested in each equation, our econometric results can be viewed as an appropriate experiment for discriminating between the effect of wealth as a financial stock and the effect of wealth as permanent income.

Therefore, the fact that current unrealized budgetary revenue do not significantly affect current excess demand transactions is consistent with the theory that measures wealth as a financial stock. Moreover, in the only case where current budgetary revenues are significant, lagged budgetary revenues are also significant. This is the case of capital expenditures. Thus, assuming that the extent to which income receipts are expected to change in the future can be approximated by the current and past difference between realized and expected income, we can say that capital expenditures are affected by current and lagged values of [TBRD] via an income expectations' effects indicating a wealth effect in the form of a change in permanent income. Capital expenditures being expenditures on durable goods there is a different causal relationship between income, wealth and expenditures depending on the kind of expenditures considered. It is in the context of the above discussion that we shall interpret the meaning of our results concerning lagged spillover effects and beginning of the month cash and other stock effects.

Before doing this we must finish our discussion of the current spillover effect.

It is important to note also that the significant spillover effects indicate that excess demand transactions, [CEED], [CEOD], [CEHD] are "substitutes" and that excess supply transactions have a positive effect on excess demand transactions, [TBRD] on [KETD] and [PBSD] on [LIAD]. This means that the cash and substitution effects are greater than the possible complementary effects. However, substitution and complementary are not tested in the usual fashion. Indeed, in most empirical research the test for complementary or substitution is carried out by considering the sign of the cross price elasticities between goods, here the test is direct in the sense that we look at the effect of a change in one transaction on another one.

When non-significant spillover effects are considered, then there are nine cases where the complementary effect is smaller than the combined cash and substitution effect and nine cases where it is greater.

In brief, there are four significant non-zero spillover effects and eighteen non-significant coefficients of which nine have a sign such that cash and substitution effects are greater than the complementary effect. Finally, it should be noted that in the flow transactions where there are non-significant variables, the other variables accounting for the other hypotheses are significant.

Let us consider the effect of lagged spillover effect.

Proposition III: Lagged Spillover Effects

As shown in Table VI-1, lagged spillover effects are present only in one equation, namely capital expenditures which responds to lagged values of capital expenditures and lagged value of total budgetary revenue. The results to be analyzed are thus: (1) the small number of significant lagged spillover effects, (2) the inclusion of current and lagged total budgetary revenue in [KETD] and (3) the inclusion of the lagged value of [KETD] in [KETD].

The small number of lagged spillover effects is consistent with the presumption that in a stock-flow model, past transactions should affect current transactions only to the extent that they change stock variables (e.g. net wealth) which influence current transactions. In other words, in stock-flow models inter-temporal adjustments are made through stocks and not through flows. This is probably why lagged spillover effects are not significant in most transactions.

Concerning the second result, we just said that current capital expenditures are affected by current and lagged values of [TBRD], via an income expectations effect. That is, if budgetary revenues are greater than expected in the current month and the past month, income receipts are expected to be larger in the future so that capital expenditures are increased this month.

Finally, it should be noted that the inclusion of lagged capital expenditures in [KETD], can be interpreted as a proxy variable for the difference between the actual and the desired stock of capital for we did not have data on the actual capital stock at each month. Our results are thus consistent with a stock adjustment mecanism which we shall study below.

Let us consider the effect of incorrect expectations about prices and interest rates.

Propositions IV and V: The Effect of not-realized expectations about prices and interest rates

Prices and interest rates effects are present only in one equation, namely, [SIFXD]. Prices of other goods and services, when available, were not significant. Moreover interest rates were not significant on transactions such as Borrowing and Capital Expenditures. Thus our results demonstrate that if incorrect expectations cannot be rejected in all cases they certainly do not explain all the difference between actual and planned transactions given the shortcomings of our data set.

Proposition VI: Beginning of the Month Cash Effect

As illustrated in Table VI-1, the beginning of the month cash turned out to be a significant explanatory variable in three endogenous flow transactions, [CEOD], [PBSD], [LIAD]. These results are of primary importance for they shed some light on two related issues: The real (or nominal) cash balance effect and the role of money as a buffer stock versus the role of money as a durable good. These are not easy problems and we do not intend to solve the issues but only indicate the possible implications of our results. Let us first consider the real balance effect. Our results indicate that we cannot reject the hypothesis that some transactions are influenced by cash considerations in the sense that if the beginning-of-month cash is greater than planned, actual transactions will be greater than planned transactions in the case of excess demand transactions and they will be smaller in the case of excess supply transactions. Several attempts to test the real balances effect have been published.[1] Patinkin asserts[2] that none of the studies presented in his review really tests the real balance effect in the manner implied in his book for they define real balances as liquid assets and give "the impression that it is real balances per se which influence consumption, instead of real balances as a component of total wealth."[3] We agree with Patinkin that most empirical research on the real balances effect has not really tested the real balance effect in the manner implied by his book, but for different reasons. In the individual experiment case, the real balances effect asserts that if real balances are changed from their initial level, at the beginning of the period, then expenditures will be changed accordingly. But as we said in Chapter 2, Patinkin's theoretical framework is one of planned behaviour and not of actual behaviour. We assert that our empirical results correspond to an individual experi-

---

[1]A survey of these studies is included in Don Patinkin, Money, Interest and Prices, Harper and Row, note M.

[2]Don Patinkin, ibid., p. 655.

[3]Don Patinkin, ibid., p. 655.

ment where if the beginning of the period cash is different than expected cash, some transactions will be changed. For this reason it represents a direct test of the cash balance effect.

It is clear that in our theoretical framework and our empirical study, cash balances are considered as a special component of wealth; in that sense Patinkin could argue that we give the impression that it is cash balances per se which influence transactions and he would be right for money plays a special role in the budgetary realization process, not because it is a component of wealth but because it operates as a constraint which gives market expression to planned transactions.

Moreover the fact that some transactions respond to other transactions with a spillover coefficient smaller than one, indicates the importance of cash as a buffer stock. Indeed the implication which Friedman derives from his analysis (of the demand for money)[1] is that money does not perform the role of shock absorber or buffer stock function in the portfolio of individuals but rather, the short-run buffer stock function is relegated to "other balance sheet items such as personal debt, consumer credit and perhaps securities."[2] Our results indicate that cash plays an important role as a buffer stock and that other stock variables are also used as buffers as we will show in our discussion of the next proposition.

---

[1] M. Friedman, "The Demand for Money: Some Theoretical and Empirical Results", Journal of Political Economy, Aug. 1959.

[2] E.L. Feige, "Expectations and Adjustments in the Monetary Sector", American Economic Review, Vol. LVII, May 1967, No. 2. Paper and Proceeding of the Seventy-ninth Annual Meeting of the A.E.A., pp. 462-473.

Proposition VII: Stock-Adjustment Effect

In order to explain correctly the meaning of our results concerning the effect of the beginning of the month stocks, let us briefly review the theoretical and econometric literature on the demand for stocks. We will accomplish this review by using Feige's[1] work on the demand for money and Nerlove's paper[2] on distributed lags in Economic Behavior.

