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THE PERSISTENCE EFFECTS OF MONETARY SHOCKS VIA INVENTORY ADJUSTMENTS :

THE CANADIAN EVIDENCE

by

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THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in the Department

of

Economics

SIMON FRASER UNIVERSITY

11 December, 1987

ISBN 0-315-48836-0

APPROVAL

Name: Anjum Siddiqui

Degree: Ph.D. (Economics)

Title of Thesis: The Persistence of Monetary Shocks via Inventory Adjustments: The Canadian Evidence

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ACKNOWLEDGEMENTS

I am grateful for the support and assistance received from the thesis committee through various stages of the preparation of this thesis.

ACKNOWLEDGEMENTS

I would like to extend my thanks to my family and friends without whose financial and emotional support it would have been very difficult to complete my Ph.D.

Special thanks are due to my mother, my brother Tafahum, and my sister Parveen for their support and assistance.

I would also like to express my sincerest gratitude to Naghmeh Tavakoli and Joanna Koczwarski for excellent ancillary research assistance and text editing. Their good cheer and encouragement was indispensable in the completion of my thesis.

My friend Dr. Tariq Rehman deserves special mention for kindling in me the desire to pursue higher studies. His contribution is much beyond the economist's tools of cost benefit analysis.

DEDICATION

To my mother

and

To the dear memory of my beloved father
who did not live to see the fruit of his inspiration

TABLE OF CONTENTS

LIST OF TABLES

page

ABSTRACT

The Blinder and Fischer hypothesis states that inventories are a propagating mechanism which can explain why *serially uncorrelated* monetary shocks can produce *serially correlated* movements in output or business cycles. The proper and complete testing of the hypothesis involves the examination of two neccessary conditions:

(i) monetary shocks should be significant in inventory equations, and

(ii) inventories should be significant in output equations.

The first condition brings out the buffer stock role of inventories and the second condition establishes whether monetary shocks are transmitted to output through inventory fluctuations. These two conditions lead to the *first* and *second stage tests* of the Blinder and Fischer hypothesis that are proposed in the thesis. Both conditions are neccessary, but neither is sufficient to examine the chain starting from monetary shocks and culminating in output fluctuations. Existing empirical studies which test for the persistence–via–inventories hypothesis have two important shortcomings. First, they typically test only one of the two conditions. Second, the definition of inventories used by these studies has been too narrow, including only finished goods inventories and neglecting other types of goods inventories (e.g. raw materials, backorders and goods in process).

The regression results of the first stage tests show that the buffer stock role of inventories is only observed for raw material inventories. In the second stage tests the goods in process, unfilled orders, and raw materials are significant in all industry classifications. However, the persistence effects of monetary shocks can only be attributed to fluctuations in raw material inventories, because this is the only inventory category for which both the necessary conditions of the Blinder & Fischer hypothesis are satisfied. The thesis also finds that there is no evidence for claiming the buffer stock role for finished goods inventories. Thus, the thesis finds that if the definition of inventories is enlarged to include all types of

goods inventories, there is evidence that inventories are a statistically significant channel of propagating the effects of monetary shocks to output.

CHAPTER I

INTRODUCTION AND OBJECTIVES

This chapter introduces the topic of research of this thesis, gives a brief survey of related studies, and outlines the research methodology.

The inclusion of unsold output (inventories) in macroeconomic models significantly changes the traditional conclusions about the effects of monetary policy. Once inventory adjustment is included in the optimising calculus of profit maximising firms, then under some assumptions it can be shown that *serially uncorrelated* monetary shocks can produce *serially correlated* movements in output and other real variables.

Keynesians and Monetarists have long recognised the real effects of unanticipated money. However the latter have generally ruled out serial correlation of output and other real variables. In the Monetarist models real variables are randomly distributed around some steady state levels or "permanent levels" or in more fashionable parlance some "natural levels". Anticipated money only affects nominal variables through its effects on the anticipated rate of inflation, leaving both the real variables as well as their natural levels unchanged. Unanticipated monetary shocks affect current output only but not future outputs because individuals form their expectations of prices and money growth rationally. This is a standard result of rational expectation models and is commonly recognised as the Lucas-Sargent-Wallace (LSW) supply function. However, Blinder & Fischer (1981) showed that by a modification of the LSW supply function this standard result can be changed. In the Blinder & Fischer supply function aggregate output is not only affected by current unanticipated inflation (as in LSW) but also adjusts proportionately to the gap between actual and desired inventories. They show that the inclusion of inventories as a buffer stock in rational expectation models can produce business cycles or serially correlated movements in output due to both unanticipated and anticipated money.

The explicit inclusion of inventories as a decision variable of the firm gives rise to a number of related issues. First, if firms partially accomodate unanticipated shocks by changes in inventories (beside changes in their output levels and prices) and firms adjust inventories only gradually, then is there a production smoothing role for inventories ? Second, if production smoothing is accepted, it follows that prices would be relatively more sticky than they would have been in the absence of inventory adjustments. There could be a number of other factors which contribute to the stickiness of prices e.g. multiperiod labour market contracts or gradual adjustment of the firm's capital stock to its desired levels. The buffer stock role of inventories is however an independent and important channel by itself which explains the observed price stickiness. Third, if decisions about production are dependent on start-of-period inventories, the observed serial correlation of output can be partly attributed to the gradual adjustment of inventories to unanticipated shocks.

This thesis is primarily concerned with the first and third implications of models with inventory adjustment, i.e. production smoothing and persistence. These two implications go hand in hand. If there is no production smoothing role of inventories, then the gradual adjustment of inventories can not explain the observed persistence in output. So testing for persistence via inventories also tests for the production smoothing role of inventories. Production smoothing is possible due to the availability of inventories, thus allowing the firm to change its output slowly (or smooth it) and avoid the rising marginal costs of changing production rapidly to accomodate unanticipated shocks.

The literature on production smoothing is not new and dates back to Metzler (1941), Abramovitz (1950), Lovell (1961, 1967), Mills (1957, 1962) and Holt et al (1960). The concern in these models is with the speed of adjustment of actual to desired inventories. Production smoothing is inferred from the estimated coefficient on desired inventories in inventory demand functions. The slower is the speed of adjustment of inventories to desired levels the greater is the evidence of production smoothing by firms. On the other hand a very high speed of adjustment implies that the effects of unanticipated shocks on inventories can only be felt in the current period. Next period inventories are promptly restored to their desired levels. This simply means that production has not been gradually changed or smoothed.

The literature on the third implication (i.e. persistence due to inventory adjustments) is relatively recent because early rational expectation models could not explain the observed persistence of output and unemployment rates. Later, a few models did make an attempt to come up with plausible explanations of persistence either through changes in capital stock (Lucas, 1975), (Fisher, 1979) or gradual adjustment of the labour stock (Sargent, 1979). Aside from these channels of persistence an important explanation of persistence is through the channel of gradual inventory adjustments by firms. In a series of papers Blinder and Fisher (1981), Cukierman (1981) and Brunner, Cukierman & Meltzer (1983) proposed theoretical models where inventories were the propagating mechanism which converted serially uncorrelated monetary surprises into serially correlated movements in real output and all other real variables. How important is the channel of gradual inventory adjustment in explaining the serial correlation of output? The answer to this question is the focus of this thesis. [1]

There have been relatively few studies which examine empirically the persistence effects of the inventory cycle. Demery & Duck (1984), Gordon (1982), Haraf (1981) and Sheffrin (1981) are the notable exceptions. The results of these studies are mixed and there is no concensus that all the persistence found by Barro (1977, 1978), Wogin (1980) and Atfield et al (1981, 1983) is attributable to inventory adjustments. Moreover these studies on persistence are done either on the U.S. or U.K. economies and there does not appear to have been any study done on Canada. This thesis tests persistence–via–inventories for the manufacturing sector of Canada at the disaggregated level of the durable and non–durable goods industries.

[1] We will not make a relative comparision of all the competing theories of channels of persistence, rather test the persistence via inventories itself. The significance (insignificance) of our test results however indirectly shows the unimportance (importance) of other channels of persistence.

The testing of the Blinder & Fischer hypothesis involves an empirical examination of two neccessary conditions; the first is the effects of monetary shocks on inventories, and the second is the effects of inventories on the evolution of output. Both conditions are neccessary and neither is sufficient, hence the testing of both these linkages is important. Ignoring either condition would be an incomplete examination of the chain starting from monetary shocks and culminating in output fluctuations. However empirical studies which test for the persistence–via–inventories hypothesis have typically erred in their approach by testing only for the first or the second condition. These studies can be generally classified as *first stage* or *second stage* tests of the persistence hypothesis. In the first stage tests, finished goods inventories are regressed on current and lagged monetary shocks. If any past shocks are statistically significant, it is naively inferred to be evidence in favour of inventories being the "cause" of persistence of monetary shocks in output equations. The rationale for this inference is that firms hold inventories as a buffer stock against unanticipated shocks (monetary shocks in this thesis). These shocks directly change the buffer stocks of inventories, which in turn influence the time path of a firm's production and inventories. By examining evidence on the first part of the linkage, inferences are drawn about the second part of the linkage. Since the dependent variable is inventories and not output, the results of this test can only be construed to be partial evidence on persistence–via–inventories.

In the second stage tests, output is directly regressed on the variable which transmits the observed persistence of monetary shocks in output equations. This variable is finished goods inventories, the gradual adjustment of which (due to adjustment costs) is the very reason why output does not instantly go back to its desired levels once it is disturbed by an unanticipated shock (monetary or other). The results of the second stage test by themselves cannnot be construed to be conclusive evidence for the hypothesis that buffer stocks of inventories cause persistence of monetary shocks in output equations. If the hypothesis of persistence–via–inventories is to be empirically verified, two conditions have to be satisfied (a) monetary shocks should be significant in inventory equations. (b) inventories should be significant in output equations. If only (a) occurs, **merely** the buffer stock role of inventories is confirmed, and (b) establishes that these buffer stocks transmit the effects of monetary shocks to output.

If (a) does not occur and only (b) occurs then one can still claim the effect of the inventory cycle on the time path of output, however we cannot say that inventories are used as buffer stocks, because inventories may be fluctuating due to other reasons besides buffer stock motives. Finally if only (a) occurs and (b) does not occur then the buffer stock role of inventories is verified, but we cannot claim that inventories transmit these effects of monetary shocks to real variables i.e. output, employment etc.

Thus for the Blinder and Fischer hypothesis to be completely tested, both (a) and (b) have to be examined. The empirical literature has either tested (a) or (b) which is insufficient evidence for their conclusion that inventories transmit the persistence effects of monetary shocks to output equations.

This thesis contributes to empirical research in two ways:

(1) First, it examines the effects of using the generalized multivariate model of inventory investment [2] in the *first stage* on the issue of persistence–via–inventories vis a vis the simple multivariate model of the type that has been used by other authors, e.g. Demery and Duck (1984) for U.K. In the first stage tests the buffer stock role of inventories is generally examined by researchers by narrowly defining inventories to only include finished goods inventories. We have also examined the buffer stock role of *other goods inventories* e.g. raw materials, backorders and goods in process.

(2) Second, it performs a modified *second stage test* of the persistence hypothesis in which output is regressed on inventories. This test uses a different definition of

[2] The generalized multivariate model (Maccini and Rossana, 1985; Maccini, 1984) is discussed at length in Chapter III. The difference between the simple and the generalized multivariate model is that the latter uses a larger set of explanatory variables than the former in the inventory demand function.

inventories from that used by other researchers who have performed the second stage test (Gordon, 1982; Haraf, 1981; Sheffrin, 1981). Generally inventories are classified as finished goods inventories, because it is assumed that all *other goods inventories* carried by the firm, are eventually reflected in the behaviour of finished goods inventories (Eisner and Strotz, 1963). Recent work by Sheehy and Reagan (1985) and older analysis by Darling (1962), Feldstein and Auerbach (1976), shows that these different inventory types do not all move together over the business cycle. Consequently, they should be modelled separately from finished goods inventories and recognised as distinct influences on output. We believe that a proper test of the Blinder & Fischer (1981) hypothesis cannot be done unless *all goods inventory types* (and not merely finished goods inventories) are used as regressors in the output equation.

The remainder of the thesis is arranged as follows: Chapter II concentrates on the theoretical model of Demery & Duck (1984). They integrate the Blinder & Fischer (1981) argument with the Lucas (1973) model, to examine the effects on production of changes in relative prices via changes in inventories. We assert that the test proposed by Demery & Duck are *first stage tests* of the Blinder and Fischer hypothesis. We suggest a version of *second stage tests* of this hypothesis.[3] The derivation of the equations of the second stage test has been done by a simple algebraic manipulation of the Demery and Duck model. In our opinion, by also including the second stage of the linkage we have suggested complete tests of the Blinder & Fischer hypothesis, as opposed to the incomplete tests (through either the first or the second stage) proposed by other researchers.

Chapter III is largely based on the narration of the multivariate models of inventory investment of Maccini and Rossana (1984) and Maccini (1984). The explanatory variables proposed by this model will be used in our estimated equations for inventories (first stage

[3] Second stage tests of the Blinder and Fischer hypothesis have been done before by other researchers (Sheffrin 1981; Haraf 1981, Gordon 1982) but the estimated equations of these models are quite different from our equations.

test) and output (second stage test). The reason for presenting the multivariate model is to discuss the microeconomic rationale of the complete set of explanatory variables used in inventory and output equations. Demery and Duck in their estimations for U.K. used only a small subset of the variables of the generalized multivariate model. If the complete set of variables is the one that is relevant in the firm's decisions, then these variables must be included in the inventory and output equations, otherwise results will be biased due to specification error. It is quite possible that their inclusion may change the inferences made about persistence when only a small subset of expalnatory variables is used, as was done by Demery and Duck. In our results of the generalized multivariable model (see chapter IV), we found that the R^2 of the estimated inventory and output equations did increase significantly. However this improved specification did not change the inferences on persistence that were obtained in the simple multivariate model. In this chapter the equations of the Maccini and Rossana model have been slightly modified to include monetary variables (unanticipated and anticipated shocks) as well as imports, price of capital and the capital stock. The inclusion of monetary variables was neccessary since the estimated coefficients on lags of unanticipated money would give us an idea of the strength and length of this persistence. [4] The role of capital has been discussed at length by Maccini (1984) but in their empirical paper (Maccini & Rossana, 1985), the effects of capital were not examined. In our empirical equations we have tested for capital by using the total capital stock employed in machinery and equipment, building construction and engineering, in the manufacturing sector. [5] Chapter IV presents the regressions of the first stage and second stage tests to evaluate the persistence attributable to inventory adjustments. At the end of each test are the summarized conclusions of those tests.

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[4] Maccini & Rossana (1984) did not include the monetary variables since they were not interested in the issue of persistence and were more concerned with a proper specification for an inventory demand function.

[5] I am aware of only one study by Bryant (1981), where capital was explicitly included in the inventory equations, but the difference between Bryant and our equation is the simultaneous inclusion of the persistence variable (i.e. monetary shocks) beside the capital stock and other relevant variables mentioned in the multivariate inventory adjustment model.

Chapter V concludes the findings of this thesis and presents suggestions for further research. We found that the combined results of the first and second stage tests allow us to conclude that the Blinder and Fischer hypothesis is validated for Canada, when the appropriate definition of inventories is goods inventories other than finished goods inventories. Chapter VI outlines the procedure for the construction of some time series data on key variables which was not available in published form. This study would not have been possible had this crucial data not been constructed. All the estimates have been done with seasonally adjusted data, because raw data was not available for a number of variables.

CHAPTER II

INVENTORY ADJUSTMENT AND PERSISTENCE IN REAL VARIABLES

Introduction

Generally in rational expectation models deviations of current output from trend can only be explained in terms of current unanticipated inflation. Any other past variables, e.g. past monetary shocks, should not be statistically significant since they were already part of the information set available at the end of last period, and their influence is incorporated in yesterday's expectations of today's prices. In direct contrast to the predictions of theoretical models, a number of empirical studies; Barro (1977), Wogin (1980), Atfield, Demery & Duck (1981), Atfield & Duck (1983), have found lagged monetary surprises influencing current output. How can we explain the significance of lagged monetary surprises or the serial correlation in output ? There could be many mechanisms producing the observed serial correlation in output in rational expectation models. For example, Lucas (1975) has shown that by accounting for capital stock in the model, unanticipated inflation affects current output and thereby future capital stocks. Fischer (1979) employs a similar growth model and stresses the timing of the persistence effects of anticipated money on output. Sargent (1979) shows that the serial correlation of the natural rate of output would be observed in economies where firms gradually adjust their labour stock in the face of rising adjustment costs. Intertemporal substitution between consumption and production is another cause of persistence in real variables (Long & Plosser, 1983). Lilien (1982) attributes persistence in output and unemployment to increased dispersion in the shifts to technology, and tastes.

In this thesis we are solely concerned with the role of inventory adjustment in producing these business cycles. Blinder and Fischer (1981), Cukierman (1981), Brunner, Cukierman and Meltzer (1983), Amihud and Mendelson (1981) have all shown with varying assumptions that the inventory cycle is highly correlated with the real variable cycle. Of the above mentioned papers the paper by Blinder and Fischer became more prominent just because it incorporated instantaneous price adjustments[1] and still obtained the result of serial correlation of output. Their hypothesis is that an unanticipated positive (negative) shock is accomodated by the firms through both increases (decreases) in output as well as decreases (increases) in inventories. In the presence of positive costs of shifting production and carrying inventories, firms gradually restore inventories to their equilibrium (desired) levels. Consequently output remains above (below) its steady state level until such time that inventory equilibrium is achieved. Thus the Blinder and Fischer (B & F) model can be generally described as a two stage model of persistence. In the first stage unanticipated shocks affect inventory levels and in the second stage inventories affect output levels.

This chapter is organised in two main parts. In the first part the Demery & Duck (1984) model[2] is presented and evaluated. In this model production and inventory decisions are expressed in terms of current and lagged monetary surprises. D & D then tested their inventory equation for the U.K. to provide evidence for the persistence-via-inventories hypothesis. I shall refer to the D & D approach as the *first stage test* of the B & F hypothesis. D & D stopped short of the complete testing of the B & F hypothesis. Therefore, using the D & D model, I have derived the theoretical equations for output expressed as a function of current and lagged inventories. These equations were not derived by D & D but are subsumed in their model. These equations constitute the *second stage tests* in which the effects of inventories on output are examined. Together the first and second stage tests follow the linkage from monetary disturbances through inventories to output. In the second part of the chapter the functional specification of the empirical equations has been discussed. These specifications form the basis of the linear empirical equations (6 and

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[1] The other papers assumed that prices were preset by monopoly firms period by period but not within the period.

[2] The model incorporates the key features of the Lucas (1972, 1973) and Blinder & Fischer (1981) models of firm behaviour.

7) of chapter III, that were eventually estimated in chapter IV.

THE DEMERY & DUCK MODEL

Assume a Phelps–Friedman economy with many islands which can be understood as different markets. In a world of imperfect information expectations are formed rationally and market participants utilise all information currently available to them. They know only the nominal prices of the good in their market and not in other markets. They also do not know the aggregate price level but form expectations about it on the basis of information available in their market.

In the presence of unsold output, production differs from sales by the change in inventories. Sales are determined by the locally perceived relative price. These two features of the model are represented by the following equations.

$$Y^s_t(x) = \beta_0 + \beta_1(p_t(x) - E_x P_t) \qquad (1)$$

$$Y^p_t(x) = Y^s_t(x) + \{ N_t(x) - N_{t-1}(x) \} \qquad (2)$$

where $Y^s_t(x)$ and $Y^p_t(x)$ are the level of sales and production in market (x), $p_t(x)$ is the log of the price of the good in market (x) and $E_x P_t$ is the log of expectation formed in market (x) of the aggregate price level. $N_t(x)$ is the level of inventories held by suppliers of the x^{th} good at the end of period t or begining of period t+1.

Firms hold inventories as buffer stocks to meet unexpected changes in demand. Inventories are restored only gradually when disturbed from their optimal levels, because of positive costs of adjustment. The inventory demand function of a firm is given by:

$$N_t(x) = \lambda N^*_t(x) + \sum_{i=1}^{n} \gamma_i \; N_{t-i}(x) - \phi(p_t(x) - E_x P_t) \qquad (3)$$

$$0\le \lambda \le 1 \quad 0\le \gamma_i \le 1 \quad \phi \ge 0 \quad \sum_{i=1}^{n}\gamma_i = 1-\lambda$$

where $N^*_t(x)$ is the long run desired level of inventories. λ is an adjustment parameter of actual to desired inventories. Inventories at the end of period t are a linear function of desired inventories and current unanticipated inflation ($p_t(x)-E_x P_t$). Since each period's ending inventories are partly determined by start-of-period inventories, considering some finite past justifies the inclusion of the second term in (3).

Unanticipated inflation will lead a profit maximising firm to to increase both sales and production, but the sales response would be greater thereby reducing next period's starting inventories (or this period's ending inventories $N_t(x)$). The sales response is greater than production because the firm is faced with a dual decision. It has to decide how much to produce for inventories today and how much to withdraw from inventories for sale. If tomorrow's perceived relative price is independent of today's relative price and also production costs are not affected, then it is more beneficial to sell today than tomorrow. Hence the increase in sales is greater than the increase in production, so inventory carryover falls.

In (3) if γ_i is unconstrained then we do not get a precise *a priori* pattern on the way lagged monetary surprises influence current output. We can impose a pattern by assuming the quadratic cost of adjustment function, i.e. γ_1 equals $1-\lambda$ and $\gamma_2 = \gamma_3 ... = \gamma_n =$ 0. The imposition of this constraint is not dictated by the model, it is a device to reduce the number of terms in the final solution associated with γ_2 to γ_n. The general solution without the constraint will still have the same results with respect to persistence.

Desired inventories have been specified in the literature to depend on expected sales and expected inventory carrying costs. Since the firm is a profit maximizer it wants to maximize the expected discounted present value of its real profits. This discounting suggests the introduction of the real interest rate as an explanatory variable in the desired inventory function. However following Blinder and Fischer (1981), nominal and hence real interest rates would be suppressed from the model. Their inclusion would merely increase the algebraic complications. In spite of this simplification one can still show the principal result that *serially uncorrelated* monetary surprises can produce *serially correlated* output movements. [3]

Desired inventories are simply assumed to depend on some constant η and the expected inflation rate as viewed from market (x). The constant term reflects some desired positive level of inventories which a firm would like to hold to prevent stockouts. The higher the expected inflation the more would be the desired inventories of a firm. This is so because higher expected inflation erodes the future rate of return on money holdings or increases the relative rate of return on holding inventories.[4]

$$N^{*}_{t}(x) = \eta - \delta\{ p_t(x) - E_x P_{t+1}\} \qquad \delta \geq 0 \tag{4}$$

Demand in market (x) is assumed to depend on the locally perceived real money balances and relative price as well as a market specific relative demand disturbance.

$$Y^{d}_{t}(x) = \alpha_0 + \alpha_1\{ M_t - E_x P_t\} - \alpha_2\{ p_t(x) - E_x P_t \} + \epsilon^{d}_{t}(x) \tag{5}$$

where $Y^{d}_{t}(x)$ is the local demand in market (x). M_t is the log of the money stock and $\epsilon^{d}_{t}(x)$ is a serially uncorrelated random shock in market (x) with zero mean and constant variance σ^2_t.

Finally the money supply is governed by the following simple feedback rule which is known by economic agents,

$$M_t = M_{t-1} + g + u_t \tag{6}$$

[3] For a model which does not suppress real interest rates and still gives the same result see Cukierman (1981).

[4] The implicit assumption is that it is a two asset model, i.e. a nominal asset money, and a real asset, goods inventories.

where g is a known constant and u_t is a random shock to the money supply with zero mean and constant variance σ_u^2.

The above model is now used to first solve for equilibrium prices for market (x) and then expressions are derived for aggregate prices and output for the whole economy. Prices in each local market (x) adjust fully and instantaneously to equate local demands and supplies (sales). Equating (1) and (5) and substituting for M_t from (6) we get the following reduced form expression for prices in the x^{th} market.

$$p_t(x) = \frac{1}{\alpha_2 + \beta_1} \{ \alpha_0 + \alpha_1 g + \alpha_1 u_t + (\alpha_2 + \beta_1 - \alpha_1) E_x P_t + \epsilon_t^d(x) \} \quad (7)$$

The suppliers in each market (x) would like to know whether the nominal price in their market is high due to a positive aggregate demand shock u_t or relative demand shock $\epsilon_t^d(x)$. They would respond differently in the two cases. Since a change in u_t equally increases nominal prices in all markets (x) and sales are dependent only on relative prices of their goods (as perceived in market (x)) therefore firms would not like to change sales if u_t changes. Sales would be increased only if relative demand changes in the x^{th} market.

Firms can observe increases in their nominal prices but they do not know the source of these price changes. However they do know the composite disturbance $\alpha_1 u_t + \epsilon_t^d(x)$. Once they observe the price they are in fact observing the composite disturbance. This would be clear if we rewrite (7) in the following way

$$p_t(x) - \frac{1}{\alpha_2 + \beta_1} \{ (\alpha_0 - \beta_0) + \alpha_1 M_{t-1} + \alpha_1 g + (\alpha_2 + \beta_1 - \alpha_1) E_x P_t \} = \frac{1}{\alpha_2 + \beta_1} \{ \alpha_1 u_t + \epsilon_t^d(x) \} \quad (7)'$$

All the left hand side variables are known to market participants in the x^{th} market. They know the price in their market, the values of the coefficients of the model, the components of the monetary feedback rule m_{t-1} and g and they also know their expectation for the average price level. Since (7') is an equation, knowledge of the left hand side implies knowledge of the right hand side. There is however a signal extraction problem faced by the market participants. They do not know and would like to find out the individual components $\alpha_1 u_t$ and $\epsilon^d_t(x)$ in the composite disturbance term. They can solve their problem by taking the conditional expectation of u_t based on knowledge of the combined disturbance term (k_t). Let us define $k_t = \alpha_1 u_t + \epsilon^d_t(x)$.

Agents know the stochastic specifications of u_t and $\epsilon^d_t(x)$, that is they know the unconditional means and variances. If u_t and k_t are joint normal then the conditional expectation of u_t given k_t is:

$$E [u_t \mid k_t] = \mu_u + \xi \frac{\sigma_u}{\sigma_k(x)} (k - \mu_k)$$

where μ_u, μ_k are the unconditional means, and the correlation coefficient is :

$$\xi = \frac{Cov (u , k)}{\sigma_u \sigma_k} = \frac{E [\{ u - E(u) \} \{ k - E(k) \}]}{\sigma_u \sigma_k}$$

We know the unconditional means $\mu_u = \mu_k = 0$, since by definition u and k are random variables.

$$E [u_t \mid k_t (x)] = 0 + \frac{E [(u) (k)]}{\sigma_u \sigma_k} . \frac{\sigma_u}{\sigma_k} (k)$$

and

$$\begin{aligned} E [(u) (k)] &= E [u (\alpha_1 u + \epsilon(x))] \\ &= E [\alpha_1 u^2 + u \epsilon(x))] \\ &= \alpha_1 E (u)^2 + E(u) . E \{ \epsilon(x) \} \end{aligned}$$

$$= \alpha_1 \sigma_u^2 + E(u) . E \{ \epsilon(x) \}$$

$$E [u_t \mid k_t(x)] = \frac{[\alpha_1 \sigma_u^2 + E(u) . E \{ \epsilon(x) \}] . (k)}{\sigma_k^2} = \frac{\alpha_1 \sigma_u^2}{\sigma_k^2}(k)$$

and

$$\sigma_k^2 = E [k - \mu_k]^2$$
$$= E [k]^2 = E [\alpha_1^2 + 2 \alpha_1 u \epsilon^d(x) + (\epsilon^d)^2]$$
$$= \alpha_1^2 \sigma_u^2 + \sigma_\epsilon^2$$

therefore the expectation of u_t in market (x) is

$$E [u_t \mid k_t (x)] = \frac{\alpha_1 \sigma_u^2}{\alpha_1^2 + \sigma_u^2 + \sigma_\epsilon^2} \{ u_t + \epsilon_t(x) \}$$

Once we aggregate over x markets, the $\epsilon_t^d(x)$ terms drop out because they sum to zero. The economy wide average expectation of u_t is $E(u_t)$ which is the sum of expectations over all markets divided by the number of markets.

$$E (u_t) = \theta^* u_t \tag{9}$$

where

$$\theta^* = \frac{\alpha_1 \sigma_u^2}{\alpha_1^2 + \sigma_u^2 + \sigma_\epsilon^2}$$

The random monetary shock would be more correctly perceived the more the variance of the aggregate demand shock is represented in this model by the variance of the monetary shock u_t. The story behind this is quite simple. If expectations are rational the perceptions of economic agents should be related to the true process determining prices, that is the true liklihood of any unexpected high price being due to a random aggregate demand increase in relative demand. Thus in economies in which random movements in aggregate demand are large and frequent it would be rational for economic agents to attribute the unexpectedly high prices in their markets to increases in aggregate demand. Consequently economic agents would correctly revise upwards their price expectations and not change output. This hypothesis was tested and verified by Lucas (1973) in a multi-country empirical study which found that economies in which the random element in aggregate demand had a high variance were economies in which random movements in aggregate demand had little effect on real output.

Now that the procedure for solving the signal extraction problem has been outlined we can proceed to solve for the aggregate price level equation of the D & D model. Summming $p_t(x)$ over all markets and dividing up by the number of markets we get an expression for aggregate prices. Once again the serially uncorrelated random relative demand terms – the $\epsilon_t(z)$'s would cancel out.

$$P_t = \frac{1}{\alpha_2 + \beta_1} [(\alpha_0 - \beta_0) + \alpha_1 M_{t-1} + \alpha_1 g + \alpha_1 u_t + (\alpha_2 + \beta_1 - \alpha_1) E_t P_t] \quad (10)$$

Equation (10) has a term for expected prices on the right hand side. We can eliminate it by solving (10) by the technique of undetermined coefficients. The method is as follows:

1. Specify a linear conjectured solution for the price level as a function of all the predetermined and exogenous variables.
2. Take the expected value of conjectured prices and substitute that into $E_t P_t$ in (10).
3. Equate the right hand sides of the conjectured solution with (10) and solve for the undetermined coefficients π_i's .
4. Finally substitute these solutions of the π_i's in the conjectured price solution.

The aggregate price level is then given by,

$$P_t = \frac{\alpha_0 - \beta_0}{\alpha_1} + M_{t-1} + g + \frac{\alpha_1 u_t}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1 \theta^*} \tag{11}$$

and aggregate sales are solved from the aggregate version of (1) given by

$$Y^s_t = \beta_0 + \beta_1 (P_t - E_t P_t) \tag{1'}$$

Take expectations of (11) and then subtract it from (11) and substitute in (1)'

$$Y^s_t = \beta_0 + \frac{\beta_1 \alpha_1 (1 - \theta^*) u_t}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1 \theta^*} \tag{12}$$

Aggregate inventories[5] and production are given by

$$N_t = \lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i}$$

$$- \left[\frac{\lambda\delta\alpha_1 + \phi\alpha_1 (1 - \theta^*)}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1\theta^*} - \lambda\delta\theta^* \right] u_t \tag{13}$$

$$Y^p_t = \beta_0 + \lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i} - N_{t-1}$$

$$+ \left[\frac{\alpha_1 (\beta_1 - \phi)(1 - \theta^*) - \lambda\delta\alpha_1}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1\theta^*} + \lambda\delta\theta^* \right] u_t \tag{14}$$

Equations (13) and (14) state that inventories and production are determined by past inventories and current unanticipated aggregate demand shocks, represented in this model by current monetary shocks. The appearance of g in the third term of (14) suggests that production is also affected by an anticipated component of the feedback rule. A deeper

[5]For a solution of the model see the attached Appendix 1 at the end of Chapter II.

inspection would however reveal that this is not correct, g *appears* to be affecting Y^p but in fact the g terms are also incorporated in the N_{t-i} terms and therefore cancel out. This result is obvious if we perform the successive substitutions for the N_{t-i} terms. See equation (16) below. Thus the standard result of the invariance of output to policy parameters is preserved in this model with inventory adjustments.

The same result of the invariance of output to policy parameters can also be shown for steady state output levels. In their paper D & D have not derived this result. However by making some assumptions (given below) this result can be derived. Equations (13) and (14) are not expressions for long run steady state inventory or output levels. Once we substitute N_{t-i} from (13) into (14) we notice that the $\lambda\delta g$ cancels out in (14). This is easily shown if we assume $N_{t-i} = \overline{N}$, $\gamma_i = 1-\lambda$ and $u_t = 0$ for simplicity, and $\overline{N}$ is defined to be some long run constant desired level of inventories.

Then equation (13) is written as:

$$\overline{N} = \lambda\eta + \lambda\delta g + (1-\lambda) N_{t-i}$$

$$\overline{N} = \lambda\eta + \lambda\delta g + (1-\lambda) \overline{N}$$

$$\overline{N} - (1-\lambda) \overline{N} = \lambda\eta + \lambda\delta g$$

$$\lambda\overline{N} = \lambda\eta + \lambda\delta g \tag{13)'}$$

and (14) becomes

$$Y_t^p = \beta_0 + \lambda\eta + \lambda\delta g + (1-\lambda) N_{t-i} - N_{t-1}$$

$$Y_t^p = \beta_0 + \lambda\eta + \lambda\delta g + (1-\lambda) \overline{N} - \overline{N}$$

$$Y_t^p = \beta_0 + \lambda\eta + \lambda\delta g - \lambda \overline{N} \tag{14)'}$$

Substitute $\lambda\overline{N}$ from (13)' into (14)' and notice that the $\lambda\delta g$ cancel out

$$\overline{Y} = Y_t^p = \beta_0 + \lambda\eta + \lambda\delta g - \lambda\eta - \lambda\delta g$$

and output is not dependent on anticipated monetary policy.

FIRST STAGE TEST OF PERSISTENCE

In the Blinder and Fischer model persistence or serial correlation of output is a two stage phènomena. In the first stage the buffer stocks of inventories are affected by unanticipated monetary shocks and in the second stage slowly adjusting inventories influence the time path of output. The specifications for the first stage can be derived by expressing (13) and (14) entirely in terms of current and past monetary surprises by successive substitutions for N_{t-i} in terms of u_{t-i}.[6] This is seen by considering the special case where $\gamma_1 = 1 - \lambda$ and $\gamma_2 = \gamma_3 = ... = \gamma_n = 0$.[7]

$$N_t = \eta + \delta g - \pi_2 u_t - (1-\lambda)\pi_2 u_{t-1} - (1-\lambda)^2 \pi_2 u_{t-2} - .... - (1-\lambda)^s \pi_2 u_{t-s} \quad (15)$$

$$Y^p_t = \beta_0 + \pi_1 u_t + \lambda\pi_2 u_{t-1} + \lambda(1-\lambda)\pi_2 u_{t-2} + \lambda(1-\lambda)^2 \pi_2 u_{t-3} + ... + \lambda(1-\lambda)^s \pi_2 u_{t-s} \quad (16)$$

where

$$\pi_1 = [\ \frac{\alpha_1 (\beta_1 - \phi) (1 - \theta^*) - \lambda\delta\alpha_1}{(\alpha_2 + \beta_1) (1 - \theta^*) + \alpha_1\theta^*} + \lambda\delta\theta^*\ ]$$

and

$$\pi_2 = [\ \frac{\lambda\delta\alpha_1 + \phi\alpha_1 (1 - \theta^*)}{(\alpha_2 + \beta_1) (1 - \theta^*) + \alpha_1\theta^*} - \lambda\delta\theta^*\ ]$$

Equation (15) is referred to as the *first stage test* of the persistence of monetary shocks that is observed when output equations of the type of (16) are estimated. In equations (15) and (16) we observe that output is independent of anticipated monetary policy

[6] For the solutions of (15) and (16) see Appendix 1.

[7] This result would also hold in the general case where $\sum_{i=1}^{n} \gamma_i = 1-\lambda$.

whereas inventories are not. This is because increases in g increase anticipated inflation and thus desired and actual inventories are increased.

The traditional models of rational expectations, <u>without</u> inventory adjustments or other persistence mechanisms invariably state that output is a function of only current monetary surprises. Empirical studies have however found that current as well as *past* monetary surprises are statistically significant in explaining variations in output. In (15) and (16) a theoretical model has finally been specified which has lagged money as an explanatory variable. Recall that models which do not have persistence mechanisms built into them do not have lagged monetary shocks in output equations. This result is commonly known as the Lucas-Sargent-Wallace (LSW) aggregate supply function.

The sign of u_t in the solution equations given above by D & D for N_t and Y_t is ambiguous,' so we cannot say *a priori* if current and lagged monetary surprises would increase or decrease current production and inventory levels. There are three simultaneous influences at work which is seen in the three terms in the numerators of π_1 and π_2 in (15) and (16). These three influences can be described as the perceived relative demand effect, the expected price decrease effect and the expected price increase effect. These are discussed below as (a), (b) and (c) respectively.

(a) The positive influence of positive monetary shocks on production would only take place if firms interpret this to be a relative demand increase for their respective products. The influence on end of period t inventories, N_t, would be negative because firms would be meeting part of the perceived demand increase through inventory depletions. These effects are captured by the terms $\alpha_1(\beta_1 - \phi)(1 - \theta^*)$ and $\phi\alpha_1(1 - \theta^*)$ in the numerators of π_1 and π_2. The value of θ^* determines the accuracy of a firm's expectations towards a

' This ambiguity is not present in the models of B & F (1981) or Brunner et al (1983) or Cukierman (1981). All of these models propose an unambiguous negative effect of positive shocks on inventories.

monetary shock. If $\theta^{*} = 1$, then the firm will not err in interpreting the monetary shock (see equation (9)).

(b) A high perceived current relative price also means that next period firms expect their nominal prices to fall. The high relative price of the current period was perceived by firms to be the result of high (perceived) relative demand. Tomorrow's relative demand is independent of today – ϵ_t^d is a serially uncorrelated, random relative demand shock. So as $E_x P_{t+1}$ falls, desired inventories, N_t^{*}, and consequently end of period t inventories, N_t fall. From (13) we can see that production also falls; these effects on production and inventories are represented by $\lambda \delta \alpha_1$.

(c) A final influence of u_t on production and inventories is captured by the term $\lambda \delta \theta^{*}$. Firms do not know u_t but by knowing the structure of the economy they are aware that increases in u_t will not be matched by equivalent price increases this period (due to misperceptions about u_t and ϵ_t^d). Rather the economy would react by some combination of changes in production and inventories. In the beginning of next period when u_t does become known, nominal prices would be increased[9] reflecting the nominal increase in money supply. This anticipated future scenario means that today's expectations of tomorrow's prices ($E_x P_{t+1}$) are increased. Hence desired inventories, production and consequently actual inventories are increased.

The ambiguity of the effect of u_t on production and inventories could be largely removed if δ, the response coefficient of desired inventories to unanticipated shocks is negligible. Then a positive monetary surprise would increase production and decrease inventories. A positive sign on the coefficient of unanticipated money in the output equation means that the negative effect of a perceived fall in expected inflation on both output and inventories ($\lambda \delta \alpha_1$) will be outweighed by the positive effects of perceived increases in

[9]The firm is not merely a price taker but a price setter with some monopoly power.

relative prices ($\alpha_1 (\beta_1 - \phi)(1-\theta^*)$) and perceived increases in expected inflation ($\lambda\delta\theta^*$). Assuming $\delta=0$ means that expected inflation does not affect desired inventories. This assumption would break the channel proposed by Blinder & Fischer (1981) for anticipated money to affect output. They showed that if inventories are a function of real interest rates and if expected inflation changed real interest rates (due to the Mundell effect) then anticipated monetary growth could affect production. A number of empirical studies have been unable to find the effects of anticipated monetary growth on production. This evidence (which is not unanimous) suggests the possibility of δ being zero or close to zero.

