The Macroeconomic Effects of Fiscal and Monetary Impulses and of Financial Crisis in the United States During the Interwar Period.

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The macroeconomic effects of fiscal and monetary impulses and of financial crisis in the United States during the interwar period

Raynold, Prosper, Ph.D.
The Louisiana State University and Agricultural and Mechanical Coll., 1989
THE MACROECONOMIC EFFECTS OF FISCAL AND MONETARY IMPULSES
AND OF FINANCIAL CRISIS IN THE UNITED STATES
DURING THE INTERWAR PERIOD

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Economics

by
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August, 1989
ACKNOWLEDGEMENTS

Several persons have contributed significantly to the completion of this dissertation. While their contributions differ in nature they were all crucially important to the successful completion of this project.

In historical order, I wish to firstly thank my father, St. Brice Raynold and my mother, Philomen Raynold who both bore numerous burdens and endured many hardships to ensure both my spiritual and secular education. Their devotion, caring, and fortitude, are constant sources of inspiration to me. Additionally, thanks are due to all my brothers and sisters who in ways great and small contributed to my education. In particular, I am grateful to my brothers Mc Elryn and Anderson with whom I shared many hardships in the early years of my academic career.

For most of my tenure in graduate school I have benifited immensely from the love, loyalty, and patience of my wife Julietta Rosemary Raynold. These, among her many laudable characteristics have allowed me to capture a sense of serenity and purpose without which I could not have completed this dissertation. For these and many more intangible contributions, I offer her my sincerest thanks and deepest gratitude.

Throughout the dissertation process, the chairpersons of my committee; Professors Thomas R. Beard and W. Douglas McMillin have given generously of their time and energy to provide me with guidance that has been both timely and of the highest quality. For this and the indelibly positive influence they have had on my development as an economist and scholar, I am deeply grateful. Further, I wish to thank
the other members of my committee, Professors W. Patton Culbertson, William D. Lastrapes, and Gary C. Sanger for their thoughtful participation in the dissertation process. Finally, to Professor William J. Moore whose frank advice helped in so many circumstances and to my office mates who were frequently supportive, I say thank you!
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ABSTRACT

This dissertation employs vector autoregressive techniques to improve our empirical understanding of fiscal and monetary policy and the effects of financial crisis in the interwar period. The issues investigated include: (a) the validity of the Ricardian equivalence and debt monetization hypotheses; (b) the effect of changes in the money supply on output, prices, and interest rates; (c) the impact of changes in average marginal tax rates and government expenditures on the macroeconomy; and (d) the effects of disruptions in financial intermediation and deterioration in the quality of private balance sheets on the macroeconomy.

Two vector autoregressive models are estimated and variance decompositions (VDCs) and impulse response functions (IRFs) are calculated. In addition, a Monte Carlo integration procedure is used to calculate standard errors for these parameters. Deficits, government expenditures, average marginal tax rates, M2, the 4-6 month rate on prime commercial paper, the wholesale price index and industrial production entered the first VAR while the other is comprised of the aforementioned variables plus the yield differential between Baa corporate and long-term U.S. government bonds. The choice of these variables reflect theoretical considerations and the necessity to avoid omitted variables bias. In particular, the inclusion of average marginal tax rates is intended to control for the distortionary effects of taxes. Additionally, the inclusion of the yield differential is
intended to capture the effects of financial crisis. It is important to note that these latter variables have not previously been included in a model of the type used here.

The results generated are supportive of those studies that have found no significant role for deficits. Average marginal tax rates are found to have substantial effects on output, interest, and prices while the effects of the proxy for financial crisis on output, interest, prices, and money, are substantial. These results are supportive of the hypothesis that macroeconomic models which do not include measures of marginal tax rates and of the degree of financial crisis may be misspecified. More generally, the empirical regularities generated provide more support for Barro's market clearing approach when bonds are not net wealth than for any other theoretical framework.
CHAPTER I

OBJECTIVES

I. Introduction

The purpose of this dissertation is to pursue a program of research that seeks to improve our understanding of fiscal and monetary policy and of the macroeconomic role of disruptions in financial intermediation in the interwar period. This investigation is necessitated by the relative paucity of the empirical literature on the interwar period and by the failure of the substantial literature on the post war era to settle many of the conflicts that persist in discussions of macroeconomic policy. While the analysis conducted in the chapters to follow does not purport to settle these differences, its contributions to the debate are significant.

In order to achieve the broad objectives indicated above, I investigate some of the more pressing issues facing macroeconomists within the framework of a vector autoregression of the type proposed by Sims(1980a). The issues to be investigated include: (a) the macroeconomic effects of federal government deficits as summarized within the debate surrounding the empirical validity of the Ricardian equivalence and debt monetization hypotheses; (b) the effects of changes in average marginal tax rates and government expenditures on the macroeconomy as measured by their impact on output, prices, and interest rates; (c) the effects of changes in the money supply on output, prices, and interest rates; and (d) the independent effects of
disruptions in financial intermediation on macroeconomic variables of concern such as prices, interest rates, output, and the supply of money.