Feige's model assumes "that the 'desired' long-run level of real cash balances depends upon 'expected' real income such as

$$m_t^* = By_t^e + \mu_t \qquad (1)$$

where m_t^* is the 'desired' long-run stock real cash balances,

y_t^e is 'expected' real income,

μ_t is a disturbance term,

and lower case letters are used to denote logarithms."[3]

Since m_t^* and y_t^e are not usually directly observable, it is necessary to relate these theoretical magnitudes to observed values. This is done by specifying a partial adjustment process of the form:

$$m_t^d = m_{t-1} + \gamma\,(m_t^* - m_{t-1}) \qquad (2)$$

where m_t^d is the current effective demand for real cash balances and γ is the adjustment elasticity.

---

[1]E.L. Feige, op. cit., pp. 462-473.

[2]Marc Nerlove, "Lags in Economic Behavior", Econometrica, Vol. 40, March 1972, Number 2, pp. 221-251.

[3]E.L. Feige, op. cit., p. 463.

Expected income is specified by an expectation generating equation such as

$$y^e_t = y^e_{t-1} + \lambda_y (y_t - y^e_{t-1}) \quad . \qquad (3)$$

where λ_y is the elasticity of income expectations. Equation (3) can be solved for expected income as a function of all past values of realized income. Adding the real supply of cash balances and an equilibrium condition for the monetary sector, one can find the reduced form equation for the monetary sector. This reduced form is

$$m_t = [(1 - \lambda_y) + (1 - \gamma)] m_{t-1} -$$

$$[(1 - \lambda_y) (1 - \gamma)] m_{t-2} +$$

$$\gamma \lambda_y B y_t + \gamma[\mu_t - (1 - \lambda_y) \mu_{t-1}] \qquad (4)$$

When both the adaptive expectation process and the partial adjustment process are operative, one cannot, on the basis of knowledge of the reduced equation coefficients, identify the structural coefficients λ_y, γ and B separately. Thus when the data set used does not include observations on desired stock and expected flows, it is generally impossible to identify the structural parameters describing the partial adjustment mechanism and the adaptive expectation process. However, Feige's contribution is precisely to show that in the case where there are multiple expectation processes-one can identify the structural coefficient by using a constrained nonlinear two-stage estimation procedure. However, the test is performed on the reduced form equation and not on the structural form equation and in that sense it is an indirect test. Nevertheless, his paper represents an important contribution to this problem and unambiguously recognize the problem of discriminating between expectation lags and adjustment lags in the demand for money. Nerlove's[1] analysis shows that this is a problem in most cases where distributed lags are used for "without strong theoretical justification for a particular form of lag distribution and perhaps even strong prior belief about the quantitative properties of that distribution and the factors on which those properties depend, it is generally impossible to isolate the lag distribution in any very definitive way from the sort of data generally available."[2]

Given this brief introduction to the problem of identifying structural parameters from reduced form equation, let us analyse the implications of our results on the beginning of the month stock effect.

Stock variables other than cash were significant in two equations only: [CEHD] and [SIFXD].

In the case of expenditures on health the negative effect of the stock of loans and advances on [CEHD] illustrates some kinds of a substitution effect. However, the positive effect of [BMDD] on [CEHD] is surprising. Indeed one would expect that the greater the level of debt, the smaller is the net wealth so that the lower would be the expenditures. Since [PBSD] and [LIAD] are related, it could be that the variations in [PBSD] and [LIAD] are strong enough to imply multi-

---

[1] Marc Nerlove, ibid.

[2] Marc Nerlove, ibid., p. 227.

collinearity between [BMDD] and [BMSLD] so that the estimated coefficients are biased.[1] This is perhaps the best explanation of the result.

The case of [SIXFD] is much more interesting because it is a direct test of the stock adjustment principle of economic behaviour and the adjustment coefficient is (-.0825). This means that if the beginning of the period stock of S.I.F. securities is greater than expected than the actual excess demand for these assets will be less than the planned level. Flows will be revised because stocks are not in "equilibrium". Note, however, that our dependent variable is the difference between the actual flow and the planned flow and not simply the actual change in stock. More precisely if we note FA, FE, SA, SE as the actual flow, the desired flow, the actual stock and the desired stock respectively, and if Z represents all the other factors in the

---

[1]Recall that the main consequences of multicollinearity are the following:

"1. The precision of estimation falls so that it becomes very difficult, if not impossible, to disentangle the relative influence of the various X variables. This loss of precision has three aspects: specific estimates may have very large errors; these errors may be highly correlated, one with another; and the sampling variances of the coefficients will be very large.

2. Investigations are sometimes led to drop variables incorrectly...

3. Estimates coefficients become very sensitive to particular sets of sample data and the addition of a few more observations can sometimes produce dramatic shifts in some of the coefficients."

J. Johnston, Econometric Methods, 2nd Edition, McGraw-Hill, 1972, p. 160.

estimated equation, our results can be expressed as:

$$(FA - FE) = \gamma(SA - SE) + Z$$

using the definition of the flows we get

$$[SA_t - SA_{t-1}] - [SE_t - SE_{t-1}] = \gamma(SA_t - SE_t) + Z$$

or

$$[SA_t] = SA_{t-1} - \gamma(SE_t - SA_t) + (SE_t - SE_{t-1}) + Z$$

It is easy to recognize that from our estimated equation we can derive the familiar stock adjustment process except that the expected flow in the t^{th} period appears as a dependent variable with a regression coefficient constrained to unity.

With respect to our propositions concerning the effect of unrealized expectations about repayment or redemption rates of liabilities or assets, our results indicate that this affects only the end-of-month cash, either because there was no error of forecast or because the error was not a significant variable in the other transactions.

Let us consider the role of ad-hoc variables in the model. As it can be seen from Table VI-1, there are three types of ad-hoc variables: Seasonal dummies, bias in the estimates and variables representing unexpected events. Table VI-1 shows that the number of such variables is relatively low. However, the use of dummies serves much the same purpose and presents the same sort of problems in our work as it does in any empirical study.

Conclusion

Our basic results are the following:

(1) Individual Rationing Effect, as measured by the negative constant term, cannot be rejected in four of our six endogenous transactions. The size of the constant term is decreasing in absolute value as we move from the first transaction in the sequence to the last one, indicating that the more "efficient" is the market, the smaller is the individual rationing effect.

(2) Current Spillover Effects are significant in four flow transactions. The fact that current unrealized revenues have little effect on other current flow transactions, is consistent with the theoretical presumption that expenditures are related to wealth. Moreover the case of capital expenditures, where current budgetary revenue and lagged revenue appear as explanatory variables, is interpreted as an income expectation effect.

(3) The small number of significant lagged spillover effects and the nature of the significant ones, indicates that in stock-flow model intertemporal adjustments are made through stock variables (including the stock of cash balances) and that the significant lagged spillover effects cannot be interpreted in the same way as the current spillover effect but should be viewed as proxy variables for expected future flows or proxy variables for a stock adjustment process.

(4) Concerning the effect of the Beginning of the Month Cash,

our results present a direct test of the cash balances effect per se and they indicate the important role of money as a buffer stock, thereby increasing the empirical evidence that money is held for transaction purposes.

(5). Our analysis of the role of stock variables in the adjustment process demonstrates the unique nature of these tests and permits us to identify the structural adjustment coefficients as opposed to the generally non-identified reduced form coefficients.