Blinder & Fischer contend that whether unanticipated inflation would have its maximal effect on output in the period that the shock occurs or its effects would be delayed one period later would depend on the relative magnitudes of the coefficients on current and one period lagged inflation in the output equation. Using the notation used by them [10] output deviates from trend by an amount γ due to current inflation and $\gamma\phi \sum_{i=0}^{\infty} \gamma_i (1-\theta)^i$ due to past unanticipated inflations. In their model inventories in any period change by an amount θ of the discrepency between actual and desired inventories, and $\phi \sum_{i=0}^{\infty} (1-\theta)^i$ is the response of actual inventories in period t to current unanticipated inflation.
They say that

> *if unanticipated inflation has a small direct effect on output, so that λ is small, but leads to a large reduction in inventories, so that ϕ is large, then the inventory rebuilding effects of unanticipated inflation on output will predominate, and the maximum effect on output will occur in the period following a given unanticipated increase in the price level.*

In terms of the D & D model the "small direct effect" of unanticipated inflation on output would occur if effects (a) and (c) are slightly larger (not significantly larger) than effect (b). If (a) and (c) are significantly larger than (b) we would see a large direct effect

[10] See Blinder & Fischer (1981), equation (29), p 291. In their paper u_t is not unanticipated monetary shocks but unanticipated inflation.

on output.[11] In the event that (a) and (c) are slightly larger than (b) an unanticipated positive monetary shock would not increase output by much, rather we would see a correspondingly larger effect on inventories which will be greatly depleted in their role as shock absorbing buffer stocks. Consequently next period the inventory rebuilding effects of this shock on output would be stronger. In terms of the Blinder and Fischer model this would translate into a smaller γ and larger ϕ in their equation (29).

SECOND STAGE TEST OF PERSISTENCE

The specification of the B & F test proposed by D & D in (15) is an incomplete way to show the persistence of shocks on production in (16). All we can infer from a test of (15) is that shocks effect inventories. We cannot say whether gradually adjusting inventories propagate the effects of these shocks to output. Thus (15) is merely a representation of the first link of the two stage process. The second stage of the link from shocks to output through inventories can be shown by directly using lagged inventories as the independent variable in the output equation. Such an equation is derived below by an algebraic manipulation of the D & D model.

Production can be derived as a function of current and past inventories as follows: First rewrite equations (13) and (14) as

$$N_t = \lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i} - \pi_2 u_t \qquad (13)$$

$$Y_t^p = \beta_0 + \lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i} - N_{t-1} + \pi_2 u_t \qquad (14)$$

From (13)

$$u_t = \frac{1}{\pi_2} (\lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i} - N_t)]$$

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[11] Refer back to the discussion on p. 21-22 of this chapter.

Substituting u_t in (14) we get,

$$Y_t^p = \beta_0 + \left(1 + \frac{\pi_1}{\pi_2}\right)(\lambda\eta + \lambda\delta g) + \left(1 + \frac{\pi_1}{\pi_2}\right)\sum_{i=1}^{n}\gamma_i N_{t-i} - \left(\frac{\pi_1}{\pi_2}\right) N_t - N_{t-1} \tag{17}$$

Equation (17) can be tested empirically and can be considered as a counterpart to equation (16) with the *lagged monetary shocks* replaced by the *lagged finished goods inventories.* If finished goods inventories are the *only* stock affecting output,[12] then both formulations convey the same information since they are derived from the same system, that is equations (13) and (14). This point is elaborated in the next section where we compare the equations of the two tests.

Once again if the quadratic restriction is imposed, (17) can be reduced in the number of explanatory variables to [13]

$$Y_t^p = \beta_0 + \left(1 + \frac{\pi_1}{\pi_2}\right)(\lambda\eta + \lambda\delta g) - \lambda N_{t-1} + \left(\frac{\pi_1}{\pi_2}\right)\left[(1-\lambda) N_{t-1} - N_t\right] \tag{17)'$$

Equation (17)' is very restrictive empirically since it only allows us the freedom to regress current and one period lagged inventories. Since we are interested in the timing or the length of the persistence effect of inventories on output we will estimate equation (17) to allow for the possibility of more than one period lagged inventories affecting output. In equations of the type given by (17) past inventories provide evidence on the production smoothing role of inventories. The more the past lags that are statistically significant, the more evidence there is on the production smoothing role of inventories.

[12] If production is a joint stock decision then output and consequently finished goods inventories would also be affected by stocks of capital and labour as well as stocks of intermediate goods and stocks of goods produced to order. This implication was first pointed out by Lucas (1967) and then amongst others by Maccini (1984).

[13] See Appendix 1 for the derivation of (17)'.

EMPIRICAL SPECIFICATIONS

First Stage Tests

We have completed the discussion of the theoretical specifications of the first and second stage tests given by equations (15) and (17) respectively. In the following discussion the empirical equations for these two tests are presented and compared.

D & D have done the first stage test by estimating the inventory demand function given by (15), for the U.K. using quarterly data. They first estimated a central bank reaction function and then used the white noise residuals (u_{t-i}) from that to substitute in the inventory demand function to get:

$$N_t = \beta_0 + \beta_1 X_t + \sum_{i=0}^{n} \gamma_i u_{t-i} + \dot{M}_t + v_t \qquad (18)$$

where

N_t are finished goods inventories, X_t is a vector of relevant decision variables which affect inventories, u_{t-i} are lagged monetary shocks, $\dot{M}_t$ is anticipated monetary growth and v_t is a random error term which is uncorrelated with u_{t-i}.

They found that monetary surprises exert a significant negative effect on inventory holdings for about a year. Equations (13) and (15) show that anticipated monetary growth should also affect inventories. This was tested by adding current and four lagged values of actual monetary growth to (18). They found that anticipated money did not affect inventories.

In chapter V we will be testing (18) with basically two specifications of the vector X_t. First, inventories are regressed on a small subset of the explanatory variables which are contained in X_t and then the larger set is used as regressors. In this thesis the first has been referred to as the simple multivariate model and the latter the generalized multivariate model of inventory investment. The reason for first using the simple multivariate model is to make our equations comparable to Demery and Duck. Second, other relevant demand and stock variables of the generalized multivariate model are added to see if this richer specification of the inventory demand function produces any different inferences on persistence than the simple model.

Second Stage Tests

Before we present the empirical equation for the second stage test it is worthwhile to further discuss the theoretical equation (17) of this test. Estimating equation (17) would give us information about the effects of monetary shocks contained in current and past finished goods inventories to explain the observed persistence in output. Finished goods inventories however, are not the only category of inventories worth our consideration. In the durable and non-durable goods industries, firms not only produce output to stock (which is carried as finished goods inventories) but they also produce to order which is reflected in a firm's inventories as unfilled orders. Moreover they carry raw material and intermediate goods inventories. Unanticipated shocks to the economy not only disturb finished goods inventories from their desired levels but also affect all other inventories which the firm carries. This is exactly the implication of the multivariate flexible accelerator model of inventory investment.

The issue of persistance thus cannot be adequately examined without examining the behaviour of these *other goods inventory types* on the current and future output levels. The more the lags of raw material inventories, goods in process inventories and back order inventories that are statistically significant the more the evidence on the persistence hypothesis via inventories. This is *not* the usual way that evidence on persistence is examined. Generally researchers look only at the significance of finished goods inventories (FGIs). This accords well with earlier traditional models in which the production decision was affected by only one buffer stock, i.e. finished goods inventories. However if production is also affected by other buffer stocks (as in the multivariate model), like unfilled orders and raw material inventories, then it is important to include these buffer stocks in examining the issue of persistence.

The effects of a business cycle will be observed incompletely if we merely look at the fluctuations in finished goods inventories. Abramovitz estimated that about 50 per cent of all manufacturing output in the U.S. was produced to order but the inventory of finished goods held against that business constituted only 15 per cent to 25 per cent of all finished goods inventories. That means that goods produced to order were held in inventory either as goods in process inventories (intermediate goods) or in undelivered form as back order inventories or in raw material inventories Thus we have good reasons for including these other inventory types in regressions of output on inventories. The inclusion of these other inventories in the *second stage test* will bring out the relationship between goods produced to order (GPO) and goods produced to stock (GPS) i.e. whether they are substitutes or complements in production.[14] By ignoring the substitutability and complementarity of FGIs (of goods produced to stock) with GPO and intermediate goods one can naively err in believing that the full thrust of a business cycle is visible from fluctuations in FGIs. In the presence of inventory interactions this is clearly a fallacious assumption. If in fact, firms absorb monetary shocks through changes in stocks of *other* goods inventories, this would support Abramovitz's findings that FGIs constitute a relatively small proportion of the total inventories carried by the industry.

If we do not examine the effects of changes in these other inventory types on output we would not be doing justice to the Blinder and Fischer hypothesis. Although the B & F hypothesis was coined in terms of finished goods inventories only, the work of Maccini (1984) and Maccini & Rossana (1984) clearly brings out the importance of these other inventory types in the production decision. We would be committing a deliberate specification error by ignoring the effects of these other inventories on output and possibly erroneously

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[14] Of course these relationships between GPO and GPS are also inferred by doing the first stage test with the multivariate model. See the regression results of chapter V for evidence on this issue.

concluding that the persistence of monetary shocks in output equations is ***not*** propagated through inventories (if the definition of inventories is so narrow as to include FGIs only).

To incorporate the influence of ***other goods inventories*** and other relevant quasi fixed stocks, cost and demand variables, the empirical version of (17) can be written as:

$$Y_t^p = \beta_0 + \beta_1 Z_t + \sum_{i=1}^{n} \gamma_i N_{t-i} + v_t \tag{19}$$

where

Z_t[15] is a vector of variables which directly affect output. It includes other goods inventories besides cost and demand variables. N_{t-i} are finished goods inventories. v_t is a serially uncorrelated random error term with mean zero. It is assumed to be independent of u_t. Equation (19) can now be tested for Canada using a number of specifications for the vector Z_t. This vector contains *all other goods inventories* (except FGIs), and other variables relevant to the firms decision making. We will be testing (19) for manufacturing inventories and shall leave the retailers and wholesalers inventories for future research.

Note that (18) and (19) both claim to test for persistence in output. D & D claim that by subjecting (18) to an empirical test they have shown that "serially uncorrelated monetary shocks can produce serially correlated movements in output". It is our contention that this claim is incorrect because the dependent variable in (18) is inventories and not output. The argument used by D & D is that monetary shocks disturb the buffer stocks of finished goods inventories, and if one **assumes** on the basis of some theoretical models like B & F (1981) and D & D (1984) that inventories in turn affect output, then the chain from monetary shocks to output is completed. One can then say that indeed inventories are the channel which explain the effects of past monetary shocks on output. Note that by merely assumming Y = f(N) and not in fact testing (empirically) that they are related, one

[15] The vectors X_t and Z_t are not equivalent, although a number of explanatory variables in both vectors are common, since the output decision also determines inventories. However there are certain costs which are inventory specific, e.g. inventory carrying costs. These costs are excluded from Z_t.

has not in fact tested for persistence-via-inventories. This is the central contention of the second stage test.

Testing (18) would only bring out the buffer stock role of inventories. We would still not be able to comment whether these inventories are the channel by which the effects of the monetary shocks are transmitted to output. The latter effects can only be established by doing the second stage test in which output is regressed on inventories. If there are no other influences on output and inventories besides monetary surprises, and inventories are the <u>only</u> channel by which past monetary surprises affect current and future output, then the two regressions (18) and (19) are similar ie. they should have similar R^2s, same magnitude of coefficients and similar lag length, barring sampling error.[16] In other words they carry the same information. This means that if we regress

$$Y_t = f (Z_t , N_{t-i} , u_{t-i}) \qquad (19)'$$

the additional terms u_{t-i} should be statistically insignificant, ie. they should carry no <u>further</u> information than is already embedded in past inventories. Equation (19)' would be a good way to test for the strength of the inventory channel as the major channel by which past monetary (as well as real) shocks affect production levels. If the u_{t-i} turn out to be statistically significant [17] this suggests that there are other channels by which past monetary shocks can be transmitted to affect current and future output. For example, unanticipated

[16] The regressions (18) and (19) could be *exactly equivalent* if N_t and Y_t are perfectly correlated. Even if there are no other influences on N_t and Y_t besides monetary surprises, and inventories are the only channel by which past monetary surprises affect current output, the presence of inventory holding costs may prevent the perfect correlation of N_t and Y_t. Moreover firms switch between LIFO and FIFO methods of inventory valuation which would also prevent the perfect correlation of inventories and output. Thus the results of (18) and (19) could at best be *similar* but not exactly equivalent. This comment however does not affect the inferences about u_{t-i} discussed in (19)'.

[17]Haraf (1981) estimated a formulation similar to (18)' and found that u_{t-i} terms were significant for the U.S. Thus the study showed the importance of other causes besides inventories. There is however an obvious difference in the model specifications of Haraf and this thesis.

money causes unanticipated changes in capital stock which in turn affects output.

One may question the possible inclusion of Z_t in the presence of past finished goods inventories (N_{t-i}). It can be argued that past FGIs already incorporate in them the influence of the vector X_t (and Z_t includes most if not all of those variables) through its influence on desired inventories. However, it is possible that these variables enter directly in the production decision over and above their influence on desired inventories. In other words these stocks are used as buffer stocks by the firm in the same way as finished goods inventories. Thus the firm absorbs shocks not only by changes in FGIs but changes in all other goods inventories, i.e. intermediate goods, backorders and raw materials. Sheehy and Reagan (1985) found that one of the stylised facts of manufacturing inventories was that output was not merely affected by finished goods inventories but also unfilled or back orders showing that backorders were not simply negative FGIs. In our thesis we find a similar result and observe a significant influence of intermediate goods inventories and raw material inventories on the production decisions of the manufacturing industry.[18] Why may this be so, since finished goods inventories are merely unsold output ? It is possible that the other inventory types are not perfectly correlated with inventories of finished goods, consequently they are showing statistical significance in an equation which also has FGIs as an additional regressor.

Empirically the significance of the vector Z_t in an equation like (19)' which also has past finished goods inventories (N_{t-i}) as an additional regressor, would show that these variables may well have a direct affect on production. On the other hand, the insignificance of N_{t-i} in (19) should not be construed to claim that inventories do not matter, i.e. they do not propagate business cycles. All we can say is that ***finished goods inventories*** are not a factor in this propagation. But this still leaves unexplored three ***other goods inventory types***, i.e. raw

[18] Bryant (1981) also found effects of capital stock and price of assets on output in an equation which also included one lag of inventories.

materials, backorders and intermediate goods inventories. There is no reason why the effects of these inventory types on output should be ignored. The significance of these other inventories in (19)' would be evidence that inventories as a whole do matter, and they are the channel by which persistence of monetary shocks is transmittted to output.

In summary, the above discussion brings out that the second neccessary condition for testing the Blinder and Fischer hypothesis is to perform the second stage test, in which the appropriate definition of inventories is *all goods inventories,* and not merely a narrow definition in the shape of finished goods inventories.

The aggregate inventory equation (13) is solved by substituting the R.H.S. terms in the aggregate version of the firms inventory demand function given below:

$$N_t = \lambda N^*_t + \sum_{i=1}^{n} \gamma_i N_{t-i} - \phi(P_t - E_t P_t) \qquad (3)'$$

The expression for the first term in (3)' is found by multiplying by λ the aggregate version of a firms desired inventory function given below:

$$N^*_t = \eta - \delta\{ P_t - E_t P_{t+1}\} \qquad (4)'$$

To solve (3)' we need to first find expressions for $P_t - E_t P_t$ and $P_t - E_t P_{t+1}$. This is accomplished by first taking the expectations of the price equation (11) and then subtracting these expectations from (11). The price expectations are taken by using the results, $E_t u_t = \theta^* u_t$ (given in (9)), $E_t M_t = M_{t-1} + g + \theta^* u_t$ (by taking expectations of (6)), and using the property of a random walk variable that $E_t u_{t+1} = E_t u_t$.

Then we find that:

$$P_t - E_t P_t = + \frac{\alpha_1 u_t (1 - \theta^*)}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1 \theta^*}$$

and

$$P_t - E_t P_{t+1} = + \frac{\alpha_1 u_t}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1 \theta^*} - g - \theta^{**} u_t$$

Substitute $P_t - E_t P_{t+1}$ in (4)' and multiply by λ to get:

$$\lambda N^*_t = \lambda\eta + \lambda\delta g - \frac{\lambda \delta \alpha_1 u_t}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1 \theta^*} + \lambda \delta \theta^* u_t$$

Finally substitute the expressions for $\lambda \dot{N}_t$ and $\phi (P_t - E_t P_t)$ in (3)' to get:

$$N_t = \lambda\eta + \lambda\delta g - \frac{\lambda \delta \alpha_1 u_t}{(\alpha_2 + \beta_1)(1 - \dot{\theta}) + \alpha_1 \dot{\theta}} + \lambda\delta\dot{\theta} u_t + \sum_{i=1}^{n} \gamma_i N_{t-i}$$

$$- \frac{\phi \alpha_1 u_t (1 - \dot{\theta})}{(\alpha_2 + \beta_1)(1 - \dot{\theta}) + \alpha_1 \dot{\theta}}$$

Simplyfying the above expression and rearranging terms we get the inventory demand equation (13):

$$N_t = \lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i}$$

$$- \left[\frac{\lambda\delta\alpha_1 + \phi\alpha_1 (1 - \dot{\theta})}{(\alpha_2 + \beta_1)(1 - \dot{\theta}) + \alpha_1 \dot{\theta}} - \lambda\delta\dot{\theta} \right] u_t \qquad \text{(Q.E.D.)}$$

The aggregate output equation (14) is solved by substituting R.H.S. expressions in (2) whose aggregate version is:

$$Y^p_t = Y^s_t + \{ N_t - N_{t-1} \} \qquad (2)'$$

Substituting expressions for Y^p_t from (12) and N_t from (13) we get:

$$Y^p_t = \left[\beta_0 + \frac{\beta_1 \alpha_1 (1 - \dot{\theta}) u_t}{(\alpha_2 + \beta_1)(1 - \dot{\theta}) + \alpha_1 \dot{\theta}} \right] + \lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i}$$

$$- \left[\frac{\lambda\delta\alpha_1 + \phi\alpha_1 (1 - \dot{\theta})}{(\alpha_2 + \beta_1)(1 - \dot{\theta}) + \alpha_1 \dot{\theta}} - \lambda\delta\dot{\theta} \right] u_t - N_{t-1}$$

Rearranging terms we get the aggregate output equation (14):

$$Y^p_t = \beta_0 + \lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i} - N_{t-1}$$

$$+ \left[\frac{\alpha_1 (\beta_1 - \phi)(1 - \theta^*) - \lambda\delta\alpha_1}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1\theta^*} + \lambda\delta\theta^* \right] u_t \qquad \text{(Q.E.D.)}$$

The theoretical inventory equation (16) of the *first stage test* can be derived by setting $\gamma_1 = 1 - \lambda$ and $\gamma_2 = \gamma_3 = \ldots\ldots \gamma_n = 0$ in (13) to get:

$$N_t = \lambda\eta + \lambda\delta g + (1 - \lambda) N_{t-1} - \pi_2 u_t \qquad \text{(i)}$$

where

$$\pi_2 = \left[\frac{\lambda\delta\alpha_1 + \phi\alpha_1 (1 - \theta^{**})}{(\alpha_2 + \beta_1)(1 - \theta^*) + \alpha_1\theta^*} - \lambda\delta\theta^* \right]$$

Substitute for N_{t-1} in (i) to get:

$$= \lambda\eta + \lambda\delta g + (1 - \lambda) [\lambda\eta + \lambda\delta g + (1 - \lambda) N_{t-2} - \pi_2 u_{t-1}] - \pi_2 u_t \qquad \text{(ii)}$$

Substitute for N_{t-2} from (i) into (ii) to get:

$$= \lambda\eta + \lambda\delta g + (1 - \lambda) \lambda\eta + \lambda(1 - \lambda) \delta g +$$

$$(1 - \lambda)^2 [\lambda\eta + \lambda\delta g + (1 - \lambda) N_{t-3} - \pi_2 u_{t-2}] - (1 - \lambda)\pi_2 u_{t-1} - \pi_2 u_t$$

Taking common coefficients gives

$$= \lambda\eta [1 + (1-\lambda) + (1-\lambda)^2] + \lambda\delta g [1 + (1-\lambda) + (1-\lambda)^2]$$

$$- \pi_2 [(1-\lambda^2 u_{t-2} + (1-\lambda) u_{t-1} + u_t] + (1-\lambda)^3 N_{t-3}$$

Collecting terms on $\lambda\eta$ and $\lambda\delta g$ we get:

$$= (\lambda\eta + \lambda\eta g) [(1-\lambda)^{0} + (1-\lambda)^{1} + (1-\lambda)^{2}]$$

$$- \pi_2 [(1-\lambda)^{2} u_{t-2} + (1-\lambda)^{1} u_{t-1} + (1-\lambda)^{0} u_{t}] + (1-\lambda)^{3} N_{t-3}$$

$$= (\eta + \delta g) [\lambda \sum_{i=1}^{n} (1-\lambda)^{i}] - \pi_2 [\sum_{i=0}^{r} (1-\lambda)^{i}] - \pi_2 [\sum_{i=0}^{r} (1-\lambda)^{i} u_{t-i}]$$

$$+ (1-\lambda)^{r+1} N_{t-(r+1)}] \qquad \text{(iii)}$$

In equation (iii) as r approaches infinity we get the following results:

$$\lambda \sum_{i=0}^{\infty} (1-\lambda)^{i} = \lambda \frac{1}{1-(1-\lambda)} = 1$$

and

$$\lambda \sum_{i=0}^{r} (1-\lambda)^{i} = \lambda \frac{1- (1-\lambda)^{r+1}}{1-(1-\lambda)} = 1- (1-\lambda)^{r+1}$$

As r approaches infinity $(1-\lambda)^{r+1}$ approaches zero, thus (iii) would be reduced to

$$N_t = (\eta + \delta g) - \pi_2 \sum_{i=0}^{r} (1-\lambda)^{i} u_{t-i} + 0 \qquad \text{(iv)}$$

Expanding the second term of (iv) we get

$$= (\lambda\eta + \delta g) - \pi_2 [(1-\lambda)^{0} u_{t} + (1-\lambda)^{1} u_{t-1} + (1-\lambda)^{2} u_{t-2} + \ldots\ldots$$

$$+ (1-\lambda)^{s} u_{t-s} + \ldots\ldots] \qquad \text{(v)}$$

Equation (iv) shows that by substituting an infinite number of times we have eliminated the last term in (iii) since it reduces to zero. Finally by rearranging (v) we get the inventory equation (15) as a function of lagged monetary shocks.

$$N_t = \eta + \delta g - \pi_2 u_t - (1-\lambda)\pi_2 u_{t-1} - (1-\lambda)^2 \pi_2 u_{t-2}$$

$$-\ldots\ldots\ldots\ldots-(1-\lambda)^s \pi_2 u_{t-s}$$

(Q.E.D.)

The output equation (16) can be derived by setting $\gamma_1 = 1 - \lambda$ and $\gamma_2 = \gamma_3 = \ldots\ldots \gamma_n = 0$ in (14) to get:

$$Y_t^p = \beta_0 + \lambda\eta + \lambda\delta g - \lambda N_{t-1} + \pi_1 u_t \qquad \text{(vi)}$$

Before we substitute for N_{t-1} in (vi) the general form of N_{t-1} can be obtained from (iii) as:

$$N_{t-1} = \eta + \delta g - \pi_2 \sum_{i=0}^{\infty} (1-\lambda)^i u_{t-(i+1)}$$

Substitute the above general form in (vi):

$$Y_t^p = \beta_0 + \lambda\eta + \lambda\delta g - \lambda [\eta + \delta g - \pi_2 (\sum_{i=0}^{\infty} (1-\lambda)^i u_{t-(i+1)}] + \pi_1 u_t$$

$$Y_t^p = \beta_0 + \pi_1 u_t + \lambda\pi_2 [\sum_{i=0}^{\infty} (1-\lambda)^i u_{t-(i+1)}]$$

Expanding terms we get the output equation (16) expressed in terms of monetary shocks.

$$Y_t^p = \beta_0 + \pi_1 u_t + \lambda\pi_2 u_{t-1} + \lambda(1-\lambda)\pi_2 u_{t-2} + \lambda(1-\lambda)^2 \pi_2 u_{t-3}$$

$$+\ldots\ldots\ldots\ldots+ \lambda(1-\lambda)^s \pi_2 u_{t-s}$$

(Q.E.D.)

The output equation (17)' of the ***second stage test*** is easily derived by substituting the value of u_t from (14) into (13) to get:

$$Y_t^p = \beta_0 + \lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i} - N_{t-1}$$
$$+ \left(\frac{\pi_1}{\pi_2} \right) \left[\lambda\eta + \lambda\delta g + \sum_{i=1}^{n} \gamma_i N_{t-i} - N_t \right]$$

Collecting common coefficients we get (17)'

$$Y_t^p = \beta_0 + \left(1 + \frac{\pi_1}{\pi_2} \right) (\lambda\eta + \lambda\delta g) - \lambda N_{t-1}$$
$$+ \left(\frac{\pi_1}{\pi_2} \right) \left[(1 - \lambda) N_{t-1} - N_t \right]$$

(Q.E.D.)

CHAPTER III

EMPIRICAL TESTING OF THE PERSISTENCE IN REAL VARIABLES

Introduction

In chapter II we presented the theoretical and empirical equations of the persistence-via-inventories hypothesis. The empirical equations were expressed in functional form. In this chapter these functional relations will be expressed as linear equations and the vectors X_t and Z_t will be specified for the inventory and output equations respectively. These specifications are very similar to the multivariate model of inventory adjustment given by Maccini (1984) and Maccini & Rossana (1984). This chapter presents a discussion of the multivariate model to give the microeconomic rationale for the chosen vectors X_t and Z_t in the inventory and output equations (19) and (18)' respectively of chapter II.

The explanatory variables used by D & D in their first stage test of the B & F hypothesis were a subset of the variables proposed in the multivariate model. They did not give any reason why they ignored the other relevant variables in tests of the persistence hypothesis through their inventory equation (19). The results of the first stage test (19) and the second stage test (18)' may be sensitive to the specification of the chosen vectors X_t and Z_t in the inventory and output equations respectively. For example if open economy effects, interaction of inventories with quasi-fixed factors of production, and joint production of goods produced to stock with goods produced to order and intermediate goods are important in determining desired inventories (and consequently output), then these variables should be included as explanatory variables in the theoretical specifications of the inventory and output equations.

In the multivariate model Maccini & Rossana (1984) point out that the inventory decision of the firm is not an isolated decision. The firm makes a joint stock decision about the levels of finished goods inventories, stocks of other goods inventories, i.e. goods in process, backorders and raw materials, and stocks of quasi-fixed factors of production, i.e labour and capital.

The important question to ask is; would the inclusion of these stock variables in the inventory demand function and hence output equation yield qualitatively and quantitively different results in the types of persistence equations estimated by D & D, Sheffrin (1981) and Haraf (1981). More specifically, in D & D would some more (or less) past monetary shocks become statistically significant ? In Sheffrin and Haraf who regress output on inventories, would some more (or less) past inventories become significant? There is some reason to believe that the results should change somewhat because the speeds of inventory adjustment were found to change, once these variables were included in the inventory demand functions by Maccini & Rossana. The speeds of inventory adjustment have an important bearing on the persistence of monetary shocks on output. If inventories adjust quickly to their desired levels then output must must be also adjusting quickly to it's desired or natural levels. In other word the effects of a monetary shock would be accomodated in a relatively shorter period of time by simultaneous changes in production and inventories. This implies that equations which regress output on monetary shocks would show that the effects of monetary shocks are dissipated rather quickly, i.e. very few past monetary shocks should be statistically significant, implying very short period persistence effects. The first and second stage tests merely decompose the effects of shocks on output into first round effects on inventories and second round effects of inventories on output. Hence there is some reason to expect that the significance of monetary lags in inventory equations and the significance of inventories in output equations would be affected by changes in speeds of inventory adjustment.

The use of the generalized multivariate model however creates another problem which is not encountered in the simple multivariate model. The significant increase in the number of explanatory variables causes the potential problem of multicollinearity due to the interrelatedness of these variables. This problem could affect the coefficients on lagged monetary shocks and lagged inventories in the inventory and output demand equations of the first and second stage tests respectively.

In the multivariate model we will also test for open economy effects as well as effects of capital stock on inventories and output which were not discussed by Maccini & Rossana (1984). There is enough theoretical and empirical literature to stress the importance of terms of trade on output. It would be interesting to discover if open economy effects impinge directly on a firm's desired inventories. I would say *a priori* that those firms which deal in imports [1] and exports of their finished product, should have their desired inventories directly affected by open economy variables like exchange rate changes. To a smaller extent all firms would be affected (whether they deal across international borders or not) by the effects of exchange rates on prices and interest rates. In my thesis open economy effects are modelled by the inclusion of expected imports in the desired inventory function. Unanticipated imports too, are also an important determinant of end of period actual inventories[2] hence they are also included in the inventory equations. The effects of both expected and unexpected imports have been captured by simply using the level of imports in regressions of the inventory and output equations. A more complete discussion of the interaction of finished goods inventories with quasi-fixed factors; *other* goods inventories and open economy variables is presented below in the multivariate model of inventory investment.

[1] Imports could be of raw material inventories or intermediate goods inventories to be used in the processing of finished goods.

[2] See Caton and Higgins (1974) and Helliwell (1974) on the RDX2 model of Canada.

MULTIVARIATE FLEXIBLE ACCELERATOR MODEL OF INVENTORY INVESTMENT

This section integrates the stock adjustment models of Maccini (1981, 1984) and Maccini and Rossana (1984) with monetary and open economy variables to yield a generalised multivariate model of inventory investment.

Maccini and Rossana (1984) have analysed empirically the interactive effects of the stocks of labour, goods in progress and raw materials but did not test for the effects of capital stock and the rental price of capital on manufacturer's inventories. I would like to add these capital stock and capital cost effects and see if the theoretical predictions of Maccini (1984) about these variables are empirically verified. In chapter II we presented a macro model of rational expectations but it lacked rigour given its inadequate treatment of desired inventories. This section alleviates this deficiency and presents inventory demand functions which have adequate microfoundations and which yield empirically testable equations for a more sophisticated inventory demand function.

A primary weakness of conventional models of inventory adjustment is their failure to recognise the dependence of the inventory decision on decisions about other stocks, e.g. capital and labour stocks and stocks of intermediate goods. Morever, in traditional models demand side effects were the focus of concern, for example inventories were typically modelled as a function of expected sales and inventory holding costs (Lovell, 1961). Blinder (1982) and Amihud and Mendelson (1980) amongst others suggest the cost and supply side effects and Maccini (1984) emphasises the jointness of stock decisions. These propositions are accomodated in the multivariate inventory model. This modification of the inventory demand function is proposed to determine whether the misspecification of the desired inventory function could be a possible reason for the low estimated speeds of adjustment of inventories to their desired levels. [3]

[3] Feldstein and Auerbach (1976) noted that the estimated speeds of inventory adjustment were implausible because wide swings in inventories could be accomodated by a few days of

The Multivariate Model

The model presented in this section is consistent with a number of theoretical approaches to inventory behaviour of firms. Therefore as pointed out earlier the model need not be derived from any particular optimization model of the firm. The approach is to write down the estimating equation, present a brief intuitive discussion of the sign of the parameters and to empirically examine if the theoretical propositions are validated.

An optimizing firm does not make independent inventory decisions, rather joint stock decisions. This is captured by the following equation:

$$\begin{aligned}\Delta \ln N_t &= \lambda (\ln N^*_t - \ln N_{t-1}) + \xi_1 (\ln L^*_t - \ln L_{t-1}) \\ &+ \xi_2 (\ln K^*_t - \ln K_{t-1}) + \delta_1 (\ln UF^*_t - \ln UF_{t-1}) \\ &+ \delta_2 (\ln GP^*_t - \ln GP_{t-1}) + \delta_3 (\ln RMS^*_t - \ln RMS_{t-1}) \\ &+ \theta (\ln Y^*_t - \ln Y_{t-1}) + \gamma u_t \end{aligned} \qquad (1)$$

$$0 \leq \lambda \leq 1 \qquad \delta_1 , \delta_2 \leq 0 \qquad \delta_3 , \xi_1 , \xi_2 , \theta, \gamma \leq 0$$

where the stars on the variables represent the desired levels of all variables. N is the level of finished goods inventories. L and K are the stocks of labor and capital. UF and GP are the inventories of unfilled orders and goods in process inventories. RMS is the stock of raw material inventories and Y is the output level.

The rationale of the explanatory variables used in equation (1) is given in the following discussion. A firm's production of finished goods (and inventories) is composed of two types of goods; goods which are produced to stock and goods which are produced to

[3](cont'd) production.

order. Generally these two types of goods are jointly produced.[4] Goods will be produced to stock if firms have a multistage production process; or they want to use their inventories as a barrier to entry in their industry; or engage in speculative activities; and use finished goods inventories as a buffer stock against demand and cost shocks. With a multistage production process firms would produce and or stock intermediate goods like goods in process. Goods which are produced to order are generally heterogenous goods and are not stored as inventory for any long length of time. In a number of empirical studies these types of goods depend on unfilled orders, a variable proposed and analysed by Childs (1961). As the firm's desired stock of unfilled orders (UF_t^*) increases relative to the past level of unfilled orders (UF_{t-1}) the goods produced to order will decrease. Assuming that goods produced to order and goods produced to stock are substitutes, the investment of the latter will increase implying that δ_1 will be will be greater than zero. If they are complements, δ_1 will be negative, and if independent, it will be zero. For similar reasons the coefficient on intermediate goods δ_2 will be either positive, negative or zero.

So far we have discussed the interaction between goods produced to stock, to order, and intermediate goods. The firm's inventory decision will also be affected by its decisions on stocks of its quasi fixed factors of production. The firm will incur adjustment costs as it changes the utilization of these factors. The three quasi fixed factors of production considered by us are raw materials, labour and capital. [5] The adjustment costs for raw materials are higher premiums or discounts that the firm must pay (give) to acquire (dispose of) these goods in line with its production of finished goods. The adjustment costs of changing employment are well known and manifest themselves in hiring, training and layoff or firing costs. Other labour costs could be hoarding costs in times of depressed demand. The

[4] For a discussion of goods produced to order see the structural model of Belseley (1969).

[5] There are a number of studies which theoretically analyse the effect of a buffer stock (inventories) on prices and output e.g. Hay (1970), Mills (1962), Blinder (1982) but none show the effects of capital except Maccini (1984).

adjustment costs for capital are the internal adjustment costs of lost output whenever the firm undertakes an investment in capital. The interaction of capital with FGIs and the implications for price and output decisions are discussed at length in Maccini (1984).

The cross adjustment coefficients on labour and capital (ξ_1 , ξ_2) are expected to be negative. The reason is that given ($N^*_t - N_t$), the higher the stocks of labour and capital relative to their desired levels the more inventories would be produced as the firm works off its excess stocks.[6] Firms would also try to equate their holdings of raw material stocks to their desired levels and by an analagous argument the sign of δ_3 would be negative.

In the inventory demand function (1), lagged output terms have been included as another explanatory variable to capture the additional production smoothing effect of inventory investment. The production smoothing hypothesis refers to the effects on inventories and production of costs that depend on changes in the level of output. A large part of these costs is captured in costs of changing the quasi fixed factors of production. Planned inventory investment depends directly on the level of output produced. If there are costs to changing the level of output, then if Y_{t-1} was high so will be Y_t. That is, we would see a certain persistence because of the costs of changing output. A higher Y_t means a higher level of planned inventory investment, suggesting that θ is negative. It would be instructive to empirically examine if the costs of changing output are adequately captured by adjustments in quasi fixed stocks or there is further need for using lagged output as an additional regressor. The last term in equation (1) is current unanticipated monetary shocks, u_t. In the absence of any unanticipated shocks the desired change in inventories would equal the actual change in inventories, and u_t would be equal to zero or in other words u_t would not be part of equation (1). However, we know from the Blinder and Fisher and the Demery & Duck

[6] The interaction between inventories and stocks of labour is discussed in the models of Nadiri and Rosen (1973), Rossana (1980) and Topel (1982). The interdependence of inventories and capital is discussed in Maccini (1981, 1984).

models that misperceptions of monetary shocks would deviate a firm's actual change in inventories from it's desired change in inventories. Hence their inclusion in the inventory change function (1) is justified. We know from the Blinder and Fisher model that a positive aggregate demand shock reduces end-of-period inventories, therefore, $\gamma \leq 0$. For a detailed discussion of the effects of monetary shocks on inventories see the derivation of (13) and (15) in Chapter II.

The model is not yet complete because we have not specified the vector which determines desired inventories, and equation (1) cannot be estimated because all the right hand side variables are expected or desired stocks.

First we write (1) in compact form as

$$\Delta \ln N_t = \beta \, (\ln Z^*_t - \ln Z_{t-1}) + \gamma \, u_t + v_t \tag{2}$$

where the stars on the vector Z_t represent the desired values of all stock variables, and

$$Z_t = \begin{matrix} N_t \\ L_t \\ K_t \\ UF_t \\ GP_t \\ RMS_t \\ Y_t \end{matrix} \qquad \beta = \{ \lambda \; \xi_1 \; \xi_2 \; \delta_1 \; \delta_2 \; \delta_3 \; \theta \}$$

The vector of desired stocks Z^*_t is composed of variables which are exogenous to the firms decision making. Assuming that the firm is a price taker in all input markets, all the input prices are exogenous. Therefore the price of capital, wages of labour and raw material prices appear as independent variables in (3). The carrying costs of all materials or goods stocks are also exogenous to the firm, therefore these costs, proxied by interest rates, are also exogenous. The firm is assumed to be a monopolistic competitor in output markets and can therefore vary its share of industry demand by varying its price, yet because of uncertainity about demand conditions the industry orders are also exogenous and they have to be forecasted. The time path of actual stocks would depend on the time path of unanticipated inflation. The less is unanticipated inflation the closer would actual Another important exogenous decision variable which affects the firm's desired and actual end-of-period inventories is the level of imports. The effects of imports are separately discussed in the sub section below.

A Note on Imports in Inventory Demand Functions

A firm's inventories are also based on both expected and unanticipated imports. The level of actual imports in any period incorporates both these desired and unanticipated components. Consequently, actual imports were used as an additional demand variable in our regression equations. Just as exchange rates and reserves were used as openness variables in the money supply equation, imports merit inclusion in the inventory demand function. Canada, being an open economy, imports a lot of its semi finished goods and raw material supplies to be used in the production of finished goods. It also imports finished imported goods which are substitutes for goods produced at home. Both these types of imports affect production and consequently inventories of goods produced at home.