Two separate vector autoregressive models are specified, estimated and interpreted. The first of these models is comprised of seven variables. These are: a short-term interest rate; a measure of the money supply; prices; industrial production; deficits; government expenditures; and a measure of average marginal tax rates. With the exception of (d) above, this model allows us to generate empirical regularities relevant to the resolution of all of the issues of concern in this dissertation. The inclusion of a measure of average marginal tax rates is of particular significance since previous empirical studies attempting to examine the issues under investigation here have not included such a variable. As will become clear in the following chapter, it is necessary to include marginal tax rates in models that seek to evaluate the effects of fiscal policy since these taxes have distortionary effects which the careful analyst must control for if the pure effects of fiscal variables such as deficits are to be isolated. Additionally, while substantial effort has been directed at developing theoretical explanations of the effects of changes in marginal tax rates, very little energy has been spent on empirical verification of these theoretical effects. This, I think, is largely due to the difficulty that surrounds the construction of an appropriate tax measure.

In addressing the widely recognized inability of changes in the money supply to adequately explain the depth and length of the Great
Depression, Bernanke (1983) used Barro's (1977) two step procedure to show that adding a proxy for financial crisis to a regression of output on unanticipated shocks to the money supply significantly improved the model's ability to explain both the length and severity of the fluctuations in output during that period. Bernanke's decision to include a proxy for financial crisis reflects a recurring theme in the literature that the availability of credit and the stock of debt in private balance sheets are important determinants of investment and, thereby, of output. Substantial research effort is currently being directed at this issue as attested to by the recent work of Bernanke and Gertler (1986, 1989), Gertler (1988), Bernanke and Blinder (1988), Gertler and Hubbard (1988), Fazzari and Athey (1987), and Blinder and Stiglitz (1988). Given the increasing importance of this issue, it seems useful to extend the investigation to a larger sample and a broader framework. Further, it should be noted that Bernanke's use of a single equation reduced form necessitated that he make highly questionable assumptions about the exogeneity of the right hand side variables. This makes his results subject to the type of criticism that structural models have been subjected to for use of the possibly spurious restrictions that Sims (1980a) has described as "incredible".

In response to the above observations, I specify and estimate an eight variable vector autoregressive model comprised of the variables in the previously mentioned seven variable model plus a proxy for financial crisis. In addition to allowing us to investigate the effects of financial crisis on variables such as interest rates, prices, output,
and the supply of money, the inclusion of this proxy permits us to engage in a comparative analysis of the results generated in the eight and seven variable models.

Most of the empirical work that has been done on the issues under consideration here have relied on models that require use of possibly spurious restrictions. These possibly spurious restrictions fall into three broad classes. These are: (a) a priori classification of the system's variables as exogenous and endogenous; (b) the exclusion of certain exogenous variables from some equations on the basis of supposedly correct a priori information; and (c) requiring that the residuals be orthogonal across equations and where serial correlation is admitted its order is frequently restricted. In order to avoid the use of highly debatable restrictions of the type outlined above, vector autoregressive models of the type suggested by Sims (1980a) are used in this dissertation. These models are multivariate reduced form models that treat all variables in the system as jointly determined. Therefore, it is not necessary to impose possibly unjustifiable restrictions on the parameter space.

As clarified in a later chapter, the interpretation of a vector autoregression (VAR) is based on impulse response functions (IRFs) and variance decompositions (VDCs) derived from the moving average representation of the VAR. These parameters are usually reported without standard errors or any measure of the confidence that can be placed in the point estimates. As noted by Runkle (1987), this is equivalent to reporting regression coefficients without t-statistics.
Therefore, I use a Monte Carlo integration procedure to calculate standard errors for the IRFs and VDCs.

II. Choice of Time Period

As indicated previously, the time period to be considered is the interwar period. McMillin and Beard (1988) use data from the same period in analyzing the effects of federal deficits and indicate several factors that motivated their choice of time period. These include: (a) the relative paucity of empirical studies on the issues under consideration here that cover the interwar period--this deficiency has been recognized by Brunner (1988) who in commenting on the state of fiscal policy in macrotheory exhorts the profession to "... extend the empirical work to as many different periods and situations involving [as many] different institutional arrangements as possible." --; (b) the fact that the interwar period was characterized by both deficits and surpluses in contrast to the post war era which has been marked by persistent deficits'; and (c) the possibility that the monetary authority's reaction function was substantially different from its post World War II function.\(^2\) It is useful to note that the period

\(^1\)In chapter II we show that under a regime of persistent deficits, rational agents may revise their expectations in a manner that alters the effects of deficits on the macroeconomy.

\(^2\)As will become clear in the discussion of debt monetization in chapter II, most theoretical formulations of the relationship between budgetary decisions and money supply growth ascribe a crucial role to the monetary authority. Since the Federal Reserve System's ultimate policy goals have evolved over time, it is likely that its reaction function in the post war era differs substantially from that in the interwar period.
under consideration was characterized by three of the most dramatic changes in government regulation of the financial markets. These changes -- the insurance of private bank deposits, the prohibition of interest on demand deposits, and the Glass - Steagall act -- make the interwar period uniquely important to the study of the nonmonetary effects of financial disintermediation (see Friedman (1966)). Additionally, this view is reinforced when one considers that the interwar period was characterized by massive fluctuations in the quality and quantity of financial intermediation and in the quality of private balance sheets.