Thus the discussion of the present chapter is consistent with the main objective of this thesis to test economic theory and not necessarily to forecast as accurately as possible the cash flow of the Government of Alberta. However, we feel that given this main objective, our model also sheds some light on the cash flow of Alberta. In order to demonstrate this, the next chapter provides the results of some simulation experiments.

CHAPTER SEVEN

SIMULATION

Introduction

It is sometimes argued that simulation analysis sheds more light on the structure of the model than on the economic behavior that the model intends to describe. Indeed, it is partly true. But we feel that simulation analysis is useful to understand economic behavior. The objective of this chapter is thus to improve our understanding of the results on the cash flow of the Government of Alberta. More precisely, we are concerned with two types of issues. On the one hand, we will illustrate the dynamic properties of the model. This is the purpose of Section 7.1. On the other hand, we will show the role of the End-of-Month Cash in the adjustment process. In other words, we will measure the extent to which a change in one transaction affects other transactions instead of the End-of-Month Cash. This will be done in Section 7.2, by comparing the dynamic multipliers on the End-of-Month Cash of each transaction. But before we present our results let us briefly describe the procedure used.

Basically, our procedure consists in (1) solving the system of equations[1] using the historical value of the exogenous variables, this yields the basic run value for each endogenous variable; (2) we

---

[1] The simulation model is presented in Appendix B.

impose on the system a shock by changing the value of one exogenous variable or of the constant terms in one endogenous equation, this yields the simulation run; (3) by comparing the value of the endogenous variables in the simulation run with those of the basic run, we get a measure of the effect of the shock on each endogenous (or predetermined) variable. We choose to conduct the simulation over a six months' period starting in June 1972 and ending in November 1972. We conduct eight different simulation experiments. The transactions to be changed exogenously are Total Budgetary Revenues, [TBRD], and Current Expenditures on Education, [CEED], the endogenous equations where the constant term is changed are Current Expenditures on other Goods and Services, [CEOD], Current Expenditures on Health, [CEHD], Capital Expenditures, [KETD], Borrowing, [PBSD], Loans and Advances, [LIAD], and Excess Demand for S.I.F. Securities, [SIFXD]. In the case of exogenous transactions, the shock consists in changing the transactions by one hundred thousand dollars in each period and in the case of the endogenous transactions we change the value of the constant term in the equation in each period, again by one hundred thousand dollars. In each simulation the dynamic multipliers were calculated as well as the change in the dynamic multipliers from period to period. These multipliers were calculated for each endogenous transaction (i.e., for [CEOD], [CEHD], [KETD], [PBSD], [LIAD], [SIFXD]) and for each predetermined stock (i.e., for [EMCD], [EMDD], [EMSLD], [EMSIFD]).

The dynamic multiplier for the i^{th} transaction in the t^{th} period is defined as

$$k_{t,i} = \frac{\begin{pmatrix}\text{Value of the endogenous} \\ \text{(or predetermined) variable} \\ \text{in the simulation run}\end{pmatrix} - \begin{pmatrix}\text{Value of the endogenous} \\ \text{(or predetermined) variable} \\ \text{in the basic run}\end{pmatrix}}{\begin{pmatrix}\text{Value of the exogenous} \\ \text{variable (or of the constant} \\ \text{term in the equation) in the} \\ \text{simulation run}\end{pmatrix} - \begin{pmatrix}\text{Value of the exogenous} \\ \text{variable (or of the con-} \\ \text{stant term in one equation)} \\ \text{in the basic run}\end{pmatrix}}$$

The change in the dynamic multiplier is defined as

$$\Delta k_{i,t} = k_{t,i} - k_{t-1,i}$$

These two types of multipliers will serve to illustrate the implications of the disequilibrium/adjustment process. This being said, let us analyze the results of the simulation.

7.1 Simulation of the Effect of a change in Total Budgetary Revenues

This section aims to describe the nature of the dynamic implications of the model by presenting the results of the first simulation. The reader will find in Appendix C, the results of all the simulation experiments. The following discussion is thus an illustration of the kind of implications that these experiments generate.

As shown in Table 7.1, the results of the first simulation indicate that an increase in the difference between actual and expected Total Budgetary Revenues will provoke an increase in the

TABLE 7.1

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN [TBRD] IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		KETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	.089		.013		.124		0.0		-.037	
July 72	.143	.054	.014	.001	.203	.080	-.174	-.174	-.032	.005
August 72	.177	.034	.010	-.003	.202	-.001	-.234	-.059	-.026	.006
Sept. 72	.205	.028	.005	-.005	.226	.023	-.283	-.049	-.021	.005
Oct. 72	.226	.021	-.002	-.007	.214	-.011	-.313	-.030	-.018	.004
Nov. 72	.245	.019	-.010	-.008		.012	-.347	-.034	-.015	.003

PERIOD	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	-.045		.856		-.037		0.0		-.045	
July 72	-.039	.006	1.392	.536	-.069	-.032	-.174	-.174	-.084	-.039
August 72	-.036	.002	1.832	.439	-.095	-.026	-.408	-.234	-.120	-.036
Sept. 72	-.034	.003	2.168	.337	-.117	-.021	-.691	-.283	-.154	-.034
Oct. 72	-.032	.001	2.467	.298	-.134	-.018	-1.004	-.313	-.186	-.032
Nov. 72	-.030	.002	2.704	.237	-.149	-.015	-1.351	-.347	-.216	-.030

difference between the actual and the planned level of Current Expenditures on other Goods and Services. The value of the dynamic multipliers indicates that a sustained increase in [TBRD] has an increasing effect on [CEOD] but the rate of change in the dynamic multiplier is decreasing illustrating that the dynamic multiplier does not explode in the first six periods. The increasing value of [CEOD] is obtained by the positive effect of [TBRD] on the End-of-Month Cash which becomes the Beginning-of-Month Cash in the next period and appears as an important variable in the equation for [CEOD]. The effect on [CEHD] is relatively small. The dynamic multipliers on Capital Expenditures are almost constant after the first period. Table 7.1 also indicates that the value of the dynamic multipliers on Borrowing is null in the first period and that in the other periods, actual borrowing will be smaller than planned borrowing when Total Budgetary Revenues increase. Moreover this dynamic multiplier is increasing at each period.

The dynamic multiplier on [LIAD] illustrates that an increase in [TBRD] leads to a decrease in [LIAD]. This surprising result is obtained because the coefficients on [TBRD] and [CEHD] in the simulation model are respectively negative and positive and are larger than the coefficients on [CEOD], [KETD] and [PBSD]. However, it is important to note that dynamic multipliers tend toward zero as the number of periods increases. This dynamic adjustment is another implication of the inter-flow and the stock-flow relationships embodied in the model.

Considering the Excess Demand for Special Investment Funds Securities, we note that an increase in [TBRD] will provoke a decrease in the demand for SIF Securities. However, the value of the multipliers is decreasing over time, indicating that the stock adjustment mechanism has a stabilizing effect.

The impact multiplier on the End-of-Month Cash shows that an increase of one dollar in Total Budgetary Revenues leads to an increase in the End-of-Month Cash of 85 cents in the first period. The size of this multiplier increases at a decreasing rate over time taking a value greater than one in the other last five months. Since the multiplier on the stock includes all the cumulative effects, we can say that over six months, an increase of six hundred thousand dollars, leads to an increase in cash at the end of six months of 2.7 hundred thousand dollars. The other part of the six hundred dollars is used to finance other expenditures or to reduce borrowing.