A firm may desire to hold inventories for a number of reasons. These could include the holding of inventories for speculative purposes; as a barrier to entry; and as a buffer stock against stockouts. The primary determinant of a firm's desired inventories still remains the state of expected demand. Irrespective of the purpose of holding inventories, expected demand would significantly influence the inventories a firm would desire to hold. The firm may not always have the production capacity to locally supply all of the anticipated demand, hence it has to import (finished goods and or intermediate goods) to meet the supply deficiency. Firms form their expectations of imports based on what they can sell (production plus inventories) and what they anticipate demand to be. Thus expected imports are not an independent factor in the determination of a firm's inventories. They are the residual between demand and sales. When demand is greater than sales, imports are positive and flow into inventories. When demand equals sales there is no need for imports and they are zero. In the event that demand falls short of the stock of goods available for sales, the excess production gets absorbed in a firms inventories, and once again the firm has no need to import. Thus the firm imports only when its expected demand is greater than expected supply.

A firm may err in forecasting imports, this error can be either due to incorrect foecasts of sales and demand as well as error in forecasting any exogenous variable which determines imports. The error in import forecasts which shows up as unanticipated imports in a firm's accounts would not only affect its current inventories and sales but also future inventories, production and sales. Thus unexpected imports also appear as an argument in the inventory demand function.

What should be the sign on the coefficient of imports in the inventory and output equations? We know from the GNP identity that imports are a leakage in the Keynesian multiplier therefore the overall effect of increased imports on inventories and output should be negative. However, since it is being assumed that imports flow into the stock of inventories, therefore atleast in some short run the increased imports are expected to show a positive coefficient. The above characterization of imports agrees with the empirical results on imports found by the RDX2 model of Canada.

The RDX2 model (1979) of Canada improved upon the treatment of imports accorded in the RDX1 model (1969). In the latter imports were not given any distinct importance and were lumped together with sales. The explanatory variable used for imports was sales minus net exports, and was referred to as 'purged GNE'. In the RDX2 model a separate treatment was given to imports by including it as an independant variable over and above sales. The same approach is adopted in this thesis. The argument given for the separate treatment of imports was that it was

> *" more reasonable to assume that final expenditure in Canada atleast on some type of imported goods will lead to temporary reductions of inventories of such such goods. In short, domestic inventories may play a buffer stock role with respect to imported goods. Thus it seems resonable to treat imports separately in the flexible accelerator component of the inventory equation".*[7]

The RDX2 model found that the coefficients on imports had weights that were first positive and then negative suggesting an additional buffer stock role of inventories with respect to imported goods. It was found thet increased imports first lead to "some immediate increase in inventories, but in the longer term a higher import content of final demand reduces desired inventories in relation to final demand, due to the implied decrease in domestic production".

Another approach to modelling the interaction of imports with inventories was taken by Caton & Higgins (1974), who accounted for the effects of imports on inventories by using a two step procedure. In the first step an import demand function was estimated and the residuals of that function which are unintended imports were then used as regresors in the inventory demand function. It was found that inventories acted as buffer stocks to unanticipated import demand shocks in Australia. Both Caton and Higgins and Helliwell et all (1979) share the common feature of using a measure of potential output (or aggregate supply) constructed through estimating a production function. We have not estimated any production function to derive our aggregate supply measure, nor have we approximated unanticipated imports from the residuals of an import demand function. However, we have followed the RDX2 model by adding imports as a whole inclusive of both its anticipated and unanticipated components.

This completes the discussion on the role of imports as well as the discussion on the

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[7] See Helliwell et all (1979), p. 64.

expected signs of various variables in the inventory demand function given by equation (1) or (2).

Equation (2) cannot be estimated unless the vector Z_t^* is specified. In the light of the above discussion on variables which are exogenous to the firms the firm's desired stocks can be expressed as

$$ln\, Z_t^* = \psi\ X_t \tag{3}$$

where

$$\psi = \begin{bmatrix} \gamma_{10} & \ldots\ldots\ldots & \gamma_{17} \\ \\ \gamma_{70} & \ldots\ldots\ldots & \gamma_{77} \end{bmatrix} \qquad X_t = \begin{bmatrix} 1 \\ ln\ O_t^* \\ ln\ IMP_t^* \\ M_t^* \\ ln\ rmp_t^* \\ ln\ w_t^* \\ ln\ pk_t^* \\ ln\ r_t^* \end{bmatrix}$$

where

ψ is a matrix of coefficients and X_t is the vector of exogenous variables. O^* is expected industry orders, rmp^* is expected real raw material prices, w^* is the expected real wage, pk^* is the expected real price of capital, r^* is the expected real interest rate, IMP^* is expected imports and M^* is anticipated money growth.

Substituting (3) in (2) we get

$$\Delta\ \ln\ N_t = \beta\psi\ X_t - \beta\ \ln\ Z_{t-1} + \gamma\ u_t + v_t \tag{4}$$

and

$$\beta\psi = (w_0 , w_1 .... w_7)'$$

Therefore (4) is written as:

$$\Delta \, ln \, N_t = w_0 + w_1 \, ln \, \overset{\bullet}{O}_t + w_2 \, ln \, \overset{\bullet}{IMP}_t + w_3 \, \overset{\bullet}{M}_t + w_4 \, ln \, \overset{\bullet}{rmp}_t + w_5 \, ln \, \overset{\bullet}{w}_t$$

$$+ w_6 \, ln \, \overset{\bullet}{pk}_t + w_7 \, ln \, \overset{\bullet}{r}_t - \beta \, ln \, Z_{t-1} + \gamma \, u_t + v_t \qquad (5)$$

$$w_1 , w_2 , w_3 \geq 0 \qquad w_4 , w_5 , w_6 , w_7 , \gamma \leq 0$$

Equation (5) states that the firm's inventories depend on expected demand, marginal costs of production, inventory carrying costs, expected imports, and levels of other relevant stocks. The literature suggests that desired inventories are positively influenced by expected sales, captured here by expected industry orders, and negatively influenced by factor input costs, captured here by raw material prices, real wage rates and the real price of capital. In addition inventory holding costs captured here by expected real interest rates have a negative influence on desired inventories. In (5) the right hand side variables are all expected variables. One simple way to model these expectations is to hypothesise that expectations are based on past distributed lags of each variable.[9] Thus the complete specification of the vector $\overset{\bullet}{Z}_t$ (or X_t) leads us to rewrite equation (18) of Chapter II with all the relevant explanatory variables.

[8] The explicit expressions for $w_0......w_7$ are obtained by multiplying β with ψ. For example $w_0 = \{ \lambda \, \gamma_{10} + \xi_1 \, \gamma_{20} + \xi_2 \, \gamma_{30} + \delta_1 \, \gamma_{40} + \delta_2 \, \gamma_{50} + \delta_3 \, \gamma_{60} + \theta \, \gamma_{70} \}$. Expressions for $w_1......w_7$ can be derived similarly.

[9] A case can be made for using one period ahead Box-Jenkins type forecasts. However this alternative could not be adopted because the generation of the forecasts would use up a number of degrees of freedom leaving insignificant observations for the actual regression of equations (5) or (6).

The Inventory Equation

Before we rewrite (18) with all the relevant variables it would certainly help us to recap the steps in the derivation of the aggregate version of the firm's inventory decision which we shall present below as equation (6). The recollection of ideas shows that we started off from a theoretical discussion of the inventory decision in the Demery & Duck model given in equation (15) on page 20. The final estimated empirical equation given by (6) was developed by starting from equation (18) chapter II, and specifying the determinants of desired inventories given by the vector X_t. The detailed discussion of the vector X_t demanded some forays in the Maccini & Rossana (1984) model (which is equation (1), Chapter III).[10]

Maccini and Rossana's basic contention about equation (1) is that the inventory and output decision is a joint stock decision, consequently the vector X_t should contain all the desired levels of stocks which can affect the firm's inventory and output decisions. These stocks are given on the R.H.S. of equation (1) — which is the Maccini & Rossana joint stock model, also referred to by us as the generalized multivariate model of inventory investment. Equation (1) is eventually expressed as (5) once the determinants of desired stocks are substituted in (1). The desired and actual stocks are a function of all the relevant exogenous variables to the firm's decision making. One of these exogenous variables affecting the end-of-period actual inventories (but not desired inventories) is unanticipated monetary shocks; which is the primary variable of interest for this thesis. In the final step expectations of the R.H.S. variables of (5) are simply modelled as a lag of the own past values of a variable.

[10] Equation (1) is very similar to the Maccini & Rossana (1984) model except for the inclusion of the capital stocks which are not part of the Maccini & Rossana formulation, but have been analysed at length in Maccini (1984).

Thus we were eventually able to obtain our final estimated equation for the **first stage test** given as:[11]

$$
\begin{aligned}
ln\ N_t = \beta_0 &+ \sum_{i=1}^{n} \beta_{1i}\ ln\ O_{t-i} + \sum_{i=1}^{n} \beta_{2i}\ ln\ IMP_{t-i} + \sum_{i=1}^{n} \beta_{3i}\ M_{t-i} \\
&+ \sum_{i=1}^{n} \beta_{4i}\ ln\ r_{t-i} + \sum_{i=1}^{n} + \beta_{5i}\ ln\ w_{t-i} + \sum_{i=1}^{n} + \beta_{6i}\ ln\ pk_{t-i} \\
&+ \sum_{i=1}^{n} \beta_{7i}\ ln\ rmp_{t-i} - \delta_1\ ln\ UF_{t-1} - \delta_2\ ln\ GP_{t-1} - \delta_3\ ln\ RMS_{t-1} \\
&- \xi_1\ ln\ L_{t-1} - \xi_2\ ln\ K_{t-1} - \theta\ ln\ Y_{t-1} + \sum_{i=0}^{n} \gamma_i\ u_{t-i} + v_t \qquad (6)
\end{aligned}
$$

$$
\begin{aligned}
&\Sigma\beta_{1i} \geq 0 \qquad \Sigma\ \beta_{2i} \geq 0 \qquad \Sigma\ \beta_{3i} \geq 0 \\
&\Sigma\ \beta_{4i} \leq 0 \qquad \Sigma\ \beta_{5i} \leq 0 \qquad \Sigma\ \beta_{6i} \leq 0 \qquad \Sigma\ \beta_{7i} \leq 0 \\
&\delta_1 \geq 0 \qquad \delta_2 \geq 0 \qquad \delta_3 \leq 0 \qquad \xi_1 \leq 0 \\
&\xi_2 \leq 0 \qquad \delta_1 \leq 0 \qquad \theta \leq 0 \qquad \gamma_i \leq 0
\end{aligned}
$$

In equation (6), the first three terms are modelling expected demand through expected industry orders, expected imports[12] and expected money supply.[13] The coefficients β_{4i} to β_{7i} capture the costs of production and inventory carrying costs. The coefficients δ_1 and δ_2 reflect the interactions of joint production of finished goods inventories with goods produced to order and intermediate goods. δ_3, ξ_1 and ξ_2 reflect the interactions of inventories with

[11] The algebra of (6) requires that distributed lags be put on the Z_{t-1} terms. However, to be consistent with Maccini & Rossana (1984), these lags have been suppressed in (6).

[12] The level of actual imports incorporates both the anticipated and unanticipated effects of imports on FGIs.

[13] The monetary variables of this equation, given by M_{t-i} and u_{t-i} are not in log transformation. However, to be consistent with the Maccini (1984) and Maccini & Rossana (1984) models on which this equation is based, we have applied the log transformation to all other variables.

quasi-fixed factors of production. The coefficient on lagged output, θ, reflects the production smoothing effect over and above what is already reflected in the estimated coefficients of the quasi fixed factors of production. To test this additional production smoothing effect, one study, e.g. Maccini & Rossana (1984) included Y_t as a regressor in their inventory demand functions. However, as stated by Lucas (1967) and Treadway (1969), if firms maximise cash flows and bear costs of factor adjustment then these exogenous factors of production should be used as regressors in the inventory demand functions rather than output which is endogenous. Preliminary testing of the output variable showed that it was insignificant, hence it was dropped from subsequent regressions.

Random shocks to the economy are accomodated by firms through accumulation or decumulation of buffer stocks of inventories and are reflected in the coefficients γ_i on past monetary shocks. The more past lags on monetary surprises that are statistically significant the longer are the persistence effects of these shocks on inventories. The coefficients γ_i should be less than zero, which shows an inverse relationship between monetary shocks and inventories. The total effect of monetary shocks on end-of-period finished goods inventories can be decomposed into the buffer stock effect and the accelerator effect. The former refers to the negative effect on inventories when unanticipated positive shocks hit the economy. The latter is the positive effect of increased production on inventories in response to positive shocks. Thus these two effects act in opposite directions on inventories. As long as the buffer stock effect dominates the accelerator effect, end-of-period inventories will be less than begining-of-period inventories. This point was clearly understood by Blinder and Fischer and brought out in the comparitive static conditions derived by them. They showed that after a shock the buffer stock effect will always dominate the accelerator effect, consequently end-of-period inventories would decline. However over time the accelerator effect of shocks would restore end-of-period inventories to their desired levels.

Note that equation (6) does not contain any lagged inventories as explanatory variables, which are are part of the standard formulation of inventory demand functions.[14] The reason is that inventories could fluctuate due to other causes besides monetary shocks. For example firms may hold inventories for speculative purposes, or as a barrier to entry for other firms in their respective industries. Hence if inventories were included on the R.H.S. to infer the buffer stock role, and u_{t-i} excluded, we would wrongly infer causation emanating from u_{t-i} whereas N_t could have changed due to causes other than buffer stock motives mentioned above. If it is true that inventories are used as buffer stocks, and to test this hypothesis N_{t-i} are included as a regressor as well as u_{t-i}, no additional information about the aggregate demand shocks would be contained in N_{t-i} that is not already reflected in u_{t-i}. Certainly N_{t-i} would still contain information about other causes of fluctuations in N_{t-i} but that is not our concern. We are interested in measuring the fluctuations in inventories only due to buffer stock reasons i.e due to aggregate demand shocks measured by changes in u_{t-i}. Thus using u_{t-i} as the only variable to measure the persistence effects of monetary shocks is the appropriate strategy on methodological grounds. It needs mention that Demery & Duck (1984) also did not use lagged inventories (N_{t-i}) in their estimated inventory demand function. However, they did not provide any reason for excluding lagged inventories from their equation.

The reader would note that (5) only contains the contemporaneous monetary shock, u_t, whereas (6) also contains lagged shocks, u_{t-i}. The reasoning of this difference between (5) and (6) is analagous to the difference between (13) and (15) in Chapter II. Recall that in the presence of lagged inventories in (13) only current monetary shocks could affect N_t. Equation (5) contains the term Z_{t-1} which includes lagged inventories (N_{t-1}) as an element. The effects of past shocks are already reflected in N_{t-1}, hence only current shocks (u_t) can appear as an argument in (5). On the other hand (6) does not have any lagged FGIs on

[14] The missing term is $(1-\lambda)\ N_{t-1}$; where λ is the adjustment speed of actual to desired inventories. Also see Maccini & Rossana (1984), equation (1).

the R.H.S., therefore the effects of monetary shocks cannot be any longer reflected in N_{t-1} as was the case in (5). Hence the appropriate formulation of measuring the effects of monetary shocks now dictates entering not only current but also lagged shocks, i.e. u_{t-i} where $i = 0$ to n.

In conventional inventory demand functions, the coefficient on lagged inventories, specifically the coefficient on $(N_t - \dot{N})$ in standard stock adjustment inventory models gives a measure of the estimated speeds of inventory adjustment to their desired levels ($\dot{N}$). As mentioned earlier, the focus of this thesis is not in estimating these speeds of inventory adjustment, although they have direct bearing on the question of production smoothing. The higher the speeds of adjustment the less the production smoothing and consequently the shorter the inventory cycle — that is fewer lags on u_{t-i} would be significant in estimated inventory equations of the type of (6).[15]

A biproduct of the exclusion of lagged inventories is that the problem of multicollinearity, which is the natural consequence of including so many interrelated stock and cost variables in (6) is reduced.

The Output Equation

Once again the empirical version of the aggregate supply or output equation is based like the inventory equation on the theoretical models of Maccini (1984) and Maccini & Rossana (1984). However, we must keep in mind that in deriving the output equation, we are starting from the theoretical equation (17) of Chapter II derived by us by manipulating the Demery & Duck model. The empirical counterpart of (17) were equations (19) and (19)' of Chapter II. The problem is to specify the determinants of the vector Z_t which is an explanatory variable in (19) and (19)'. This vector contains all the determinants of the output decision over and above the lagged monetary shocks which we know influence output and

[15] A short inventory cycle would be observed if very few inventory lags are significant in output equations (estimated with monthly or quarterly data) of the type of (7).

inventories. To present the exogenous variables which are relevant to the firm's output decision we would have to outline a brief discussion of the Maccini (1984) model on which our final estimating equation for output is based. The discussion below will also highlight the connection between the the Maccini (1984) and The Maccini & Rossana (1984) models. This is important to understand in order to see the various links which eventually lead to the final output equation estimated by us.

The Maccini Model

Maccini's model is unique in the sense that for the first time in the inventory literature, he introduces both a buffer stock (finished goods inventories) and a quasi-fixed factor of production (capital). There are a number of models which examine the price and output effects using a buffer stock of FGIs.[16] However, there are fewer studies which examine the implications of a quasi-fixed factor of production.[17] By jointly introducing inventories and capital, Maccini is able to derive decision rules not only on price and output but also on investment in these stocks, and the corresponding interactions of these investments on the prices and output. It is not our intent to regurgitate the entire contents of Maccini's paper. The paper is quite mathematical in nature and Maccini himself does not present all proofs. We shall merely present an intuitive discussion of the relevant parts of Maccini's paper. He first specifies that the firm's desired stocks of inventories and capital per unit of expected aggregate demand are inversely related to real factor input prices and real inventory holding costs which are measured in his model by the expected real interest rates. Maccini then develops the firm's short and long run price and output equations. Since we are primarily interested in the output decision, the discussion of the price decision will be

[16] Amihud and Mendelson (1983), Blinder (1982) are some of the studies amongst others.

[17] Nadiri and Rosen (1973), Rossana (1980) and Topel (1982) have studied the interaction between inventories and employment. Rose (1974) has drawn some implications of using the quasi-fixed capital stock; also Bryant (1978) has estimated inventory equations with capital as a dependant variable.

ignored.

The long run of the firm is characterised as a situation when given its expectations the firm has adjusted its stocks of capital and inventories to their desired levels.[18] The long run output equation is derived by Maccini after solving the optimality conditions of his model. The long run supply equation can be written in a simplified log-linear form as:

$$ln\ \dot{Y}/D = a_0 + a_1\ ln\ r + a_2\ ln\ w_1 + a_3\ ln\ w_2 \qquad (A-1)$$ [19]

where $\dot{Y}$ is the equilibrium long run level of output, D is expected aggregate demand, r is the interest rate that the firm uses to borrow or lend, w_1 is the real price of labour services and w_2 is the real price of capital goods.
The coefficients a_i are complex functions of the parameters of the model. Maccini shows that the level of output the firm produces in the long run is thus proportional to expected aggregate demand (D), and varies inversely with real factor input prices (w_1, w_2) and inventory holding costs (r).

In section 4 of his paper Maccini presents an analysis of the short run implications of his model. The investment equations for inventories and capital are derived. The solutions are a linear approximation of the solutions of the differential equations of his model. The planned investment decisions are expresed in the form of a multivariate flexible accelerator.

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[18] In a more general model like Maccini & Rossana (1984), the long run would be when the firm has adjusted **all** its stocks (i.e. raw materials, labour, unfilled orders and goods in process) to their desired levels.

[19] Note the absence of the time subscript from the model. This feature of the model is based on the simplistic assumption that expectations of exogenous variables were assumed to remain constant over time, i.e. $w_1(t) = w_1$, $r_t = r$ etc. At the end of his paper Maccini states that if this simplistic assumption is relaxed, the decision rules for price, output and investment would still remain functions of appropriately defined desired and actual stocks thereby implying that the qualitative results of the model would hold. The only difference would be that now the desired stocks would depend on the "discounted present value of current and future expectations of exogenous variables."

$$d\ln N/dt = a_{11} (\ln N^{\bullet} - \ln N) + a_{12} (\ln K^{\bullet} - \ln K) \quad \text{(A-2)}$$

$$d\ln K/dt = a_{21} (\ln N^{\bullet} - \ln N) + a_{22} (\ln K^{\bullet} - \ln K)$$

$$a_{11} \geq 0 \quad a_{21} \geq 0 \quad a_{12} \leq 0 \quad a_{22} \leq 0$$

Equations (A-2) are the origional formulation on which Maccini & Rossana (1984) based their multivariate flexible accelerator model— which is very similar to equation (1) of Chapter III. The essential difference between (A-2) and (1) is that the latter can be considered a more general form of (A-2). It also contains other stocks besides capital, e.g. labour, raw materials, goods in process and unfilled orders which were ignored by Maccini in equations (A-2). [20] Once the determinants of the desired inventories ($N^{\bullet}$) and capital ($K^{\bullet}$) are substituted in (A-2) and (A-3) the investment decisions in inventories and capital become functions of the exogenous factor prices and inventory holding costs.

Based on the investment decisions given above on inventories and capital, Maccini shows that the output equation can also be expressed as a function of the gaps between actual and desired stocks of inventories and capital.

$$\ln Y = \ln Y^{\bullet} + \delta_1 (\ln N^{\bullet} - \ln N) + \delta_2 (\ln K^{\bullet} - \ln K) \quad \text{(A-3)}$$

$$\delta_1, \delta_2 \geq 0$$

Once again substituting the determinants of $N^{\bullet}$ and $K^{\bullet}$ in (A-3), we get the following log-linear output equation:

$$\ln Y = \beta_0 - \delta_1 \ln N - \delta_2 \ln K + \beta_1 \ln D + \beta_2 \ln w_1$$

$$+ \beta_3 \ln w_2 + \beta_4 \ln r \quad \text{(A-4)}$$

---

[20] The proof of the signs of the adjustment coefficients a_{ij} is given in the Mathematical Appendix, available from Maccini upon request.

where β_0 is a constant whose value is determined by the parameters of the model, and β_1, $\beta_3 \geq 0$, and β_2, $\beta_4 \leq 0$. The β_j are interpreted as elasticities of output with respect to changes in the exogenous variables.

Equation (A-4) can be considered the equation on which the final estimating equation (to be presented below) of the *second stage test* will be based. Note however that (A-4) contains only one stock variable (other than FGIs), that is, capital stock. But following the joint stock discussion of Maccini & Rossana in Chapter III (see equations 1, 5 and 6), we know that the firm would also take into consideration the interaction of FGIs with stocks of labour, raw materials, backorders and goods in process. Moreover, raw material costs and imports would also affect optimal inventory and output decisions. Finally from the point of view of the Blinder and Fischer hypothesis and this thesis, the most important and primary variable of interest that affects inventories is aggregate demand shocks, as measured from the unanticipated monetary shocks. The interest in variables, other than monetary shocks mentioned above, is merely to complete the specification of the inventory and output demand functions. This is important if we are to avoid the econometric problems associated with ommitted variables. Thus if we work with an generalized multivariate model of inventory investment of the type of (1) and (5), we would eventually be able to derive an output equation with all those variables which are part of (1) and (5) but not of (A-4).

The theoretical foundation of Maccini & Rossana's (1984) paper is the work of Maccini (1984), the relevant results of which have been discussed above in skeleton form. Maccini and Rossana's generalized inventory equation (which is very similar to our equation 1) can be clearly seen to be the generalised or a more complete version of Maccini's inventory investment equation (A-2). The differences introduced at the stage of the inventory investment equation are of course then transferred and reflected in the finally estimated inventory and output equations.

Since the specification of the inventory investment equation of this thesis is based on the multivariate inventory investment model of Maccini & Rossana, we face a similar explanation problem as them in moving from a simpler inventory investment equation of the type of (A-2) of Maccini, to a more complete investment equation of the type of equation (1) used by Maccini and Rossana and us in this thesis. The answer given by Maccini and Rossana to explain the jump from (A-2) to (1), to which we also subscribe, is:

> *The model that we will use in the empirical work is a multivariate flexible accelerator or stock-adjustment model for investment in finished goods inventories. The model is consistent with a variety of theoretical approaches to inventory holding behaviour. Therefore, the empirical model will not be deduced explicitly from, and thus tied to a particular optimization model of firm behaviour. Rather the approach that we will take to specify the model is to set down the estimating equation, rationalize its parameters in intuitive terms, and indicate its relationship to existing theoretical models of firm behaviour as we proceed.* [21]

The above discussion of the inventory decision of the Maccini (1984) model (equation A-2) and its extention in the generalized inventory investment model of Maccini and Rossana (1984) (equation (1), Chapter III) essentially provides the background discussion to establish the link from equations (17) and (19)' of Chapter II through (A-2), (A-4) and (1) of Chapter III. This gives us the following output equation of the **second stage test**:

$$\begin{aligned} \ln Y_t = \beta_0 &+ \sum_{i=1}^{n} \beta_{1i} \ln O_{t-i} + \sum_{i=1}^{n} \beta_{2i} \ln IMP_{t-i} + \sum_{i=1}^{n} \beta_{4i} \ln r_{t-i} + \sum_{i=1}^{n} \beta_{5i} \ln w_{t-i} \\ &+ \sum_{i=1}^{n} \beta_{6i} \ln pk_{t-i} + \sum_{i=1}^{n} \beta_{7i} \ln rmp_{t-i} - \delta_1 \ln UF_{t-1} - \delta_2 \ln GP_{t-1} \\ &- \delta_3 \ln RMS_{t-1} - \xi_1 \ln L_{t-1} - \xi_2 \ln K_{t-1} + \sum_{i=0}^{n} \phi_i \ln N_{t-i} \\ &+ \sum_{i=0}^{n} \gamma_i u_{t-i} + v_t \end{aligned} \tag{7}$$

$\Sigma\beta_{1i} \geq 0 \quad \Sigma\beta_{2i} \geq 0 \quad \Sigma\beta_{4i} \leq 0 \quad \Sigma\beta_{5i} \leq 0 \quad \Sigma\beta_{6i} \leq 0 \quad \Sigma\beta_{7i} \leq 0$

$\delta_1 \geq 0 \quad \delta_2 \geq 0 \quad \delta_3 \leq 0 \quad \xi_1 \leq 0 \quad \xi_2 \leq 0 \quad \phi_i \leq 0 \quad \gamma_i \geq 0$

---

[21] Maccini and Rossana (1984), p. 220.

The effects of monetary shocks on inventories have already been examined in (6). Estimating equation (7) would now allow us to determine whether these shocks are transmitted to output through inventories. It is worth noting that lagged output terms and anticipated money growth which were part of the inventory investment equation are not included in the output equation. Note that interest rates have still been included. Interest rates affect output both through inventories as well as their effects on the rental rate of capital. [22] Since lagged inventories are also included in (7), the significance of interest rates in this equation can only show the effects of capital rentals not inventory carrying costs. Note that in the second last term monetary shocks have also been included. As discussed in equation (19)' of chapter II, this variable has been included to examine evidence on other channels of persistence. If u_{t-i} turn out to be statistically significant, this suggests that there are other channels by which past monetary shocks can be transmitted to affect current and future output. This means that monetary shocks are carrying a different kind of information from that embedded in various inventory stocks.

In (7), since inventories and interest rates are correlated, the ensuing multicollinearity would reduce the statistical significance of these two variables. Multicollinearity is also introduced through another channel. Lagged inventories, as pointed out in the last chapter, reflect the effects of unanticipated monetary shocks. Unanticipated shocks also affect the levels of cost and demand variables. This points out to a potentially severe multicollinearity problem due to the inclusion of so many regressors. In the next chapter the regression results for both output and inventories are presented.

[22] See Maccini (1984) on this point.

CHAPTER IV

MONEY , PERSISTENCE AND THE CANADIAN EVIDENCE

This chapter discusses the estimated equations for the first and second stage tests of the persistence explanations via inventory fluctuations. The results for the first stage test are presented first followed by a number of specifications for the second stage test. These tests are conducted with different formulations for the desired and hence actual inventory equations. The explanatory variables in the inventory equations (first stage test) and the output equations (second stage test) include the traditional demand and cost variables beside the stock interaction variables.

FIRST STAGE TEST RESULTS

The first stage test test was conducted in two steps. In the first step a money growth equation was estimated, and in the second step the residuals from this equation which are the unanticipated money growth rates were used in the inventory demand equation. The money growth equation is discussed first, followed by the inventory equation.

Money Growth

There are a number of approaches to specifying the money supply function. It can be modelled as a central bank reaction function as was done by Barro (1976) in his money growth equation for the U.S. and among others by Wogin (1981) for Canada. Alternatively money supply can be forecast from a univariate or multivariate ARIMA process. An ideal formulation would predict money supply from a complete macroeconometric model. This again would however beg the question of what is the "true" macro model.

Following Mishkin (1982) an atheoretical statistical procedure is adopted, where a money supply equation is estimated on the basis of some widely publicised exogenous variable which may not all be significant in every economy due to institutional and structural differences. A number of explanatory variables were tried in the money growth equation as "exogenous" regressors. Since Canada can be viewed as a small open economy relative to the U.S. and the rest of the world, it was expected that openness variables like foreign interest rates, exchange rates, balance of payments and external reserves of foreign exchange would exert some influence on the Canadian money supply. A number of other traditional variables which have been used as regressors in central bank reaction functions were also tried, i.e. growth rate of real GNP, unemployment rates, government budget deficits and the value of government expenditures.

The final estimated equation that was selected is:

$$m_t = a_0 + a_1 m_{t-1} + \dots\dots\dots + a_4 m_{t-4} + b_1 r_{t-1} + \dots\dots\dots + b_4 r_{t-4} + c_1 efer_{t-1} + \dots\dots\dots + c_4 efer_{t-4} + u_t \qquad (1)$$

where m_{t-i} are the monetary growth rates, r_{t-i} are the real interest rates, $efer_{t-i}$ are the external foreign exchange reserves. A detailed description of these variables is given in chapter VI. The regression results are attached on pages 66-67.

In an equation which already contained lagged monetary growth rates and domestic interest rates (See (1) Table 1a), only the value of external reserves added significantly to the "explained variance" of the dependent variable while the rest of the above mentioned regressors were found to be insignificant. It is a well known practice of the Bank of Canada to shore up the Canadian dollar and keep Canadian interest rates in line 4with US interest rates. However the inclusion of domestic interest rates already incorporates the effects of movements in U.S. interest rates as well as the value of the Canadian currency. Thus it is not surprising to find that these latter variables did not add to the significance of the

money growth equation, hence they were dropped from equation (1).
In an equation which did not contain external reserves, the growth rate of GNP was significant. However its overall significance as measured by the adjusted R^2 was less than when reserves were added as an additional variable besides lagged money and lagged interest rates. Since our criterion for choosing the money supply formulation is the "best fit", therefore this specification was dropped in favour of equation (1).

It should be noted that no contemporaneous values of the exogenous variables are included on the R.H.S. because economic agents are assumed to have information about shocks only till the beginning of the period (or end of last period) and do not know the value of the current shocks. Four lags of all the three selected explanatory variables were found to be significant in the money growth equation. Further lags of these variables were not only statistically insignificant in the t values but also did not add to the "explained variance" of the money supply process, hence they were dropped from the final equation. [1]

The regression results show that past quarterly monetary growth rates affect current monetary growth after a lag of two quarters. Interest rates have a quicker effect, they are significant at all except the second lag. The value of external reserves has an even more delayed effect on the money supply, as these effects start only after three quarters. The F tests show that these variables are jointly significant. They explain 44 per cent of the variance in the Canadian M1 growth rates. The DW statistic shows the absence of first order serial correlation.

[1] It is a common practice to use the Almon or other distributed lag schemes when using lagged variables especially in monthly data. These distributed lag schemes are very useful in conserving degrees of freedom. We are using a simple non distributed lag structure because very few lags are being used. This reduction in lags in our estimated equations is partly due to the use of quarterly data and partly due to the short run nature of the hypothesis being tested. These comments apply to both the money growth and the inventory equations.

Table 1a

MONEY GROWTH RATE EQUATION

$$\Delta \log m_t = a_0 + \sum_{i=1}^{4} \Delta a_i \log m_{t-i} + \sum_{i=1}^{4} b_i \log r_{t-i} + \sum_{i=1}^{4} c_i \log efer_{t-i} + u_t$$

OLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F
(1)	a_0	-0.190	-4.214	0.44	2.06	7.54
	a_1	-0.004	-0.044			
	a_2	-0.137	-1.414			
	a_3	0.190	2.019			
	a_4	-0.381	-3.823			
	b_1	-0.040	-3.163			
	b_2	-0.0008	-0.049			
	b_3	0.042	2.583			
	b_4	-0.017	-1.576			
	c_1	0.022	1.248			
	c_2	-0.022	-0.930			
	c_3	-0.008	-0.329			
	c_4	0.038	2.053			

Table 1b

AUTOCORRELATIONS OF MONEY GROWTH RESIDUALS

```
LAGS        AUTOCORRELATIONS

  1          +    I    +
  2          +    I    +
  3          +  XXI    +
  4          +  XXI    +
  5          +XXXXI    +
  6          +    I    +
  7          +    I    +
  8          +    I    +
  9          +    I    +
 10          +    IXXXX+
 11          +    IX   +
 12          +    IXXX +
 13          + XXXI    +
 14          +XXXXI    +
 15          +  XXI    +
 16          +    IX   +
 17          +    I    +
 18          +    IX   +
 19          +  XXI    +
 20         +     I     +
 21         +   XXI     +
 22         +     IX    +
 23         +     IXXX  +
 24         +   XXI     +
 25         +   XXI     +
 26         +     IX    +
 27         +     I     +
 28         +     IXX   +
 29         +     IXXX  +
 30         +     I     +
 31         +     I     +
 32         +     I     +
 33         +     I     +
 34         +     I     +
 35         +     I     +
 36         +   XXI     +
```

The residuals of the money growth equation u_{t-i} are the unanticipated monetary shocks. These residuals should be white noise or serially uncorrelated to qualify for inclusion in the inventory demand functions. This is ensured by estimating the money supply process with the lagged dependent variable as a regressor on the R.H.S. An examination of the autocorrelation function of the regression residuals and the Box Pierce Q statistic confirmed that the residuals were white noise (in Table 1b). The calculated Q(12) = 9.10 which is less than the critical value at the 5 per cent level, hence the null hypothesis of zero autocorrelation cannot be rejected. The same result is also visible from the diagram of the autocorrelation function which shows that individual autocorrelations at different lags are all within two standard errors. The plus signs at each lag enclose a distance of two standard errors. A spike at a particular lag extending beyond the limits of plus signs implies the presence of autocorrelated residuals. Since all autocorrelations are within two standard errors, the diagram for the autocorrelation function of the residuals shows the absence of first and higher order autocorrelation.

INVENTORY DEMAND SPECIFICATIONS

In the *first stage tests* inventory demand functions are specified to examine the buffer stock role of **all types of goods inventories**. A firm may not only use finished goods inventories as buffer stocks but also *other goods inventories.* Thus an unanticipated monetary shock could also be absorbed through variation in inventories of intermediate goods, backorders or raw material stocks. This main section of inventory demand specifications of the first stage test is organized as follows. We first discuss, in Section I, the econometric methodology followed in the selection of the regressors and the estimation problems encountered therein. Second, in Section II, the Canadian evidence on the buffer stock role of finished goods inventories is examined. Section II is divided in two parts, II A and II B. In II A, finished goods inventories are regressed on the variables from the *simple multivariate model,* while II B uses the "complete" set of regressors from the *generalized multivariate* *model.* [2] The evidence for the buffer stock role of ***other goods inventories*** is examined in Section III. The *first stage tests* conclude with a summary of the results on both finished goods and other goods inventories.

I. DATA & ECONOMETRIC METHODOLOGY OF PERSISTENCE TESTS

This study would not have been possible without the construction of consistent data sets on a number of important variables. Constant dollar series for all inventory categories were only available after 1971. The constant dollar data on these inventory categories: finished goods inventories, raw materials, goods in process and unfilled orders had to be estimated prior to 1971. These estimates were done by estimating the appropriate deflators for various inventory categories. We followed the same methodology as Statistics Canada in the construction of constant dollar series. This was neccessary to maintain consistency between pre and post 1971 data. The deflators used to compute constant dollar estimates from the nominal dollar data were also not available at the aggregate level of durable and non-durable classifications. These deflators were constructed by weighting the available deflators of individual industries of the durable and non-durable groups. A number of other data series like labour stocks had to be linked up across various base years to make them consistent. These and other problems of data construction and availablity are discussed at length in Chapter VI. At the end of Chapter VI the constructed data series have been attached. This should greatly facilitate any further estimates or duplication of the present study.

The *first stage test* of the persistence-via-inventories hypothesis was done separately on three industry classifications i.e. the total manufacturing sector; the durable goods sector, and

[2] The *simple multivariate model* is a subset of the *generalized multivariate model.* The former includes the variables, interest rates, raw material costs and wages besides the primary variable of interest, monetary shocks. The latter model includes the variables mentioned above as well as stocks of labour, capital, raw materials, unfilled orders, goods in process, price of capital and imports. See equation (6), Chapter III, which is the final estimating equation of the *first stage tests.*

the non durable goods sector. By estimating the equations for the durable and non-durable industry classifications we are testing the persistence hypothesis at a less aggregated level; this was not done by D & D or any other researcher who has tested for the persistence-via-inventories hypothesis. The hypothesis has been tested using seasonally adjusted quarterly data for the period 1963 1 to 1983 4. A case can be made for using non-seasonalized data but lack of a consistent data set for all variables prevented the use of raw data.

Previous empirical studies of Wogin (1981), Darat (1986), and Hoffman & Schlagenhauf (1976) have examined the neutrality (and persistence)[3] of money in the total GNP of the whole Canadian economy, however, our tests are conducted only on the manufacturing industry sector. This was done because the micro models of the firm's investment behaviour are basically about firms which carry finished goods (and other intermediate) inventories. So it seems a logical extension to examine aggregate behaviour at the industry level rather than also including the output and inventories of the services and farm sector, forestry, mining, etc. The output and inventory decisions of the non-manufacturing sectors differ from the traditional theoretical construct of the firm behaviour, due to the different nature of transaction costs in these sectors. This was precisely the reason for their exclusion from the data set.

The effect of unanticipated monetary shocks on inventories was first checked by regressing finished goods inventories on monetary shocks **only**, without the inclusion of any other cost or demand variables. Next, other variables were successively added and their persistence ramifications examined. These persistence effects of monetary shocks, or the buffer stock role of FGIs, and other inventories is inferred by examining **both** the individual lag

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[3] Any test of neutrality is also in a sense a test of persistence due to the inclusion of past monetary shocks in estimated output equations. The significance of past monetary shocks in these equations was evidence of persistence of shocks without testing for the cause of this persistence.

significance and joint significance of the lagged monetary shocks as seen through the t and F statistics respectively.

It can be argued that the above "forward selection" [4] methodology of successive additions of relevant variables is based on the t test criterion — which selects that set of independant variables which have significant t values and consequently add to the goodness of fit, as observed through the R^2. The regressors are augmented one by one until no more variables higher than the critical t value are available. This "forward selection" technique introduces the problems associated with specification bias due to omitted variables. The estimated coefficients on the intermediate equations would be biased with the direction of bias depending on the type of correlation of included with omitted variables.[5] Note, however that this problem shall not remain in our final, "complete", estimated equations (which have been reached through forward selection), on which the inferences on the buffer stock role of inventories are based.

The "forward selection" technique can also be dubbed as "data massaging" or "data mining". Nonetheless we are faced with the problem of selecting all those variables which are significant in explaining the variation in inventories. Some of these variables are specified in theory and have been explicitly tested for other countries (though not Canada), other variables are mentioned in theory but not tested, or the test results not reported due to possibly bad fits, e.g. price of capital and capital stocks. Thus we are left with the rather tedious experimentation of successively adding and retaining significant regressors.