Sims (1980b) and Burbidge and Harrison (1985) have conducted studies that concentrate on the interwar period. In both studies the interwar period is defined as January 1920 - December 1941. However, McMillin and Beard (1988) in attempting to concentrate on a peacetime economy eliminated the war cycles identified in Firestone (1960) from their sample. Analyzing monthly data and measuring cycles from trough to trough, Firestone identified December 1914 - March 1919 and June 1938 - October 1945 as war cycles and March 1919 - July 1921 as a post war cycle. Therefore, the period July 1921 - June 1938 corresponds to the peacetime cycles in Firestone (1960).

Barro (1981, 1987) has documented the differential effects of changes in temporary and in permanent government purchases and taxes on the macroeconomy. Given these differential effects, it seems inappropriate to treat government purchases and taxes as homogeneous quantities. However, since temporary purchases and taxes are
associated with war cycles and are usually close to zero in peacetime cycles, concentrating on a peacetime economy obviates the need to decompose these series into their aforementioned components. Given the foregoing considerations, for the purposes of this dissertation the interwar period is defined as July 1921 - June 1938. This coincides with McMillin and Beard's definition.

III. Chapter Overview

In the following chapter, an attempt is made to review the theoretical and empirical literature on fiscal and monetary policy. In particular, attention is focused on hypotheses such as Ricardian equivalence and debt monetization. Additionally, the effects of taxes, government spending, and money supply changes are reviewed. Chapter III is devoted to a theoretical and empirical discussion of the literature on the role of financial factors in the determination of aggregate economic activity. In all cases the empirical review concentrates on the interwar period.

Chapter IV presents a technical discussion of the vector autoregressive techniques used in the empirical chapters. The discussion ranges from specification to interpretation. Additionally, an attempt is made to provide a flavor of the ongoing debate on the appropriate uses of VARs.

The empirical results on the issues discussed in chapters II and III are presented in chapters V and VI. In chapter V the aforementioned seven variable model is specified and estimated and the results are interpreted. Specifically, the roles of deficits, government
spending, average marginal tax rates, and the money supply during the interwar period are examined. In addition to evaluating the effects of financial crisis on the macroeconomy in chapter VI, the results based on the eight variable model specified there are compared to that derived in the seven variable model. Finally, chapter VII summarizes the main conclusions of the dissertation and attempts to identify avenues for future research.
CHAPTER II

THE MACROECONOMIC EFFECTS OF FISCAL AND MONETARY IMPULSES:

THEORY AND EVIDENCE

I. Introduction

The primary objective of this chapter is to review the theoretical and empirical literature on the importance of fiscal and monetary impulses for the determination of aggregate economic activity. In this regard, attention will be focused on the effects of deficits, government expenditures, marginal tax rates, and money supply changes on important macroeconomic variables such as the interest rate, prices, and output. While the discussion to follow will focus on the more recent developments in this area, a brief look at the early literature should markedly enhance our ability to place the more current literature in proper perspective. In pursuit of this objective, section II below is devoted to a brief discussion of this literature.

II. The Early Debate

Writing against the backdrop of the severe economic downturn of the 1930's, Keynes attempted to show that contrary to the then dominant classical position it was possible and perhaps likely that the macroeconomy would achieve equilibrium at a level of output substantially below full employment output. In order to demonstrate this, Keynes argued that market failures in the bond and labor markets impair the coordination of economic activities and eliminate the
flexibility of prices and interest rates that the classical economists relied on to demonstrate that the macroeconomy is inherently stable.

Given these market failures, Keynes argued that government intervention was necessary to directly increase aggregate demand and thereby increase output and employment. Further, he postulated that the government could achieve this by increasing its spending or cutting taxes. Additionally, he noted that increased price flexibility or manipulation of the money supply would at best result in temporary output shifts. While this Keynesian view came to be the dominant view in macroeconomics, several authors refused to accept the Keynesian market failure approach and instead postulated the dominance of monetary policy. This led to a protracted debate as to the relative importance of monetary and fiscal policy. The essence of the theoretical side of this debate was largely captured within the framework of differing views as to the interest elasticity of the investment and money demand and supply functions. Specifically, the fiscalists considered the interest elasticity of investment to be close to zero making the IS curve nearly vertical so that an increase in the supply of money shifts the LM curve along the vertical IS curve decreasing interest rates but leaving aggregate demand unchanged. On the other hand, the monetarists argued that the interest elasticities of the demand for and the supply of money were close to zero. This meant that monetary equilibrium as captured by the LM curve was largely independent of changes in the rate of interest, thereby making the LM curve nearly vertical. Therefore, fiscal policy initiatives would shift
the IS curve along the vertical LM curve leading to changes in interest rates but no change in aggregate demand and output.