Table 7.1 also presents the value of the multipliers for Beginning-of-Month Stock of Loans and Advances, the Beginning-of-Month Stock of Debt and the Beginning-of-Month Stock of SIF Securities. The dynamic multipliers are all negative indicating that an increase in [TBRD] will reduce [BMSLD], [BMDD] and [BMSIFD]. It is by the effects on these stocks that the intertemporal adjustments of a change in [TBRD] occur. In Appendix C of the thesis we report the value of the dynamic multipliers for each simulation. In order to show the role of the End-of-Month Cash in the adjustment process, we will analyze in the next section the results of these simulation experiments.

TABLE 7.2

END-OF-MONTH CASH MULTIPLIERS

PERIOD	SIMULATION ONE TBRD		SIMULATION TWO CEED		SIMULATION THREE CEOD		SIMULATION FOUR CEHD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	.856	.536	-.555	-.592	-.748	.064	-1.087	-.994
July 72	1.392	.439	-1.148	-.503	-.684	.245	-2.081	-.775
August 72	1,832	.337	-1.650	-.430	-.439	.216	-2.856	-.672
Sept. 72	2.168	.298	-2.081	-.344	-.223	.162	-3.528	-.518
Oct. 72	2.467	.237	-2.425	-.290	-.061	.090	-4.046	-.451
Nov. 72	2.704		-2,714		-.029		-4.496	

PERIOD	SIMULATION FIVE KETD		SIMULATION SIX PBSD		SIMULATION SEVEN LIAD		SIMULATION EIGHT SIFXD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	-1.035	-.074	.939	.098	-1.099	-5.682	-1.00	-.424
July 72	-1.109	-.629	1.037	-.126	-6.781	-5.907	-1.424	-.212
August 72	-1.738	-.020	.911	-.161	-12.688	-5.019	-1.636	-.123
Sept. 72	-1.758	-.416	.750	-.148	-17.707	-3.986	-1.759	-.077
Oct. 72	-2.173	-.034	.602	-.122	-21.707	-3.066	-1.835	-.05
Nov. 72	-2.207		.481		-24.758		-1.885	

7.2 The Role of Cash Balances in the Adjustment Process

In chapter three we identify as a relevant theoretical and empirical issue the following question: Will there be any spillover effects when the transactor has sufficient stocks that can be used as buffers? This question has been answered in chapters five and six but another important related question concerns the relative importance of spillover effects and of adjustment through changes in cash. It is thus the objective of this section to measure the extent to which a change in one transaction affects other transactions instead of the End-of-Month Cash and to identify which of the transactions provokes the largest spillover effects and the smallest End-of-Month Effects. Table 7.2 presents the dynamic multipliers on the End-of-Month Cash of each transaction. For example, the first column reports the dynamic multipliers on the End-of-Month Cash and its rate of change when Total Budgetary Revenues are changed. The second column provides the multipliers on the End-of-Month Cash when Current Expenditures on Education are changed.

Ordering the transactions by the size of their multiplier effect on the End-of-Month Cash yields starting by the smallest one:

- − .029 for [CEOD]
- + .602 for [PBSD]
- − 1.835 for [SIFXD]
- − 2.173 for [KETD]
- + 2.704 for [TBRD]
- − 2.714 for [CEED]
- − 4.496 for [CEHD]
- − 24.758 for [LIAD]

This means that Current Expenditures on other Goods and Services has the largest spillover effects after six months. Indeed most of the six hundred thousand dollars decrease in [CEOD] spill over into other transactions. Following [CEOD], Borrowing has a small End-of-Month Cash multiplier. The transaction which has the largest End-of-Month Cash Effect is Loans and Advances. Indeed a six hundred thousand dollars cut in Loans and Advances implies an increase of 24.75 hundred thousand dollars in cash after six months. This result is obtained by the effect of Loans and Advances on Borrowing.

Indeed a negative change in Loans and Advances provokes an equal negative change in the Beginning-of-Month stock of Loans and Advances in the next month and this in turn means a large positive change in Borrowing.[1] An increase in Borrowing implies an increase in the End-of-Month Cash. Thus a decrease in Loans and Advances implies an increase in the End-of-Month Cash.

Conclusion

In brief, the above simulation results show that in seven of the eight simulation experiments the value of the dynamic multipliers on the End-of-Month Cash after six periods, is smaller than six, indi-

---

[1] Concerning Borrowing our results are consistent with the "threshold" nature of the decision. Indeed, in Appendix 6, the reader can see that the effects on Borrowing are of small magnitude in most simulations and of large magnitude in the simulation of a change in Loans and Advances.

cating that in most cases the six hundred dollars change does not go entirely into the End-of-Month Cash. Moreover, in the only case where the multiplier is greater than six it is through the effect on Borrowing that this large multiplier is obtained. Our results also indicate that in most cases the value of dynamic multipliers on the End-of-Month Cash is increasing at a decreasing rate meaning that the longer the period of adjustment, the smaller the effect on Cash and the larger the spillover effects on other transactions. This last result is of major importance for it sheds some light on the relative role of stocks and flows in disequilibrium adjustment process. We can thus conclude that in our stock-flow model where there are spillover effects the role of cash as a buffer stocks diminishes as the period of adjustment increases implying that at each period the spillover effects increase.

cating that in most cases the six hundred dollars change does not go entirely into the End-of-Month Cash. Moreover, in the only case where the multiplier is greater than six it is through the effect on Borrowing that this large multiplier is obtained. Our results also indicate that in most cases the value of dynamic multipliers on the End-of-Month Cash is increasing at a decreasing rate meaning that the longer the period of adjustment, the smaller the effect on Cash and the larger the spillover effects on other transactions. This last result is of major importance for it sheds some light on the relative role of stocks and flows in disequilibrium adjustment process. We can thus conclude that in our stock-flow model where there are spillover effects the role of cash as a buffer stocks diminishes as the period of adjustment increases implying that at each period the spillover effects increase.

CHAPTER EIGHT

CONCLUSION

The process of plans' realization is inherently related to the fundamental question of how economic decisions are coordinated in a market economy for perfect coordination of individual decisions implies perfect realization of plans. Indeed the literature on disequilibrium can be better termed the economics of coordination and it is not by accident if this coordination problem has been formulated by monetary theorists. Money being the medium of exchange it is used in all markets to communicate effective demands. But the communication of effective demands is itself a key element in the economics of coordination. Moreover money, communication and coordination form the basis of the process of exchange which is essentially a short-run phenomena. Thus the economics of coordination is basically the short-run monetary theory that is missing in the neo-classical paradigm.

This monetary theory is only at its beginning but it has already raised important objections to the Walrasian approach to exchange phenomena and proposed alternative hypotheses to explain the process of exchange and the role of money in disequilibrium situations. These alternative hypotheses raise important questions concerning the behaviour of microeconomic units operating in disequilibrium situations. The most relevant question concerns the presence of current spillover effects in the case where plans are not realized and when the transactors have sufficient stocks that can be used as buffers in a disequilibrium process. Indeed, in pure-flow model, plans will have to be revised but in stock-flow model, stocks of liquid assets allow expenditures to be maintained when receipts fall off.