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[4] The discussion on the "forward selection" technique is motivated by the comments of Peter Kennedy who is a member of the supervisory committee of my thesis. I am thankful to Peter for drawing my attention to this econometric caveat.

[5] For a simple discription of the specification probelms due to ommitted variables, see Kmenta (1971), 392-95.

This methodology is not without some benefit, as Kennedy (1984) states

> *sometimes such experimentation uncovers empirical regularities that point to errors in theoretical specifications. For example, through data-mining one of my colleagues discovered a result that led him to re-examine the details of the British Columbia stumpage fee system..... Because of this, he was able to develop a much more satisfactory theoretical specification, and thereby to produce better empirical results.*[6]

The idea of adding successive variables came to my mind after reading the results of Maccini and Rossana who adopted the "forward selection technique" with known variables in mind. In their estimated inventory equation which also had the lagged dependant variable as a regressor, they found that the speeds of inventory adjustment were found to increase as successive regressors were added. The speeds of adjusment were assessed from the estimated coefficient on the lagged dependant variable. It would be very reasonable to expect that speeds of inventory adjustment should be very closely related to the issue of persistence. In particular an economy experiencing fast adjusment speeds of actual to desired inventories would be one where aggregate demand shocks do not persist for any appreciable period of time. And since speeds of inventory adjustment changed as additional regressors were added, therefore inferences on persistence of aggregate demand shocks are also expected to change as the inventory equation is augmented with relevant regressors.

Following the method of Maccini & Rossana (1984), another important reason for adding successive variables is that we are also interested in examining the individual significance of a number of stock variables, e.g. stocks of labour, capital and *other goods inventories.* Though the ***first stage*** tests are primarily concerned in determining the influence of monetary shocks on inventories, yet these other variables are an important part of the overall specification of the inventory demand function. By neglecting these relevant cost and demand variables we would be committing a specification error — which is our criticism of Demery & Duck. However, by including this complete set of inter-related variables *all at*

[6]Kennedy (1984), p. 77.

once, and not through "forward selection" it is quite possible that due to multicollinearity the individual significance of some of these variables may not be observed. This point is raised in Kennedy (1984) who states that

> *Unfortunately, a variable included in an earlier step may have its usefulness negated by the inclusion of new variables, whose joint significance is more effective in explaining the variation in the dependant variable that the variable included earlier had explained.*[7]

Thus we are left with the uneasy task of establishing the individual significance of a number of interrelated variables while at the same time coping with the problem of multicollinearity — which mars the significance of these collinear variables. In our case the multitude of lagged regressors compound the problem of multicollinearity.

In this thesis the estimations have been done both for the levels and the growth rates of the dependent variable. It is a fairly standard practice amongst econometricians to apply various transformations i.e. logs, differencing, on the variables to get the "best fit". [8] It is possible that results with one transformation may be significant while the other transformation may give insignificant results. Sometimes in cases of multicollinearity it is useful to apply the differencing transformation as was found to be true in estimations of this thesis. Multicollinearity and autocorrelation were of great concern in our specification search because a number of lagged inter-related independant variables were used. The first differencing not only reduced the severity of multicollinearity but also improved somewhat the first degree serial correlation of the errors as seen from the improved Durbin Watson statistic in first differenced equations.

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[7] Kennedy (1984) p 79.

[8] It is assumed that atheoretical transformations are being ruled out. There is no theoretical reference in the Blinder and Fischer model which is at odds with either transformation employed by us.

All equations marked (a) are the levels results of log-linear equations, while (b) gives the results of the first differences of (a). We shall basically be describing the GLS results of (a) since problems of autocorrelation are greatly reduced by using the GLS technique as compared to OLS.[9] Equations (b) which are first differences of the logs of variables in (a) have been estimated only through OLS, since running GLS on the first differences amounts to another round of differencing of the dependent and independent variables. There are two issues in regard to doing GLS on the first differenced equations (b). First, it was found to be largely unneccesary to perform GLS on (b) because the problem of autocorrelation was more or less corrected for most regressions (of Tables 1 through 5), as seen through the Durbin Watson statistics of the OLS results of (b). Second, even if GLS is performed on (b), it becomes very difficult to give an economic interpretation to the estimated coefficients of the twice differenced log linear equations. Hence only OLS results of (b) are presented.

The reported coefficient of determination, R^2, is the R^2 corrected for degrees of freedom. It needs mention that the reported R^2 of the GLS results which apply the autocorrelation correction, is the R^2 of the transformed variable $log\ N_t - \rho\ log\ N_{t-1}$. This cannot be directly compared to the R^2 of the OLS results which states the explained variance of the origional variable $log\ N_t$. It would be more appropriate to report in the GLS equations, R^2s of the origional variable $log\ N_t$, rather than the transformed variable $log\ N_t - log\ N_{t-1}$. This however is a shortcoming of the TROLL computer programme used by us to regress most of the equations of this thesis. This programme does not compute R^2s on the origional variable. This shortcoming is however corrected in the first stage tests on *other goods inventories* reported in Table 4. These equations were estimated with the SHAZAM computer package which computes the R^2s on the origional untransformed variables. The reader may find the differences in the reported R^2s to be an inconvenience, but this is

[9] Moreover the results of (b) can be compared to Maccini & Rossana (1984) to evaluate the significance of various variables in the inventory demand equations. They also used the same transformation as (b). This may not be immediately obvious but becomes clear on reading the footnote No. 21 in Maccini & Rossana, on the Hatanaka procedure, p. 227.

merely an artifact of the software and not a deliberate introduction.

A final comment needs to be given about the two techniques of testing persistence that have been applied in this thesis. The first technique has been elaborated in the first and second stage tests of persistence. These tests were done through conventional regression equations, for example see equations (6) and (7) chapter III. It was suggested by Dr. Peter Kennedy, who is a member of the thesis committee, that the alternative technique of formal causality analysis should also be explored to test for causal relations between monetary shocks and inventories, and inventories and output. From a battery of available causality tests, we chose the Granger causality tests. Results are attached in the appendix at the end of Chapter IV.

II. EFFECTS OF MONETARY SHOCKS ON FINISHED GOODS INVENTORIES

II A. THE SIMPLE MULTIVARIATE MODEL RESULTS

In the *total manufacturing sector* the effects of monetary shocks on inventories were first examined by using the OLS technique. The results are given in the attached tables at the end of section II A in equations i(a) and i(b) Table 1. The presence of first order serial correlation suggested the generalised least squares (GLS) estimation technique. The DW statistic improved by using the GLS method but was still less than 2, and the value of the autocorrelation coefficient was 1. The value of the Durbin Watson statistic and the autocorrelation coefficient suggested first differences of the log linear equations marked (a). This means that equation (b) becomes a regression of growth rates of N_t on the growth rates of the R.H.S. variables. Note that we only take the first difference of the vector u_t, and not the first difference of logs of u_t (as was done for other variables). The reason is that u_t are already growth rates of unanticipated money. [10]

[10] The vector u_t is the residual of the estimated money growth rate equation (see p.64) Hence these residuals or unanticipated money are also in terms of growth rates.

When lagged money is the only dependent variable, both OLS and GLS results of equation i(b), as well as GLS results of i(a) show that unanticipated monetary shocks are statistically significant at all lags (including the contemporaneous term), and all estimated coefficients have the correct negative sign. All t values are greater than one. A "V" pattern of the effects of lagged money is observed. However, it should be noted that the estimated coefficients at different lags are very close in value. Barro and some other researchers have found an inverted V pattern on the coefficients of the lagged money on output and unemployment rates. The V pattern in inventory regressions is consistent with the inverted V pattern in output regressions because monetary (or any other) shocks increase production and reduce inventories. As the specification was improved by adding more relevant explanatory variables the V pattern became more pronounced and the estimated coefficients also significantly differed in magnitude.

The largest t value is on the last lag of unanticipated money, showing strong persistence effects on finished good inventories of monetary shocks that hit the economy one year ago. The R^2 corrected for degrees of freedom is not very high and only 3 per cent of the variation in finished goods inventories can be "explained" [11] by aggregate monetary shocks. This simply means that only 3 per cent of the fluctuation in inventories (transformed variable) can be "explained" by misperceptions about aggregate monetary shocks. The rest of the variance is attributable to other relevant cost and demand variables and hence they should be included as regressors.[12] Although, t values are significant, the F statistic is below its critical value suggesting inconsistent results. Rao (1976) has shown that such a result is possible and F(k,v) can be less than its critical value (c) if the absolute t value of each of the k "discarded variables" is less than the square root of kc. The word discarded variable

[11] As mentioned above, this reported measure of R^2 needs to be interpreted with caution, since it is computed on the transformed variable $log\ N_t - \rho\ log\ N_{t-1}$. It is clearly not a measure of goodness of fit of the origional variable $log\ N_t$.

[12] The results of including these variables are presented in section II B in the Generalized Multivariate Model.

may be misleading. In the context of our thesis the equivalent of discarded variables would be the lagged monetary shocks in whose joint significance we are interested. The highest t value is 2.24 which is less than 4 x 2.33 = 3.05,[13] therefore, Rao's t value condition is satisfied and the F value less than its critical value is rationalised.[14] In spite of this rationalization the insignificant F values show that the results are tentative in nature, and the evidence on the buffer stock role of FGIs in the total manufacturing sector is weak in these very simple equations of Table 1.

The *durable goods* sector shows similar effects of lagged shocks. An "almost V" pattern of coefficients is observed, with the maximum effect of a shock showing up in inventories three periods later, and then gradually declining for another two quarters. The "explained" variance of durable goods industries is 4 per cent in i(b). The equations for the *non-durable* sector show that lagged monetary shocks have a weaker effect on inventories (by the R^2 criterion) compared to other industry classifications. The "explained" variance is only 1 per cent in i(b). The F test for joint significance shows that the null hypothesis of zero effects of explanatory variables cannot be rejected. The t values at individual lags are however all greater than one and all coefficients have the correct negative sign.

We have completed the examination of the simplest inventory equations (for all industry aggregations) where monetary shocks were the only explanatory variable. These simple equations are ambiguous regarding the buffer stock role of FGIs. Although the t values on monetary shocks are significant, the F statistic shows the joint insignificance of R.H.S. variables. These simple equations are not adequate representations of the inventory demand functions. It needs to be seen whether the improvement in the specification of the inventory

[13] In i(a) and i(b), Table 1, in fact k = 5 if we include the contemporaneous term in the coefficients γ_0 to γ_4. But by definition, the issue of persistence is related to past monetary shocks, therefore we drop γ_0 and choose k = 4. Moreover, from the F tables the critical F value is 2.33, which is the value of c. Thus, kc = 4 x 2.33.

[14] The same anomaly was also found by Haraf in his tests on U.S. data.

demand function would lead to any different conclusions about the buffer stock role of FGIs.

The first subset of these other relevant variables in the inventory equations are expected real interest rates, expected real wages and expected real raw material prices.[15] Expected real interest rates are proxying for expected inventory holding costs, and expected real wages and raw material prices are proxying for expected labour and raw material costs.[16] Expectations were simply modelled as past lagged values of these variables. The estimated equations of the *simple multivariate* model for all industry aggregations are ii(a) and ii(b) of Table 1 (attached at the end of section II A). The first lagged value of all the above mentioned cost side exogenous variables turned out to be statistically insignificant in all industry classifications, unlike D & D's results for the U.K. Additional lags on real wages and real interest rates[17] were also insignificant and hence these variables were dropped from the model, but real raw material costs were significant in the lagged response both in ii(a) and ii(b). In total manufacturing, raw material costs have two correct sign coefficents at the first and third lag, and the coefficient at the first lag is significant at the 5 per cent level. However the coefficient at the second lag is "wrong sign significant".

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[15] This subset of variables was also used and found significant by D & D in their regressions. Throughout the thesis this subset is referred to as the *simple multivariate* model of inventory investment.

[16] Statistics Canada does not have published data for the raw material price index for the manufacturing sector. We had to construct this price index from the published data on costs of materials and supplies given in dollars. That means it included both the quantity and price change effects in the reported dollar amounts. Since we are only interested in the raw material price changes, a Paasche price index was constructed. Moreover the index for the durable and non-durable industry classifications had to be compiled from the cost of materials data on individual industries included under these classifications. See chapter VI for details.

[17] Interest rates have been found to be an insignificant measure of the carrying costs of inventories in a number of studies. The earlier literature has been summarised by Irvine (1981a). More recent papers have devised alternate capital carrying cost measures which are more firm specific. Irvine (1981a, 1981b) found that retail and wholesale inventories were sensitive to their cost measures. Rubin (1980) and Akhtar (1983) found aggregate inventories to be interest sensitive. There is only one study on the manufacturing sector where a specially constructed capital cost measure was significant (Leiberman, 1980). In tests on 20 industries, Blinder (1985) found that interest rates were insignificant in most industries.

Inspite of this mixed evidence on the t values of individual lags, the inclusion of raw material costs significantly increased the R^2 from 3 to 13 per cent in ii(a) and to 15 per cent in ii(b) in the total manufacturing sector but had a dampening effect on the t values of lagged money residuals. This will be clear if we compare the the money coefficients in ii(a) and ii(b) with i(a) and i(b). Only the last lag of money retained its significance. The signs on the coefficients of lagged money residuals are still correct and negative, thus showing that positive monetary shocks deplete not only current but also future inventories.

The *durable goods sector* shows results similar to total manufacturing. The "explained variance" of durable goods inventories increased from 4 to 17 per cent in ii(a) and to 19 per cent in ii(b) when raw material costs were added to lagged monetary shocks. The inclusion of costs made the t values on the intermediate lags of money insignificant. The contemporaneous and last lag were still significant, however the pattern of coefficients also changed and the "V" pattern is no longer observed. This may be partly due to a strongly significant "wrong sign" effect of raw material costs on inventories in the second quarter. The addition of raw material costs has also significantly improved the F value and it is now significant at the 5 per cent level. We no longer observe the anomalous result of significant t values and an insignificant F value. The inclusion of raw material costs in the inventory equation of the *non-durable sector* did nothing to improve the R^2, as the individual lag coefficients on raw material costs were insignificant.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

$$\log N_t = \beta_0 + \sum_{i=0}^{n} \gamma_i u_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	8.137	269.658	-0.06	0.02	0.05	8.094	0.139	0.03	1.62	1.49	1.00
	γ_0	0.853	0.335				-0.499	-1.751*				
	γ_1	-0.143	-0.058				-0.690	-1.904*				
	γ_2	-0.545	-0.220				-0.692	-1.838*				
	γ_3	-0.349	-0.140				-0.644	-1.831*				
	γ_4	-0.286	-0.114				-0.615	-2.247*				
i(b)	β_0	0.009	2.543	0.04	1.74	1.68						
	γ_0	-0.520	-1.910*									
	γ_1	-0.679	-1.966*									
	γ_2	-0.691	-1.934*									
	γ_3	-0.661	-1.962*									
	γ_4	-0.631	-2.394*									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

$$\log N_t = \beta_0 + \sum_{i=0}^{n} \gamma_i u_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	$\bar{R}^2$	D.W.	F	GLS VALUE	GLS T STAT	$\bar{R}^2$	D.W.	F	
1(a)	β_0	7.295	197.354	-0.06	0.02	0.03	7.243	0.098	0.04	1.67	1.69	1.00
	γ_0	0.894	0.286				-0.815	-2.270*				
	γ_1	-0.151	-0.050				-0.869	-1.901*				
	γ_2	-0.663	-0.218				-0.882	-1.859*				
	γ_3	-0.358	-0.117				-0.757	-1.709*				
	γ_4	-0.281	-0.092				-0.720	-2.087*				
1(b)	β_0	0.011	2.467	0.05	1.79	1.91						
	γ_0	-0.832	-2.423*									
	γ_1	-0.868	-1.993*									
	γ_2	-0.897	-1.990*									
	γ_3	-0.788	-1.856*									
	γ_4	-0.742	-2.231*									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

$$\log N_t = \beta_0 + \sum_{i=0}^{n} \gamma_i u_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
i(a)	β_0	7.571	302.896	-0.06	0.02	0.07	7.531	0.149	0.01	1.59	1.20	1.00
	γ_0	0.823	0.390				-0.248	-1.009				
	γ_1	-0.136	-0.066				-0.530	-1.689*				
	γ_2	-0.457	-0.223				-0.522	-1.604*				
	γ_3	-0.347	-0.169				-0.534	-1.754*				
	γ_4	-0.297	-0.143				-0.516	-2.182*				
i(b)	β_0	0.007	2.431	0.02	1.70	1.30						
	γ_0	-0.272	-1.152									
	γ_1	-0.511	-1.701*									
	γ_2	-0.510	-1.641*									
	γ_3	-0.540	-1.844*									
	γ_4	-0.528	-2.303*									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

SIMPLE MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
ii(a)	β_0	-2.736	-1.190	0.16	0.15	2.98*	8.339	0.326	0.13	1.50	2.53*	1.00
	γ_0	0.149	0.065				-0.365	-1.338**				
	γ_1	-1.712	-0.752				-0.320	-0.881				
	γ_2	-1.443	-0.636				-0.340	-0.868				
	γ_3	-0.577	-0.251				-0.489	-1.365**				
	γ_4	-0.456	-0.203				-0.512	-1.898*				
	β_{71}	4.116	2.059*				-0.821	-3.204*				
	β_{72}	-5.224	-1.442**				0.817	2.606*				
	β_{73}	3.396	1.650*				-0.045	-0.184				
ii(b)	β_0	0.009	2.721	0.15	1.62	2.82*						
	γ_0	-0.389	-1.502**									
	γ_1	-0.300	-0.868									
	γ_2	-0.320	-0.861									
	γ_3	-0.479	-1.404**									
	γ_4	-0.507	-1.964*									
	β_{71}	-0.849	-3.455*									
	β_{72}	0.811	2.702*									
	β_{73}	-0.081	-0.343									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

SIMPLE MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
11(a)	β_0	3.315	1.104	-0.08	0.05	0.27	7.513	0.110	0.17	1.59	3.19*	1.00
	γ_0	0.669	0.211				-0.621	-1.816*				
	γ_1	-0.704	-0.227				-0.506	-1.141				
	γ_2	-1.215	-0.390				-0.443	-0.935				
	γ_3	-0.468	-0.148				-0.482	-1.084				
	γ_4	0.029	0.009				-0.632	-1.887*				
	β_{71}	1.913	0.853				-0.879	-3.649*				
	β_{72}	-2.529	-0.626				0.860	2.702*				
	β_{73}	1.442	0.623				-0.034	-0.141				
11(b)	β_0	0.011	2.696	0.19	1.72	3.55*						
	γ_0	-0.642	-1.983*									
	γ_1	-0.491	-1.164									
	γ_2	-0.434	-0.965									
	γ_3	-0.488	-1.151									
	γ_4	-0.639	-1.995*									
	β_{71}	-0.894	-3.879*									
	β_{72}	0.858	2.820*									
	β_{73}	-0.050	-0.220									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

SIMPLE MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
ii(a)	β_0	1.519	1.203	0.17	0.09	3.15*	7.608	0.448	-0.01	1.55	0.93	1.00
	γ_0	0.434	0.231				-0.217	-0.861				
	γ_1	-1.087	-0.577				-0.419	-1.263				
	γ_2	-1.171	-0.624				-0.445	-1.267				
	γ_3	-0.797	-0.428				-0.513	-1.622*				
	γ_4	-0.743	-0.405				-0.483	-1.976*				
	β_{71}	2.233	1.744				-0.200	-1.052				
	β_{72}	-1.306	-0.610				0.202	1.008				
	β_{73}	0.893	0.683				-0.025	-0.136				
ii(b)	β_0	0.007	2.445	0.003	1.66	1.03						
	γ_0	-0.246	-1.021									
	γ_1	-0.406	-1.280									
	γ_2	-0.428	-1.279									
	γ_3	-0.504	-1.659*									
	γ_4	-0.479	-2.030*									
	β_{71}	-0.224	-1.219									
	β_{72}	0.181	0.931									
	β_{73}	-0.056	-0.310									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Summary -- Simple Multivariate Model

In summary, the results for the simple multivariate model in the total manufacturing and durable goods sectors show that :

1. On the basis of t and F value criterion there is weak evidence that past monetary shocks can explain persistence in inventories. Judging by the tvalue criterion the persistence of monetary shocks in Canada is longer than the one year persistence found by D & D for the total manufacturing sector of the U.K. We cannot compare our results with them for the durable and non-durable industries because they did not disaggregate by sectors.
2. Raw material costs are a statistically important variable in the total manufacturing and durable goods sector. Their inclusion increases the "explained variance" of inventories between 13 to 15 per cent in the total manufacturing and the durable goods sectors respectively. The addition of raw material costs as an additional variable has however reduced the significance of money at individual lags in all three industry classifications. The last lag of money in all three sectors still retains its statistical significance, thereby providing some evidence that inventories can be affected by monetary shocks occuring as early as five quarters earlier.

The results for the simple multivariate model show that the evidence on the buffer stock role of finished goods inventories is weak by both the t value and the F value criterion. First, out of the five lags (inluding the contemporaneous lag) on monetary shocks, only one lag is significant at the 5% level in the total manufacturing, and only two lags are significant in the durable and non-durable goods sectors. Second, the F test for the joint significance of all R.H.S. variables shows that the null hypothesis of zero buffer stock effects is accepted for all industry classifications. This completes the first stage tests which were conducted from the subset of explanatory variables used by D & D. In what follows we will add more variables to equation (ii) of Table 1, and comment on whether the inclusion of those variables changes the inferences about persistence attributable to inventories. As mentioned before the *a priori* expectation is that the results should change somewhat, because Maccini & Rossana found that speeds of inventory adjustment changed when the specification of the inventory demand functions was improved.

II B. THE GENERALIZED MULTIVARIATE MODEL RESULTS

The influence of the larger set of explanatory variables on the inventory investment decision for FGIs will be examined by systematically adding other demand variables (besides unanticipated money) and the relevant cost and stock variables alluded to in chapter III. This section is divided into three subsections. First, the regression results of adding the demand variables are presented. Second, the joint production of goods produced to stock (stored as FGIs) with goods produced to order (accounted in a firm's inventories as unfilled orders), and intermediate goods is examined. Third, the interaction of FGIs with quasi fixed stocks of capital, labour and raw materials is examined. The results of the generalized model are given from equation (iii) of Table 1 to the last equation of Table 3. The tables of regression results for each of the subsections of II B are attached at the end of the explanation of results for each subsection.

In the comparison of equations (a) and (b) of the generalized multivariate model with equations ii(a) and ii(b) of the simple multivariate model, one should be cognisant of the differences in the independent and dependent variables, hence the R^2s should be accordingly interpreted. For the same reason we cannot directly compare the size of the coefficients on the lagged monetary shocks. To be consistent we should only compare level equations marked (a) with the level equations, and growth rate equations marked (b) with their counterpart in other equations. It was important to mention this because once additional variables are added we should know which equations to correlate.

So far we have examined the effect on inventories of costs of production and aggregate demand modelled solely by aggregate monetary shocks. The variables traditionally used to capture industry demand are new industry orders or shipments. Both these proxies for demand were tested, the results for shipments were very similar to the new industry orders. Hence only the results of the former are retained.

1. DEMAND EFFECTS

New Industry Orders

The addition of a traditional demand variable (industry orders) to an equation which had monetary surprises and raw material costs (See equation (iii) Table 1) increased the R^2 from 13 to 16 per cent in the levels equations of the *total manufacturing sector.* Expected orders increase desired and hence actual inventories. The literature recognises that the long run effect of orders on inventories is positive. There may be a short run negative "involuntary" effect on inventories due to the buffer stock role of inventories. It was found that the signs on coefficients of all lags are positive in the levels equation iii(a) but the growth rate equation iii(b) has two negative signs which are statistically insignificant. The positive effect of orders on inventories is not instantaneous but occurs with a two period lag.[11] This points to possible delays in production due to high transaction costs in immediate production and delivery. It is also possible that firms are giving priority to the delivery of unfilled orders before they satisfy the new orders. That this may well be true was borne out by the results of the *second stage test* for all industry classifications (Table 5). In the second stage test, when output was regressed on inventories, the *non-durable sector* showed that backorders as far as one year back were being satisfied from current output. Moreover,

[11] In some empirical studies this lag is referred to as a slow speed of adjustment; other studies call it a slowly changing inventory "target". The literature has not provided an adequate theoretical explanation of this issue. The problem is discussed in Blinder (1981) and Feldstein and Auerbach (1976).

the total manufacturing and durable goods sectors also showed a highly significant effect of backorders on output in the contemporaneous period. Thus backorders were given more immediate attention by the firms relative to new orders.[19] This may be so because backorders are relatively more important to durable goods industries compared to the non-durable sector, because durable goods industries produce a number of non-homogeneous goods and it is important that back orders be satisfied within a reasonable time horizon, or otherwise goodwill and expected profits will decline.

New orders show results similar to the total manufacturing sector for the *non-durable goods sector*, with orders affecting inventories with a three period lag. The addition of new orders in (iii) marginally increases the explained variance of non-durable inventories by another 1 per cent from equation (ii). The *durable goods* industries show that new orders do not add to the "explained variance" of durable goods inventories. All the three lagged values of orders are insignificant and consequently there is no improvement in R^2. When demand was proxied by shipments the results were very similar to the orders equation. The R^2 was however 1 per cent higher and the t values on the lags of money were marginally more significant. In the non-durable goods industries shipments did not increase the "explained variance" over and above the orders equations.[20]

Imports

A firm's desired inventories are also based on both expected and unexpected imports. The level of actual imports incorporates both these anticipated and unanticipated components. Consequently, the level of actual imports was used as an additional demand variable in our regression equations. The results for imports are presented in equations (iv) of Table 1 for all industry classsifications. As mentioned earlier on page 48, the overall effect of imports on

[19] The significance of backorders was however not observed in the inventory equations of the first stage test.

[20] Since the results are so similar these equations are not presented.

inventories should be negative, although in the short run we could see a positive effect as imports flow into and increase inventory levels. Unfortunately we have to report that the results obtained for the import variable are suspect and tentative in nature. A number of equations were estimated in which the demand variable was imports instead of new industry orders. We found that the results for imports were not consistent across data transformations (a) and (b), where the former equations are in log-linear form and the latter in first differences of the log-linear variables. Additional variables like unfilled orders, goods in process, raw materials and capital were also added successively to the equations which contained imports. The results show that in the log-linear equations imports are statistically significant at atmost two of the four lags. However the suspect result is that even when six lags on imports were used, most of the signs on the estimated coefficients in the log-linear equations were positive. This seems curious because we would normally expect imports to add to inventories for only say, two or atmost three quarters. After that time we expect that imports should appear to be a leakage from the National Income stream — thus we should see negative signs from approximately the fourth lag onwards. Due to the extremely tentative nature of results on the import variable these experimental import equations are not reported but their results are available from me upon request.

In the reported import equations of Table 1 (see iv) the results for the *total manufacturing sector* show that 2 of the 4 lagged coefficients on imports in iv(a) have a positive sign at the 5 per cent level. The pattern of coefficients on imports shows a lagged response of inventories to changes in imports. This seems quite plausible in view of possible delivery lags due to production as well as delivery lags due to transportation across international borders, the former lag being more common in made to order non-homogeneous goods. When imports are included and orders excluded in (iv)a the R^2 is 43 per cent. This is more than twice the "explained variance" of the orders equation. Including orders in the import equation however did not add to the "explained variance". This suggests the relative importance of imports over orders as a demand variable in the total manufacturing sector.

Similar results were obtained for the ***durable goods sector***. In the durable goods sector the R^2 of the equation which had imports (see iv(a)) was three times that of the equation which had orders. In the ***non-durable goods*** sector imports are not as important a determinant of desired inventories as in the durable goods sector. The relative variance "explained" by the imports equations is less than that of the orders equations. The R^2 is only 4 per cent, however the last two lags of imports are significant at the 10 per cent level.

There seems to be a possible reason for the unfavourable results on imports. The culprit is overly aggregated unrepresentative data. Ideally we would have liked to have data on imports segregated by sectors— but such data was not available. The only time series on imports that is available is the total merchandise imports for the whole economy (which includes the farm and service sector), rather than disaggregated by the three sectors under consideration. Obviously, using the total economy's imports instead of the imports of durable and non-durable sectors would give inconsistent results in the regression equations of these sectors.

What is the effect on the persistence variable (monetary shocks) of adding demand variables like orders and imports to the simple inventory equation of the type estimated by D & D?

In this thesis our counterpart to D & D's estimated equation for the UK are equations ii(a) and ii(b) of Table 1.[21] The addition of orders in the durable goods sector in the levels equation iii(a) makes the contemporaneous lag on money insignificant. There is a general dampening of the t values on monetary lags in all the three industry classifications, but the

[21]These equations are referred to as the *simple multivariate model* in this thesis. They incorporate all the explanatory variables used by D & D with the exception of wages and interest rates which were dropped because they were found to be insignificant for Canada.

last lag of money in all equations still retains its significance. It would not be very surprising if even the last lag became insignificant since the presence of high multicollinearity between the two demand variables, i.e. monetary shocks and orders, greatly inflates the standard errors and biases downwards the t values on lagged money coefficients.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

GENERALISED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
iii(a)	β_0	-2.642	-2.749	0.86	0.44	45.69*	5.859	2.724	0.16	1.48	2.46*	0.99
	γ_0	-0.887	-0.935				-0.184	-0.662				
	γ_1	-1.028	-1.075				-0.177	-0.486				
	γ_2	-0.998	-1.038				-0.249	-0.624				
	γ_3	-0.813	-0.824				-0.463	-1.221				
	γ_4	-1.477	-1.542				-0.492	-1.724*				
	β_{71}	2.178	2.444				-0.732	-2.709*				
	β_{72}	-0.535	-0.324				0.874	2.587*				
	β_{73}	-0.931	-0.961				-0.408	-1.427**				
	β_{11}	-1.077	-2.430				0.033	0.252				
	β_{12}	0.352	0.601				0.062	0.447				
	β_{13}	1.609	3.519				0.330	2.357*				
iii(b)	β_0	0.008	1.981	0.15	1.55	2.33*						
	γ_0	-0.261	-0.962									
	γ_1	-0.178	-0.505									
	γ_2	-0.194	-0.506									
	γ_3	-0.366	-0.988									
	γ_4	-0.417	-1.487**									
	β_{71}	-0.793	-2.989*									
	β_{72}	0.927	2.807*									
	β_{73}	-0.307	-1.082									
	β_{11}	-0.053	-0.394									
	β_{12}	-0.028	-0.197									
	β_{13}	0.243	1.691*									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

GENERALISED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iii(a)	β_0	-3.029	-2.183	0.80	0.36	31.65*	6.224	2.540	0.16	1.62	2.48*	0.99
	γ_0	-1.488	-1.090				-0.526	-1.499**				
	γ_1	-0.951	-0.703				-0.439	-0.961				
	γ_2	-1.032	-0.752				-0.439	-0.888				
	γ_3	-1.311	-0.934				-0.610	-1.252				
	γ_4	-1.842	-1.328				-0.715	-1.977*				
	β_{71}	2.109	2.084				-0.827	-3.206*				
	β_{72}	-1.571	-0.880				0.830	2.448*				
	β_{73}	0.064	0.063				-0.185	-0.690				
	β_{11}	-0.481	-1.297				0.077	0.778				
	β_{12}	0.258	0.564				0.057	0.569				
	β_{13}	1.193	3.264				0.121	1.211				
iii(b)	β_0	0.010	2.247	0.17	1.71	2.52*						
	γ_0	-0.609	-1.803*									
	γ_1	-0.459	-1.047									
	γ_2	-0.399	-0.844									
	γ_3	-0.485	-1.028									
	γ_4	-0.626	-1.779*									
	β_{71}	-0.871	-3.483*									
	β_{72}	0.861	2.621*									
	β_{73}	-0.101	-0.385									
	β_{11}	0.008	0.084									
	β_{12}	-0.004	-0.039									
	β_{13}	0.056	0.553									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
iii(a)	β_0	-0.206	-0.361	0.85	0.27	43.75*	2.912	1.767	0.10	1.66	1.85	0.98
	γ_0	-0.117	-0.143				0.030	0.115				
	γ_1	-0.997	-1.232				-0.259	-0.767				
	γ_2	-1.319	-1.636				-0.317	-0.883				
	γ_3	-1.029	-1.269				-0.384	-1.165				
	γ_4	-1.166	-1.474				-0.448	-1.812*				
	β_{71}	1.112	2.027				-0.219	-1.177				
	β_{72}	0.204	0.216				0.231	1.095				
	β_{73}	-1.237	-1.985				-0.237	-1.187				
	β_{11}	-0.711	-1.042				-0.067	-0.311				
	β_{12}	0.446	0.485				0.188	0.908				
	β_{13}	1.235	1.968				0.579	2.725*				
iii(b)	β_0	0.005	1.494	0.02	1.72	1.18						
	γ_0	-0.035	-0.134									
	γ_1	-0.231	-0.702									
	γ_2	-0.253	-0.725									
	γ_3	-0.321	-0.994									
	γ_4	-0.395	-1.621*									
	β_{71}	-0.237	-1.293									
	β_{72}	0.272	1.306**									
	β_{73}	-0.172	-0.858									
	β_{11}	-0.220	-0.970									
	β_{12}	0.046	0.210									
	β_{13}	0.445	2.007*									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

GENERALISED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{2i} \log IMP_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iv(a)	β_0	2.191	2.842	0.92	0.21	75.46*	3.422	3.279	0.43	1.61	6.27*	0.93
	γ_0	-0.675	-0.884				-0.364	-1.277				
	γ_1	-1.039	-1.361				-0.359	-0.996				
	γ_2	-1.086	-1.397				-0.455	-1.141				
	γ_3	-0.711	-0.913				-0.427	-1.150				
	γ_4	-0.825	-1.074				-0.519	-1.809*				
	β_{71}	-0.009	-0.013				-0.560	-2.227*				
	β_{72}	0.848	0.695				0.846	2.681*				
	β_{73}	-0.496	-0.726				-0.196	-0.776				
	β_{21}	-0.090	-0.721				0.020	0.471				
	β_{22}	0.007	0.055				0.044	0.967				
	β_{23}	0.205	1.519				0.115	2.600*				
	β_{24}	0.177	1.379				0.116	2.646*				
iv(b)	β_0	0.006	1.005	0.13	1.63	2.05						
	γ_0	-0.412	-1.491**									
	γ_1	-0.341	-0.967									
	γ_2	-0.343	-0.879									
	γ_3	-0.357	-0.985									
	γ_4	-0.478	-1.694*									
	β_{71}	-0.750	-2.567*									
	β_{72}	0.866	2.819*									
	β_{73}	-0.122	-0.480									
	β_{21}	-0.026	-0.468									
	β_{22}	-0.001	-0.027									
	β_{23}	0.067	1.112									
	β_{24}	0.065	1.096									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{2i} \log IMP_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iv(a)	β_0	-1.168	-1.435	0.93	0.30	91.15*	1.341	1.250	0.49	1.71	7.82*	0.91
	γ_0	-0.733	-0.849				-0.627	-1.746*				
	γ_1	-1.156	-1.376				-0.573	-1.297				
	γ_2	-1.134	-1.310				-0.637	-1.316**				
	γ_3	-0.330	-0.378				-0.418	-0.913				
	γ_4	-0.832	-0.957				-0.602	-1.695*				
	β_{71}	-0.119	-0.199				-0.620	-2.596*				
	β_{72}	0.531	0.495				0.889	2.796*				
	β_{73}	0.215	0.359				-0.143	-0.595				
	β_{21}	-0.165	-1.178				0.037	0.692				
	β_{22}	-0.128	-0.824				0.021	0.379				
	β_{23}	0.302	1.982				0.135	2.464*				
	β_{24}	0.370	2.507				0.176	3.224*				
iv(b)	β_0	0.014	2.368	0.18	1.70	2.61*						
	γ_0	-0.673	-1.941*									
	γ_1	-0.560	-1.291									
	γ_2	-0.395	-0.849									
	γ_3	-0.357	-0.795									
	γ_4	-0.576	-1.645*									
	β_{71}	-0.944	-3.692*									
	β_{72}	0.874	2.827*									
	β_{73}	-0.007	-0.029									
	β_{21}	-0.063	-1.015									
	β_{22}	-0.049	-0.659									
	β_{23}	0.007	0.115									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$

Table 1
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \beta_{7i} \sum_{i=1}^{3} \log rmp_{t-i} + \beta_{2i} \sum_{i=1}^{3} \log IMP_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iv(a)	β_0	8.873	13.915	0.86	0.22	44.93*	7.412	10.186	0.04	1.67	1.32	0.98
	γ_0	0.026	0.033				-0.064	-0.242				
	γ_1	-0.915	-1.155				-0.300	-0.897				
	γ_2	-1.362	-1.690*				-0.389	-1.070				
	γ_3	-1.386	-1.717*				-0.459	-1.360**				
	γ_4	-0.790	-0.998				-0.460	-1.757*				
	β_{71}	0.059	0.109				-0.111	-0.578				
	β_{72}	0.248	0.281				0.165	0.809				
	β_{73}	-0.788	-1.451				-0.076	-0.400				
	β_{21}	7.4E-08	2.165				1.8E-08	1.473**				
	β_{22}	3.6E-08	0.917				1.4E-08	1.125				
	β_{23}	-1.9E-08	-0.046				2.0E-08	1.570**				
	β_{24}	3.3E-09	0.093				2.0E-08	1.510**				
iv(b)	β_0	0.005	1.258	-0.02	1.68	0.87						
	γ_0	-0.258	-1.004									
	γ_1	-0.395	-1.214									
	γ_2	-0.353	-1.007									
	γ_3	-0.462	-1.444**									
	γ_4	-0.514	-2.044*									
	β_{71}	-0.199	-1.043									
	β_{72}	0.212	1.063									
	β_{73}	-0.092	-0.489									
	β_{21}	-0.013	-0.299									
	β_{22}	0.043	0.845									
	β_{23}	0.050	1.086									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

2. JOINT PRODUCTION

Now we investigate the question whether finished goods are jointly produced with goods produced to order, and intermediate goods. The discussion of the multivariate model in chapter III brings out that a firm may produce both to stock and to order. The former goods are carried as finished goods inventories and the latter are reflected as backorders. If the goods produced to stock (GPS) and goods produced to order (GPO) are either substitutes or complements, FGIs would be affected by changes in backorders. By similar reasoning FGIs would also be influenced by changes in inventories of intermediate goods. Our interest in joint production is not merely to find out if production is a joint stock decision, but in knowing how the inclusion of these joint stock variables affects the issue of persistence (as seen through the lagged monetary response) and the overall significance of the inventory and output equations. The results on joint production are given in Table 2.

As pointed out in the discussion of the multivariate model in chapter III, if production is in fact a joint stock decision then the stock of unfilled orders and or the stock of goods in process inventories (intermediate goods) should have a significant impact on finished goods inventories. This was investigated (in Table 2) by separately adding the stock of unfilled orders and goods in process inventories to equation (iii) of Table 1, which has new orders as the demand variable. The results of adding unfilled orders to the new orders equation (iii of Table 1) are given in (i) of Table 2. Similarly, when intermediate goods were added to the new orders equation results are shown in (ii) of Table 2.