It should be noted that the foregoing discussion outlines extreme versions of the fiscalist and monetarist hypotheses. However, it is generally true that the fiscalists attributed a dominant role to fiscal policy while the monetarist assigned an equally dominant role to changes in the money supply. Since the theoretical literature was clearly unable to conclusively settle this issue, a substantial body of empirical evidence was generated in an attempt to do so. Early authors such as Friedman and Meiselman (1963) and Andersen and Jordan (1968) presented single equation reduced form evidence in support of the monetarist position. However, other authors such as Ando and Modigliani (1965) and De Prano and Mayer (1965) were very critical of the methods used by Friedman and Meiselman. Also de Leeuw and Kalchbrenner (1969) outlined several criticisms of the procedures in Andersen and Jordan which according to these authors makes the strong support found for the monetarist hypothesis -- that monetary policy is much more significant than fiscal policy -- unreliable.

In addition to the above debate, there was a substantial amount of disagreement about the effects of a bond financed increase in government expenditures on the macroeconomy. Several authors including Blinder and Solow (1974) and Brunner and Meltzer (1972, 1976) argued that fiscal policy initiatives which require that the fiscal authority issue or purchase bonds will have asset market effects. Specifically, these authors argued that an increase in government spending financed
by issuing bonds leads to an increase in households' net wealth positions. Therefore, in addition to the usual expansionary effect associated with an increase in government spending, the increase in wealth leads to an outward shift in the IS curve due to increased consumption spending and to an inward shift in the LM curve due to the increase in the demand for money associated with the wealth increase. Under this scenario, there is an unambiguous increase in the rate of interest while the change in aggregate demand depends on the relative sizes of the shifts in the IS and LM curves. Further, Blinder and Solow (1974) showed that a fiscal policy of the type described will be expansionary if the macroeconomic system is stable.

More recently, substantial attention has been devoted to analyzing the effects of monetary and fiscal policies under rational expectations. At the theoretical level several authors including Lucas (1981), Barro (1976), Sargent (1973), McCallum and Whitaker (1979), and McCallum (1980) have developed macroeconomic models that incorporate the rational expectations hypothesis. These authors have shown that in a regime where economic agents behave purposefully with respect to their formation of expectations, both monetary and fiscal policies are unable to systematically influence the level of output. However, other authors such as Fisher (1977) have shown that monetary policy may be effective in the presence of price level stickiness induced by long-term labor contracts. At the empirical level the results have been mixed. Barro (1977) presents substantial evidence in support of the neutrality hypothesis while Mishkin (1979) demonstrates the opposite. Since the
empirical results appear to be sensitive to the empirical methodology, the empirical validity of the neutrality hypothesis remains an open question. It should be noted, however, that the promulgation of the rational expectations hypothesis has had a substantial impact on the manner in which stabilization policy in general and fiscal policy in particular is viewed. Specifically, the idea that agents are rational and therefore make use of all available information has permeated discussions of the effects of fiscal variables on the macroeconomy.

In section III, an attempt is made to selectively review the more recent theoretical and empirical literature on the macroeconomic effects of deficits. In section IV, I summarize the main results with respect to the role of government expenditures and taxes while in section V a selective discussion of the effects of changes in the money supply is presented. In all cases the empirical discussion focuses on the interwar period. Further, and in order to ensure the consistency of arguments to follow in this and other chapters, the basic Keynesian IS-LM model of aggregate demand which allows for feedback from its corresponding AD-AS framework is taken to be representative of traditional (Keynesian) macroeconomic models.

III. Deficits and the Macroeconomy: Theory and Empiricism

A. Ricardian Equivalence

In analyzing the effects of deficits on the macroeconomy, concern usually centers on the effects of deficits on interest rates, prices, and output on the one hand, and on its effects on the supply of money on the other. As indicated in section II, in the traditional view, a
substitution of debt for tax finance, holding government spending constant, induces households to perceive an increase in their wealth which leads to an increase in consumption and an outward shift in the IS curve. The increase in wealth also leads to an increase in the demand for money which shifts the LM curve inwards. Therefore, the net effect of a substitution of debt for tax finance is an unambiguous increase in interest rates while the change in aggregate demand and thereby output depends on the relative size of the shifts in the IS and LM curves. In general, Keynesians argue that the shift in the IS is greater so that output increases while Monetarists view the contractionary LM shift as either completely offsetting or swampng the expansionary IS shift. Therefore, in the Monetarist view the substitution of debt for tax financing is either contractionary or neutral. In both of these approaches the crucial link in the analyses is the assumption that households perceive the increase in their holdings of bonds as an improvement in their net wealth positions.

The view that society can increase its collective wealth by incurring a debt to itself has been questioned by Tobin (1971) and Bailey (1962). These authors have argued that the necessity to make interest and possibly principal payments in the future requires higher future taxes. Therefore, in order for the wealth effects discussed in the previous paragraph to be operative it seems necessary to assume that households are shortsighted and thereby do not foresee the higher future taxes implied. Reflecting the influence of the rational expectations literature, Barro (1974) has argued that in a world where
agents are rational in the sense that they make use of all pertinent information available to them, households will perceive the higher future taxes implied by a current substitution of debt for tax finance. Therefore, a temporary reduction in tax rates financed by a bond issue while holding government spending constant will have no real effects since households will increase their current savings by an amount that exactly offsets the higher future taxes implied. Under this scenario, households do not perceive that the increase in their holdings of government bonds improves their net wealth positions. Therefore, the crucial link which leads to a nonneutral role for deficits is severed. A clear implication of the foregoing discussion is that agents view a given current deficit as equivalent to a current tax burden of equal size. Since this equivalence was originally alluded to in Ricardo's writings, the foregoing hypothesis is frequently referred to as Ricardian equivalence.