Thus the present thesis has been essentially an attempt to derive a stock-flow model of plans' realization and to apply it to monthly data on planned and actual transactions of the full budget of the Treasury Department of the Government of Alberta in order to test the empirical implications of the literature on disequilibrium. Over all the results indicate that we cannot reject the hypotheses of individual rationing effect, spillover effect, incorrect expectations effect, stock adjustment effect and cash balances effect in the process of plans' realization. Thus the originality of the thesis rests on the stock-flow nature of the model and on the uniqueness of the data set which permits us to carry out the first direct test of the major empirical microeconomic propositions of the literature on disequilibrium. More precisely, we have answered our three major questions raised in the introduction:

1) In the case studied, unrealized planned transactions in a given market do influence realized transactions in other markets in the same period but the spillover coefficients is less than one in all cases. Moreover, in some cases there is no significant spillover effect and the adjustment is made through change in cash holding at the end of the month.

2) As far as our study is concerned, a non-simultaneous adjustment process is a better hypothesis than a simultaneous one. Indeed, our results indicate that a recursive sequence of adjustment is "most likely" present.

3) Finally, stocks of financial assets and liabilities play an important role in the intertemporal dynamic adjustment as shown in the simulation experiments presented in the previous chapter.

Our suggestions for further research are the following:

As noted in chapter three, a major improvement in the theoretical model can be achieved by making the sequence of transactions endogenous. This improvement can be obtained by analyzing the role of information and transaction costs in exchange and monetary theory. It is not an easy task but it does represent an important research suggestion. In analyzing the sequence of transactions it will be important to introduce expectations about rationing. Obviously, as we move into this new theoretical approach to monetary exchange, the concepts of market, prices and money will all take a different meaning.

As far as empirical research is concerned, a major improvement would be to test the model using data generated by business firms and household units and other public institutions. Indeed, many applications of the theory would permit to identify some constant patterns of behavior and thus improve our understanding of the monetary phenomena, which we like to think, has been achieved by the present research.

REFERENCES

ALCHIAN, A.: "Information Costs, Pricing and Resource Unemployment", in E.S. Phelps et al., Microeconomic Foundations of Employment and Inflation Theory, Norton, 1970, pp. 27-52.

AGARWALA, R., T. BURNS, and M. DUFFY: "Forecasting Gross Private Fixed Investment Using Intentions Survey Data", The Manchester School, Dec. 1969, pp. 279-293.

ARROW, K.J.: "Toward a Theory of Price Adjustment", in M. Abramovitz, ed., The Allocation of Resources, Standford, 1959.

BALL, R.J. and DRAKE, P.S., "The Relationship between Aggregate Consumption and Wealth", International Economic Review, Vol. 5, No. 1, January 1964.

BARRO, R.J.: "A Theory of Monopolistic Price Adjustment", Review of Economic Studies, 39, Jan. 1972.

BARRO, R.J. and H.I. GROSSMAN: "A General Disequilibrium Model of Income and Employment", American Economic Review, March 1971, pp. 82-93.

BANK OF CANADA, "The Financing of Provincial and Municipal Government and Their Enterprises", Bank of Canada Review, Oct. 1972, pp. 3-22.

CLOWER, R. (ed.): Readings in Monetary Theory, Penguin, 1969.

CLOWER, R. (ed.): "The Keynesian Counter-Revolution: A Theoretical Appraisal", in Readings in Monetary Theory, 1969.

CLOWER, R.W.: "Theoretical Foundations of Monetary Policy", in Monetary Theory and Monetary Policy in the 1970, Ed. G. Clayton, J.C. Gilbert, and R. Sedgwick, Oxford University Press, 1971.

CLOWER, R.W.: "Competition, Monopoly and the Theory of Price", Pakistan Economic Journal, pp. 219-226.

CLOWER, R.W. and JOHNSON, M.B.: "Income, Wealth and the Theory of Consumption", in Value, Capital and Growth, Ed. J.N. Wolfe, Aldine, 1968, pp. 45-96.

DAGENAIS, M.G.: "A Threshold Regression Model", Econometrica, Vol. 36, No. 2, April 1969, pp. 193-203.

DAGENAIS, M.G.: "Application of a Threshold Regression Model to Household Purchase of Automobiles", Cahier No. 7304, Département des Sciences Economiques, Université de Montréal, 1973.

DEVLETOGLOU, N.C.: "Thresholds and Transaction Costs", Quarterly Journal of Economics, Vol. 85, No. 1, Feb. 1971.

EVANS, M.K.: Macroeconomic Activity, Theory, Forecasting and Control, Harper and Row, 1969.

FEIGE, E.L.: "Expectations and adjustments in the Monetary Sector", American Economic Review, Vol. LVII, 1962, No. 2, pp. 462-473, Papers and Proceeding.

FRIEDMAN, M.: "The Demand for Money: Some Theoretical and Empirical Results", Journal of Political Economy, August 1959.

FRIEDMAN, M.: A Theory of the Consumption Function, Princeton, N.J., Princeton University Press, 1957.

GOLDBERGER, A.: Econometric Theory, John Wiley and Sons Inc., New York, 1969.

GOLDFELD, S.M., and R.E. QUANDT: "Some Tests for Homoscedasticity", Journal of the American Statistical Association, 60, p. 540.

GROSSMAN, H.I.: "Money, Interest and Prices in Market Disequilibrium", Journal of Political Economy, 79, Sept/Oct. 1971, pp. 943-961.

HAHN, Frank H.: "Equilibrium with Transaction Costs", Econometrica, May 1971, 39, pp. 417-440.

HELLIWELL, J., and G. GLORIEUX: "Realization of Aggregate and Sectoral Investment Forecast", Bank of Canada, Ottawa, Mimeo, June 1968.

HIRSHLEIFER, J.: "Exchange Theory: The Missing Chapter", Western Economic Journal, 6, 1973, pp. 129-146.

HOWITT, Peter: Studies in the Theory of Monetary Dynamics, Ph. D. Dissertation, Northwestern University, June 1973.

JOHNSON, A.W., and J.M. ANDREWS: Provincial and Municipal Governments and the Capital Markets, Working Paper #4 for the Royal Commission on Banking and Finance, Nov. 1972, Ottawa.

JOHNSTON, J.: Econometric Methods, 2nd Edition, McGraw-Hill, 1972.

LEIJONHUFVUD, A.: "Effective Demand Failures", Swedish Journal of Economics, 1973.

LEIJONHUFVUD, Axel: "Notes on the Theory of Markets", Intermountain Economic Review, Fall 1970, 1, 1, pp. 1-13.

LEIJONHUFVUD, Axel: On Keynesian Economics and the Economics of Keynes, Oxford University Press, 1968.

MODIGLIANI, Franco, and Kalman J. COHEN: The Role of Anticipations and Plans in Economic Behavior and Their Use in Economic Analysis and Forecasting, Bureau of Economic and Business Research, University of Illinois, Urbana, 1961.

NEIHANS, J.: "Money and Barter in General Equilibrium With Transactions Costs", American Economic Review, Dec. 1971, 61, pp. 773-783.

NERLOVE, M.: "Lags in Economic Behavior", Econometrica, Vol. 40, March 1972, Nov. 2, pp. 221-251.

NEUFELD, E.P.: The Financial System of Canada, It's Growth and Development, Macmillan of Canada, Toronto, 1972.