Unfilled Orders

All three industry classifications show that goods produced to stock (which are stored as finished goods inventories) are not statistically correlated with goods produced to order (which are accounted as unfilled orders) i.e. $\delta_1 = 0$. See equation (i), Table 2, for all industry classifications.[22] Unfilled orders in all these industries are insignificant showing the independence of GPO and GPS in equations (i). To explore the possibility of longer lagged adjustment between goods produced to order and stock we added more lags to unfilled orders in the inventory equations. This had no impact on the significance of results and all further lags were insignificant.

Goods in Process or Intermediate Goods

As mentioned above, equations (ii) of Table 2 show the interaction between goods produced to stock and intermediate goods. In the non-durable sector, production decisions of GPS and intermediate goods are independent, shown by the insignificance of the estimated coefficient on goods in process inventories, i.e. $\delta_2 = 0$. This result did not change when more lags were added to intermediate goods. The durable goods and total manufacturing sectors show that $\delta_2 \leq 0$[23] and significant, showing the complementarity of GPS and intermediate goods. This is normally the result because intermediate goods may be an input to production. This is more likely to happen if production is a multistage process. Adding more lags to intermediate goods inventories did not show the significance of any further lags in the durable goods and total manufacturing sectors. The first lag continued to retain its significance in both the orders and imports equations. Thus the results show that intermediate goods are complements in the durable goods and total manufacturing sector and independent in the non-durable sector.

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[22] Refer back to equation (1) chapter III.

[23] Note that δ_2 has been entered in the regression equation with a negative sign.

Table 2

FIRST STAGE TESTS

FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

JOINT PRODUCTION WITH GOODS PRODUCED TO ORDER

GENERALIZED MULTVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \delta_1 \log UF_{t-1} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	-4.270	-3.908	0.87	0.51	46.37	5.642	2.892	0.16	1.51	2.29*	0.99
	γ_0	-1.000	-1.099			1.55	-0.154	-0.546			0.76	
	γ_1	-1.045	-1.142				-0.128	-0.345				
	γ_2	-1.161	-1.260				-0.221	-0.552				
	γ_3	-1.271	-1.325				-0.477	-1.250				
	γ_4	-1.950	-2.092*				-0.499	-1.743*				
	β_{71}	2.132	2.500				-0.742	-2.731*				
	β_{72}	-0.678	-0.429				0.853	2.511*				
	β_{73}	-0.936	-1.010				-0.423	-1.472**				
	β_{11}	-0.820	-1.886				0.076	0.528				
	β_{12}	0.517	0.918				0.089	0.619				
	β_{13}	1.683	3.841				0.358	2.469*				
	δ_1	0.194	2.760				0.046	0.755				
i(b)	β_0	0.008	1.999	0.15	1.59	2.25*						
	γ_0	-0.227	-0.827			0.67						
	γ_1	-0.127	-0.355									
	γ_2	-0.167	-0.432									
	γ_3	-0.381	-1.026									
	γ_4	-0.424	-1.509**									
	β_{71}	-0.806	-3.027*									
	β_{72}	0.905	2.726*									
	β_{73}	-0.319	-1.123									
	β_{11}	-0.006	-0.045									
	β_{12}	-0.001	-0.008									
	β_{13}	0.272	1.839*									
	δ_1	0.052	0.859									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.

* Significant at the 5% level

** Significant at the 10% level

The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 2
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

JOINT PRODUCTION WITH GOODS PRODUCED TO ORDER

SIMPLE MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \delta_1 \log UF_{t-1} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	-3.370	-2.331	0.80	0.37	28.97*	6.235	2.530	0.15	1.63	2.26*	0.99
	γ_0	-1.519	-1.110			0.87	-0.502	-1.408**			1.15	
	γ_1	-0.946	-0.698				-0.401	-0.857				
	γ_2	-1.121	-0.813				-0.418	-0.836				
	γ_3	-1.580	-1.097				-0.623	-1.269				
	γ_4	-2.082	-1.468**				-0.719	-1.976*				
	β_{71}	2.066	2.036				-0.843	-3.215*				
	β_{72}	-1.521	-0.850				0.833	2.444*				
	β_{73}	-0.029	-0.028				-0.193	-0.714				
	β_{11}	-0.382	-0.984				0.099	0.886				
	β_{12}	0.302	0.654				0.065	0.638				
	β_{13}	1.233	3.339				0.131	1.270				
	δ_1	0.076	0.856				0.026	0.435				
i(b)	β_0	0.011	2.286	0.16	1.73	2.33*						
	γ_0	-0.576	-1.679*			1.21						
	γ_1	-0.405	-0.906									
	γ_2	-0.369	-0.772									
	γ_3	-0.501	-1.057									
	γ_4	-0.630	-1.781*									
	β_{71}	-0.897	-3.528*									
	β_{72}	0.866	2.627*									
	β_{73}	-0.109	-0.415									
	β_{11}	0.038	0.343									
	β_{12}	0.006	0.064									
	β_{13}	0.068	0.660									
	δ_1	0.038	0.655									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 2
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

JOINT PRODUCTION WITH GOODS PRODUCED TO ORDER

SIMPLE MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \delta_1 \log UF_{t-1} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	-0.299	-0.821	0.94	0.56	106.52*	2.860	1.719*	0.09	1.63	1.75	0.97
	γ_0	-0.599	-1.131			4.28*	0.031	0.114			0.77	
	γ_1	-1.237	-2.385*				-0.260	-0.763				
	γ_2	-1.384	-2.680*				-0.320	-0.883				
	γ_3	-1.395	-2.678*				-0.380	-1.139				
	γ_4	-1.341	-2.646*				-0.442	-1.748*				
	β_{71}	0.536	1.507				-0.219	-1.166				
	β_{72}	0.152	0.252				0.230	1.084				
	β_{73}	-0.866	-2.162*				-0.243	-1.205				
	β_{11}	0.169	0.381				-0.076	-0.331				
	β_{12}	0.838	1.423**				0.188	0.891				
	β_{13}	0.472	1.156				0.584	2.734*				
	δ_1	0.455	10.22				-0.016	-0.190				
i(b)	β_0	0.006	1.643	0.02	1.66	1.12						
	γ_0	-0.054	-0.205			0.44						
	γ_1	-0.229	-0.696									
	γ_2	-0.246	-0.704									
	γ_3	-0.287	-0.878									
	γ_4	-0.354	-1.413**									
	β_{71}	-0.243	-1.321**									
	β_{72}	0.283	-1.350**									
	β_{73}	-0.174	-0.865									
	β_{11}	-0.306	-1.200									
	β_{12}	-0.001	0.004									
	β_{13}	0.422	1.882*									
	δ_1	-0.067	-0.749									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 2
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

JOINT PRODUCTION WITH INTERMEDIATE GOODS

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \delta_2 \log GP_{t-1} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
11(a)	β_0	-2.833	-2.464	0.85	0.43	41.36	4.185	2.020	0.20	1.54	2.75*	0.99
	γ_0	-0.922	-0.958			0.97	-0.208	-0.765			0.66	
	γ_1	-1.029	-1.070				-0.035	-0.098				
	γ_2	-1.019	-1.051				-0.138	-0.352				
	γ_3	-0.835	-0.838				-0.320	-0.851				
	γ_4	-1.497	-1.550*				-0.393	-1.392**				
	β_{71}	2.193	2.442				-0.592	-2.176*				
	β_{72}	-0.519	-0.313				0.931	2.816*				
	β_{73}	-0.893	-0.909				-0.258	-0.895				
	β_{11}	-1.083	-2.424				-0.099	-0.693				
	β_{12}	0.323	0.542				-0.082	-0.542				
	β_{13}	1.526	2.863				0.134	0.818				
	δ_2	-0.109	-0.307				-0.527	-2.140*				
11(b)	β_0	0.006	1.737	0.18	1.61	2.55*						
	γ_0	-0.266	-1.001			0.66						
	γ_1	-0.060	-0.173									
	γ_2	-0.113	-0.299									
	γ_3	-0.257	-0.701									
	γ_4	-0.339	-1.220									
	β_{71}	-0.662	-2.469*									
	β_{72}	0.971	2.991*									
	β_{73}	-0.176	-0.619									
	β_{11}	-0.159	-1.119									
	β_{12}	-0.150	-0.979									
	β_{13}	0.074	0.452									
	δ_2	-0.477	-1.981*									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 2
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

JOINT PRODUCTION WITH INTERMEDIATE GOODS

GENERALIZED MULTVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \delta_2 \log GP_{t-1} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
11(a)	β_0	-4.955	-3.147	0.81	0.33	31.31	3.809	1.994	0.23	1.70	3.08*	0.99
	γ_0	-1.948	-1.455			1.13	-0.533	-1.585**			0.99	
	γ_1	-1.217	-0.924				-0.271	-0.612				
	γ_2	-1.356	-1.013				-0.291	-0.610				
	γ_3	-1.495	-1.097				-0.373	-0.786				
	γ_4	-2.008	-1.490				-0.512	-1.442**				
	β_{71}	2.163	2.203				-0.644	-2.513*				
	β_{72}	-1.310	-0.755				0.850	2.614*				
	β_{73}	0.138	0.140				-0.117	-0.451				
	β_{11}	-0.566	-1.568				-0.032	-0.313				
	β_{12}	0.093	0.207				-0.057	-0.544				
	β_{13}	0.810	2.076				0.007	0.069				
	δ_2	-0.683	-2.355				-0.521	-2.712				
11(b)	β_0	0.008	1.887	0.22	1.77	2.98*						
	γ_0	-0.593	-1.813*	1.13		1.13						
	γ_1	-0.320	-0.749									
	γ_2	-0.290	-0.632									
	γ_3	-0.305	-0.660									
	γ_4	-0.461	-1.329**									
	β_{71}	-0.705	-2.806*									
	β_{72}	0.872	2.748*									
	β_{73}	-0.047	-0.186									
	β_{11}	-0.077	-0.744									
	β_{12}	-0.098	-0.935									
	β_{13}	-0.036	-0.350									
	δ_2	-0.464	-2.460*									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 2
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

JOINT PRODUCTION WITH INTERMEDIATE GOODS

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \delta_2 \log GP_{t-1} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
11(a)	β_0	-0.007	-0.015	0.88	0.43	51.32	3.061	1.789	0.09	1.64	1.65	0.98
	γ_0	-0.492	-0.661			2.65	0.034	0.128			0.81	
	γ_1	-1.617	-2.182*				-0.265	-0.777				
	γ_2	-1.845	-2.513*				-0.321	-0.888				
	γ_3	-1.335	-1.825*				-0.382	-1.152				
	γ_4	-1.172	-1.650*				-0.440	-1.761*				
	β_{71}	0.784	1.574				-0.226	-1.197				
	β_{72}	0.295	0.348				0.236	1.108				
	β_{73}	-1.646	-2.901				-0.245	-1.202				
	β_{11}	-0.288	-0.464				-0.063	-0.289				
	β_{12}	0.636	0.770				0.193	0.916				
	β_{13}	1.692	2.952				0.593	2.670*				
	δ_2	0.963	4.287				0.044	0.275				
11(b)	β_0	0.006	1.556	0.01	1.68	1.10						
	γ_0	-0.029	-0.109			0.54						
	γ_1	-0.240	-0.728									
	γ_2	-0.259	-0.740									
	γ_3	-0.315	-0.972									
	γ_4	-0.378	-1.533**									
	β_{71}	-0.250	-1.348**									
	β_{72}	0.283	1.347**									
	β_{73}	-0.186	-0.918									
	β_{11}	-0.217	-0.950									
	β_{12}	0.052	0.234									
	β_{13}	0.470	2.069*									
	δ_2	0.089	0.561									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

3. INVENTORY AND QUASI-FIXED STOCK INTERACTION

The interaction of the production decision (which is also an inventory decision) with the stocks of quasi fixed factors of production will now be investigated. The three quasi fixed factors of production that are considered are raw material stocks,[24] stocks of labour and capital stocks. The estimated equations are presented in Table 3. For all three industry classifications, equation (i) is for raw material stocks, equation (ii) presents the results on capital, and (iii) shows the stock effects of labour.

Raw Material Stocks

In all three industry classifications an effect of raw materials on FGI was only found in the levels equation i(a) and not in the growth rate equation i(b). None of the t values in the growth rate equations (marked b) are significant at the 5% level of significance. In the log-linear equations (marked a), both the durable goods and total manufacturing show lagged adjustment of finished goods inventories to raw materials, with the third lag on raw materials being statistically significant with the correct negative sign. An increase in actual raw material inventories relative to the desired stock of raw materials will lead to an increase in production and FGIs. Note that a negative δ_3 implies a positive effect on inventories since raw materials have been entered in the regression equations with a negative coefficient. See the signs and explanation of equation (1) in chapter III. Raw material stocks have a more immediate effect on inventories in the non-durable goods industry as compared to other industry classifications. Raw materials are statistically significant at the first lag with 5% significance levels and the correct negative signs.

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[24] In this we have referred raw materials to be one of the inventries in the *other goods inventories.* Maccini & Rossana however refer to raw materials as one of the quasi-fixed stocks which interact with FGIs. This difference in nomenclature has no bearing on the qualitative or quantitive results of our thesis.

Capital Stock

The evidence on the interaction of production with the capital stock is relatively strong as compared to other quasi fixed stocks (see equation ii, Table 3). In all three industry classifications the stocks of capital are statistically significant with the correct signs. However, as was the case with raw materials, this significance is only observed in the levels equations ii(a) and not in the growth rate equations ii(b); except for non-durables. The overall evidence for the log-linear capital equations shows that excess capital stocks are used to increase inventories and production. The issue of capital needs to be investigated further with other definitions of capital than that used in this study. We used the total capital employed in construction, engineering and machinery and equipment of the manufacturing sector. One needs to examine the behaviour of capital when broken down by each of these disaggregated categories. This will be more important when using individual industry or firm data. We did not do so in this thesis because we are more interested in the behaviour of aggregates. Moreover, as repeatedly mentioned before the primary interest of the thesis is to assess the impact of lagged monetary shocks on inventories and output. The interest in other variables like capital etc., is only to the extent of specifying the "correct" inventory equation.

Labour Stock

The interaction of goods produced to stock with labour in iii(a) and iii(b) is not found to be statistically significant in durable goods industries. The non-durable goods sector however shows a lagged interaction with labour in the third quarter. This significance was obtained in both the levels and growth rate equations. The first two lags are insignificant at the 5% level, but have the correct negative sign implying that labour hoarding increases inventories and output. The total manufacturing shows that one lag of labour is significant at the 10% level. These results at best show weak evidence of interaction of production with employment.

Having presented the results of the individual equations in which the significance of the quasi-fixed factors of production and jointly produced goods was examined in separate equations, we shall see what happens to the statistical significance of these stocks once they are all combined together in one equation. We are aware that in dealing with a relatively large number of inter-related regressors we are bound to find multicollinearity, once they are all combined in one regression equation. Consequently, we should expect that due to this problem some of the variables which were significant when included by themselves (with the exclusion of other collinear variables) can possibly become insignificant when all variables are regressed at once. This is exactly what we found in our estimations. Equation (iv) of Table 3 presents the final equation, when all relevant regressors have been included in the finished goods inventory demand function. Equation (iv) is important from our point of view and supersedes all previous equations, because it can be considered the culminating equation of the "forward selection" technique. This equation only retains those regressors which remained ststistically significant in the event that all regressors were lumped together in one single equation. We shall base our inferences on persistence, or the buffer stock role of FGIs by looking at the significance of lagged monetary shocks in this "final" equation of the *generalized multivariate model.* [25]

Now that we have completed the examination of the relevant decision variables in the firm's inventory decision, the important question to ask is; what is the effect of including all these variables on the inferences on the buffer stock role of inventories. Are the inferences on the buffer stock role of inventories the same in the *generalized multivariate model* with its many variables, as compared to the *simple multivariate model* with much fewer variables, tested by us and Demery & Duck ? It will be seen below that very similar inferences are obtained in both the simple and generalized multivariate models.

[25] From our point of view the two important equations whose results will be compared are equation (ii), Table 1, and equation (iv), Table 3, which belong to the *simple* and *generalized multivariate models* respectively.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING
QUASI-FIXED STOCK INTERACTION (RAW MATERIALS)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \sum_{i=1}^{3} \delta_{3i} \log RMS_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	-6.155	-3.046	0.90	0.22	56.32	-2.890	-1.038	0.37	1.57	4.57*	0.95
	γ_0	-0.592	-0.736			0.79	-0.070	-0.241			0.24	
	γ_1	-0.770	-0.977				-0.022	-0.063				
	γ_2	-0.923	-1.172				-0.135	-0.349				
	γ_3	-0.692	-0.853				-0.164	-0.436				
	γ_4	-1.019	-1.228				-0.261	-0.906				
	β_{71}	-1.744	-0.993				-0.736	-0.852				
	β_{72}	3.616	1.122				0.677	0.447				
	β_{73}	-0.178	-0.099				1.030	1.063				
	β_{11}	-0.455	-1.099				-0.129	-0.810				
	β_{12}	0.079	0.158				-0.101	-0.569				
	β_{13}	0.096	0.205				0.221	1.281				
	δ_{31}	3.361	1.575				0.667	0.671				
	δ_{32}	-3.140	-0.881				0.449	0.283				
	δ_{33}	-1.278	-0.712				-1.915	-2.134*				
i(b)	β_0	0.004	0.928	0.20	1.63	2.51*						
	γ_0	-0.060	-0.214			0.28						
	γ_1	0.011	0.033									
	γ_2	-0.060	-0.159									
	γ_3	-0.149	-0.407									
	γ_4	-0.292	-1.027									
	β_{71}	-1.418	-1.377**									
	β_{72}	1.457	0.[illegible]96									
	β_{73}	0.322	0.289									
	β_{11}	-0.088	-0.556									
	β_{12}	-0.037	-0.207									
	β_{13}	0.268	1.544**									
	δ_{31}	1.244	1.130									
	δ_{32}	-0.360	-0.212									
	δ_{33}	-1.112	-1.007									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS R^2 is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

QUASI-FIXED STOCK INTERACTION (RAW MATERIALS)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \sum_{i=1}^{3} \delta_{3i} \log RMS_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	$\bar{R}^2$	D.W.	F	GLS VALUE	GLS T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	-10.601	-3.552	0.88	0.23	45.88*	-3.658	-1.185	0.29	1.77	3.42*	0.97
	γ_0	-0.550	-0.491			0.39	-0.558	-1.527**			0.98	
	γ_1	-0.292	-0.267				-0.407	-0.864				
	γ_2	-0.593	-0.547				-0.456	-0.910				
	γ_3	-0.711	-0.649				-0.482	-1.001				
	γ_4	-1.313	-1.181				-0.555	-1.522**				
	β_{71}	-0.289	-0.185				-0.081	-0.106				
	β_{72}	-0.342	-0.120				-0.363	-0.278				
	β_{73}	2.990	1.809				1.446	1.639**				
	β_{11}	-0.368	-1.057				-0.044	-0.380				
	β_{12}	-0.137	-0.364				-0.096	-0.791				
	β_{13}	0.041	0.106				0.020	0.169				
	δ_{31}	1.815	0.908				-0.240	-0.284				
	δ_{32}	0.855	0.258				1.332	0.961				
	δ_{33}	-4.030	-2.333				-2.043	-2.355*				
i(b)	β_0	0.007	1.270	0.18	1.82	2.33*						
	γ_0	-0.514	-1.448			0.92						
	γ_1	-0.320	-0.694									
	γ_2	-0.301	-0.609									
	γ_3	-0.376	-0.794									
	γ_4	-0.540	-1.514**									
	β_{71}	-0.825	-0.932									
	β_{72}	0.522	0.373									
	β_{73}	0.726	0.747									
	β_{11}	-0.024	-0.213									
	β_{12}	-0.057	-0.470									
	β_{13}	0.046	0.388									
	δ_{31}	0.391	0.423									
	δ_{32}	0.438	0.298									
	δ_{33}	-1.171	-1.160									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

QUASI-FIXED STOCK INTERACTION (RAW MATERIALS)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \beta_{7i} \sum_{i=1}^{3} \log rmp_{t-i} + \beta_{1i} \sum_{i=1}^{3} \log O_{t-i} - \delta_{3i} \sum_{i=1}^{3} \log RMS_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	$\bar{R}^2$	D.W.	F	GLS VALUE	GLS T STAT	$\bar{R}^2$	D.W.	F	ρ
1(a)	β_0	-1.952	-1.949	0.86	0.23	42.37	-0.098	-0.053	0.19	1.69	2.67*	0.96
	γ_0	-0.083	-0.104			0.69	0.031	0.119			0.53	
	γ_1	-0.741	-0.926				-0.166	-0.490				
	γ_2	-0.963	-1.195				-0.193	-0.531				
	γ_3	-0.760	-0.946				-0.292	-0.879				
	γ_4	-0.915	-1.170				-0.386	-1.552**				
	β_{71}	1.656	2.780				0.358	1.001				
	β_{72}	0.013	0.014				0.137	0.643				
	β_{73}	-0.901	-1.430				-0.205	-1.030				
	β_{11}	-0.807	-1.208				-0.239	-1.011				
	β_{12}	0.118	0.129				-0.048	-0.196				
	β_{13}	0.793	1.223				0.444	1.962*				
	δ_3	-0.824	-2.097				-0.737	-1.860*				
1(b)	β_0	0.004	1.021	0.03	1.75	1.22						
	γ_0	-0.023	-0.090			0.51						
	γ_1	-0.171	-0.517									
	γ_2	-0.175	-0.497									
	γ_3	-0.265	-0.818									
	γ_4	-0.359	-1.469**									
	β_{71}	0.182	0.475									
	β_{72}	0.192	0.886									
	β_{73}	-0.163	-0.818									
	β_{11}	-0.312	-1.310**									
	β_{12}	-0.095	-0.384									
	β_{13}	0.373	1.635*									
	δ_3	-0.536	-1.240									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

QUASI-FIXED STOCK INTERACTION (CAPITAL)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \varepsilon_2 \log K_{t-1} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
ii(a)	β_0	-2.872	-3.185	0.87	0.25	48.79*	-0.083	-0.047	0.34	1.56	4.55*	0.95
	γ_0	-0.891	-1.003			1.52	-0.270	-0.984			0.79	
	γ_1	-0.849	-0.948				-0.189	-0.531				
	γ_2	-0.700	-0.774				-0.186	-0.475				
	γ_3	-0.508	-0.548				-0.329	-0.876				
	γ_4	-0.959	-1.055				-0.383	-1.355*				
	β_{71}	0.967	1.065				-0.761	-2.873*				
	β_{72}	0.085	0.055				0.996	2.982*				
	β_{73}	-0.343	-0.372				-0.189	-0.651				
	β_{11}	-0.887	-2.120				-0.102	-0.735				
	β_{12}	0.186	0.339				-0.103	-0.692				
	β_{13}	0.789	1.602				0.183	1.239				
	ε_2	-0.773	-3.357*				-0.917	-3.237				
ii(b)	β_0	-0.003	-0.377	0.16	1.59	2.29*						
	γ_0	-0.277	-1.025			0.57						
	γ_1	-0.153	-0.436									
	γ_2	-0.143	-0.372									
	γ_3	-0.295	-0.793									
	γ_4	-0.371	-1.318**									
	β_{71}	-0.739	-2.763*									
	β_{72}	1.017	3.022*									
	β_{73}	-0.185	-0.622									
	β_{11}	-0.110	-0.779									
	β_{12}	-0.107	-0.688									
	β_{13}	0.183	1.219									
	ε_2	-1.264	-1.265									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

QUASI-FIXED STOCK INTERACTION (CAPITAL)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \epsilon_2 \log K_{t-1} \rho v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
II(a)	β_0	-8.049	-5.892	0.87	0.24	48.27*	-2.340	-1.091	0.34	1.72	4.54*	0.95
	γ_0	-1.172	-1.067			0.39	-0.637	-1.845*			1.30	
	γ_1	-0.700	-0.644				-0.516	-1.154				
	γ_2	-0.469	-0.423				-0.440	-0.913				
	γ_3	-0.114	-0.099				-0.465	-0.972				
	γ_4	-0.856	-0.760				-0.603	-1.692*				
	β_{71}	0.546	0.643				-0.774	-3.088*				
	β_{72}	-0.604	-0.419				0.906	2.724*				
	β_{73}	1.193	1.421				0.008	0.032				
	β_{11}	-0.695	-2.317				-0.040	-0.379				
	β_{12}	0.024	0.064				-0.063	-0.594				
	β_{13}	0.161	0.481				0.005	0.051				
	ϵ_2	-1.710	-6.358				-1.206	-3.736*				
II(b)	β_0	0.002	0.252	0.17	1.74	2.38*						
	γ_0	-0.642	-1.888*			1.14						
	γ_1	-0.480	-1.094									
	γ_2	-0.403	-0.852									
	γ_3	-0.451	-0.953									
	γ_4	-0.602	-1.706*									
	β_{71}	-0.799	-3.054*									
	β_{72}	0.898	2.714*									
	β_{73}	-0.028	-0.104									
	β_{11}	-0.029	-0.268									
	β_{12}	-0.046	-0.418									
	β_{13}	0.020	0.188									
	ϵ_2	-0.920	-0.946									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

QUASI-FIXED STOCK INTERACTION (CAPITAL)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \beta_{7i} \sum_{i=1}^{3} \log rmp_{t-i} + \beta_{1i} \sum_{i=1}^{3} \log O_{t-i} - \varepsilon_2 \log K_{t-1} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	$\hat{T}$ STAT	$\bar{R}^2$	D.W.	F	ρ
ii(a)	β_0	0.852	1.327	0.87	0.21	45.476	1.171	0.957	0.28	1.71	3.69*	0.94
	γ_0	-0.288	-0.368			0.76	-0.013	-0.051			0.50	
	γ_1	-0.883	-1.151				-0.234	-0.704				
	γ_2	-1.034	-1.344**				-0.252	-0.712				
	γ_3	-0.748	-0.967				-0.307	-0.940				
	γ_4	-0.694	-0.907				-0.377	-1.534*				
	β_{71}	0.657	1.214				-0.225	-1.229				
	β_{72}	0.358	0.400				0.283	1.359**				
	β_{73}	-1.020	-1.716*				-0.149	-0.747				
	β_{11}	-0.756	-1.170				-0.236	-1.058				
	β_{12}	0.469	0.539				0.006	0.028				
	β_{13}	0.507	0.791				0.416	1.877*				
	ε_2	-0.599	-3.040				-0.627	-2.476*				
ii(b)	β_0	-0.005	-0.576	0.03	1.75	1.25						
	γ_0	-0.017	-0.066			0.53						
	γ_1	-0.174	-0.530									
	γ_2	-0.181	-0.516									
	γ_3	-0.254	-0.784									
	γ_4	-0.357	-1.465**									
	β_{71}	-0.225	-1.233									
	β_{72}	0.286	1.380**									
	β_{73}	-0.146	-0.730									
	β_{11}	-0.223	-0.989									
	β_{12}	0.020	0.090									
	β_{13}	0.426	1.930*									
	ε_2	-1.089	-1.350**									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

QUASI-FIXED STOCK INTERACTION (LABOUR)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \xi_1 \Delta \log L_{t-1} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
iii(a)	β_0	3.520	1.407	0.87	0.33	45.97	6.792	2.696	0.18	1.48	2.51*	0.99
	γ_0	-0.673	-0.735			0.34	-0.211	-0.765			0.66	
	γ_1	-0.716	-0.773				-0.183	-0.507				
	γ_2	-0.625	-0.669				-0.252	-0.639				
	γ_3	-0.246	-0.253				-0.409	-1.083				
	γ_4	-0.762	-0.795				-0.454	-1.603*				
	β_{71}	1.291	1.405				-0.738	-2.758*				
	β_{72}	-0.094	-0.059				0.866	2.591*				
	β_{73}	-0.820	-0.880				-0.416	-1.470**				
	β_{11}	-0.791	-1.799				0.058	0.442				
	β_{12}	0.463	0.821				0.119	0.837				
	β_{13}	1.467	3.317				0.384	2.689*				
	ξ_1	0.895	2.651				0.264	1.563**				
iii(b)	β_0	0.007	1.752	0.16	1.53	2.32*						
	γ_0	-0.271	-1.002			0.58						
	γ_1	-0.191	-0.546									
	γ_2	-0.213	-0.556									
	γ_3	-0.337	-0.914									
	γ_4	-0.395	-1.413**									
	β_{71}	-0.795	-3.014*									
	β_{72}	0.914	2.781*									
	β_{73}	-0.320	-1.134									
	β_{11}	-0.020	-0.149									
	β_{12}	0.027	0.188									
	β_{13}	0.297	2.001*									
	ξ_1	0.224	1.358**									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS
QUASI-FIXED STOCK INTERACTION (LABOUR)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} - \xi_1 \Delta \log L_{t-1} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
iii(a)	β_0	8.378	3.370	0.86	0.28	41.88	6.654	0.388	0.15	1.62	2.25*	1.00
	γ_0	-0.844	0.718			0.13	-0.537	1.519			1.27	
	γ_1	-0.219	0.188				-0.421	0.912				
	γ_2	-0.193	0.163				-0.426	0.855				
	γ_3	0.167	0.135				-0.575	1.159				
	γ_4	-0.417	0.342				-0.704	1.932*				
	β_{71}	0.359	0.387				-0.840	3.217*				
	β_{72}	-0.659	0.428				0.829	2.433*				
	β_{73}	0.399	0.456				-0.179	0.662				
	β_{11}	-0.003	0.011				0.091	0.864				
	β_{12}	0.511	1.293				0.075	0.684				
	β_{13}	0.888	2.790				0.131	1.268				
	ξ_{11}	1.804	5.223				0.107	0.425				
iii(b)	β_0	0.010	2.175	0.16	1.71	2.26*						
	γ_0	-0.611	1.795*			1.13						
	γ_1	-0.[illegible]53	1.025									
	γ_2	-0.397	0.834									
	γ_3	-0.474	0.991									
	γ_4	-0.623	1.756*									
	β_{71}	-0.877	3.457*									
	β_{72}	0.860	2.601*									
	β_{73}	-0.098	0.372									
	β_{11}	0.015	0.143									
	β_{12}	0.004	0.036									
	β_{13}	0.061	0.578									
	ξ_{11}	0.044	0.184									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

NON DURABLE GOODS

QUASI-FIXED STOCK INTERACTION (LABOUR)

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \beta_{7i} \sum_{i=1}^{3} \log rmp_{t-i} + \beta_{1i} \sum_{i=1}^{3} \log O_{t-i} - \varepsilon_{1i} \sum_{i=1}^{3} \Delta \log L_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iii(a)	β_0	-0.567	-0.291	0.85	0.25	33.52	1.924	0.993	0.11	1.70	1.75	0.99
	γ_0	-0.332	-0.371			1.16	-0.131	-0.489			0.75	
	γ_1	-0.935	-1.130				-0.239	-0.722				
	γ_2	-1.385	-1.678*				-0.347	-0.980				
	γ_3	-1.039	-1.239				-0.372	-1.146				
	γ_4	-1.187	-1.426				-0.463	-1.894*				
	β_{71}	1.219	2.128				-0.122	-0.653				
	β_{72}	0.097	0.098				0.168	0.790				
	β_{73}	-1.213	-1.847				-0.212	-1.047				
	β_{11}	-0.802	-1.103				-0.091	-0.404				
	β_{12}	0.500	0.506				0.216	1.000				
	β_{13}	1.248	1.718				0.419	1.724*				
	ε_{11}	-0.092	-0.400				-0.096	-1.278				
	ε_{12}	0.196	0.818				-0.031	-0.390				
	ε_{13}	-0.173	-0.748				-0.165	-2.213*				
iii(b)	β_0	0.006	1.545	0.07	1.76	1.46						
	γ_0	-0.182	-0.694			0.72						
	γ_1	-0.223	-0.694									
	γ_2	-0.306	-0.895									
	γ_3	-0.332	-1.050									
	γ_4	-0.427	-1.782*									
	β_{71}	-0.137	-0.746									
	β_{72}	0.208	0.990									
	β_{73}	-0.155	-0.771									
	β_{11}	-0.206	-0.895									
	β_{12}	0.080	0.352									
	β_{13}	0.283	1.135									
	ε_{11}	-0.113	-1.523**									
	ε_{12}	-0.045	-0.578									
	ε_{13}	-0.171	-2.378*									

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

TOTAL MANUFACTURING

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{3i} \log RMS_{t-i} - \delta_{21} \log GP_{t-1} - \varepsilon_{21} \Delta \log K_{t-1} + v_t$$

	COEF	OLS VALUE	OLS T STAT	$\bar{R}^2$	D.W.	F	GLS VALUE	GLS T STAT	$\bar{R}^2$	D.W.	F	ρ
iv(a)	β_0	-0.254	-0.157	0.92	0.21	88.51	2.193	0.974		1.73		0.95
	γ_1	-1.008	-1.430			1.37	0.105	0.395			0.94	
	γ_2	-1.023	-1.458				-0.089	-0.268				
	γ_3	-0.866	-1.231				-0.274	-0.861				
	γ_4	-0.752	-1.081				-0.419	-1.701*				
	β_{71}	-1.515	-1.924				-1.880	-3.579*				
	β_{72}	1.836	1.890				1.862	3.182*				
	β_{31}	1.951	1.793				1.745	-2.689*				
	β_{32}	-1.384	-0.954				-0.837	1.339**				
	β_{33}	-0.410	-0.527				-0.410	0.345				
	β_{21}	-0.102	-0.461				-0.551	2.247*				
	ε_2	-0.865	-3.660				-0.692	2.265*				
iv(b)	β_0	-0.0004	-0.037	0.24	1.79	3.49*						
	γ_1	0.190	0.746			0.97						
	γ_2	0.035	0.107									
	γ_3	-0.169	-0.537									
	γ_4	-0.367	-1.506**									
	β_{71}	1.962	-3.625*									
	β_{72}	-1.911	3.202*									
	β_{31}	1.824	-2.733*									
	β_{32}	-0.838	1.348**									
	β_{33}	-0.356	1.164									
	β_{21}	-0.513	2.005*									
	ε_2	-0.838	0.889									

This is the final equation of the first stage tests for the Total Manufacturing sector. It includes the persistence variable, monetary shocks, as well as other cost and stock variables found significant when included together in one equation. The inferences on the buffer stock role of FGIs are based on the F values of this equation--- also see Table 5S(a).
Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

DURABLE GOODS

GENERALIZED MULTIVARIATE MODEL

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{2} \beta_{7i} \log rmp_{t-i} - \delta_2 \log GP_{t-1} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
iv(a)	β_0	-4.914	-4.193	0.80	0.18	44.57*	3.236	2.219		1.59		0.99
	γ_0	-2.005	-1.488		2.01		-0.491	-1.515**			1.16	
	γ_1	-1.734	-1.321				-0.245	-0.575				
	γ_2	-2.220	-1.688*				-0.309	-0.687				
	γ_3	-2.409	-1.842*				-0.421	-1.005				
	γ_4	-2.244	-1.700*				-0.576	-1.811*				
	β_{71}	1.504	2.759				-0.605	-2.565*				
	β_{72}	-0.568	-1.006				0.694	3.169*				
	δ_{21}	-1.073	18.621				0.513	3.417*				
iv(b)	β_0	0.008	1.964	0.22	1.77	3.88*						
	γ_0	-0.474	-1.492**			1.46						
	γ_1	-0.156	-0.374									
	γ_2	-0.297	-0.677									
	γ_3	-0.438	-1.064									
	γ_4	-0.625	-1.993*									
	β_{71}	-0.646	-2.739*									
	β_{72}	0.643	2.974*									
	δ_{21}	0.349	2.136*									

This is the final equation of the first stage tests for the Durable Goods sector. It includes the persistence variable, monetary shocks, as well as other cost and stock variables found significant when included together in one equation. The inferences on the buffer stock role of FGIs are based on the F values of this equation--- also see Table 5S(a).
Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 3
FIRST STAGE TESTS
FINISHED GOODS INVENTORIES

$$\log N_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} - \sum_{i=1}^{3} \beta_{3i} \log RMS_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iv(a)	β_0	0.399	1.051	0.83	0.24	61.14	1.818	1.207	0.98	1.54		0.97
	γ_1	-0.944	-1.139			0.75	-0.187	-0.746			0.52	
	γ_2	-1.127	-1.349				-0.188	-0.609				
	γ_3	-0.268	-0.324				-0.235	-0.802				
	γ_4	-0.118	-0.143				-0.315	-1.348**				
	β_{31}	0.978	-1.542				-0.380	-1.897*				
	β_{32}	0.174	-0.175				-0.062	-0.314				
	β_{33}	-2.113	-3.409				-0.329	-1.658*				
iv(b)	β_0	0.005	1.332		1.64	1.44						
	γ_1	-0.182	-0.772			0.69						
	γ_2	-0.233	-0.779									
	γ_3	-0.314	-1.084									
	γ_4	-0.373	-1.609*									
	β_{31}	-0.292	-1.429**									
	β_{32}	0.030	0.148									
	β_{33}	-0.236	-1.160									

This is the final equation of the first stage tests for the Non-Durable Goods sector. It includes the persistence variable, monetary shocks, as well as other cost and stock variables found significant when included together in one equation. The inferences on the buffer stock role of FGIs are based on the F values of this equation--- also see Table 5S(a).
Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

An examination of equation (iv) for all industry classifications shows that in this "final" equation of the generalized multivariate model, in which the specification search has been completed, the results on the buffer stock role of finished goods inventories are very discouraging. The GLS results of the log-linear equations iv(a) and the OLS results of the first difference equation, (iv)b, show that none of the industry classifications have significant partial F values on monetary shocks. However, by the t value criterion we see that most equations (in all industry sectors) show that monetary shocks are significant at the 5% level, at the fourth lag.

We cannot blame multicollinearity for these poor results on the buffer stock role of finished goods inventories. If multicollinearity was the only cause of insignificance of monetary shocks in (iv), then we should have seen monetary shocks to be significant in the parsimonous equations of the simple multivariate model (see ii(a) and ii(b) Table 1). These equations did not have many regressors and consequently did not have much multicollinearity. However the equations of the simple multivariate model suffered from another shortcoming — that of specification error due to omitted variables.[26]

So what was achieved by doing a through specification search of all the relevant explanatory variables, whose individual significance is only of secondry interest to us, in the question of examining the persistence of monetary shocks in finished goods inventory equations.

The principal results can be summarized as:

1. It is true that the tedious specification search could not find an improved role of FGIs as buffer stocks against monetary shocks. The evidence on the persistence effects of monetary shocks is zero by the F value criterion and very weak by the t value criterion. This statement is applicable to both the simple and generalized multivariate

[26] These omitted variables once added one by one gave us equation (iv) of the generalized multivariate model.

models.

2. This exercise of a move from the simple to the generalized multivariate model also revealed that our *apriori* expectations of seeing somewhat different results in the two models were not realized. However, after examining the results of the generalized multivariate model we can atleast claim that no effort was spared in the specification search and the insignificance of monetary shocks in finished goods inventory equations in Canada cannot at least be blamed on improperly specified inventory equations.

III. EFFECTS OF MONETARY SHOCKS ON OTHER GOODS' INVENTORIES

The foregoing analysis of first stage test shows that in most of our estimated equations in all industry classifications, unanticipated monetary shocks have a negligible effect on finished goods inventories. Is it possible that the buffer stock role of inventories is being manifested through variations in *other goods inventories* i.e. raw materials, unfilled orders and goods in process? This question was examined by regressing *other goods inventories* on monetary shocks and other relevant decision variables. A number of these decision variables were tried and found to be statistically insignificant; hence they were dropped from the equations which were finally estimated. Once again in keeping with the methodology adopted for FGI regressions earlier, we will be estimating our equations in both levels and rates of change. The former are marked as (a) and the latter appear as equations (b). The results for all industry classifications are given in Table 4. Since OLS results of the log linear equations (a) were marred by autocorrelation the discussion of GLS results are presented below. Equations (i), (ii) and (iii) show the results of the effects of monetary shocks on unfilled orders, goods in process and raw material stocks respectively. The following discussion on the significance of monetary shocks will be coined in terms of both the t and F value criterion.