In his seminal attempt to give formal content to the Ricardian equivalence hypothesis, Barro (1974) relied on several key considerations. Most prominently, he constructed intertemporal budget constraints for both government and households. The government budget constraint required that the discounted value of future government expenditures plus any government debt outstanding from previous periods be equal to the present value of future taxes. Additionally, the household budget constraint required that the sum of the present values of expected future consumption and taxes be equal to the present value of expected future income and any inherited assets. The
government budget constraint implies that any substitution of future for current taxes holding government spending constant leads to an equality between current government expenditures financed from non-tax sources and the present value of future taxes. This implication together with the household budget constraint suggests that household's opportunity sets are unaffected by deficits and therefore leads to no change in their optimal intertemporal consumption decisions. The validity of this approach hinges on the assumption that the representative household's planning horizon is at least as long as the period over which the debt will be repaid. In this regard, Barro assumed that the representative household has an infinite planning horizon. Further, in order to circumvent the obvious discrepancy between this assumption and the observed facts, Barro assumed that generations of the representative household are linked by altruistically motivated intergenerational transfers and proceeded to show that under this assumption the representative household can be characterized as an infinitely lived decision-making unit. In addition to the above considerations, Barro's formulation relied on the following assumptions: (a) all taxes are lump sum; (b) private capital markets are perfect; and (c) no uncertainty or risk exists with respect to the intertemporal and cross-sectional incidence of postponed taxes.

Several authors have questioned the validity of the Ricardian view that transfers between successive generations of families are both widespread and motivated only by altruism. In their 1987 paper, Bernheim and Bagwell observe that given the widespread occurrence of
transfers between successive generations, most individuals would be embedded in a single interconnected network. This would mean that total wealth would be the sole determinant of each individual's consumption and that marginal increases in wealth would be shared by the entire population. Further, they note that any additional bequest would be divided between the recipient and his contemporaries so that the resulting increment to his consumption would be immaterial. Under this scenario, it is reasonable to suggest that donors would choose to make no bequest. Additionally, other authors including Feldstein (1986) and Laitner (1979) have argued that under reasonable assumptions with respect to productivity, preferences, and income distribution, many parents will choose to make no bequest and transfers from the young to the old may occur. However, as noted by Bernheim (1987), Ricardian equivalence would continue to hold for policies that do not change the pattern of linkages between generations. Therefore, rebuttal of the Ricardian position requires the absence of both bequests and transfers from the young to the old.

In addition to criticism of the Ricardian position with respect to the ubiquity of transfers, many authors object to altruism as the sole motivation for transfers. In this regard, Brunner (1986) has noted that since the life cycle hypothesis of consumption implies that the marginal propensity to consume increases with age, combining that hypothesis with intergenerational selfishness as opposed to altruism causes transfers between generations to alter aggregate real consumption. Therefore, since a substitution of debt for tax financing
effects a transfer from the young to the old, such a policy would be nonneutral under intergenerational selfishness. However, since wealth transfers are frequently observed there appears to be a better fit between intergenerational altruism and the data.

Within the Barro framework, the reliance on altruism as the sole motivation for intergenerational transfers is crucial to demonstrating the neutrality of deficits. However, it seems reasonable to argue, as does Brunner (1986), that bequest could be observed in the absence of altruism. Specifically, since agents are uncertain about the length of their lives, there is some probability that they may live beyond their expected life spans. Therefore, in order to avoid using all their resources before death, agents will hold on to some quantity of resources above that required for their expected life spans in order to hedge against the risk of running out of resources before they die. It follows from this analysis that a substantial amount of resources will be transferred to the next generation even in the absence of altruism. A clear implication of the foregoing discussion is that the presence of substantial intergenerational transmission of wealth does not necessarily imply Ricardian equivalence.

In order to isolate the pure effects of deficits, Barro’s formulation of the equivalence hypothesis required that he make the counterfactual assumption that taxes are lump sum. However, in the presence of distortionary taxes, budget deficits alter the temporal incidence of these taxes, and, thereby, agents’ incentives to work and produce are differentially influenced from one period to the next. For
example, in a two period world a current reduction in marginal tax rates financed by bond issue will be offset by higher tax rates in the final period. In the first period agents have greater incentives to work and produce; therefore, output increases. However, in the final period the increase in marginal tax rates provides a disincentive for agents to work and produce; therefore, output decreases. As Barro (1979; 1989) has noted, this implies that the choice between debt and tax finance matters and that an optimal time path for marginal tax rates exists.