OSTROY, Joseph M.: "The Informational Efficiency of Monetary Exchange", American Economic Review, Sept. 1973, LXIII, Nov. 4, pp. 1597-1610.

PATINKIN, Don: "The Limitations of Samuelson's 'Correspondence Principle' ", Metroeconomica, 4, August 1952, pp. 37-43.

PATINKIN, Don: Money, Interest and Prices, Harper and Row, 1965.

THEIL, H.: Economic Forecast and Policy, 2nd ed., Amsterdam, North Holland, 1965.

TOBIN, J.: "Estimation of Relationships for Limited Dependent Variables", Econometrica, 1958, pp. 24-36.

TUCKER, D.: "Macroeconomic Models and the Demand for Money Under Market Disequilibrium", Journal of Money, Credit and Banking, Feb. 1971, pp. 57-83.

NEIHANS, J.: "Money and Barter in General Equilibrium With Transactions Costs", American Economic Review, Dec. 1971, 61, pp. 773-783.

NERLOVE, M.: "Lags in Economic Behavior", Econometrica, Vol. 40, March 1972, Nov. 2, pp. 221-251.

NEUFELD, E.P.: The Financial System of Canada, It's Growth and Development, Macmillan of Canada, Toronto, 1972.

OSTROY, Joseph M.: "The Informational Efficiency of Monetary Exchange", American Economic Review, Sept. 1973, LXIII, Nov. 4, pp. 1597-1610.

PATINKIN, Don: "The Limitations of Samuelson's 'Correspondence Principle' ", Metroeconomica, 4, August 1952, pp. 37-43.

PATINKIN, Don: Money, Interest and Prices, Harper and Row, 1965.

THEIL, H.: Economic Forecast and Policy, 2nd ed., Amsterdam, North-Holland, 1965.

TOBIN, J.: "Estimation of Relationships for Limited Dependent Variables", Econometrica, 1958, pp. 24-36.

TUCKER, D.: "Macroeconomic Models and the Demand for Money Under Market Disequilibrium", Journal of Money, Credit and Banking, Feb. 1971, pp. 57-83.

SOURCES OF DATA

Alberta Statistical Review, Monthly, published by The Bureau of Statistics, Alberta Treasury.

Annual Budget Speech, presented annually by the Provincial Treasury, Edmonton, Alberta.

Bank of Canada Review, Monthly, Bank of Canada, Ottawa.

Consolidated Revenue Funds: Statements of Cash Transaction and of the End of Month Cash Position, Monthly, Alberta Budget Bureau, Treasury Department, Edmonton, Alberta.

Public Accounts of the Province of Alberta, Annual, printed by Printer to the Queen's Most Excellent Majesty, Edmonton, Alberta.

Review of Business Conditions, Annual, published by the Department of Industry and Commerce, of the Government of Alberta.

Summary of Receipts and Expenditures, Monthly, Alberta Budget Bureau, Treasury Department, Edmonton, Alberta.

APPENDIX A

Definition of variables

The following notation will be used:

The last letter in each variable's name is either one of these three:

A: for actual,

E: for estimated or expected,

D: for actual minus expected, i.e., A-E.

Variables representing transactions:

Source: Alberta Treasury Department

Period: September 1969 to February 1973

All variables are in thousands of current dollars.

1) [CEE]: Current Expenditures on Education

2) [CEH]: Current Expenditures on Health and Hospital Services

3) [CEO]: Current Expenditures on Goods and Services other than Expenditures on Education and Health and Hospital Services

i.e. [CEO]: [CET] - [CEE] - [CEH]

4) [CET]: Total Current Expenditures on Goods and Services

5) [KET]: Total Capital Expenditures

6) [LIA]: Loans and Advances

7) [SIFX]: Excess Demand for Special Investment Funds' financial instruments, defined as: [SIFP - SIFS]

where

[SIFP]: Purchases of SIF instruments

[SIFS]: Sales of SIF instruments

8) [PBS]: Total Provincial Borrowing, including all direct borrowing, i.e., market borrowing, non-market borrowing (v.g. Canada Pension Fund) and bank borrowing

9) [BMC]: Beginning-of-month Cash

10) [EMC]: End-of-Month Cash

11) [BMD]: Beginning-of-month Stock of Debt

12) [EMD]: End-of-month Stock of Debt

13) [BMSL]: Beginning-of-month Stock of Loans and Advances

14) [EMSL]: End-of-month Stock of Loans and Advances

15) [BMSIF]: Beginning-of-month Stock of Special Investment Fund Securities

16) [EMSIF]: End-of-month Stock of Special Investment Fund Securities

17) [REDD]: Debt Redemption

18) [REDL]: Repayment of Loans and Advances

19) [REDSIF]: Redemption of Special Investment Fund Securities

20) [TBR]: Total Budgetary Revenue

Other variables:

21) TREND : Trend variable, September 1969: 1,... February 1973: 42.

22) Dummy variables for seasonal adjustment are noted by the first three letters of the name of each month; v.g. JAN for January, equals one if the observation corresponds to January and equals zero if the observation does not correspond to January.

23) FEXRA : Exchange rate between the Canadian and the American dollar, i.e., Canadian cents per unit of U.S. dollars, Average noon rates, Spot,

Source: Bank of Canada Review, Ottawa, Monthly.

24) FEXRE : Expected exchange rate between the U.S. and the Canadian dollar, defined as the average of the actual values

25) FEXRD : The difference between the actual and the expected exchange rate: FEXRA - FEXRE

26) IR3A5A : Average bond yields on the 3 to 5 years Government of Canada securities

Source: Bank of Canada Review
Ottawa, Monthly

27) IR3A5E : Expected bond yield on the 3 to 5 years Government of Canada securities, defined as the average of the actual values of the actual bond yield in the past 12 months

28) IR3A5D : The difference between the actual and the expected bond yield, defined as: IR3A5A - IR3A5C

29) KETDL : Capital expenditures lagged one month: KETD(-1)

30) KETDLL : Capital expenditures lagged two months: KETD(-2)

31) LIAE* : Trend value of planned loans and advances estimated by the following equation:

LIAE*: 864.1684 + 56.999918 (TREND)
(2.17) (3.5356)

R^2: .2381 S.E.E.: 1266.39

D.W.: 1.48

32) RLIAE : (LIAE - LIAE*) deviation of planned loans and advances from their trend value.

33) CEQE* : Trend value of current expenditures on goods and services other than education and health and hospital services.

It is estimated as:

CEOE*: 29706.17 + 419.68 (TREND)
(7.32) (2.55)

R^2: .1401 S.E.E.: 12911.4

D.W.: 1.6552

34) RCEOE : (CEOE - CEOE*) deviation of planned current expenditures on other goods and services from their Trend estimated value.

(35) TBRDL : Total Budgetary Revenue lagged one month: TBRD(-1)

(36) DUM_1 : A dummy variable which takes a value of one in June and July 1970 but which is zero in all other periods.

(37) DUM_2 : A dummy variable which takes the value of one in September 1971 but which is zero in all other periods.

(38) DUM_3 : A dummy variable which takes the value of one in November 1972 and zero in all other periods.