Unfilled Orders

In the total manufacturing sector unanticipated money is significant at the 5% level at the contemporaneous quarter in both the levels and growth rates equations, however the joint significance of monetary lags is rejected in both equations by the F value criterion. The durable goods industry mirrors the results of the total manufacturing, and the non-durable sector shows that unfilled orders are not used as buffer stocks.

Goods in Process

Except in the durable goods sector where two lags are significant in in the levels equation (ii a), none of the other sectors show the significance of unanticipated money. However, the partial F values in all equations reject the buffer stock role of goods in process .inventories.

Raw Material Stocks

In the total manufacturing sector the buffer stock role of raw materials is observed for the growth rate equation, but not for the levels equation. In the growth rate equation the contemporaneous and three further lags are significant in the t values. The joint significance of monetary shocks is also found through the partial F statistic. The durable and non-durable industry sectors show that the buffer stock role of raw materials is accepted through both the t and F value criterion. An examination of significant lag lengths shows that the buffer stock role of raw materials is shorter in the non-durables compared to the other two sectors.

The above results for various ***other goods inventories*** show that in the total manufacturing and durable goods sector the effects of monetary shocks are felt on raw materials for 2 quarters including the current quarter. By the F value criterion there is no evidence of the buffer stock role of backorders or goods in process inventories in any industry classification. However, the t values at some monetary lags were found significant in the unfilled orders equations for total manufacturing and durable goods. It seems that the poorest results are obtained for the goods in process inventories where only the durable goods sector showed two lags significant in the t values, however, by the F value criterion, all sectors show that goods in process inventories do not play a buffering role against monetary shocks. The results for the evidence of the buffer stock role of all inventory types are summarised in Table 5S(a). [27] The asterisks against the significant F values quickly bring to attention that in all industry classifications raw materials are the only category of inventories that are significant in the F values. The overall evidence of the first stage tests suggests that in Canada the buffer stock role of inventories is only found for raw materials and rejected for all other inventory categories, as seen from the F value criterion.

This completes the discussion of the first stage tests in which the buffer stock role of all goods inventories was examined by estimating the inventory demand functions for various inventory categories. The significance of some other goods inventories, like raw materials, suggests that these inventories should also be used as regressors (besides FGIs) in the output equations of the second stage test.

[27]See after p. 166.

Table 4
FIRST STAGE TESTS ON OTHER GOODS INVENTORIES
(UNFILLED ORDERS)

TOTAL MANUFACTURING

$$\log UF_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

GLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	-6.862	-2.904	0.28	1.64		0.96
	γ_0	1.083	1.935*			1.32	
	γ_1	0.811	1.123				
	γ_2	0.184	0.236				
	γ_3	-0.331	-0.437				
	γ_4	-0.737	-1.294				
	β_{11}	0.646	2.758*				
	β_{12}	0.675	2.906*				
	β_{13}	0.503	2.124*				
			OLS				
i(b)	β_0	0.007	0.922	0.06	1.82	1.69	
	γ_0	0.923	1.673**			0.92	
	γ_1	0.760	1.083				
	γ_2	0.238	0.317				
	γ_3	-0.135	-0.182				
	γ_4	-0.573	-1.015				
	β_{11}	0.479	1.9128				
	β_{12}	0.531	2.145*				
	β_{13}	0.366	1.468**				

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the origional variable *log* UF_t.

Table 4
FIRST STAGE TESTS ON OTHER GOODS INVENTORIES
(UNFILLED ORDERS)

DURABLE GOODS

$$\log UF_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

GLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
1(a)	β_0	-2.197	-0.985	0.98	1.71		0.97
	γ_0	1.496	2.026*			1.21	
	γ_1	1.144	1.197				
	γ_2	0.409	0.403				
	γ_3	-0.255	-0.257				
	γ_4	-0.824	-1.090				
	β_{11}	0.441	2.377*				
	β_{12}	0.463	2.463*				
	β_{13}	0.459	2.487*				
			OLS				
1(b)	β_0	0.012	1.238	0.02	1.88	1.20	
	γ_0	1.272	1.763*			0.87	
	γ_1	1.042	1.132				
	γ_2	0.443	0.456				
	γ_3	-0.007	-0.007				
	γ_4	-0.617	-0.831				
	β_{11}	0.295	1.525**				
	β_{12}	0.334	1.715*				
	β_{13}	0.336	1.758*				

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the origional variable *log* UF_t.

Table 4
FIRST STAGE TESTS ON
OTHER GOODS INVENTORIES
(UNFILLED ORDERS)

NON DURABLES

$$\log UF_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

GLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	-0.223	-0.127	0.97	1.70		0.98
	γ_0	0.091	0.266			0.55	
	γ_1	0.290	0.689				
	γ_2	-0.055	-0.132				
	γ_3	-0.297	-0.893				
	β_{11}	0.874	3.862*				
			OLS				
i(b)	β_0	-0.002	-0.474	0.08	1.78	2.58*	
	γ_0	0.083	0.248			0.60	
	γ_1	0.321	0.776				
	γ_2	-0.032	-0.079				
	γ_3	-0.291	-0.882				
	β_{11}	0.956	3.422*				

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the origional variable *log* UF_t.

Table 4
FIRST STAGE TESTS ON OTHER GOODS INVENTORIES
(GOODS IN PROCESS)

TOTAL MANUFACTURING

$$\log GP_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{2} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

GLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
ii(a)	β_0	1.222	2.634	0.99	1.55		0.91
	γ_0	-0.130	-1.076			0.80	
	γ_1	-0.029	-0.187				
	γ_2	0.135	0.077				
	γ_3	-0.131	-0.795				
	γ_4	-0.144	-1.168				
	β_{71}	-0.073	-0.627				
	β_{72}	-0.356	-2.404*				
	β_{73}	-0.079	-0.663				
	β_{11}	0.283	5.392*				
	β_{12}	0.446	8.509*				
	β_{13}	0.321	5.891*				
			OLS				
ii(b)	β_0	0.001	0.358	0.53	1.64	9.80*	
	γ_0	-0.135	-1.122			0.78	
	γ_1	0.059	-0.377				
	γ_2	0.011	-0.066				
	γ_3	-0.138	-0.844				
	γ_4	-0.140	-1.127				
	β_{71}	-0.081	-0.689				
	β_{72}	-0.341	-2.331*				
	β_{73}	-0.031	-0.245				
	β_{11}	0.265	4.450*				
	β_{12}	0.413	6.493*				
	β_{13}	0.289	4.549*				

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS R^2 is computed on the origional variable *log* GP_t.

Table 4
FIRST STAGE TESTS ON OTHER GOODS INVENTORIES
(GOODS IN PROCESS)

DURABLE GOODS

$$\log GP_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

GLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
11(a)	β_0	1.070	2.038	0.99	1.30		0.93
	γ_0	-0.155	-0.740			1.34	
	γ_1	-0.086	-0.316				
	γ_2	-0.219	-0.758				
	γ_3	-0.585	-2.082*				
	γ_4	-0.398	-1.861*				
	β_{11}	0.237	4.623*				
	β_{12}	0.291	5.687*				
	β_{13}	0.270	5.349*				

OLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
11(b)	β_0	0.003	1.041	0.32	1.42	5.82*	
	γ_0	-0.204	-0.831			1.03	
	γ_1	-0.215	-0.867				
	γ_2	-0.307	-1.125				
	γ_3	-0.552	-2.040*				
	γ_4	-0.328	-1.577				
	β_{11}	0.183	3.376*				
	β_{12}	0.224	4.090*				
	β_{13}	0.208	3.884*				

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the origional variable *log* GP_t.

Table 4
FIRST STAGE TESTS ON OTHER GOODS INVENTORIES
(GOODS IN PROCESS)

NON DURABLES

$$\log GP_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

GLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
ii(a)	β_0	1.595	1.504	0.98	2.14		0.97
	γ_0	-0.047	-0.252			0.39	
	γ_1	-0.051	-0.231				
	γ_2	0.073	0.332				
	γ_3	0.175	0.993				
	β_{11}	0.076	0.550				
	β_{12}	0.265	1.899*				
	β_{13}	0.298	2.029*				
			OLS				
ii(b)	β_0	0.003	1.221	0.006	2.58*	1.01	
	γ_0	-0.118	-0.645			0.60	
	γ_1	0.055	0.256				
	γ_2	0.090	0.424				
	γ_3	0.192	1.125				
	β_{11}	-0.019	-0.130				
	β_{12}	0.186	1.287				
	β_{13}	0.192	1.233				

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the origional variable *log* GP_t.

Table 4
FIRST STAGE TESTS ON OTHER GOODS INVENTORIES
(RAW MATERIALS)

TOTAL MANUFACTURING

$$\log RMS_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + \sum_{i=1}^{3} \beta_{5i} \log O_{t-i} + v_t$$

GLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iii(a)	β_0	2.966	6.397	0.99	1.64		0.81
	γ_0	0.047	0.392			0.92	
	γ_1	-0.069	-0.454				
	γ_2	0.155	0.303				
	γ_3	-0.145	-0.921				
	γ_4	-0.056	-0.464				
	β_{71}	-0.286	-2.461*				
	β_{72}	-0.342	-2.304*				
	β_{73}	-0.123	-1.048				
	β_{11}	0.359	7.008*				
	β_{12}	0.376	7.172*				
	β_{13}	0.312	6.023*				
	β_{51}	0.082	0.843				
	β_{52}	- 0.137	-1.427**				
	β_{53}	-0.045	-0.434				
iii(b)	β_0	0.005	0.988	0.17	2.06	2.49*	0.75
	γ_0	-0.303	-3.210*			3.21*	
	γ_1	-0.436	-2.941*				
	γ_2	-0.289	-1.717*				
	γ_3	-0.204	-1.324**				
	γ_4	-0.007	-0.069				
	β_{71}	0.145	1.481**				
	β_{72}	-0.158	-1.528**				
	β_{73}	0.196	1.786*				
	β_{11}	0.103	1.900*				
	β_{12}	0.080	1.308**				
	β_{13}	0.001	0.027				
	β_{51}	-0.023	-0.282				
	β_{52}	- 0.261	-2.738*				
	β_{53}	-0.163	-1.864*				

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced. The OLS results of (b) showed that the coefficients on u_{t-i} were insignificant. By estimating through GLS this problem was solved, and the coefficients on u_{t-i} became individually and jointly significant.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the origional variable *log* RMS_t.

Table 4
FIRST STAGE TESTS ON OTHER GOODS INVENTORIES
(RAW MATERIALS)

DURABLE GOODS

$$\log RMS_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{2} \beta_{7i} \log rmp_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

GLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iii(a)	β_0	3.466	10.416	0.99	1.69		0.72
	γ_0	0.479	2.897*			2.88*	
	γ_1	0.482	2.375*				
	γ_2	0.398	1.947*				
	γ_3	0.014	0.082				
	β_{71}	-0.619	-9.581*				
	β_{11}	0.298	7.630*				
	β_{12}	0.325	8.506*				
	β_{13}	0.291	7.654*				
			OLS				
iii(b)	β_0	0.003	1.738	0.51	1.69	11.71*	
	γ_0	0.242	1.678**			0.96	
	γ_1	0.240	1.338**				
	γ_2	0.218	1.232				
	γ_3	0.013	0.092				
	β_{71}	-0.448	-6.489*				
	β_{11}	0.175	4.479*				
	β_{12}	0.212	5.592*				
	β_{13}	0.184	4.842*				

Equation (b) is a regression where both the dependent and independent variables of (a) have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS R^2 is computed on the origional variable *log* RMS_t.

Table 4
FIRST STAGE TESTS ON
OTHER GOODS INVENTORIES
(RAW MATERIALS)

NON DURABLES

$$\log RMS_t = \beta_0 + \sum_{i=0}^{4} \gamma_i u_{t-i} + \sum_{i=1}^{3} \beta_{1i} \log O_{t-i} + v_t$$

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
			GLS				
iii(a)	β_0	3.520	4.088	0.99	1.25		0.98
	γ_0	-0.295	-2.255*			3.13*	
	γ_1	-0.269	-2.137*				
	β_{11}	0.299	2.837*				
	β_{12}	0.206	1.946*				
			OLS				
iii(b)	β_0	0.003	1.609	0.09	1.46	2.99*	
	γ_0	-0.268	-2.158*			3.20*	
	γ_1	-0.284	-2.310*				
	β_{11}	0.194	1.722*				
	β_{12}	0.099	0.875				

Equation (b) is a regression where both the dependent and the independent variables have been first differenced.
* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the origional variable *log* RMS_t.

Summary of First Stage Results

The first stage tests were done to assess the buffer stock role of **all** types of goods inventories carried by the firm. The buffer stock role was deduced from the significance of lagged monetary shocks in the inventory equations of the finished goods as well as other goods inventories. Finished goods inventory equations were regressed on the explanatory variables of two models i.e. the simple multivariate model and the generalized multivariate model. The latter model was arrived at by successively augmenting the FGI equations of the simple multivariate model by known regressors.

1. The results for the finished goods inventory equations show that in the simplest of the simple inventory equations which had current and lagged monetary shocks as the **only** regressor, the buffer stock role of FGIs is very weak. Though individual lag significance was obtained at all lags, the monetary variables were not significant as a whole as seen from the F statistic. The "explained variance" of these simple equations is 5 per cent or less in all industry classifications. This means that misperceptions of monetary shocks can only "explain" a small per centage of the total variation in finished goods inventories of the manufacturing sector.

2. When other relevant expected cost variables were added to these simple equations, particularly the subset of variables used by D & D (which we have dubbed the *simple multivariate model*), the individual lag significance of monetary shocks in all three industry classifications was reduced, although the R^2 increased significantly in all but the non-durable goods sector. The intermediate lags on money became insignificant but the last lag still retained its significance in all sectors and in the durable goods sector the contemporaneous lag was also significant which was not the case in non-durables and total manufacturing sector. Using only the F value criterion, the results of the simple multivariate model show that the buffer stock role of finished goods inventories is not observed in the manufacturing sector of Canada.

3. The results of regressing finished goods inventrories on the regressors of the ***generalized multivariate model*** showed the significance of a number of cost, demand, and stock variables that were added to the simple multivariate model. The R^2s of the FGI equations inadvertently increased, thereby improving upon the specification bias which was present in the FGI equations of the simple multivariate model. However, we must remember that the interest in determining the "correct specification" of the FGI equation is only secondary (though arguably important for econometric reasons). The primary interest lies in establishing the buffer stock role of finished goods inventories (and other goods inventories), as seen through the significance of lagged monetary shocks. The results of the finally selected FGI equation (which has all those regressors which retain their significance when combined together in one equation), show that the inferences on persistence in the generalized multivariate model are the same as in the simple multivariate model. Using the F value criterion we find that all industry classifications reject the buffer stock role of finished goods inventories.

4. The lack of evidence of the buffer stock role of finished goods inventories neccessitated the examination of *other goods inventories* as possible avenues for a buffering role against aggregate demand shocks. Using the F value criterion, it was found that the evidence for the buffering role of *other goods inventories* is also quite weak. The null hypothesis of a buffer stock role is rejected for goods in process and backorder inventories for all industry classifications. However, all sectors of the manufacturing industry show that raw materials play a statistically significant buffering role. This is seen through both the significant F value as well as significant t values at individual lags of monetary shocks in the raw material equations.

SECOND STAGE TEST RESULTS

The buffer sock role of various goods inventories was examined in the estimated equations of the first stage test. In the second stage test we shall examine whether the effects of monetary shocks are transmitted to output through those buffer stocks. This question was examined in three steps; first, output was regressed on different inventory types, second, other variables (of the vector Z_t) like cost and demand factors etc. were added and finally the unanticipated monetary shocks were included as another regressor. As pointed out in the discussion of equation (19)' in chapter II, the significance of monetary shocks provides evidence on other channels of persistence, i.e. channels other than inventories. We shall now present the results of the second stage test equation (7) of chapter III.

The dependent and independent variables are logarithmic first differences representing the rates of change of these variables. The estimated coefficients can accordingly be interpreted as elasticities. In our results we have *not* estimated any levels equations in the second stage tests as was done in the first stage tests. In the first stage tests the purpose of using different transformations was to test whether the multivariate model was robust enough to be significant under more than one transformation. That task has already been accomplished in the first stage tests, hence nothing more would be gained by repeating the tedious exercise in the second stage tests. An important reason for using only the first difference form rather than the log linear form is that the problems of both, autocorrelation and multicollinearity are greatly reduced in the first difference transformation. The regression results of the second stage test are presented in Table 5. Equations 1 to 4 can be compared across the three industry classifications since they are similar in their explanatory variables. Equation 5 and onwards are not directly comparable between industries due to dissimilar explanatory variables. Some explanatory variables were not significant in some industry classifications, so they were consequently dropped giving rise to dissimilar equations. The results using the generalised least squares technique (GLS) will primarily be presented, and only when there is no need for autocorrelation correction will we present the ordinary least squares (OLS) results.

The second stage tests are first discussed for total manufacturing followed by durable and the non-durable sectors. In the output equations for each industry sector, the impact of finished goods inventories is evaluated first followed by the impact of other goods inventories. The tables of regression results are attached at the end of the explanation of results for each industry classifaication.

TOTAL MANUFACTURING

For the manufacturing sector as a whole **finished goods inventories** in 1(a) disturbed one quarter back can explain the persistence in current output. All the coefficients on FGIs have the expected negative sign and all but one t value on the estimated coefficients is greater than unity. As was found for the simple equations of the first stage test in which monetary shocks were the only explanatory variable, the F statistic shows that all the right hand side lags of FGIs taken as a whole are not significant although individual significance is found at one of the three lags. This result was also found for the simple equations of the first stage test in which monetary shocks were the only explanatory variable. Inventories and output have an inverse relationship, an unanticipated monetary shock which decreases current period inventories increases current and future output more than what would otherwise have been, had inventories been at their desired levels. The contemporaneous term is insignificant and the first quarter lag is significant at the 5 per cent level with a t value of 1.89. One should note the correspondence between the R^2 in the second stage test versus the R^2 in the first stage test. In the second stage test the R^2 of 3 per cent is compared to an R^2 of 3 per cent in the first stage test for the total manufacturing sector. If monetary shocks are the *only* shocks affecting inventories and hence output, then persistence whether measured through a distributed lag of monetary stocks or a distributed lag of inventories should have similar R^2s in the two equations (barring sampling error). It would be quite unlikely to find great differences in the "explained variance"s of these two types of simple equations in which the only explanatory variables are either inventories or monetary stocks. One can ask how can we postulate similar or close (we are not saying *exact*) R^2s when the dependent variable is not the same. The inventory or output decision is a very similar decision except for inventory carrying costs which would directly determine the level of inventories to be carried and hence indirectly the level of output to be produced. Hence if these two decisions are so similar, information about the monetary shock (assuming it is the only shock), which changes inventories can also be inferred from an equation which regresses output on inventories. In other words these two equations will have close R^2s; however, this is a qualified statement.[28]

Now we shall separately examine the effects of each of the **other goods inventories** on output. Equations (2), (3) and (4) of Table 5 show the significance of goods in process inventories, raw material inventories and inventories of unfilled orders respectively.. There is no requirement in equations (2) to (4) that the expected sign of the coefficients on these other inventory types be negative as was the case for finished goods inventories. Depending on the relationship between GPS, GPO and intermediate goods, the signs on δ_1, δ_2 could be either greater than, less than or equal to zero. The goods in process inventories show mixed results, the contemporaneous term is significant with a negative sign while the third quarter lag is significant with a positive sign. We cannot unambigously conclude whether finished goods and intermediate goods are substitutes or compliments. Recall that unambigous complementarity was found between FGI and intermediate goods in the first stage test equations of Table 2.

Raw material inventory stocks are expected to have a negative sign ($\delta_3 \leq 0$) because excess raw materials are expected to increase production and inventories. A negative sign

[28] See the restrictions in the footnote number 16 p. 30, Chapter II.

implies a positive effect because raw materials were entered in the regression equations with a negative sign. They could also have been entered in the estimated equations with positive signs, which is the usual practice, but, we used negative signs to be consistent with equation (7) discussed in Chapter III. Raw material stocks were found to be individually statistically insignificant at all lags except the last, where it is "wrong sign significant" at the 5 per cent level.

Unfilled orders in 4(a) display strong significance only for the current term and no further lags were significant. The significance of the contemporaneous term on unfilled orders seems very plausible because production and finished goods inventories alone cannot normally meet excess demand. It is only rational that in the face of production and delivery lags the firm should use back orders as buffers in unanticipated demand situations. But it is rather quizzical that no lagged back orders influence current production, implying that as a rule back orders are cleared by the end of the current period leaving no room for this periods back orders to influence next period's output. It is possible that aggregation of industries, even at the level of durable and non-durable industries, may be responsible for the insignificance of lagged unfilled orders. No conclusive statement can be made about the insignificance of lagged unfilled orders unless their role in specific industries (like food and beverage, wood products etc) is separately examined.

Equations 1 to 4 were also estimated without the contemporaneous lags of various inventories. The results are given in equations 1(b) to 4(b). This was basically done to see the impact of dropping the contemporaneous term on the R^2 and t values of the remaining coefficients. There was no change in the results for finished goods, intermediate goods, and raw material inventory equations. The signs and significance of various lags in 1(b), 2(b) and 3(b) remains the same as in 1(a), 2(a) and 3(a) and there is a small change in R^2. The unfilled orders equation, however, shows that dropping the contemporaneous term on unfilled orders reduces the R^2 by 24 per cent, suggesting that unanticipated shocks have their affect mainly through current back orders. This point is further discussed later.

Overall, these very simple equations show that by themselves finished goods inventories can explain persistence in output for about one quarter, and goods in process inventories as far as one year ago. The conclusion for intermediate goods inventories is tentative given the mixed signs found in 2(a). It will be seen later that as more variables are added, the mixed signs on intermediate goods inventories are corrected and an unambigous one year effect of these inventories is obtained. This suggests the effects of a possible specification bias on the estimated coefficients, due to the ommission of relevant variables.

The simple equations discussed above do not include the effects of cost, demand, and stock variables. The search for statistically significant variables culminated in equation 5. This equation regresses output on **all goods inventories**, other cost and stock variables, as well as monetary shocks. As mentioned in the discussion of equation (19)' in Chapter II, the monetary shocks have been added to see if they carry any information over and above what is already embedded in inventories of various kinds, notably finished goods inventories. It was found that all lags of monetary shocks have the correct positive signs,but onlytwo lags are significant in the t-values. The F value is 1.62 which is less than the critical value at the 5% level of significance. Thus by the F value criterion we find no evidence of the *other channels of persistence* of monetary shocks in output equations for the total manufacturing sector.

Table 5
SECOND STAGE TESTS

TOTAL MANUFACTURING

$$\Delta \log Y_t = \beta_0 + \sum_{i=0}^{2} \phi_i \, \Delta \log N_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	0.012	4.866	0.06	1.34	2.77*	0.012	3.484	0.02	2.06	1.54	0.33
	ϕ_0	-0.038	-0.529				-0.030	-0.441				
	ϕ_1	-0.138	-1.903*				-0.131	-1.891*				
	ϕ_2	-0.113	-1.571**				-0.090	-1.318**				
i(b)	β_0	0.012	4.877	0.07	1.34	4.05*	0.012	3.473	0.03	2.06	2.23	0.33
	ϕ_1	-0.145	-2.022*				-0.125	-1.850*				
	ϕ_2	-0.116	-1.619*				-0.090	-1.329**				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

TOTAL MANUFACTURING

$$\Delta \log Y_t = \beta_0 - \sum_{i=0}^{4} \delta_{2i} \, \Delta \log GP_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
ii(a)	β_0	0.010	4.017	0.13	1.51	4.06*	0.011	3.250	0.06	2.03	2.39	0.28
	δ_{20}	-0.412	-2.810*				-0.271	-1.924*				
	δ_{21}	0.012	0.075				-0.028	-0.195				
	δ_{22}	0.140	0.844				0.092	0.628				
	δ_{23}	0.312	2.026*				0.337	2.327*				
ii(b)	β_0	0.011	4.425	0.05	1.34	2.56*	0.012	3.262	0.03	2.09	1.75	0.36
	δ_{21}	-0.208	-1.345**				-0.057	-0.393				
	δ_{22}	0.036	0.213				0.012	0.092				
	δ_{23}	0.375	2.361*				0.323	2.209*				

Equation ii(b) is the same as equation ii(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$

Table 5
SECOND STAGE TESTS

TOTAL MANUFACTURING

$$\Delta \log Y_t = \beta_0 - \sum_{i=0}^{3} \delta_{3i} \, \Delta \log RMS_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iii(a)	β_0	0.011	4.352	0.07	1.42	2.49*	0.012	3.360	0.02	2.08	1.36	0.34
	δ_{30}	-0.276	-1.467				-0.050	-0.283				
	δ_{31}	-0.051	-0.233				-0.127	-0.694				
	δ_{32}	0.291	1.333				0.200	1.088				
	δ_{33}	0.244	1.290				0.295	1.660*				
iii(b)	β_0	0.012	4.628	0.05	1.30	2.57*	0.012	3.404	0.03	2.09	1.78	0.35
	δ_{31}	-0.223	-1.203				-0.138	-0.783				
	δ_{32}	0.215	1.008				0.182	1.064				
	δ_{33}	0.300	1.608*				0.297	1.680*				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

TOTAL MANUFACTURING

$$\Delta \log Y_t = \beta_0 - \sum_{i=0}^{3} \delta_{1i} \Delta \log UF_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iv(a)	β_0	0.006	2.790	0.23	1.29	7.29*	0.006	1.919	0.22	2.07	6.89*	0.37
	δ_{10}	-0.174	-5.214*				-0.160	-5.135*				
	δ_{11}	0.0001	-0.003				-0.0003	-0.007				
	δ_{12}	-0.013	-0.380				-0.019	-0.575				
	δ_{13}	0.022	0.643				-0.001	0.038				
iv(b)	β_0	0.009	3.459	-0.01	1.39	0.72	0.011	2.549	-0.03	2.07	0.29	0.43
	δ_{11}	-0.037	-0.940				0.035	0.962				
	δ_{12}	-0.021	-0.518				-0.012	-0.318				
	δ_{13}	0.019	0.505				0.0009	0.027				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

TOTAL MANUFACTURING

$$\Delta \log Y_t = \phi_0 + \sum_{i=0}^{3} \phi_i \Delta \log N_{t-i} - \sum_{i=1}^{3} \delta_{2i} \Delta \log GP_{t-i} - \sum_{i=1}^{3} \delta_{3i} \Delta \log RMS_{t-i} - \sum_{i=0}^{3} \delta_{1i} \Delta \log UF_{t-i} + \beta_{7i} \sum_{i=1}^{3} rmp_{t-i}$$

$$+ \sum_{i=0}^{3} \gamma_i \Delta u_{t-i} - \sum_{i=1}^{3} \epsilon_{2i} \Delta \log K_{t-i} + v_t$$

OLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F
(5)	ϕ_0	-0.012	-1.915*	0.59	2.37	7.19*
	ϕ_1	-0.022	-0.376			0.34
	ϕ_2	0.045	0.778			
	ϕ_3	-0.031	-0.583			
	δ_{21}	0.092	0.658			3.05*
	δ_{22}	0.034	0.249			
	δ_{23}	0.374	2.739*			
	δ_{31}	-2.055	-3.722*			5.35*
	δ_{32}	2.302	2.628*			
	δ_{33}	-1.104	-1.887**			
	δ_1	-0.121	-4.601*			21.18*
	β_{71}	2.056	4.028*			
	β_{72}	-2.321	-2.741*			
	β_{73}	1.209	2.172*			
	γ_0	-0.041	-0.317			1.62
	γ_1	0.229	1.399**			
	γ_2	0.310	1.837*			
	γ_3	0.068	0.539			
	ϵ_{21}	-10.243	-3.508*			
	ϵ_{22}	17.407	3.280*			
	ϵ_{23}	-8.692	-2.994*			

Equation (5) is the final equation of the Second Stage Tests. It includes all those variables of the Expanded Multivariate Model which were found significant. The inferences on the effects of various inventories, on the Total Manufacturing Output are based on this equation. These inferences are based on the t-values and the partial F values for various inventory categories. Also see Table 5S(b) where these partial F values are reported.

* Significant at the 5% level

** Significant at the 10% level

The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

DURABLE GOODS

In the durable goods industry finished goods inventories explain 2 per cent of the variation in output in (1)a Table 4. All the coefficients on FGIs have the expected negative sign and two of the four t values are greater than unity with the first period lag showing significance at the 5 per cent level. As in the total manufacturing sector the R^2 of 2 per cent in the second stage test is close to the R^2 of 4 per cent found in the first stage test.

Equations (2), (3) and (4) deal with goods in process inventories, raw material inventories and inventories of unfilled orders respectively. As was found in total manufacturing, goods in process inventories (intermediate goods) gave mixed results and we cannot infer if finished goods are complements or substitutes of intermediate goods. The F statistic cannot reject the insignificance of all the explanatory variables. Recall that in the first stage tests FGI were found to be complements of intermediate goods.

Raw material stocks again showed mixed results with the first quarter lag significant with the correct sign but the fourth quarter lag being "wrong sign significant" in 3(b). The joint significance of all R.H.S. variables given by the F statistic cannot be rejected in 3(b) though it is rejected in 3(a).

Overall these simple equations show that by using the t value criterion we find that finished goods inventories can explain persistence in output of durable goods for about one quarter and raw materials and goods in process inventories explain persistence for about one year. The conclusion on goods in process inventories and raw materials is tentative due to the mixed signs found on the coefficients of these two inventory types. Equations iv(a) and iv(b) show that the significant drop in the R^2 in 4(b) (which does not contain the contemporaneous term on backorders), is evidence that unanticipated shocks have their effects mainly through current backorders. The insignificance of *past* backorders was also found in the finished goods inventory equations of the first stage test. This points out a consistency in the output and inventory equations.

Having seen the results of these simple equations, we now mount a search for the other relevant cost and stock variables. During the specification search it was found that in the durable goods output, both input prices, that is wages and price of capital were insignificant and hence, dropped from the equations. One of the demand variables, new industry orders, was similarly found insignificant and was consequently dropped from the equations. Orders were highly correlated with a number of other explanatory variables used in our estimated equations. It was important to exclude them because the data matrix was highly collinear in their presence. Thus the problem of multicollinearity was partially corrected.

The search for the appropriate output equation for the durable goods sector is now complete as seen in equation (5). We will now add the lagged monetary shocks to see if any further persistence in output can be explained over and above what was explained through different types of inventories.

A glance at the partial F values in equation (6) reveals that finished goods inventories are jointly insignificant, but goods in process, raw materials, and unfilled orders are significant. Another notable observation in equation (6) is the individual significance of the contemporaneous and past lags of monetary shocks. The lagged shocks have the correct positive sign which shows that past shocks reduce inventories in those periods and increase not only the output in that period (as seen from the significance of the contemporaneous term) but also future outputs.

What can one conclude about the significance of lagged monetary shocks in an equation which also includes lagged values of all inventory types? As pointed out in the discussion of equation (19)' in chapter II, the significance of u_{t-i} (lagged monetary shocks) in the presence of lagged FGIs provides evidence on "other channels of persistence" besides

FGIs. The lagged monetary shocks are carrying a different kind of, or more information than, is already contained in FGIs.

How much of the additional variance of output can be explained by lagged monetary shocks ?

A comparision of equation (6) with (5) shows that the inclusion of monetary shocks increases the R^2 by 6 per cent. The partial F value of monetary shocks is 3.04 which is significant at the 5% level. This suggests significant evidence of *other channels of persistence* in the output of durable goods industries.

Table 5
SECOND STAGE TESTS

DURABLE GOODS

$$\Delta \log Y_t = \beta_0 + \sum_{i=0}^{3} \phi_i \Delta \log N_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
i(a)	β_0	0.014	3.776	0.04	1.63	1.88	0.014	3.190	0.02	2.02	1.48	0.17
	ϕ_0	-0.005	-0.071				-0.003	-0.048				
	ϕ_1	-0.165	-1.984*				-0.164	-2.013*				
	ϕ_2	-0.084	-1.009				-0.084	-1.033				
	ϕ_3	-0.088	-1.058				-0.076	-0.936				
i(b)	β_0	0.014	3.868	0.05	1.63	2.54*	0.014	3.271	0.03	2.02	1.99	0.17
	ϕ_1	-0.166	-2.028*				-0.164	-2.025*				
	ϕ_2	-0.084	-1.017				-0.084	-1.040				
	ϕ_3	-0.087	-1.063				-0.076	-0.942				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

DURABLE GOODS

$$\Delta \log Y_t = \beta_0 - \sum_{i=0}^{4} \delta_{2i} \, \Delta \log GP_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
ii(a)	β_0	0.011	2.901	0.05	1.73	2.06	0.011	2.602	0.02	2.01	1.49	0.15
	δ_{20}	-0.307	-2.173*				-0.235	-1.677**				
	δ_{21}	0.091	0.585				0.067	0.458				
	δ_{22}	-0.024	-0.158				-0.038	-0.259				
	δ_{23}	0.265	1.833**				0.262	1.845**				
ii(b)	β_0	0.012	3.213	0.004	1.56	1.12	0.012	2.656	-2.4E-04	2.04	0.99	0.22
	δ_{21}	-0.043	-0.298				0.024	0.168				
	δ_{22}	-0.065	-0.414				-0.079	-0.555				
	δ_{23}	0.264	1.788**				0.235	1.647**				

Equation ii(b) is the same as equation ii(a) less the contemporaneous lag on the indépendant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

DURABLE GOODS

$$\Delta \log Y_t = \beta_0 - \sum_{i=0}^{3} \delta_{3i} \, \Delta \log RMS_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iii(a)	β_0	0.012	3.188	0.07	1.63	2.53*	0.012	2.774	0.05	2.02	2.15	0.19
	δ_{30}	-0.180	-0.812				-0.082	-0.379				
	δ_{31}	-0.318	-1.184				-0.382	-1.573**				
	δ_{32}	0.189	0.705				0.140	0.580				
	δ_{33}	0.426	1.898**				0.484	2.217*				
iii(b)	β_0	0.012	3.373	0.07	1.59	3.16*	0.013	2.847	0.06	2.03	2.83*	0.20
	δ_{31}	-0.447	-2.064*				-0.424	-1.980**				
	δ_{32}	0.147	0.560				0.114	0.496				
	δ_{33}	0.469	2.151*				0.498	2.322*				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

DURABLE GOODS

$$\Delta \log Y_t = \beta_0 - \sum_{i=0}^{3} \delta_{1i} \Delta \log UF_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
iv(a)	β_0	0.005	1.726	0.24	1.52	7.39*	0.005	1.345	0.24	2.03	7.47*	0.24
	δ_{10}	-0.196	-5.315*				-0.195	-5.444*				
	δ_{11}	-0.009	-0.242				-0.011	-0.303				
	δ_{12}	-0.009	-0.242				-0.011	-0.319				
	δ_{13}	1.32E-04	0.003				-0.009	-0.254				
iv(b)	β_0	0.009	2.515	-0.03	1.61	0.32	0.010	2.180	-0.04	2.02	0.05	0.23
	δ_{11}	-0.038	-0.884				0.006	0.156				
	δ_{12}	-0.013	-0.298				-0.011	-0.276				
	δ_{13}	0.001	0.030				-0.011	-0.279				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

DURABLE GOODS

$$\Delta \log Y_t = \beta_0 + \sum_{i=0}^{3} \phi_{1i} \Delta \log N_{t-i} - \sum_{i=1}^{3} \delta_{2i} \Delta \log GP_{t-i} - \sum_{i=1}^{3} \delta_{3i} \Delta \log RMS_{t-i} - \delta_1 \Delta \log UF_{t-1} + \beta_{7i} \sum_{i=1}^{3} \Delta \log rmp_{t-i} - \sum_{i=1}^{3} \varepsilon_{2i} \Delta \log K_{t-i} + v_t$$

OLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F
(5)	β_0	-0.016	-2.077*	0.51	2.31	6.49*
	ϕ_0	0.094	1.317**	1.51		
	ϕ_1	-0.088	-1.192			
	ϕ_2	0.063	0.882			
	δ_{21}	0.247	1.891**	3.15*		
	δ_{22}	-0.022	-0.167			
	δ_{23}	0.322	2.388*			
	δ_{31}	-2.293	-4.306*	7.44*		
	δ_{32}	2.538	2.838*			
	δ_{33}	-1.252	-1.986**			
	δ_1	-0.139	-4.422*	20.22*		
	β_{71}	2.291	4.604*			
	β_{72}	-2.737	-2.238*			
	β_{73}	1.558	2.632*			
	ε_{21}	-7.149	-2.167*			
	ε_{22}	11.666	2.017*			
	ε_{23}	-6.286	-1.977**			

Equation (5) includes all variables of the Expanded Multivariate Model **except** monetary shocks which are included in (6).

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

DURABLE GOODS

$$\Delta \log Y_t = \beta_0 + \sum_{i=0}^{3} \phi_{1i} \Delta \log N_{t-i} - \sum_{i=1}^{3} \delta_{2i} \Delta \log GP_{t-i} - \sum_{i=1}^{3} \delta_{3i} \Delta \log RMS_{t-i} - \sum_{i=0}^{3} \delta_{1i} \Delta \log UF_{t-i} + \sum_{i=1}^{3} + \beta_{7i} \Delta \log rmp_{t-i}$$

$$- \sum_{i=1}^{3} \varepsilon_{2i} \Delta \log K_{t-i} + \sum_{i=0}^{3} \gamma_i' \Delta u_{t-i} + v_t$$

OLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F
(6)	β_0	-0.017	2.283*	0.56	2.48	6.37*
	ϕ_0	0.089	1.287			2.28
	ϕ_1	-0.101	1.417**			
	ϕ_2	0.113	1.633*			
	δ_{21}	0.187	1.479**			3.76*
	δ_{22}	-0.073	0.571			
	δ_{23}	0.391	2.946*			
	δ_{31}	-1.853	3.495*			4.98*
	δ_{32}	1.966	2.232*			
	δ_{33}	-0.854	1.372**			
	δ_{10}	-0.134	4.470*			20.98*
	β_{71}	1.818	3.624*			
	β_{72}	-2.166	2.605*			
	β_{73}	1.268	2.198*			
	ε_{21}	-8.264	2.572*			
	ε_{22}	13.459	2.387*			
	ε_{23}	-7.241	2.345*			
	γ_0	0.251	1.322**			3.04*
	γ_1	0.525	2.178*			
	γ_2	0.800	3.311*			
	γ_3	0.302	1.624*			

Equation (6) is the final equation of the Second Stage Tests. It includes all those variables of the Expanded Multivariate Model which were found significant. The inferences on the effects of various inventories, on the Durable Goods Output are based on this equation. These inferences are based on the t-values and the partial F values for various inventory categories. Also see Table 5S(b) where these partial F values are reported

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$

NON DURABLE GOODS

In the non-durable goods sector, equations 1(a) to 4(a) show the impact of various inventory types on production of this sector. The signs on the coefficients of finished goods inventory are all correctly negative. All but the contemporaneous t values are greater than one, and the second and third quarter lags are significanct at the 5 per cent level. The F statistic suggests that lags of FGI as a whole are not jointly significant.