Additionally, and, as is well known, the Ricardian framework assumes that capital markets are perfect. However, in the presence of capital market imperfections households may face liquidity constraints. In such a setting, one of the by-products of a debt financed tax cut may be that it allows liquidity constrained households to alleviate their liquidity problem by (in effect) borrowing via the government. Therefore, their marginal propensity to consume out of a temporary tax cut will be close to one while that of households with no liquidity constraints will be zero. To the extent that a substantial fraction of households are constrained in this manner, the substitution of debt for tax financing will increase aggregate consumption such that deficits have real effects.

Since risk and uncertainty continue to exist even under the assumption of perfect capital markets and since the Ricardian argument essentially ignores these factors, it is useful to investigate the implications of these factors for Ricardian equivalence. In the
presence of uncertainty households face some risk associated with uncertainty about the cross-sectional incidence of the future taxes implied by a substitution of debt for tax financing. Various authors including Barro (1981a) and Chan (1983) have argued that households attempt to hedge this risk by increasing their current savings by an amount that exceeds that required to exactly offset the future taxes implied. Under this scenario, current aggregate consumption falls as do aggregate demand and output. Along similar lines, Barsky, Mankiw, and Zeldes (1984) argue that agents face uncertainty with respect to their future incomes. Further, they demonstrate analytically that a postponement of taxes by a substitution of debt for tax financing lowers the risk of adverse fluctuations in future income so that agents reduce their current precautionary demand for savings and increase real consumption. Under this scenario, deficits have expansionary real effects.

As indicated earlier, perhaps the most basic assumption underlying the Ricardian argument is that the government faces an infinite intertemporal budget constraint which requires that the present values of government expenditures and taxes be equal. In order for this constraint to hold, it is necessary for agents to know with certainty that any debt incurred to finance current expenditures will ultimately be repaid. However, in a framework where uncertainty is taken into consideration, it is reasonable to expect that rational agents would revise their expectations with respect to the ultimate repayment of the debt if persistent deficits are incurred over a substantial period of
time. So, for example, if the fiscal authority issues new bonds to finance the payment of principal and interest on the existing debt, agents may come to believe that taxes will never be increased to pay for this debt. Under such a scenario, Ricardian equivalence would not hold.

As is clear from the preceding discussion, the controversy over the effects of deficits on interest rates, prices, and output cannot be settled at the theoretical level. Therefore, it is imperative that we focus attention on the empirical literature in the hope that it will shed further light on this issue.

Traditional macroeconomic models rely on the presumption that government bonds are net wealth in order to demonstrate that an increase in deficits will lead to higher interest rates and ambiguous but likely expansionary effects on output and the general level of prices. However, since Ricardian equivalence denies that households perceive an increase in their holdings of government bonds as enhancing their net wealth positions, it severs the crucial link in the traditional models. At the empirical level, this means that given a well constructed macro model, it is possible to distinguish among these competing hypotheses by examining the effects of deficits on either interest rates, consumption, output or prices or on some combination of these. Most empirical studies have concentrated on the effects of deficits on consumption and on interest rates.

In spite of the substantial body of empirical literature on the macroeconomic effects of deficits, there is still no consensus on this
issue. Several authors have investigated the effects of deficits on consumption with mixed results. For example, Barro (1978), Seater (1982), Kormendi (1983), Aachauer (1985), and Seater and Mariano (1985) find no evidence that an increase in government debt leads to an increase in consumption. In contrast to these studies, Feldstein (1978, 1979, 1982), Blinder and Deaton (1985), Boeskin and Kotlikoff (1985), and Modigliani and Sterling (1986) find evidence of a positive response of consumption to deficits. In recognition of the fact that the consumption functions specified in these studies and others like them do not incorporate both the Ricardian equivalence and traditional hypotheses, Evans (1988) used a model developed in Blanchard (1985) that incorporates both hypotheses. Evans' empirical results provide strong support for the Ricardian view.

With respect to the effects of deficits on interest rates, several authors including Plosser (1982, 1987), Evans (1985, 1987, 1989), and McMillin and Beard (1988) found no evidence that federal deficits increase interest rates. Additionally, McMillin (1986) found that various measures of deficits failed to Granger cause short-term interest rates. Further, using a par value measure of debt, Dywer (1982) found no support for a causal link between debt and the rate of inflation. Later, Cox (1985) used a market value measure of government debt and showed that increases in debt lead to higher rates of inflation. In a recent paper, Hafer and Hein (1987) were able to reconcile these conflicting results by demonstrating that the positive
effects found by Cox were due to the failure to capture the interest
rate effects inherent in the market value measure.

With the exception of Evans (1985, 1987) and McMillin and Beard
(1988), all of the studies cited above focus on the post war era. In
his 1985 paper Evans examined the effects of deficits on interest rates
for periods in United States history when deficits were particularly
high. These periods include the Civil War, World Wars I and II, and
more recent post war experience. Evans found no evidence of a positive
relationship between deficits and interest rates. Moreover, the only
significant effects were negative. As the theoretical literature
reviewed above indicates, this is not inconsistent with a Ricardian
world with uncertainty about the future incidence of taxes.
Additionally, Evans (1987) investigated the possibility that previous
studies have found no relationship between deficits and interest rates
because interest rates are more closely related to expectations of
future deficits than to current and past deficits. Using monthly data
from June 1908 to March 1984, he found no statistically significant
positive effects of deficits on interest rates. Moreover, the only
significant effects were negative.