APPENDIX B

THE SIMULATION MODEL

[CEOD] = -7136.65439 + .08898 [TBRD] - .48429 [CEED]
(-4.37) (.710) (-3.68)

+ .06323 [BMCD] + 11455.7135 [MAR] + 8961.344 [MAY]
(2.963) (2.69) (2.271)

+ 12747.1694 [JUNE] + 9299.339 [JULY]
(2.998) (2.39)

+ 8822.84 [AUG] - .3479 [RCEOE]
(2.336) (-3.68)

$\bar{R}^2$ = .677 n = 42
D.W. = 1.791 S.E.E. = 6122.75

[CEHD] = 7561.7246 + .019748 [TBRD] + .03175179 [CEED]
(5.21) (.864) (.974)

- .0749118 [CEOD] - .1295 [BMSLD] + .02903 [BMDD]
(-1.40) (-1.387) (1.346)

- 284.671 [TREND] + 2670.112 [NOV]
(-4.256) (1.492)

$\bar{R}^2$ = .516 n = 42
D.W. = 1.42 S.E.E. = .3026

[KETD] = -3055.7337 + .12683 [TBRD] - .03017 [CEED]
(-2.554) (1.499) (-.252)

- .024405 [CEOD] - .0781823 [CEHD] + .13764 [TBRDL]
(-.256) (-.42305) (1.657)

- .45664 [KETDL] + .2886 [KETDLL]
(-2.711) (1.750)

$\bar{R}^2$ = .5116   n = 40

D.W. = 2.06   S.E.E. = 4261

[PBSD] = -33244.649 - .4465559 [BMCD] - 5.6159 [BMSLD]
(-2.98) (-3.04) (-3.4)

(Estimated by Maximum Likelihood)

[LIAD] = -1286.373 - .03124 [TBRD] + .01185 [CEED]
(-2.35) (-.897) (.266)

+ .08090 [CEHD] - .0829 [CEOD] + .00479 [KETD]
(1.120) (-1.96) (.198)

+ .06730 [PBSD] + .02423 [BMCD] - .9769 [RLIAE]
(2.627) (3.75) (-3.591)

$\bar{R}^2$ = .50   n = 42

D.W. = 2.67   S.E.E. = 1912.26

[SIFXD] = - 729.70 - .04104 [TBRD] - .09876 [CEED]
(-.588) (-1.0) (-1.469)

- .05445 [CEOD] + .07901 [CEHD]
(-1.079) (.7961)

+ .029842 [KETD] - .013107 [PBSD] + .09912 [LIAD]
(.4553) (-.502)

+ 310.4252 [FEXRD] - 1312.95 [1R3A5D]
(2.102) (-2.192)

- .082558 [BMSIFD] + 8414.35 [DUM_1]
(1.928) (4.949)

+ 7137.35 [DUM_2] - 14050.8842 [DUM_3]
(3.20) (-6.048)

$\bar{R}^2$ = .8072 n = 41
D.W. = 2.434 S.E.E. = 2058

[EMCD] = [BMCD] + [TBRD] - [CEED] - [CEOD] - [CEHD] - [KETD] + [PBSD] - [LIAD] - [SIFXD] + [REDSIFD] + [REDLD] - [REDDD]

[EMDD] = [BMDD] + [PBSD] - [REDDD]

[EMSLD] = [BMSLD] + [LIAD] - [REDLD]

[EMSIFD] = [BMSIFD] + [SIFXD] - [REDSIFD]

APPENDIX C

SIMULATION RESULTS

TABLE C.1

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN (TBRD) IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		KETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	.089		.013		.124		0.0		-.037	
July 72	.143	.054	.014	.001	.203	.080	-.174	-.174	-.032	.005
August 72	.177	.034	.010	-.003	.202	-.001	-.234	-.059	-.026	.006
Sept. 72	.205	.028	.005	-.005	.226	.023	-.283	-.049	-.021	.005
Oct. 72	.226	.021	-.002	-.007	.21[illegible]	-.011	-.313	-.030	-.018	.004
Nov. 72	.245	.019	-.010	-.008		.012	-.347	-.034	-.015	.003

PERIOD	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	-.045		.856		-.037		0.0		-.045	
July 72	-.039	.006	1.392	.536	-.069	-.032	-.174	-.174	-.084	-.039
August 72	-.036	.002	1.832	.439	-.095	-.026	-.408	-.234	-.120	-.036
Sept. 72	-.034	.003	2.168	.337	-.117	-.021	-.691	-.283	-.154	-.034
Oct. 72	-.032	.001	2.467	.298	-.134	-.018	-1.004	-.313	-.186	-.032
Nov. 72	-.030	.002	2.704	.237	-.149	-.015	-1.351	-.347	-.216	-.030

TABLE C.2

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN [CEED] IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		KETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	-.484		.068		-.024		0.0		.057	
July 72	-.519	-.035	.063	-.005	-.012	.012	-.074	-.074	.042	-.016
August 72	-.557	-.037	.059	-.005	-.023	-.011	-.043	.031	.032	-.010
Sept. 72	-.589	-.032	.056	-.003	-.013	.010	.002	.045	.025	-.007
Oct. 72	-.616	-.027	.054	-.001	-.020	-.007	.053	.050	.020	-.005
Nov. 72	-.638	-.022	.055	.001	-.014	.006	.092	.039	.017	-.004
	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	-.062		-.555		.057		0.0		-.062	
July 72	-.056	.006	-1.148	-.592	.099	.042	-.074	-.074	-.118	-.056
August 72	-.051	.005	-1.650	-.503	.131	.032	-.117	-.043	-.169	-.051
Sept. 72	-.046	.005	-2.081	-.430	.156	.025	-.115	.0[illegible]2	-.215	-.046
Oct. 72	-.042	.004	-2.425	-.344	.176	.020	-.062	.053	-.257	-.042
Nov. 72	-.038	.004	-2.714	-.290	.193	.017	.030	.092	-.296	-.038

TABLE C.3

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN [CEOD] IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		KETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	1.000		-.075		-.019		0.0		-.089	
July 72	.953	-.047	-.060	.015	-.010	.008	.834	.834	-.046	.043
August 72	.957	.004	-.030	.030	-.022	-.012	1.063	.229	-.027	.019
Sept. 72	.972	.016	.003	.033	-.017	.005	1.104	.041	-.017	.010
Oct. 72	.986	.014	.036	.033	-.025	-.008	1.102	-.002	-.010	.007
Nov. 72	.996	.010	.069	.033	-.023	.002	1.087	-.015	-.005	.005

PERIOD	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	-.070		-.748		-.089		0.0		-.070	
July 72	-.067	.003	-.684	.064	-.135	-.046	.834	.834	-.136	-.067
August 72	-.060	.006	-.439	.245	-.162	-.027	1.897	1.063	-.197	-.060
Sept. 72	-.053	.007	-.223	.216	-.179	-.017	3.002	1.104	-.250	-.053
Oct. 72	-.046	.007	-.061	.162	-.189	-.010	4.104	1.102	-.296	-.046
Nov. 72	-.040	.007	.029	.090	-.194	-.005	5.190	1.087	-.336	-.040