Intermediate goods inventories stored as goods in process affect current output showing the effects of shocks occuring more than a year ago (see 2a). The sign of the last coefficient is positive implying that finished goods and intermediate goods are substitutes in production.

Raw material supplies in equation 3(a) have "wrong sign significance" on three of the four lags. It will be seen that this "wrong sign significance" is due to a specification error caused by omitted variables. Once these relevant variables were added this problem was eradicated. Unfilled orders in 4(a) show their impact only contemporaneously. This suggests a very short term buffer role played by back orders when unanticipated shocks hit the economy. The sign on the coefficient of unfilled orders is negative implying that GPS and GPO are complements in production.

The OLS results for equations 1(a) to 4(a) show the presence of first order positive serial correlation as evidenced by the value of the Durbin Watson statistic. It will be seen in the discussion below that part of this serial correlation is corrected with the addition of other relevant variables.

The search for a completely specified output equation which includes the effects of costs and other relevant stocks leads to the estimation of (5). This equation contains all relevant and significant variables except monetary shocks. Since the search for the relevant variables has been exhausted we finally check for evidence on ***other channels of persistence*** by including the monetary shocks as an additional regressor in (5). The results of (6) show that unfilled orders and goods in process inventories are significant determinants of the output of non-durable goods industries. Finished goods inventories have again failed in significance as seen from the t, and partial F values of finished goods inventories. Equation (6) also shows that monetary shocks are not statistically significant; the partial F value is insignificant, and there is no improvement in R^2; showing the relative unimportance of "other channels" to explain the persistence in non-durable goods output. This contrasts sharply with the results of the durable goods sector.

Table 5
SECOND STAGE TESTS

NON DURABLE GOODS

$$\Delta \log Y_t = \beta_0 + \sum_{i=0}^{3} \phi_i \, \Delta \log N_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
i(a)	β_0	0.011	6.161	0.05	1.06	2.15	0.011	3.843	0.02	2.02	1.43	0.48
	ϕ_0	-0.042	-0.711				-0.018	-0.363				
	ϕ_1	-0.077	-1.296				-0.070	-1.282				
	ϕ_2	-0.088	-1.477**				-0.096	-1.767*				
	ϕ_3	-0.066	-1.112				-0.094	-1.814*				
i(b)	β_0	0.011	6.149	0.06	1.05	2.71*	0.011	3.847	0.03	2.02	1.88	0.48
	ϕ_1	-0.083	-1.425**				-0.063	-1.236				
	ϕ_2	-0.093	-1.585**				-0.096	-1.767*				
	ϕ_3	-0.066	-1.111				-0.094	-1.822*				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

NON DURABLE GOODS

$$\Delta \log Y_t = \beta_0 - \sum_{i=0}^{3} \delta_{2i} \Delta \log GP_{t-i} + v_t$$

		OLS					GLS					
	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F	VALUE	T STAT	$\bar{R}^2$	D.W.	F	ρ
ii(a)	β_0	0.010	5.160	0.03	1.03	1.60	0.011	3.401	0.03	2.02	1.74	0.52
	δ_{20}	-0.099	-1.130				0.019	0.262				
	δ_{21}	-0.063	-0.734				0.019	0.208				
	δ_{22}	0.105	1.199				0.112	1.205				
	δ_{23}	0.219	2.411*				0.192	2.536*				
ii(b)	β_0	0.010	5.440	0.02	0.97	1.71	0.011	3.505	0.05	2.02	2.32	0.52
	δ_{21}	-0.043	-0.504				0.004	0.057				
	δ_{22}	0.079	0.934				0.108	1.184				
	δ_{23}	0.193	2.196*				0.194	2.577*				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$

Table 5
SECOND STAGE TESTS

NON DURABLE GOODS

$$\Delta \log Y_t = \beta_0 - \sum_{i=0} \delta_{3i} \Delta \log RMS_{t-i} + v_t$$

	COEF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
iii(a)	β_0	0.011	6.471	0.13	1.14	4.12*	0.012	4.279	0.08	2.13	2.84*	0.48
	δ_{30}	-0.143	-1.441				-0.004	-0.052				
	δ_{31}	0.143	1.435**				0.179	1.998*				
	δ_{32}	0.221	2.216*				0.224	2.501*				
	δ_{33}	0.189	1.904*				0.192	2.188*				
iii(b)	β_0	0.012	6.725	0.12	1.06	4.74*	0.012	4.362	0.09	2.13	3.85*	0.48
	δ_{31}	0.113	1.151				0.180	2.098*				
	δ_{32}	0.200	2.018*				0.224	2.518*				
	δ_{33}	0.166	1.684*				0.192	2.229*				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

NON DURABLE GOODS

$$\Delta \log Y_t = \beta_0 - \sum_{i=0}^{3} \delta_{1i} \Delta \log UF_{t-i} + v_t$$

	COFF	OLS VALUE	OLS T STAT	OLS $\bar{R}^2$	OLS D.W.	OLS F	GLS VALUE	GLS T STAT	GLS $\bar{R}^2$	GLS D.W.	GLS F	ρ
iv(a)	β_0	0.008	5.125	0.13	1.13	4.21*	0.008	3.298	0.07	1.91	2.56*	0.44
	δ_{10}	-0.116	-2.978*				-0.097	-2.758*				
	δ_{11}	-0.045	-1.138				-0.043	-1.234				
	δ_{12}	-0.011	-0.296				-0.012	-0.348				
	δ_{13}	-0.034	-0.894				-0.038	-1.097				
iv(b)	β_0	0.008	5.151	0.05	1.14	2.42	0.009	3.201	-0.01	1.99	0.75	0.47
	δ_{11}	-0.079	-1.961*				-0.025	-0.719				
	δ_{12}	-0.018	-0.428				-0.010	-0.286				
	δ_{13}	-0.038	-0.956				-0.047	-1.326				

Equation i(b) is the same as equation i(a) less the contemporaneous lag on the independant variable.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$

Table 5
SECOND STAGE TESTS

NON DURABLE GOODS

$$\Delta \log Y_t = \beta_0 + \sum_{i=0}^{2} \phi_{1i} \Delta \log N_{t-i} - \sum_{i=0}^{3} \delta_{1i} \Delta \log UF_{t-i} - \sum_{i=1}^{3} \delta_{3i} \Delta \log RMS_{t-i} - \sum_{i=1}^{3} \delta_{2i} \Delta \log GP_{t-i} + \sum_{i=1}^{2} \beta_{7i} \Delta \log rmp_{t-i}$$

$$- \sum_{i=0}^{3} \varepsilon_{2i} \Delta \log K_{t-i} + v_t$$

OLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W	F
(5)	β_0	0.007	1.768**	0.51	1.77	6.72*
	ϕ_1	0.002	0.488			2.01
	ϕ_2	-0.040	-0.878			
	ϕ_3	-0.100	-2.146*			
	δ_{10}	-0.067	-2.141*			3.03*
	δ_{11}	-0.013	-0.409			
	δ_{12}	0.002	0.061			
	δ_{13}	-0.056	-1.711**			
	δ_{14}	-0.057	-1.781**			
	δ_{31}	-1.254	-4.955*			13.16*
	δ_{32}	0.952	4.449*			
	β_{71}	1.355	6.173*			
	β_{72}	-0.949	-4.448*			
	ε_{21}	-2.273	-0.915			
	ε_{22}	8.619	1.859**			
	ε_{23}	-6.227	-2.467*			

Equation (5) includes all variables of the Expanded Multivariate Model **except** monetary shocks, which are included in (6).

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$.

Table 5
SECOND STAGE TESTS

NON-DURABLE GOODS

$$\Delta \log Y_t = \beta_0 + \sum_{i=0}^{2} \phi_{1i}\, \Delta \log N_{t-i} + \sum_{i=0}^{3} \delta_{1i}\, \Delta \log UF_{t-i} + \sum_{i=1}^{3} \delta_{3i}\, \Delta \log RMS_{t-i} + \sum_{i=1}^{3} \delta_{2i}\, \Delta \log GP_{t-i} + \beta_{7i} \sum_{i=1}^{2} \Delta \log rmp_{t-i}$$

$$+ \sum_{i=1}^{3} \varepsilon_{2i}\, \Delta \log K_{t-i} + \sum_{i=0}^{3} \gamma_i\, \Delta\, u_{t-i} + v_t$$

OLS

	COEF	VALUE	T STAT	$\bar{R}^2$	D.W.	F
(6)	β_0	0.008	1.699**	0.51	1.73	5.50*
	ϕ_1	0.020	0.429			1.87*
	ϕ_2	-0.038	-0.823			
	ϕ_3	-0.098	-2.085*			
	δ_{10}	-0.073	-2.277*			2.91*
	δ_{11}	-0.007	-2.223*			
	δ_{12}	-0.004	-0.142			
	δ_{13}	-0.049	-1.456**			
	δ_{14}	-0.056	-1.734**			
	δ_{31}	-1.219	-4.684*			11.16*
	δ_{32}	0.873	3.811*			
	β_{71}	1.301	5.719*			
	β_{72}	-0.894	-3.972*			
	ε_{21}	-2.608	-1.038			
	ε_{22}	9.304	1.976**			
	ε_{23}	-6.568	-2.553*			
	γ_0	-0.033	-0.340			0.98
	γ_1	-0.012	-0.099			
	γ_2	0.154	1.280			
	γ_3	0.056	0.583			

Equation (6) is the final equation of the Second Stage Tests. It includes all those variables of the Expanded Multivariate Model which were found significant. The inferences on the effects of various inventories, on the Non-Durable Goods Output are based on this equation. These inferences are based on the t-values and the partial F values for various inventory categories. Also see Table 5S(b) where these partial F values are reported.

* Significant at the 5% level
** Significant at the 10% level
The GLS $\bar{R}^2$ is computed on the transformed variable $\log N_t - \rho \log N_{t-1}$

Summary of Second Stage Results

To summarise the results of the second stage test for all industry classifications, the following stylised facts emerge from our estimated equations:

1. The inferences on the buffer stock role of various goods inventories were determined by two types of equations. In the first type we regressed some very simple equations in which the only dependent variable was contemporaneous and lagged values of either FGIs, or other goods inventories, depending on the inventory being examined. The second type of equations utilised the variables suggested in the generalised multivariate model. These equations examine the effects on output of **all goods inventories**, as well as other variables e.g. inventory carrying costs and quasi-fixed factors of production. [29]
2. If persistence in output is to be measured only by looking at the significance of lagged finished goods inventories, then the evidence for the Blinder & Fischer hypothesis is very weak by the t value criterion, and zero by the F value criterion. In all industry classifications FGIs are only significant (in t-values) at some lags in both the very simple equation (i), and the completely specified equations of the generalised multivariate model. However, the partial F values of FGIs in all these equations are statistically insignificant.
3. The persitence in output of Canadian manufacturing industries can however be explained by *simultaneously* looking at the fluctuations in *other goods inventories* held by the firm i.e. inventories of intermediate goods, unfilled orders and raw materials.

   In the output of the total manufacturing sector, persistence effects of monetary shocks can be explained for one year by the inclusion of these other goods inventories. This persistence is largely explained through lagged adjustment of raw material inventories which show a one year persistence effect as seen by the significant t values at the

[29] Evidence for the first type of equations is given in equations (i) to (iv). The results of the second type of equations are given in equation (5) for the total manufacturing sector and equation (6) for both the durable and non-durable sectors.

fourth quarter lag.[30]

4. It is difficult to conclude which industry classification shows the strongest results on persistence–via–inventories. By using the F–value criterion we find that both the durable goods and total manufacturing show the joint significance of all other goods inventories except finished goods inventories. In these two sectors, raw materials and goods in process show relatively longer lagged effects as seen from the t–values at past lags. The non–durable sector shows that past lags of FGIs or goods in process are not significant. In this sector persistence is only explained through raw material inventories.

5. In the total manufacturing and durable goods backorders are only significant at the contemporaneous lag and hence do not explain any persistence. On the other hand the backorders show a five quarter effect on non–durable goods output. This finding contrasts with our *a priori* expectations of a longer persistence effect of backorders especially in durable goods industries which are characterised by non–homogeneous goods and take a longer time to be produced. The significance of past lags of unfilled orders in the non durable goods sector cannot be inferred that unfilled orders are propagating the effects of monetary shocks, because lagged unfilled orders are not significant in the first stage tests of this sector.

6. Finally, unantcipated monetary shocks were added to equation (5) in the total manufacturing and equations (6) for the durable and non–durable sectors respectively. This variable was added to see if it carries any additional information over and above various inventories which are part of the above mentioned equations. It was discussed in equation (19) Chaper II, that the significance of monetary shocks in an equation which already includes other inventories, would be construed to be evidence in favour of *other channels of persistence*. Monetary shocks were found to be jointly significant in the durable goods sector and not in other sectors. This suggests some indirect

[30] Although it is the third lag, but including the contemporaneous quarter it is the fourth quarter.

evidence of other channels of persistence in the durable goods sector. The evidence can only be claimed to be indirect at best because formal tests on other channels of persistence were not designed — monetary shocks were merely used as a proxy for these other channels. The insignificance of monetary shocks in the total manufacturing and non durables suggests that in these two sectors inventories are the important channel of persistence. No additional information is contained in lagged mmonetary shocks that is not already reflected in lagged inventories.

A lot of ground has been covered in the discussion and presentation of first and second stage tests. The first stage tests separately examined evidence on the effects of monetary shocks on FGIs and *other goods inventories*. The second stage tests examined the effects of FGIs and all other goods inventories on the output equations. It would be informative for the reader to see together the conclusions from both the first and second stage tests.

Joint Summary Of First and Second Stage Tests

The combined results of the first and second stage tests can be seen from Table 5S. This is a two part table. Part (a) shows in tabular form the persistence effects of monetary shocks on various inventory types and part (b) shows the effects of these shocks on output through buffer stocks of various inventories. Table 5S(a) and 5S(b) thus show the results of the first and the second stage tests. The results in Table 5S(a) are the GLS results of the final equations of the first stage tests for various inventories. For example, for FGIs it is equation (4) of Table 3; for other goods inventories, they are equations (i) to (iii) of Table 4. In Table 5S(b) the results of the final equation of the second stage tests are shown. See equations (5), (6), and (6), for total manufacturing, durables and non-durables respectively.

Table 5S

5S(a)		FGI	UF	GP	RMS
	Total Manufacturing	0.94[a]	1.32[a]	0.80[a]	3.13[a]*
	Durables	1.16[a]	1.21[a]	1.34[a]	2.88[a]*
	Non Durables	0.52[a]	0.55[a]	0.39[a]	3.21b*

Effects of monetary shocks on all inventory categories in first stage test

(b)		FGI	UF	GP	RMS
	Total Manufacturing	0.34	21.18*	3.05*	5.35*
	Durables	2.28	20.98*	3.76*	4.98*
	Non Durables	1.87	2.91*	^	11.16*

Effects of all inventory categories on output in second stage test

Table 5S(a) contains the partial F values of monetary shocks in inventory equations of the First Stage Tests, and 5S(b) contains the partial F values of various inventories in the output equations of the Second Stage Tests.

a Shows the partial F values of the GLS results of equations (a).

^ This variable was dropped due to insignificance. It was merely adding to multicollinearity.

* Significant at the 5% level.

** Significant at the 10% level.

FGI Finished goods inventories.

UF Unfilled orders.

GP Goods in process or intermediate goods.

RMS Raw material stocks.

As pointed out before the Blinder and Fisher hypothesis can only be empirically true if **both the first stage and second stage tests are significant**, i.e. monetary shocks should be significant in inventory equations in Table 5S(a) and inventories should be significant in output equations in 5S(b). The significance of the first stage tests provides evidence on the buffer stock role of various inventories while the second stage tests show whether these inventories transmit the effects of shocks to output. If we only observe significance of inventories in (b), it cannot be inferred that these effects may be due to buffer stock reasons, but rather they are due to some other cause of fluctuations in inventories, e.g. a firm may experience fluctuations in inventories when it engages in speculative activities or uses inventories as a barrier to entry. The importance of these other causes is, however, an empirical issue and no *a priori* claims can be made about the relative magnitude of these causes compared to the buffer stock motive.

The combined results of Table 5S(a) and 5S(b) show that FGIs do not succeed in explaining the persistence effects of monetary shocks in any sector. Also goods in process and back order inventories fail to explain any persistence in any sector. Hoevever, the significance of raw materials in both the first and and second stage tests is evidence that monetary shocks are propagated to output through raw materials. This important finding establishes the buffer stock role of raw materials over and above finished goods inventories and other inventories carried by the firm.

The chapter concludes with the finding that if the definition of inventories is enlarged to include all types of goods inventories and not only finished goods inventories, there is evidence that raw material inventories are a statistically significant channel of propagating the effects of monetary shocks to output. Hence the significance of lagged monetary shocks in output equations which has been found in numerous empirical studies can be explained by lagged inventory adjustment.[31] In our opinion, the first and second stage tests when combined

[31] The results for most of the estimated equations for the second stage test are consistent

together constitute a viable test of the Blinder–Fischer hypothesis, and we have succeeded to some degree in showing that indeed inventories are an important and independent channel of persistence.

[31](cont'd) with the estimated equations of the first stage test. By consistent we mean that variables which were significant in the inventory equations were more or less significant in the output equations.

The Blinder and Fisher hypothesis has been tested in the preceeding pages by using the conventional regression technique. The procedure followed was to use known "exogenous" variables as regressors in the inventory demand and output supply functions. It was suggested by one member of the thesis committee that it would be useful to see if the regression results are corraborated by causality tests on the same issue. It was hard to say *a priori* if there would be any significant difference in results under the two techniques, i.e. conventional regression vs causality tests. However, since causality tests are also essentially regressions, I did not expect to find evidence for the buffer stock role in equations employing the latter technique when lack of such evidence had been found using the former technique. Nevertheless, these causality tests were done for the sake of completion.

A number of causality testing techniques are available in the econometricians tool box. I have chosen the Granger causality tests to test the Blinder and Fischer hypothesis. This technique is better than the Sims tests because it avoids the problems associated with the use of adhoc filters to produce white noise residuals.

Since the thesis contends that the Blinder and Fischer hypothesis is a two stage hypothesis, therefore we had to establish (a) the link from monetary shocks to inventories,[32] and (b) the propagation of these monetary shocks through inventories to output. This necessitated doing Granger causality tests on both (a) and (b), which meant that two sets of two equations each had to be estimated.

[32] Earlier in the thesis we have estimated the effects of monetary shocks on all kinds of inventories carried by the economy. Note that in the first stage tests, not only did we estimate the buffer stock role of finished goods inventories, but also raw materials, backorders, and goods in process. However, in the causality tests we only consider finished goods inventories.

To test the link from monetary shocks to inventories the following multivariate equations were estimated.

$$N_t = \beta_0 + \gamma_0 u_t + \sum_{j=1}^{m} \gamma_j u_{t-j} + \sum_{i=1}^{n} \beta_i N_{t-i} + \epsilon_t$$

$$u_t = \alpha_0 + d_0 N_t + \sum_{i=1}^{n} c_i u_{t-i} + \sum_{j=1}^{m} d_j N_{t-j} + v_t \qquad (1)$$

Simply put the notion of Granger causality states that u causes N if γ_0, γ_j are significant, and N causes u if d_0, d_j are significant. If both these sets of coefficients are significant in the two equation set then we have evidence of bidirectional causality and if only either one is significant we have unidirectional causality. Since we are interested to test if monetary shocks **persist** in inventory movements, therefore our interest is not in instantaneous causality. Thus we ignore γ_0 and search for the significance of γ_j. This would also facilitate the presentation of the results as we shall only be reporting the partial F values on γ_j and d_j to infer causal relations.

To test if inventories are the propagators of aggregate demand shocks to output, the following set of equations was estimated.

$$Y_t = \beta_0 + \gamma_0 N_t + \sum_{j=1}^{m} \gamma_j N_{t-j} + \sum_{i=1}^{n} \beta_i Y_{t-i} + \epsilon_t$$

$$N_t = \alpha_0 + d_0 Y_t + \sum_{i=1}^{n} c_i N_{t-i} + \sum_{j=1}^{m} d_j Y_{t-j} + v_t \qquad (2)$$

One again the significance of γ_j is important for us to establish the propagating effects of inventories to output.

In equations (1) and (2) we are mainly interested in the significance of the lagged coefficients on u_{t-i} and N_{t-i}. If both these coefficients are significant then the causal chain from monetary shocks through inventories to output is completed. The results are presented in the following tables by using the partial F values.

Causal Relations Between Unanticipated Money and Inventories

	γ_j	β_i	c_i	d_i
Total Manufacturing	0.046	2497.6*	0.739	2.32
Durable Goods	0.039	1528.9*	0.702	2.91*
Non Durable Goods	0.126	1504*	0.665	1.63

Causal Relations Between Inventories and Output

	γ_j	β_i	c_i	d_i
Total Manufacturing	1.57	1044.6*	354.78	1.93
Durable Goods	1.47	639.98*	338.47	1.02
Non Durable Goods	1.62	1583.14*	330.06	2.50*

The results on the causal relations in the two tables are very clear. In none of the sectors u does not cause N, and N only causes u in the durable goods sector. Thus we do not find any evidence of the buffer stock role for finished goods inventories in any sector. This lack of evidence was also found in the first stage tests. The second table shows the causal relations between inventories and output. The partial F values show that N does not

Granger cause Y in any sector and Y causes N only in the non durable goods sector. Finished goods inventories were also found to be insignificant in the second stage tests. The combined causality results of the two tables thus corroborate the inferences drawn earlier with the first and second stage tests of conventional regression equations of inventories and output.

CHAPTER V

CONCLUSION

The Blinder and Fischer hypothesis states that inventories are the propagating mechanism of the observed persistence of monetary shocks on output, or in other words inventories can explain why *serially uncorrelated* monetary shocks can produce *serially correlated* movements in output, or business cycles.

The proper and complete testing of the hypothesis involves an empirical verification of two neccessary conditions:

(i) monetary shocks should be significant in inventory equations.

(ii) inventories should be significant in output equations.

The first condition brings out the buffer stock role of inventories and the second condition establishes whether monetary shocks are transmitted to output through inventory fluctuations. These two conditions have been referred in the thesis as the *first* and *second stage tests* of the Blinder and Fischer hypothesis. Both conditions are neccessary but neither is sufficient to examine the chain starting from monetary shocks and culminating in output fluctuations. Existing empirical studies which test for the persistence–via–inventories hypothesis have two important shortcomings. First, they typically test one of the two conditions. Second, the definition of inventories used by these studies has been too narrow, including only finished goods inventories and neglecting other types of goods inventories (e.g. raw materials, backorders and goods in process).

The Blinder and Fischer hypothesis was tested for the manufacturing sector of Canada at the disaggregated level of durable and non–durable goods industries. The estimation period is 1963 1 to 1983 4, and the data set are seasonally non adjusted. The explanatory variables used in the inventory (first stage tests) and output equations (second stage tests) are basically given in the multivariate model of inventory investment of Maccini and Rossana (1984) and

Maccini (1984). However, we also added some other variables which had not been considered by Maccini and Rossana. These variables are imports, capital stock and the persistence variable, monetary shocks.

The combined regression results of the first and the second stage tests of the Blinder and Fischer hypothesis bring out the relative importance of raw materials over finished goods inventories, and other inventories, in propagating the effects of monetary shocks to output equations. Although a number of inventories were found to be significant in the second stage tests, yet their significance in the second stage tests alone is not sufficient to establish the link from monetary shocks to output. It was necessary that these inventories be significant in the first stage tests to establish their buffer stock role. This significance was not found in the first stage tests, and thus we cannot claim that their significance in the second stage tests means that they are propagating the effects of monetary shocks to output.

The results also show that using the generalized multivariate model of inventory investment significantly improves the R^2 of the first and second stage test equations. However, the inclusion of these significant variables does not improve the persistence results obtained in the simple multivariate model. The simple multivariate model is merely a subset of the generalized multivariate model. The inclusion of a number of interrelated variables in the latter does however cause a problem of multicollinearity, which has probably reduced the t values of the estimated coefficients on lagged monetary shocks, as well as other variables. This suggests that the possible gains of a better specification in the generalized multivariate model have been probably wiped out due to the effects of multicollinearity.

The thesis concludes with the finding that if the definition of inventories is enlarged to include all types of goods inventories, there is evidence to claim that raw material inventories are a statistically significant channel of propagating the effects of monetary shocks to output. Hence the significance of lagged monetary shocks in output equations which has been found in numerous empirical studies can be explained by lagged raw material inventory adjustment.[1] In our opinion, the first and the second stage tests when combined together constitute a viable test of the Blinder-Fischer hypothesis, and we have succeded in showing that indeed inventories are an important and independent channel of persistence.

While this study has answered some questions, there is still room for improvement. First, issues of persistence should best be tested by raw data. Monetary shocks do not have their first impact on massaged data which has been seasonally corrected. They first effect the buffer stocks of deseasonalised data. These effects are then propagated to output as claimed by Blinder and Fischer. Using seasonally adjusted data does not fully capture the random movements in monetary shocks and their effects on inventories. Due to data availability problems most other studies on persistence suffer from the same shortcoming.

Second, the Blinder and Fischer hypothesis, though it is a macro theory, is basically based on firm behaviour. By aggregating over firms and industries, the persistence effects of monetary shocks on inventories are probably diffused. One needs to also look for evidence on the persistence hypothesis at the micro level of a particular industry level or the firm.

Third, the modelling of expectations in this study is very simple. Expectations have been modelled by a simple lag of the past values of a variable. A better approach would be to estimate one-period-ahead forecasts by the Box-Jenkins time series methodology. This would theoretically improve the problems of multicollinearity faced in the equations of the multivariate model. We did not follow this method because the data set available to us was not sufficient in observations. A number of degrees of freedom would be lost in estimating the one period ahead forecasts, thus leaving insufficient degrees of freedom for estimating the inventory and output equations of the first and second stage tests.

[1] The results for most of the estimated equations for the second stage test are consistent with the estimated equations of the first stage test. By consistent we mean that variables which were significant in the inventory equations were more or less significant in the output equations.

Fourth, the results should improve somewhat by estimating the money growth and inventory equations as a system, by using three stage least squares or the full information maximum likilihood methods (FIML). This was not done by us since the computer packages available in the university gave inconsistent results when some preliminary equations were tested by FIML method. Consequently, further efforts to estimate with a systems approach were abandoned.

CHAPTER VI

NOTES ON DATA CONSTRUCTION

Deflators for Manufacturing Industries[1]

Data on *constant dollar* FGI, raw materials and goods in process inventories are not available in published form before 1971. These data were obtained from Statistics Canada in-house computer sheets.[2] Constant dollar data are also not available before 1971 for unfilled orders, shipments and new industry orders. We had to construct these data prior to 1971 using the appropriate deflators for shipments and unfilled orders, and new orders were then computed as the residual between unfilled orders and shipments. In constructing the unfilled orders, new orders and shipments series we have utilised the deflating procedures followed by Statistics Canada. The similarity of the deflating techniques ensures the consistency of pre and post 1971 data. The detailed description is given in Statistics Canada Catalogue 13-004, the March 1982 issue. A summarised account is given below.

Manufacturing industries produce both to order [3] and to stock. [4] Constant dollar inventories (of all types) and shipments can easily be calculated for the latter industry type by simply deflating the current dollar values of shipments, new orders and unfilled orders by the Industry Selling Price Indexes (ISPI). Using the same procedure for deflating the

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[1] This thesis would have been difficult to complete without the help of Mr Walter Piovesan, the data librarian at Simon Fraser University. He was instrumental in retrieving a number of time series from the CANSIM Main Base of Statistics Canada. Also, during the initial stages of data collection, the assistance of Mr. Deepak Agrawal is appreciated.

[2] I am thankful to Mr. Peter Wilkinson of Statistics Canada for sending me these data.

[3] These are durable goods industries and include the wood, furniture and fixtures, primary metal, fabricated metal products, machinery, transportation equipment, electrical products and non-metallic mineral products industries.

[4] These are non-durable goods industries and include food and beverage, tobacco products, rubber, leather, textile, clothing, paper and allied products, printing publishing and allied, petroleum and coal product industries. This category also includes chemical products and miscellaneous products industries.

shipments, new orders and unfilled orders of the industries which produce to order is not appropriate. In these industries there is a significant lag between the receipt of orders and shipments. Shipments and unfilled orders in such industries flow from new orders placed at times t, t−1, ... t−n valued at prices which were in effect at those time periods. Consequently, if a simple deflating procedure is used, shipments and unfilled orders in constant dollars would be overstated when prices are falling and understated when prices are rising. There are significant production lags in industries which produce to order. The three step procedure outlined below embodies in the deflators the structure of the production lags and reflects the actual price of the shipments and unfilled orders.

New orders by definition are the residual derived from shipments and unfilled orders:

$$O_t = UF_t - UF_{t-1} + S_t \qquad (1)$$

or

$$UF_t = UF_{t-1} + O_t - S_t \qquad (2)$$

We have to first construct data on constant dollar shipments in order to construct the series for new and unfilled orders. However, due to production and shipment lags current dollar shipments in industry j at any time t, are a weighted average of the current dollar new orders.

Step 1

$$S_{jt} = \sum_{i=0}^{n} w_{ji} O_{j\,t-i} \qquad \text{with} \quad \sum_{i=0}^{n} w_{ji} = 1 \text{ for all industries j.} \qquad (3)$$

where w_{ji} is the proportion of new orders placed at time t−i that were shipped at time t in industry j, assumed constant for all values of t.

The deflator for shipments of industry j at time t can be estimated by :

Step 2

$PS_{jt} = \sum_{i=0}^{n} w_{ji} \; ISPI_{j\,t-i}$ where $ISPI_{j\,t-i}$ is the industry selling price index of industry j.

Finally the constant dollar value of shipments at time t is given by

Step 3

$$KS_t = S_t \;/\; PS_t \quad (5)$$

The OLS estimation of (3) neccessitated the imposition of the condition that $\sum_{i=0}^{n} w_{ji} = 1$. This was done as follows. [5] Expanding (3) we get:

$$S_{jt} = w_t \, O_t + w_{t-1} \, O_{t-1} + \ldots\ldots\ldots + w_{t-n} \, O_{t-n} \quad (3)'$$

Let the condition be imposed that :

$$w_t + w_{t-1} + \ldots\ldots\ldots + w_{t-n} = 1$$

Substituting these weights in (3)' and simplying we get:

$$S_t - O_t = w_{t-1} \, (O_t - O_{t-1}) + w_{t-2} \, (O_t - O_{t-2}) + \ldots\ldots\ldots + w_{t-n} \, (O_t - O_{t-n})$$

Once w_{t-1} to w_{t-n} are estimated by OLS, w_t can be easily calculated by substituting these weights in the constraint condition.

We are still left with the task of estimating constant dollar estimates of unfilled orders from 1961 1 to 1970 4. We need not go through the tedious procedure of calculating the weights for unfilled orders as we did for the shipments. The weights of unfilled orders are

[5] For a concise description see Kennedy (1985), p. 163.

related to the weights of shipments in the following way :

$$W_{ji} = 1 - \sum_{k=0}^{i} w_{jk} \qquad (4)$$

The intuitive rationale of this relation is that the proportion of new orders placed at time t–i that are still unfilled at time t ($W_{ji} O_{j\,t-i}$) must be equal to the new orders placed at time t–i less the portion of these new orders that were shipped during the periods t–i, t–i+1, t–i+2,....,t, that is $w_{ji} O_{j\,t-i}$, $w_{j\,i-1} O_{j\,t-i}$, $w_{j\,i-2} O_{j\,t-i}$, ..., $w_{j\,0} O_{j\,t-i}$.
Thus we have

$$W_{ji} O_{j\,t-i} = O_{j\,t-i} - \sum_{k=0}^{i} O_{j\,t-i} w_{jk}$$

which is equation (4) after simplification.

Raw Material Price Index

The data on a raw material price index are available only from 1977 onwards. These data are not suitable for our purposes because it is a price index of raw materials in both the agricultural and non-agricultural sectors. We are interested in a price index classified by total manufacturing, durable goods and non-durable goods industries.

This index was constructed from the published data on cost of materials and supplies available from 1961 onwards which excludes the costs of fuel and electricity. A Paasche price index for year 1 (taking the index of year 0 as unity) is constructed by using the formula:

$$P = \frac{p^1 q^1}{p^0 q^1}$$

where $p^k q^k$ is $\sum_{i=1}^{n} p_i^k q_i^k$, and k is the k^{th} time period, and i = 1,....., n are the number of goods included as raw materials in the raw material price index.

In this index the prices have been weighted by the quantities in the final year (not base year). The shortcoming of this index is well known, it underestimates the rise in the actual cost of raw materials. The issue of the appropriate price index is still unresolved. It all depends on the approach taken to solve the welfare changes of the individual, i.e. in the event of a price change should the individual be rewarded by the "compensating variation" or "equivalent variation" principle.[6]

Historical data are available for the numerator series in the form of costs of materials and supplies. The denominator used in the calculation of the price index is chosen to be the constant dollar value of raw material inventories, which is base year prices times the physical stock of raw materials. Since the numerator series is based on the quantity of materials and supplies, we think it is most appropriate to divide by the raw material stock series. Finally to get real raw material prices the estimated price index was deflated by the ISPI of the respective industry classifications.

Two problems need to be mentioned regarding the construction of this price index. First, it is not clear what quantity series is used by Statistics Canada in the construction of costs of materials and supplies, though as the name suggests it must be a quantity series based on raw materials. Consequently the materials and supplies used by Statistics Canada would differ by some amount (due to definitional, measurement and rounding errors) from the raw material inventory series used by us in the denominator of the estimated price index. If the quantities used by Statistics Canada are consistently greater (lower) than the raw material stocks used by us, we would be introducing an upward (downward) bias in the estimated price index. Unfortunately there was no expedient way around this problem, hence the methodology adopted by us was the best alternative available.

[6] See Layard and Walters (1978) for a detailed discussion of the various price indices.

Second, we could only get yearly data for costs of materials and supplies, but for our regressions we need quarterly data. The TROLL computer program was used to estimate quarterly series from yearly data. In our estimated equations for the first and second stage tests, the coefficients on raw material price index showed mixed sign significance. It is quite possible that some of those results are an artifact of the constructed data.

Industry Selling Price Index (ISPI)

The industry selling price index was only available for total manufacturing and not for durable and non-durable industries. The ISPIs for durable and non-durable industries were constructed from the ISPIs of individual industries within these sectors. The ISPIs of individual industries had to be weighted by the weights of these ISPIs in the total ISPI for the manufacturing sector.

Therefore,

$$ISPI_{Dur,\ Non-dur} = \sum_{j=1}^{n} w_j \ ISPI_j$$

The above equation was computed for both the durable and non-durable good industries. Data for the price indexes of transportation equipment, clothing, tobacco, rubber, electrical, metal fabricating, machinery, and miscellaneous industries was not available to the public due to confidentiality reasons. These data were obtained from in-house computer sheets of Statistics Canada. [1]

The estimated ISPIs for durables, non-durables and total manufacturing were then used in the calculation of constant dollar unfilled orders, shipments and new orders. They were also used for deflating other nominal variables such as wages, price of capital, and raw material prices to get real price indexes for these variables.

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[1] I am thankful to the Prices Division of Statistics Canada for releasing this confidential data.

Output Output is defined to be the quarterly index of Real Domestic Product in Total Manufacturing, Durable and Non-durable goods industries.

The data before 1971 is indexed to the 1961 base year, and the latter data is indexed to the 1971 base year. The data for the period 1961-1971 was linked to the latter data by multyplying by the following link factors.

Total Manufacturing	: 100/183.549
Durable Goods	: 100/205.699
Non-durable Goods	: 100/166.099

Source :

Catalogue 61-516 from 1961 1 to 1971 4.

Catalogue 61-005 from 1972 1 to 1985 4. or CANSIM, matrix 1130.

Capital Stocks

Capital is defined to be the flows and stocks of fixed non-residential capital based on the 1970 standard industrial classification. It is the constant dollar end year total net stock in machinery and equipment, building construction, and engineering. The capital stock for the durable and non-durable sectors was calculated by adding the capital stocks of industries in those sectors. This data are only available annually from surveys, consequently the TROLL computer programme was used to construct quarterly estimates from the annual data.

Source : Catalogue 13-568 and 13-211, and CANSIM, matrices 3488 through 3508.

Labour Stocks or Employment

A consistent time series of employment is not available for the sample period 1961-1985. There were two inconsistencies which had to be resolved.

(1) The data from January 1961 to March 1983 are index numbers of employment and from March 1983 onwards are number of employees in thousands.

(2) The measure of surveys also changed in 1983. Prior to April 1983 the data is on firms of 20 or more employees, whereas after April 1983 firms of all sizes are being covered in the survey.

The first problem was fixed by converting the employee series after March 1983 to index numbers of employment. The following scalars were used for multiplying the employment series.

Total Manufacturing	:	100/1251.3
Durable Goods	:	100/559.6
Non-Durable Goods	:	100/691.8

Thus we obtained an index number series of employment from 1961 to 1985.

The second problem was solved by multiplying the series up to March, 1983 by the the ratio :

$$\frac{\text{\# of employees in March, 1983 under new survey}}{\text{\# of employees in March, 1983 under old survey}}$$

The linking factors for the three sectors are:

Total Manufacturing	:	1.2157
Durable Goods	:	1.2078
Non-Durable Goods	:	1.2226

We finally have a consistent time series, adjusted both for units of measurement and differences in survey measures.[1]

Source: Catalogue 72-002 and CANSIM Data Base.

[1] The advice of Mr Jack Beauregard of the Labour Division of Statistics Canada is appreciated in the construction of the employment index.

Money Supply

The money supply series is the Canadian M1, which is currency and demand deposits of chartered banks. The growth rates of the money supply used in the money supply function are first differences of logs of M1.

Source: Bank of Canada Review and CANSIM Data Base.

Real Interest Rates

The real interest rates are the 90 day treasury bill rates minus the rate of inflation measured by the consumer price index for all items. *Source*: Bank of Canada Review and Catalogue 62-001, 62-010 and CANSIM, matrix 2560, 1922.

Foreign Exchange Reserves

The foreign exchange reserves are Canada's official international reserves, in millions of U.S. dollars. These data were available only in seasonally unadjusted form. Seasonal adjustment was done by the TROLL seasonal adjustment computer programme.

Source: Bank of Canada Review and CANSIM, matrix 2553.

Imports

Imports are the total merchandise imports from all countries, by commoddities, based on the standard commodity classification, in thousands of dollars.

Source : Catalogue 65-007 and CANSIM, matrix 3653.

APPENDIX 3 DATA

The estimation period was 1963 1 to 1983 4. All the series attached in the appendix are of quarterly seasonally adjusted data. The tables show the logs of the data series.

The data are arranged as follows. We first present the data used in the estimation of the money supply function followed by separate data sets for the Total Manufacturing, Durables and Non Durable sectors. To be able to replicate the second stage test results the reader would have to convert the given log series into growth rates of the respective variables. The complete data set are presented from next page onwards.