In addition to Evans (1985, 1987), McMillin and Beard (1988) have
investigated the effects of deficits on interest rates, prices, and
output during the interwar period. They employed vector autoregressive
techniques of the type proposed by Hsiao (1982) to a model comprised
of deficits, a short-term interest rate, the money supply, industrial
production, and prices. These authors found no evidence of positive
effects of deficits on short-term interest rates, industrial production, and prices.

In general, the empirical literature on the macroeconomic effects of deficits is subject to a number of criticisms. Specifically, the papers cited above are subject to at least two of four limitations. These are: (a) the vast majority of studies focus on the post war era thereby paying insufficient attention to other eras, particularly the interwar period; (b) almost all of these studies are subject to criticism for omitted variables bias because they exclude either government expenditures or a measure of marginal tax rates or both; (c) a large number of authors use structural models that require use of the possibly spurious restrictions that Sims (1980a) has described as incredible; and (d) those authors who use a vector autoregressive model have not presented standard errors or confidence intervals for the variance decompositions and impulse response functions on which they rely to make inferences.

B. Deficits and the Money Supply

In addition to the possible effects of deficits on interest rates, prices, and output, there is an ongoing concern in the literature that the monetary authority monetizes at least part of the deficit such that increases in deficits induce growth in the money supply. Several alternative theories postulating such a link have been advanced in the literature. One such view widely ascribed to Buchanan and Wagner (1977) assumes that the monetary authority's primary concern is with financial stability as represented by low and stable interest rates.
Therefore, the Fed uses monetary policy to counteract forces that induce financial instability. Under this scenario and the assumption that Ricardian equivalence does not hold, an increase in households' holdings of government bonds due to a bond financed deficit puts upward pressure on interest rates thereby causing the Fed -- in its overriding concern with financial stability -- to increase the money supply in an effort to counter the increasing interest rates.

A second theoretical view of the link between deficits and the money supply argues that in addition to its concern with financial stability, the Fed has macrostabilization goals such as price level stability. Since it is likely that the simultaneous pursuit of both objectives will conflict, Fed response to an increase in the deficit will depend on which of its concerns is dominant. For example, McMillin and Beard (1980) argue that in a non-Ricardian world, an increase in deficits places upward pressure on both prices and interest rates. If the Fed's financial stability objective is dominant, it will increase the money supply to counter rising interest rates. On the other hand, if its macrostabilization concerns are dominant, it will decrease the money supply in an attempt to control rising prices. Therefore, the effect of deficits on money growth is ambiguous in this framework.

Barro (1977) has constructed a model in which federal government expenditures are financed by a combination of taxes and money issue. He argues that these methods of finance are characterized by administrative and other deadweight costs that increase, ceteris
paribus, at an increasing rate with the total amount of revenue raised with a particular method. Additionally, Barro posits an inverse relationship between the costs of raising revenue via taxes and the amount of capital invested in the tax collection technology. In this framework, the fiscal authority chooses a combination of taxes and money creation that minimizes the total costs of raising revenue. Therefore, any increase in government expenditures will typically involve increases in both taxes and money creation. A clear link is thereby established between government budget actions and the supply of money.

In attempting to demonstrate the possible inability of the monetary authority to successfully conduct a long-term anti-inflationary policy in the presence of persistent deficits, Sargent and Wallace (1981) argue that federal government deficits are financed by a combination of bond sale proceeds and seignorage (i.e. revenue from money creation). Given that the fiscal authority dominates the monetary authority in the sense that it independently sets its budget and all current and future deficits and/or surpluses, it dictates the total amount of revenue required from bond sales and seignorage. Therefore, to the extent that the fiscal authority's ability to raise revenue from bond issues is constrained by public demand for government bonds, the passive monetary authority has no choice but to increase its supply of seignorage to the fiscal authority by increasing the supply of money. While this view of the relationship between deficits and money supply growth clearly implies some degree of debt monetization, it addresses
what is primarily a long run concern which is outside the scope of the short run considerations of this dissertation.

At the empirical level, there is no clear consensus on the debt monetization hypothesis. Several authors including McMillin and Beard (1980), Hamburger and Zwick (1981), Levy (1981), Allen and Smith (1983), and McMillin (1986) find evidence of monetization while Barro (1977), Mikanen (1978), Dywer (1982), and McMillin and Beard (1982) find no evidence of monetary accommodation in post war data. This literature is in general subject to the same limitations as the empirical work on Ricardian equivalence. In particular it concentrates on the post war era while ignoring other time periods during which differing institutional frameworks and *modus operandi* might have influenced the results. This is an important consideration since in virtually all theories of debt monetization a crucial role is ascribed to the monetary authority.