TABLE C.4

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN [CEHD] IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		KETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	0.0		1.000		-0.078		0.000		0.081	
July 72	-.069	-.069	0.995	-0.005	-0.040	0.038	0.033	0.033	0.062	-0.019
August 72	-.132	-.063	0.992	-0.002	-0.078	-0.038	0.130	0.069	0.049	-0.013
Sept. 72	-.181	-.049	0.993	0.001	-0.049	0.029	0.200	0.070	0.039	-0.010
Oct. 72	-.223	-.042	0.997	0.004	-0.073	-0.024	0.279	0.079	0.032	-0.007
Nov. 72	-.256	-.033	1.004	0.006	-0.053	0.020	0.330	0.051	0.026	-0.006

PERIOD	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	0.085		-1.087		0.081		0.000		0.085	
July 72	0.080	-0.005	-2.081	-0.994	0.142	0.062	0.033	0.033	0.164	0.080
August 72	0.073	-0.007	-2.856	-0.775	0.192	0.049	0.163	0.130	0.237	0.073
Sept. 72	0.069	-0.004	-3.528	-0.672	0.231	0.039	0.363	0.200	0.306	0.069
Oct. 72	0.063	-0.0[illegible]5	-4.046	-0.518	0.263	0.032	0.641	0.279	0.369	0.063
Nov. 72	0.059	-0.004	-4.496	-0.451	0.289	0.026	0.971	0.330	0.428	0.059

3 OF/DE 3

TABLE C.5

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN [KETD] IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		KETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	0.000		0.000		1.000		0.000		0.005	
July 72	-0.065	-0.065	0.004	0.004	0.545	-0.455	0.435	0.435	0.013	0.008
August 72	-0.070	-0.005	0.016	0.011	1.040	0.496	0.398	-0.038	0.012	-0.001
Sept. 72	-0.110	-0.040	0.029	0.013	0.683	-0.358	0.611	0.214	0.014	0.002
Oct. 72	-0.111	-0.001	0.045	0.016	0.988	0.305	0.543	-0.068	0.012	-0.002
Nov. 72	-0.137	-0.026	0.061	0.016	0.745	-0.243	0.664	0.121	0.012	0.000

PERIOD	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	0.030		-1.035		0.005		0.000		0.030	
July 72	0.013	-0.017	-1.109	-0.074	0.017	0.013	0.435	0.435	0.044	0.013
August 72	0.028	0.015	-1.738	-0.629	0.029	0.012	0.833	0.398	0.072	0.028
Sept. 72	0.016	-0.012	-1.758	-0.020	0.043	0.014	1.444	0.611	0.088	0.016
Oct. 72	0.010	-2.173	-0.416	0.055	0.012	0.012	1.987	0.543	0.114	0.026
Nov. 72	-0.018	-0.008	-2.207	-0.034	0.066	0.012	2.651	0.664	0.131	0.018

TABLE C.6

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN [PBSD] IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		KETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	0.000		0.000		0.000		1.000		0.067	
July 72	0.059	0.059	0.016	0.016	-0.003	-0.003	0.203	-0.797	0.033	-0.035
August 72	0.066	0.006	0.017	0.001	-0.002	-0.001	-0.025	-0.228	0.019	-0.013
Sept. 72	0.058	-0.008	0.014	-0.003	-0.003	-0.001	-0.078	-0.053	0.013	-0.006
Oct. 72	0.047	-0.010	0.011	-0.003	-0.001	0.001	-0.080	-0.002	0.010	-0.003
Nov. 72	0.038	-0.009	0.008	-0.003	-0.002	-0.000	-0.069	0.011	0.007	-0.002

PERIOD	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	-0.006		0.929		0.067		1.000		-0.006	
July 72	-0.001	0.005	1.037	0.098	0.100	0.033	1.203	0.203	-0.007	-0.001
August 72	0.001	0.002	0.911	-0.126	0.119	0.019	1.178	-0.025	-0.007	0.001
Sept. 72	0.001	0.000	0.750	-0.161	0.133	0.013	1.100	-0.078	-0.006	0.001
Oct. 72	0.001	-0.000	0.602	-0.148	0.142	0.010	1,020	-0.080	-0.005	0.001
Nov. 72	0.001	-0.000	0.481	-0.122	0.150	0.007	0.951	-0.069	-0.005	0.001

TABLE C.7

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN [LIAD] IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		KETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	0.000		0.000		0.000		0.000		1.000	
July 72	-0.069	-0.069	-0.124	-0.124	0.011	0.011	-5.125	-5.125	0.624	-0.376
August 72	-0.429	-0.359	-0.327	-0.203	0.031	0.019	-6.093	-0.968	0.435	-0.189
Sept. 72	-0.802	-0.373	-0.532	-0.205	0.050	0.020	-5.898	0.196	0.319	-0.116
Oct. 72	-1.120	-0.317	-0.721	-0.189	0.070	0.019	-5.450	0.448	0.239	-0.080
Nov. 72	-1.372	-0.252	-0.891	-0.170	0.086	0.016	-5.012	0.438	0.179	-0.060

PERIOD	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	0.099		-1.099		1.000		0.000		0.099	
July 72	0.115	0.016	-6.781	-5.682	1.624	0.624	-5.125	-5.125	0.214	0.115
August 72	0.104	-0.011	-12.688	-5.907	2.059	0.435	-11.218	-6.093	0.318	0.104
Sept. 72	0.086	-0.018	-17.707	-5.019	2.378	0.319	-17.116	-5.898	0.404	0.086
Oct. 72	0.068	-0.018	-21.692	-3.986	2.617	0.239	-22.566	-5.450	0.472	0.068
Nov. 72	0.051	-0.017	-24.758	-3.066	2.797	0.179	-27.578	-5.012	0.523	0.051

TABLE C.8

DYNAMIC MULTIPLIERS AND CHANGES IN THE DYNAMIC MULTIPLIERS WHEN [SIFXD] IS CHANGED BY 100 THOUSAND DOLLARS

PERIOD	CEOD		CEHD		RETD		PBSD		LIAD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	0.000		0.000		0.000		0.000		0.000	
July 72	-0.063	-0.063	0.005	0.005	0.001	0.001	0.447	0.447	0.011	0.011
August 72	-0.090	-0.027	0.018	0.013	0.000	-0.001	0.572	0.125	0.013	0.001
Sept. 72	-0.103	-0.013	0.034	0.016	0.000	-0.000	0.594	0.022	0.012	-0.001
Oct. 72	-0.111	-0.008	0.50	0.016	-0.001	-0.001	0.583	-0.011	0.010	-0.002
Nov. 72	-0.116	-0.005	0.066	0.016	-0.002	-0.001	0.562	-0.021	0.008	-0.002

PERIOD	SIFXD		EMCD		EMSLD		EMDD		EMSIFD	
	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change	Dynamic	Change
June 72	1.000		-1.000		0.000		0.000		1.000	
July 72	0.917	-0.083	-1.424	-0.424	0.011	0.011	0.447	0.447	1.917	0.917
August 72	0.842	-0.075	-1.636	-0.212	0.024	0.013	1.018	0.572	2.758	0.842
Sept. 72	0.774	-0.068	-1.759	-0.123	0.036	0.012	1.612	0.594	3.532	0.774
Oct. 72	0.712	-0.062	-1.835	-0.077	0.046	0.010	2.195	0.583	4.244	0.712
Nov. 72	0.655	-0.057	-1.885	-0.050	0.054	0.008	2.756	0.562	4.899	0.655