GROWTH RATE OF MONEY SUPPLY (M1)

1953	2	0.010818	-0.019775	-0.009328	0.006633
1954	2	0.000727	0.008804	0.019171	0.037923
1955	2	0.023259	0.024837	0.001114	-0.009648
1956	2	0.007192	-0.003123	-0.009836	-0.012777
1957	2	0.002966	-0.010015	0.016516	0.024678
1958	2	0.040812	0.042297	0.025762	-0.009791
1959	2	-0.013742	-0.002844	-0.01214	0.006388
1960	2	0.017614	0.005071	0.017217	0.01828
1961	2	-0.005208	0.025157	0.01565	-0.001317
1962	2	0.003723	-0.001704	0.035487	0.007176
1963	2	0.027288	0.00298	0.005925	0.021419
1964	2	0.014186	0.003789	0.01176	0.016428
1965	2	0.024734	0.02153	0.005295	0.022802
1966	2	0.016098	0.009598	0.028478	0.035649
1967	2	0.025081	0.003261	0.019689	-0.003143
1968	2	-0.001968	0.041881	0.019399	0.020595
1969	2	0.02211	-0.010931	0.005733	0.005905
1970	2	0.003972	0.014114	0.018443	0.037521
1971	2	0.043437	0.037378	0.037868	0.025044
1972	2	0.026683	0.037135	0.047754	0.03212
1973	2	0.032242	0.030086	0.019984	0.022232
1974	2	0.047704	-0.01559	0.004451	0.058726
1975	2	0.038396	0.037272	0.058797	-0.008397
1976	2	0.00448	0.018168	0.011882	0.021428
1977	2	0.031743	0.017889	0.026072	0.023108
1978	2	0.020395	0.025976	0.034123	-0.010269
1979	2	0.028371	0.027344	-0.000783	0.014318
1980	2	-0.006357	0.038904	0.045207	-0.01328
1981	2	0.008783	-0.002008	-0.027904	0.014806
1982	2	0.008331	-0.01064	0.026352	0.042628
1983	2	0.025838	0.034053	0.001617	0.007257
1984	2	0.009974	-0.015315	0.006607	0.00881
1985	2	0.012517	·0.028499	0.03154	

REAL INTEREST RATES = NOMINAL RATES - EXPOST INFLATION RATES

1961 1	1.13817	1.0975	0.902867	0.978787
1962 1	1.1421	1.3891	1.6362	1.36726
	1.29473	1.21232	1.27105	1.29873
	1.34608	1.28712	1.31703	1.33333
	1.30806	1.35111	1.40773	1.45382
	1.56642	1.62146	1.61353	1.62887
	1.49548	1.42739	1.49732	1.69573
	1.90021	1.92129	1.74394	1.76128
	1.86574	1.92908	2.04003	2.04382
	2.00922	1.84859	1.71064	1.52985
	1.37711	1.14056	1.34531	1.19476
	1.24038	1.28676	1.25799	1.28933
	1.41362	1.64429	1.81335	1.86116
	1.83375	2.11959	2.20193	2.03212
	1.84436	1.93065	2.06663	2.13219
	2.17615	2.19323	2.20818	2.14888
	2.04564	1.97773	1.96295	1.97625
	1.99872	2.10516	2.18292	2.32398
	2.38448	2.38012	2.43683	2.61171
	2.64535	2.5145	2.35056	2.65307
	2.81529	2.901	3.00299	2.76036
	2.67985	2.73762	2.63104	2.35823
	2.23244	2.21653	2.22609	2.24851
1984 1	2.3048	2.42721	2.50888	2.35931
1985 1	2.34043	2.25473	2.18806	2.18261

FOREIGN EXCHANGE RESERVES

1953 1	7.56621	7.5393	7.51736	7.53684
1954 1	7.56281	7.56743	7.58874	7.60082
	7.58686	7.59778	7.60521	7.58571
	7.58654	7.59103	7.58727	7.61089
	7.6191	7.61677	7.61278	7.58769
	7.58633	7.60364	7.60483	7.6065
	7.59889	7.61875	7.61397	7.60122
	7.61386	7.58403	7.60007	7.57781
	7.64333	7.68285	7.68663	7.71838
	7.61537	7.49454	7.76552	7.83204
	7.88065	7.92296	7.85502	7.83779
	7.84876	7.85853	7.89427	7.93534
	7.95903	7.96345	8.00074	8.00243
	7.98765	7.9676	7.92531	7.89027
	7.89608	7.89247	7.89297	7.90996
	7.80329	7.88105	7.90526	7.9688
	8.01825	8.00542	7.99251	8.03704
	8.13992	8.30924	8.42301	8.45067
	8.47877	8.48108	8.51558	8.58541
	8.64144	8.69169	8.74054	8.72683
	8.69185	8.67218	8.64685	8.66793
	8.70019	8.72	8.69122	8.6771
	8.66603	8.58645	8.56614	8.59346
	8.65623	8.66733	8.65639	8.6381
	8.58353	8.54373	8.48815	8.38137
	8.30098	8.4502	8.32147	8.46848
	8.44164	8.40973	8.36428	8.28434
	8.30244	8.35008	8.30075	8.2297
	8.14418	8.0764	7.94589	8.27448
	8.16634	8.07663	8.18438	8.20998
	8.35316	8.42366	8.39048	8.40532
1984 1	8.28439	8.13918	8.20471	8.08386
1985 1	8.0464	8.11003	8.09114	8.08246

RESIDUALS OF MONEY GROWTH EQUATION

1961 1	0.008253	-0.001019	-0.004018	-0.00646
1962 1	-0.014166	-0.009552	0.000012	-0.031078
	-0.015815	0.010245	-0.024283	0.001882
	0.00011	0.000831	-0.017292	-0.012395
	0.001729	0.00738	0.000317	-0.011091
	0.005671	0.004019	0.001822	0.006306
	0.021128	0.007329	-0.021721	0.00896
	-0.00413	0.006464	0.025502	0.001448
	0.006712	0.006876	-0.005197	0.00108
	-0.006933	-0.005596	-0.016539	-0.00982
	0.009353	0.00447	-0.003811	0.005215
	-0.002676	-0.008248	0.009323	0.014968
	-0.004626	0.001528	0.004381	0.003943
	-0.005539	0.01516	-0.032792	-0.00771
	0.013228	0.010511	0.003251	0.02886
	-0.019332	-0.011689	-0.00919	0.007259
	-0.013903	-0.006315	-0.012491	-0.003889
	-0.002557	0.003218	0.001035	0.024733
	-0.019829	0.015967	0.011088	-0.003488
	-0.003116	-0.015004	0.026001	0.016424
	-0.007796	0.007842	-0.006052	-0.00935
	-0.012875	-0.007042	0.002207	-0.0028
	0.018942	0.010359	0.013126	-0.007132
1984 1	0.002293	-0.005697	-0.01478	-0.011006
1985 1	-0.013013	0.001575	0.002587	0.015751

FINISHED GOODS INVENTORIES

1961 1	7.5974	7.61628	7.6303	7.65302
1962 1	7.674	7.67338	7.68233	7.695
	7.71542	7.72974	7.72944	7.74255
	7.7542	7.77289	7.78503	7.79304
	7.81386	7.82218	7.83769	7.84867
	7.85309	7.87942	7.90162	7.92708
	7.9766	7.98435	7.98458	7.96844
	7.95437	7.95027	7.95168	7.95414
	7.95939	7.97316	7.98219	8.00681
	8.01654	8.02726	8.03614	8.02726
	8.02366	8.00781	7.98662	8.00169
	8.01047	8.01676	8.0253	8.01058
	7.98264	7.97831	7.99125	7.99475
	7.98435	7.99979	8.0108	8.07621
	8.12009	8.13143	8.1046	8.10933
	8.13584	8.16004	8.1898	8.20458
	8.47164	8.47289	8.47408	8.47609
	8.47296	8.45283	8.42625	8.42208
	8.4296	8.44347	8.45688	8.47991
	8.49064	8.51866	8.51853	8.49078
	8.51198	8.52754	8.53882	8.56776
	8.5771	8.56972	8.54241	8.50221
	8.45822	8.42354	8.42427	8.45077
1984 1	8.45155	8.46471	8.47838	8.49276
1985 1	8.50862	8.50553	8.51739	8.5243

REAL INCOME OF THE TOTAL MANUFACTURING SECTOR

1961 1	3.95808	3.98376	4.01077	4.03419
1962 1	4.0514	4.0822	4.09861	4.10581
	4.1183	4.10671	4.15144	4.18848
	4.2186	4.23214	4.2455	4.27017
	4.29276	4.31413	4.3329	4.37355
	4.39327	4.39798	4.39731	4.41854
	4.42051	4.42247	4.43805	4.44254
	4.44447	4.4846	4.49803	4.53025
	4.55117	4.56204	4.57053	4.56601
	4.56771	4.54829	4.54134	4.5361
	4.60517	4.62791	4.65929	4.67755
	4.67698	4.70676	4.72515	4.76037
	4.8017	4.80721	4.82043	4.84386
	4.8719	4.85938	4.84951	4.83434
	4.7875	4.78549	4.79373	4.80811
	4.83447	4.86606	4.86372	4.85368
	4.87532	4.87258	4.87137	4.87537
	4.88273	4.91248	4.92705	4.96096
	4.97839	4.97553	4.98145	4.97391
	4.97247	4.92634	4.93041	4.95761
	4.96699	4.98917	4.95463	4.91725
	4.87316	4.84733	4.8334	4.79057
	4.846	4.86971	4.90085	4.94918
	4.95238	4.95635	4.99033	4.98494
1985 1	4.98623	5.00345	5.03106	5.04059

RAW MATERIALS (CONSTANT DOLLARS)

1961 1	7.64396	7.63932	7.64348	7.66011
1962 1	7.67183	7.69074	7.69545	7.69333
	7.68907	7.69652	7.69758	7.71349
	7.72533	7.75662	7.78641	7.81157
	7.82976	7.86019	7.87677	7.90027
	7.92708	7.95507	7.9766	7.99261
	8.01091	8.01323	8.02432	8.01522
	8.01345	8.00914	8.0087	8.02224
	8.02932	8.04302	8.06107	8.07796
	8.09874	8.09448	8.10016	8.11073
	8.09864	8.09468	8.1041	8.11442
	8.11333	8.13359	8.15995	8.17245
	8.1778	8.19671	8.20704	8.24003
	8.29705	8.33215	8.38076	8.41804
	8.44269	8.44017	8.42479	8.41146
	8.39201	8.39894	8.37532	8.37409
	8.34696	8.34641	8.3449	8.35067
	8.36023	8.36194	8.36132	8.36699
	8.39034	8.41117	8.43916	8.44749
	8.45006	8.46898	8.45091	8.43945
	8.44312	8.44477	8.46097	8.4626
	8.45992	8.42156	8.37055	8.33135
	8.30951	8.29305	8.29221	8.30053
1984 1	8.30869	8.33479	8.35263	8.3542
1985 1	8.33759	8.34284	8.35216	8.33111

GOODS IN PROCESS (CONSTANT DOLLARS)

1961 1	6.91804	6.96161	6.96066	6.98872
1962 1	7.0079	7.02643	7.04694	7.06105
	7.06048	7.0676	7.07468	7.08143
	7.10688	7.11612	7.17063	7.18917
	7.21401	7.26122	7.27078	7.32295
	7.36116	7.40347	7.43209	7.46927
	7.45915	7.45645	7.45588	7.44892
	7.45895	7.46355	7.48624	7.50531
	7.52976	7.55747	7.57695	7.58342
	7.59488	7.59405	7.60589	7.59371
	7.57866	7.56907	7.56562	7.57558
	7.5846	7.59957	7.60506	7.62397
	7.64651	7.67786	7.72238	7.74385
	7.76345	7.78932	7.80126	7.81116
	7.78794	7.77919	7.76118	7.75291
	7.77303	7.77821	7.77639	7.79661
	7.79825	7.7889	7.78378	7.79962
	7.79578	7.79359	7.80275	7.81292
	7.84346	7.86301	7.87626	7.90397
	7.90949	7.92684	7.90483	7.90593
	7.92045	7.92117	7.9196	7.92226
	7.91547	7.89108	7.86532	7.80561
	7.74688	7.72356	7.73543	7.77079
1984 1	7.79989	7.79948	7.81089	7.82551
1985 1	7.8148	7.80194	7.81923	7.81897

UNFILLED ORDERS (CONSTANT DOLLARS)

1962 1	7.38099	7.39622	7.39882	7.38767
1963 1	7.41767	7.41961	7.43097	7.45671
	7.51773	7.55119	7.55586	7.56866
	7.59438	7.63257	7.65843	7.67562
	7.72999	7.76763	7.78168	7.78976
	7.79049	7.76855	7.76487	7.76581
	7.76804	7.78034	7.79165	7.81712
	7.8751	7.90932	7.91797	7.92377
	7.98679	7.97454	7.96945	7.96531
	8.47568	8.50357	8.4927	8.48838
	8.4585	8.49174	8.51305	8.54869
	8.61196	8.67522	8.76525	8.87005
	8.94499	9.01038	9.08251	9.10142
	9.08364	9.01323	8.9597	8.93687
	8.88834	8.85884	8.84058	8.80347
	8.82918	8.88211	8.88174	8.89946
	8.90314	8.94824	8.98151	9.04613
	9.09538	9.1283	9.13544	9.14857
	9.18352	9.13877	9.11427	9.10183
	9.09654	9.09751	9.07353	9.02091
	8.96499	8.92421	8.86097	8.81438
	8.83831	8.83662	8.92771	9.06835
1984 1	9.08708	9.13486	9.13018	9.11453
1985 1	9.10945	9.09698	9.08391	9.05952

CAPITAL STOCK (CONSTANT DOLLARS)

1952 1	7.8826	7.92607	7.96774	8.00773
1953 1	8.0115	8.01524	8.02269	8.03377
	8.04751	8.06082	8.07289	8.08377
	8.09436	8.10809	8.12568	8.14691
	8.17093	8.19499	8.21846	8.24138
	8.26301	8.2807	8.29385	8.30273
	8.30823	8.31407	8.32109	8.32927
	8.33835	8.34766	8.35694	8.36624
	8.37521	8.38288	8.38899	8.39358
	8.39716	8.40175	8.40788	8.41548
	8.42417	8.43229	8.43953	8.44586
	8.45181	8.45944	8.46912	8.48085
	8.49426	8.50847	8.5232	8.53842
	8.55434	8.57218	8.59206	8.61387
	8.63671	8.65753	8.67568	8.69137
	8.70473	8.71652	8.72684	8.73579
	8.74366	8.75195	8.76093	8.77062
	8.78113	8.79327	8.80714	8.82269
	8.8392	8.85419	8.86708	8.87801
	8.8872	8.89557	8.90334	8.91052
	8.91739	8.92508	8.9338	8.94356
	8.95434	8.96626	8.97928	8.9934
	9.00822	9.0225	9.03596	9.04862
	9.06042	9.07117	9.08079	9.08936
	9.09709	9.10495	9.11316	9.12169
	9.13033	9.13799	9.14444	9.14973
	9.15414	9.15884	9.16408	9.16988
	9.17619	9.18321	9.1909	9.19924
	9.20835	9.21884	9.23077	9.2441
	9.25821	9.27074	9.28118	9.2896
	9.29608	9.3008	9.30378	9.30507
	9.30491	9.30439	9.30374	9.30301
1984 1	9.3024	9.30302	9.30511	9.30866
1985 1	9.3132	9.31693	9.31942	9.32066

LABOUR STOCK OR EMPLOYMENT

1961 1	7.22231	7.2578	7.29485	7.27991
1962 1	7.26788	7.30805	7.33788	7.31436
	7.29559	7.33228	7.35407	7.34571
	7.34453	7.37587	7.40535	7.39133
	7.38921	7.42313	7.4539	7.4546
	7.48053	7.51216	7.53108	7.519
	7.50192	7.50974	7.53015	7.50451
	7.47897	7.50194	7.52106	7.516
	7.50832	7.53928	7.54161	7.53391
	7.5122	7.51823	7.52352	7.49746
	7.48261	7.51169	7.5229	7.50614
	7.493	7.52468	7.53574	7.53076
	7.52793	7.57078	7.58838	7.58725
	7.58311	7.61356	7.61708	7.58359
	7.53063	7.55404	7.54489	7.53037
	7.53416	7.56435	7.56708	7.5438
	7.51697	7.54614	7.55547	7.53195
	7.51452	7.56437	7.58854	7.57908
	7.57147	7.60559	7.6208	7.59909
	7.57655	7.58778	7.58715	7.57485
	7.57358	7.6169	7.60177	7.55835
	7.51831	7.51774	7.49374	7.42682
	7.41424	7.46222	7.48358	7.45178
1984 1	7.39236	7.4272	7.44403	7.41732
1985 1	7.40627	7.44692	7.46619	7.44239

RAW MATERIAL PRICES

1961 1	4.48042	4.57216	4.64811	4.70565
1962 1	4.70113	4.68936	4.69878	4.72177
	4.75118	4.76525	4.78038	4.77559
	4.77149	4.7509	4.73613	4.73017
	4.7345	4.7273	4.73403	4.73392
	4.72928	4.7175	4.70524	4.69176
	4.67129	4.67016	4.66557	4.68639
	4.70428	4.72657	4.74614	4.7528
	4.7652	4.76363	4.74889	4.7266
	4.69448	4.69285	4.68975	4.69019
	4.72002	4.74291	4.75219	4.76035
	4.77986	4.77844	4.77146	4.77883
	4.79387	4.79621	4.80799	4.79789
	4.76228	4.7385	4.68926	4.63941
	4.59409	4.58472	4.6017	4.63005
	4.67381	4.68631	4.72132	4.72618
	4.75197	4.75691	4.77109	4.78604
	4.80289	4.82666	4.85013	4.86489
	4.85826	4.84554	4.8157	4.7957
	4.77499	4.74721	4.7698	4.79902
	4.82042	4.83088	4.80913	4.78401
1982 1	4.74973	4.76076	4.80089	4.84628
1983 1	4.8872	4.92064	4.93253	4.92977

DURABLE GOODS

FINISHED GOODS INVENTORIES

1961 1	6.6796	6.69539	6.70441	6.73657
	6.76119	6.75538	6.75149	6.75305
	6.77765	6.80165	6.82618	6.8222
	6.81564	6.83662	6.86101	6.88004
	6.90241	6.91804	6.94505	6.95686
	6.9751	6.99973	7.0082	7.02584
	7.08451	7.09257	7.09174	7.06248
	7.05387	7.0452	7.05618	7.0659
	7.06162	7.08031	7.09755	7.12956
	7.17089	7.18134	7.19268	7.18235
	7.1642	7.15644	7.11639	7.12636
	7.12233	7.12502	7.12983	7.11693
	7.10195	7.10003	7.1301	7.1394
	7.14493	7.13516	7.16884	7.24351
	7.27725	7.28299	7.24732	7.25583
	7.27748	7.29867	7.32712	7.34558
	7.68509	7.67848	7.66716	7.67771
	7.66247	7.65413	7.62933	7.63337
	7.66918	7.69409	7.70691	7.73398
	7.75677	7.79194	7.79111	7.75562
	7.75462	7.76952	7.78225	7.83029
	7.84776	7.83966	7.80981	7.7486
	7.67941	7.64683	7.64635	7.68494
	7.69909	7.72135	7.72312	7.72415
1985 4	7.73368	7.72651	7.73295	7.7616

REAL INCOME IN DURABLES

1961 1	3.83368	3.87084	3.89585	3.92985
1962 1	3.95158	3.99726	4.02195	4.03836
	4.05029	4.07372	4.07867	4.13546
	4.17061	4.18181	4.19801	4.2261
	4.27191	4.30723	4.3183	4.3774
	4.39675	4.39555	4.38954	4.42159
	4.421	4.42217	4.43493	4.44183
	4.42683	4.48824	4.51944	4.54867
	4.56702	4.57807	4.57757	4.57055
	4.56904	4.54145	4.53469	4.49532
	4.60517	4.63362	4.66697	4.68678
	4.67716	4.70436	4.7249	4.77269
	4.83424	4.83511	4.85819	4.87414
	4.91472	4.89966	4.89772	4.88625
	4.81672	4.82349	4.84495	4.86316
	4.88146	4.89916	4.8921	4.88451
	4.91986	4.91326	4.91396	4.91643
	4.90947	4.95515	4.96793	5.00627
	5.03776	5.02211	5.02787	5.01227
	5.00356	4.93233	4.9436	4.98586
	4.99082	5.02534	4.97407	4.91945
	4.86598	4.83659	4.81379	4.73048
	4.80132	4.8346	4.87639	4.95482
	4.96765	4.95937	5.01835	5.0054
1985 1	5.01129	5.03219	5.06792	5.0691

RAW MATERIALS

1961 1	6.81271	6.81527	6.81088	6.83123
1962 1	6.84801	6.87178	6.87901	6.88175
	6.88585	6.88959	6.89804	6.90375
	6.92034	6.96885	7.0073	7.0533
	7.08003	7.10743	7.1394	7.17829
	7.20959	7.22524	7.26052	7.28047
	7.28733	7.2946	7.28665	7.27471
	7.26915	7.26799	7.26543	7.29912
	7.31233	7.34429	7.37044	7.37651
	7.40225	7.39429	7.3873	7.38936
	7.39634	7.39203	7.39572	7.41075
	7.41858	7.44405	7.48174	7.49868
	7.49998	7.51335	7.55031	7.58545
	7.63691	7.68279	7.72827	7.76966
	7.80643	7.79839	7.78835	7.76316
	7.73616	7.72827	7.68784	7.68417
	7.6438	7.63337	7.62754	7.64428
	7.67152	7.674	7.68494	7.70436
	7.72209	7.75762	7.79372	7.80289
	7.80981	7.82751	7.8199	7.81062
	7.81292	7.8144	7.83874	7.84293
	7.83241	7.79345	7.72489	7.66247
	7.62348	7.6039	7.60489	7.62119
	7.62738	7.66513	7.69606	7.70226
	7.66685	7.66247	7.67121	7.6546

GOODS IN PROCESS

1961 1	6.33328	6.40081	6.39582	6.43508
1962 1	6.46873	6.49224	6.52356	6.54487
	6.52356	6.53621	6.53862	6.54439
	6.58709	6.59213	6.67288	6.69909
	6.72423	6.7916	6.84019	6.85013
	6.93212	6.98595	7.02406	7.06447
	7.02997	7.0184	7.01511	7.00003
	7.02495	7.03262	7.05761	7.07946
	7.09893	7.13781	7.15825	7.15877
	7.1788	7.17396	7.18589	7.1673
	7.14861	7.1317	7.11015	7.11856
	7.12662	7.14388	7.14072	7.15696
	7.17855	7.22548	7.28665	7.31699
	7.33433	7.35841	7.37128	7.38067
	7.33542	7.32185	7.30047	7.28162
	7.30854	7.31743	7.3161	7.35607
	7.35137	7.34062	7.32449	7.34773
	7.35436	7.35522	7.36265	7.37233
	7.42198	7.45472	7.47231	7.51335
	7.5251	7.54592	7.51607	7.51534
	7.52941	7.52474	7.52402	7.52672
	7.51407	7.4909	7.46049	7.38626
	7.30182	7.28436	7.31033	7.36032
	7.40123	7.40062	7.42198	7.44736
	7.44503	7.42118	7.44308	7.45124

UNFILLED ORDERS

1961 1	6.96438	7.00211	7.0221	7.0342
1962 1	7.06894	7.08336	7.08891	7.10835
	7.19024	7.24029	7.25677	7.26996
	7.30288	7.33641	7.35346	7.37587
	7.44727	7.48482	7.49411	7.50471
	7.51233	7.49333	7.49504	7.48872
	7.47345	7.47902	7.48725	7.50407
	7.57477	7.62079	7.63456	7.6421
	7.62737	7.60709	7.60054	7.58296
	8.2797	8.3114	8.29013	8.2802
	8.246	8.27961	8.30293	8.34355
	8.4159	8.4826	8.58423	8.70467
	8.7925	8.87645	8.96243	8.99164
	8.98114	8.9077	8.85195	8.82732
	8.77467	8.74076	8.71943	8.67152
	8.70118	8.76233	8.76259	8.77776
	8.77406	8.81581	8.84856	8.91977
	8.9747	9.01022	9.01954	9.04161
	9.08557	9.03987	9.01506	8.99855
	8.99189	8.99545	8.97339	8.91972
	8.86362	8.82316	8.75532	8.70792
	8.73236	8.72902	8.82757	8.98034
	9.00094	9.04974	9.04444	9.02746
1985 4	9.01991	9.0061	8.9882	8.95897

CAPITAL STOCK (CONSTANT DOLLARS)

1952 1	7.01639	7.03955	7.06294	7.08648
1953 1	7.10947	7.12955	7.14618	7.15968
	7.17022	7.18017	7.18969	7.19888
	7.2086	7.22243	7.24114	7.26442
	7.29097	7.31709	7.34197	7.36561
	7.38725	7.40424	7.41589	7.42241
	7.42513	7.42926	7.43595	7.4452
	7.45631	7.46748	7.47806	7.48819
	7.49731	7.50415	7.5082	7.50961
	7.50916	7.51091	7.51562	7.52338
	7.53323	7.54211	7.54935	7.55486
	7.55959	7.56702	7.57792	7.59224
	7.60899	7.62593	7.64225	7.65808
	7.67395	7.69251	7.7142	7.73887
	7.76509	7.78837	7.80782	7.82367
	7.8362	7.84659	7.85501	7.86156
	7.86679	7.87343	7.88196	7.89236
	7.90452	7.91854	7.93431	7.95174
	7.96986	7.98544	7.99764	8.00668
	8.01309	8.01912	8.02525	8.03149
	8.03807	8.04613	8.05591	8.06733
	8.08022	8.09421	8.10907	8.12485
	8.14104	8.15635	8.1704	8.18322
	8.1947	8.20442	8.21218	8.21808
	8.22257	8.22733	8.23277	8.23892
	8.24537	8.25088	8.2551	8.25807
	8.26017	8.26317	8.26748	8.27303
	8.27995	8.28905	8.30031	8.31378
	8.32878	8.34373	8.35811	8.37198
	8.38478	8.3944	8.40042	8.4029
	8.40237	8.40087	8.39892	8.39655
	8.39387	8.39157	8.38981	8.38859
	8.38807	8.38895	8.39135	8.39532
1985 4	8.40083	8.4083	8.41768	8.42895

LABOUR STOCK OR EMPLOYMENT

1961 1	6.4473	6.48836	6.50639	6.50879
1962 1	6.50494	6.5551	6.56802	6.54305
	6.55068	6.58467	6.58961	6.60199
	6.61107	6.64326	6.65769	6.66223
	6.67638	6.71197	6.72036	6.75153
	6.76029	6.78999	6.78985	6.79446
	6.78522	6.78125	6.78826	6.77483
	6.74311	6.76657	6.77258	6.79012
	6.79171	6.82326	6.79801	6.81812
	6.7986	6.79053	6.77699	6.75585
	6.75148	6.77979	6.77956	6.78499
	6.7769	6.79972	6.80433	6.81653
	6.82199	6.85982	6.88043	6.88863
	6.88522	6.91663	6.91011	6.88666
	6.82269	6.84136	6.82772	6.83454
	6.82654	6.84265	6.82994	6.82453
	6.79707	6.81658	6.81891	6.81136
	6.79514	6.84428	6.86117	6.86886
	6.86702	6.89623	6.90208	6.89403
	6.87195	6.86286	6.85312	6.85397
	6.85342	6.89729	6.85834	6.82304
	6.7849	6.7649	6.72007	6.64473
	6.63568	6.69431	6.72191	6.70016
	6.63029	6.66023	6.6706	6.65437
	6.65123	6.69093	6.70715	6.70792

1961 1	4.32902	4.523	4.69159	4.81222
	4.80565	4.79197	4.80462	4.83099
	4.86103	4.8829	4.88889	4.88693
	4.8674	4.82503	4.80547	4.79037
	4.80297	4.81255	4.81303	4.80249
	4.79469	4.79405	4.76464	4.74156
	4.7259	4.71775	4.73608	4.76937
	4.80471	4.83655	4.86888	4.86408
	4.87663	4.85849	4.83239	4.81261
	4.76364	4.75768	4.76527	4.77836
	4.79749	4.82688	4.84454	4.84735
	4.85526	4.84831	4.83298	4.84199
	4.86885	4.88164	4.86794	4.85338
	4.81857	4.78057	4.73301	4.67956
	4.62435	4.62313	4.63731	4.67994
	4.73325	4.76153	4.81314	4.81912
	4.856	4.86881	4.88581	4.88876
	4.88804	4.91424	4.93282	4.94366
	4.95366	4.93121	4.89092	4.86012
	4.81892	4.77786	4.77997	4.80194
	4.82313	4.82889	4.78912	4.74574
	4.69979	4.70157	4.76433	4.85289
	4.94031	4.99999	5.02486	5.02125

NON DURABLE GOODS

FINISHED GOODS INVENTORIES

1961 1	7.08757	7.10852	7.12582	7.1423
1962 1	7.16085	7.16369	7.18108	7.20092
	7.21867	7.22669	7.20983	7.23442
	7.25794	7.27517	7.27932	7.28001
	7.2998	7.30317	7.31077	7.32119
	7.31588	7.34343	7.37526	7.4061
	7.4493	7.45684	7.4578	7.45066
	7.43288	7.43189	7.42675	7.42417
	7.43603	7.44639	7.44969	7.46908
	7.45568	7.46661	7.47364	7.46585
	7.47307	7.45124	7.44386	7.4626
	7.48043	7.48923	7.50035	7.48437
	7.44736	7.44132	7.44191	7.44112
	7.41878	7.45298	7.44717	7.50549
	7.55713	7.57267	7.55241	7.55433
	7.58443	7.61085	7.64156	7.65365
	7.86391	7.87169	7.88307	7.87816
	7.88483	7.85516	7.82711	7.81615
	7.79948	7.80357	7.81749	7.8369
	7.83663	7.858	7.85851	7.83795
	7.87917	7.89531	7.90532	7.91705
	7.91887	7.91218	7.88721	7.86608
	7.84398	7.80751	7.80927	7.82538
	7.8144	7.81937	7.84372	7.86978
	7.89108	7.89146	7.9079	7.89618

REAL INCOME OF NON DURABLES

1961 1	4.0673	4.08366	4.11067	4.12634
1962 1	4.14082	4.15885	4.16915	4.16728
	4.18026	4.20481	4.21909	4.23665
	4.26412	4.27841	4.29003	4.31125
	4.31287	4.3209	4.34774	4.36931
	4.38968	4.40008	4.4045	4.41548
	4.41911	4.42346	4.44064	4.44276
	4.4617	4.48098	4.47756	4.51185
	4.53601	4.54628	4.56463	4.56086
	4.56588	4.55581	4.54819	4.57399
	4.60517	4.62209	4.65143	4.6681
	4.67681	4.70919	4.72539	4.74772
	4.76755	4.77809	4.78061	4.81218
	4.82651	4.81679	4.7981	4.77877
	4.75696	4.74541	4.73894	4.74897
	4.78442	4.83131	4.83408	4.82137
	4.82802	4.82954	4.82623	4.83191
	4.85484	4.86726	4.8838	4.91278
	4.91432	4.92596	4.93205	4.93343
	4.93992	4.92024	4.91686	4.92809
	4.94223	4.95109	4.93451	4.915
	4.88038	4.8581	4.85291	4.84805
	4.88939	4.90412	4.92506	4.94343
1984 1	4.93663	4.95327	4.96107	4.96374
1985 1	4.96015	4.97343	4.99223	5.01081

RAW MATERIALS

1961 1	7.07214	7.06191	7.0727	7.08646
1962 1	7.09424	7.10933	7.11206	7.10606
	7.09506	7.10551	7.10058	7.12475
	7.13276	7.14992	7.17242	7.17956
	7.19017	7.2233	7.22597	7.23514
	7.25771	7.29732	7.30586	7.3181
	7.3473	7.34493	7.37379	7.36729
	7.36897	7.3618	7.36328	7.35819
	7.35947	7.35543	7.36539	7.39306
	7.40893	7.40833	7.42635	7.44503
	7.41457	7.41095	7.42595	7.43169
	7.42178	7.43681	7.45163	7.45953
	7.46908	7.49369	7.4761	7.50677
	7.56976	7.59321	7.64524	7.67802
	7.68922	7.69287	7.67152	7.67136
	7.66011	7.68279	7.67647	7.67771
	7.66372	7.67276	7.67539	7.67058
	7.66262	7.66356	7.65112	7.64236
	7.67167	7.67678	7.69591	7.70331
	7.70105	7.72135	7.6915	7.67756
	7.68279	7.68463	7.6915	7.69013
	7.69652	7.65886	7.62754	7.61333
	7.6092	7.59589	7.59321	7.59337
	7.60357	7.6176	7.62152	7.61809
1983 4	7.62152	7.63675	7.64667	7.62103

GOODS IN PROCESS

1961 1	6.1033	6.11589	6.1203	6.1334
1962 1	6.13267	6.14419	6.14918	6.15273
	6.18209	6.1814	6.19509	6.20321
	6.20388	6.21926	6.23441	6.24093
	6.2653	6.27977	6.22059	6.34681
	6.3081	6.32853	6.33859	6.36933
	6.40633	6.42	6.42433	6.43187
	6.4151	6.41401	6.4324	6.44625
	6.48004	6.48667	6.50429	6.52209
	6.51718	6.52405	6.53572	6.53572
	6.52747	6.53136	6.56009	6.57275
	6.58341	6.59441	6.61473	6.63813
	6.66228	6.66696	6.68169	6.68669
	6.71052	6.73973	6.74993	6.7608
	6.77727	6.77689	6.76465	6.77422
	6.78295	6.78181	6.77916	6.76465
	6.77765	6.77079	6.78483	6.78785
	6.76542	6.75771	6.77002	6.78106
	6.77613	6.77002	6.7746	6.77499
	6.76734	6.77727	6.77194	6.77689
	6.79235	6.80424	6.80091	6.80351
	6.80867	6.78181	6.76542	6.73419
	6.72303	6.68918	6.67498	6.68211
	6.68752	6.68752	6.67834	6.66992
	6.64075	6.652	6.65929	6.64031

UNFILLED ORDERS

1962 1	6.25984	6.27204	6.29801	6.26487
1963 1	6.3043	6.27453	6.24012	6.17617
	6.19491	6.1663	6.19205	6.23305
	6.24216	6.23148	6.20303	6.21469
	6.21944	6.2713	6.32226	6.32466
	6.32864	6.36658	6.39504	6.39553
	6.37509	6.34391	6.323	6.34704
	6.40219	6.43387	6.45391	6.50327
	6.52583	6.52553	6.51876	6.51924
	6.78921	6.79527	6.79346	6.81882
	6.74993	6.75887	6.79682	6.81674
	6.80535	6.83662	6.84977	6.86415
	6.88653	6.93375	6.96665	6.98872
	6.98903	6.93375	6.90341	6.83733
	6.75499	6.71255	6.67834	6.67119
	6.65716	6.66483	6.67034	6.71296
	6.71052	6.70073	6.69539	6.7338
	6.79235	6.86101	6.89804	6.91506
	6.921	6.9331	6.92264	6.86066
	6.81198	6.77613	6.75499	6.7803
	6.78785	6.76465	6.72263	6.6796
	6.62539	6.58156	6.56103	6.5216
	6.54103	6.55393	6.57693	6.59396
	6.59213	6.62804	6.63156	6.63024
	6.65157	6.65415	6.6896	6.71215

CAPITAL STOCK (CONSTANT DOLLARS)

1952 1	7.39161	7.41273	7.43245	7.45081
1953 1	7.46773	7.48265	7.49554	7.50642
	7.51579	7.52574	7.53653	7.54826
	7.56106	7.57626	7.59378	7.61376
	7.63546	7.65776	7.68003	7.70242
	7.72412	7.74238	7.7567	7.76721
	7.77465	7.78169	7.78891	7.79637
	7.80397	7.81202	7.82039	7.82908
	7.8379	7.8462	7.85378	7.86067
	7.86696	7.87362	7.88066	7.88824
	7.89604	7.90364	7.91091	7.91783
	7.92462	7.93234	7.94121	7.95116
	7.96215	7.97451	7.98808	8.0029
	8.01885	8.03617	8.05474	8.07453
	8.09493	8.11399	8.13124	8.14678
	8.16075	8.17352	8.18523	8.1959
	8.20563	8.21513	8.22445	8.23362
	8.24292	8.25375	8.26626	8.28047
	8.29578	8.31037	8.32378	8.33606
	8.34721	8.35726	8.36621	8.37407
	8.38112	8.38855	8.39655	8.40512
	8.41437	8.4248	8.4365	8.44945
	8.46323	8.4768	8.48982	8.50238
	8.51439	8.52589	8.53689	8.54736
	8.55739	8.56749	8.57763	8.58791
	8.59805	8.60722	8.61524	8.62215
	8.62815	8.63401	8.63991	8.64587
	8.65177	8.65736	8.66254	8.66734
	8.67225	8.67958	8.68976	8.70273
	8.71773	8.73234	8.74593	8.75857
	8.76994	8.77893	8.78525	8.78898
	8.79046	8.79114	8.79135	8.7911
	8.79046	8.78989	8.78948	8.78923
1985 4	8.78918	8.78945	8.7901	8.7911

LABOUR STOCK OR EMPLOYMENT

1961 1	6.60494	6.63553	6.68892	6.65921
1962 1	6.63985	6.671	6.71594	6.67846
	6.6514	6.68551	6.72738	6.70037
	6.68978	6.72027	6.76366	6.73239
	6.71475	6.747	6.79913	6.77055
	6.81302	6.85009	6.88397	6.85578
	6.83122	6.85022	6.88321	6.84616
	6.82637	6.84897	6.88016	6.8541
	6.82558	6.86794	6.8962	6.86236
	6.8385	6.84072	6.88066	6.85022
	6.82566	6.85543	6.87726	6.83968
	6.82167	6.86185	6.87903	6.85758
	6.84668	6.89447	6.9091	6.59496
	6.89385	6.92345	6.93684	6.89344
	6.8513	6.87936	6.8747	6.83881
	6.84598	6.89838	6.9158	6.87554
	6.84932	6.88767	6.902	6.86496
	6.84633	6.8969	6.92801	6.90204
	6.88908	6.92757	6.95196	6.91693
	6.89397	6.92573	6.93287	6.90821
	6.90617	6.949	6.95624	6.90527
	6.86347	6.88075	6.87516	6.81548
	6.79993	6.83855	6.85453	6.81392
	6.76365	6.80273	6.82524	6.78946
1985 4	6.77148	6.81282	6.8349	6.78897

RAW MATERIAL PRICES

1961 1	3.16996	3.21397	3.23586	3.25375
1962 1	3.24998	3.23887	3.24408	3.26186
	3.28783	3.29333	3.31462	3.30725
	3.31592	3.31384	3.30438	3.30841
	3.3081	3.28845	3.30325	3.31537
	3.316	3.29494	3.29894	3.29347
	3.26656	3.27168	3.24723	3.25977
	3.26573	3.28219	3.29161	3.30916
	3.32089	3.33497	3.33119	3.30598
	3.28989	3.29172	3.2774	3.2649
	3.30412	3.31992	3.32054	3.33372
	3.36452	3.36771	3.36749	3.37074
	3.37023	3.35785	3.39193	3.38182
	3.3405	3.32903	3.27695	3.23211
	3.20072	3.18579	3.20946	3.22543
	3.26174	3.25898	3.27681	3.27897
	3.29112	3.28583	3.29523	3.32005
	3.35318	3.37304	3.39991	3.41699
	3.38989	3.38043	3.35015	3.32458
	3.30583	3.28015	3.32503	3.37356
	3.41412	3.44339	3.44812	3.44229
	3.41363	3.43015	3.44586	3.4503
1983 4	3.44976	3.46021	3.46098	3.45986

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