In partial sensitivity to the above considerations, Joines (1985) investigated the relationship between the growth of the monetary base and deficits using yearly observations from 1872-1983. Specifically, he specified a reaction function with measures of the contemporaneous and lagged values of normal and abnormal deficits as independent variables. Additionally, he included a measure of gold inflows into the United States for those years in which such flows were important in order to capture the effects of these flows on the monetary base. Joines finds that the strongest effects of deficits on money growth appear during the period 1915-53. However, when he adds lagged values
of the rate of unemployment as independent variables, these effects disappear. Further, he argues that this reversal suggests that the monetary authority responds to fluctuations in economic activity which are highly correlated with government deficits.

Additionally, and perhaps more pertinently, McMillin and Beard (1988) use vector autoregressive techniques to evaluate the role of deficits during the interwar period. Their results with respect to the relationship between deficits and the rate of growth of M1 indicate that there was no monetary accommodation during that period. Since the empirical technique used by McMillin and Beard was radically different from that used by Joines, the similarity of their results is of some significance.

IV. Macroeconomic Effects of Government Spending and Taxes

A. Government Spending

Within the standard IS-LM framework, an increase in government expenditures causes an outward shift in the IS curve attended by an increase in interest rates and aggregate demand. Additionally, the increase in aggregate demand leads to an increase in the general level of prices. However, the model makes no predictions about the rate of inflation. This standard Keynesian view has been criticized for failing to take the benefits derived by households from government purchases into account.

The emergence of the rational expectations hypothesis as the dominant macroeconomic hypothesis on the formation of expectations brought with it a revision of the basic Keynesian approach to analyzing
the macroeconomic effects of government spending. In particular, various authors including Bailey (1971), Kormendi (1983), and Barro (1981b) have argued that since the influence of government purchases on private consumption and production decisions are ignored in the Keynesian model, it implicitly assumes that economic agents are myopic in that they do not perceive the flow of benefits that accrue to them from government purchases. Additionally, Barro (1981b; 1987) has documented the differential effects of changes in temporary and permanent government purchases. Since government purchases are treated as a homogeneous quantity in the Keynesian framework, there appeared to be a need to revise traditional textbook explanations of the effects of government purchases on macroeconomic activity.

Barro (1981b; 1987) has attempted to give theoretical body to these objections to the standard approach in his market clearing approach to macroeconomics. In his approach, total government purchases are considered to be comprised of two conceptually distinct components, namely, temporary and permanent purchases. Permanent government purchases are defined as "the constant flow that has the same present value as the actual flow of purchases". Therefore, we can solve for permanent purchases in the following fashion:

\[ G_p + G_p[1+r]^{-1} + \ldots = G_1 + G_2[1+r]^{-1} + \ldots \]  
\[ (2.1) \]

where \( G_p \) represents permanent purchases, \( r \) is the relevant interest rate, \( G_i \) represents actual government purchases in the \( i^{th} \) period for \( i = 1, 2, \ldots \). Rearranging equation (2.1) and solving for \( G_p \) we get

\[ G_p = r[1+r]^{-1}[G_1 + G_2(1+r)^{-1} + \ldots] \]  
\[ (2.2) \]
From equation 2.2, an increase in temporary government purchases leaves permanent expenditures unchanged. Therefore, a current increase in $G$, which is later offset by a decrease in purchases in some future period would be classified as an increase in temporary purchases. The usual example of an increase in temporary purchases is the increase in government outlays on defense expenditures during wars. Given the above dichotomization of government purchases, any attempt at explaining the macroeconomic effects of changes in government spending requires separate consideration of the effects of permanent and temporary changes.

Accordingly, in his market clearing approach, Barro recognizes that public services may substitute for some aspects of private consumption such that an increase in these public services induces households to reduce their private spending. So, for example, a one unit increase in $G$, which leaves $G_0$ unchanged (i.e. an increase in temporary purchases) leads to a reduction in private aggregate consumption of $\alpha$ units, where $\alpha$ is assumed to be greater than zero but less than one. Since the one unit increase in $G$, directly increases aggregate demand by one unit and decreases aggregate consumption by $\alpha$ units, the net change in aggregate demand is equal to $(1-\alpha)$ units. Since $0 < \alpha < 1$, aggregate demand increases. On the supply side, some public services may serve as an input into private production or may enhance the marginal

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1Equations (2.1), (2.2), (2.3), and (2.4) are equivalent to and based on Barro's (1987, pp. 314, 328, and 334) equations (12.5), (12.8), and (12.9), respectively.
productivities of labor and capital. Therefore, it is reasonable to argue that a one unit increase in $G$, leads to an increase in aggregate supply of $\beta$ units, where $\beta$ is assumed to be greater than zero and less than one. Under the assumption that $\alpha+\beta < 1$, Barro notes that the increase in aggregate demand given by $(1-\alpha)$ will exceed the increase in aggregate supply so that the resulting aggregate excess demand equal to $(1-\alpha-\beta)$, will be positive.

In this framework, the interest rate adjusts to clear the commodity market whose clearing condition is given by:

$$C^d(r_1, G_1, G_{Pi}, ...) + I^d(r_1, ...) + G_1 = Y^a(r_1, G_1, ...)$$  \hspace{1cm} (2.3)$$

where $C^d$, $I^d$, and $Y^a$ represent aggregate consumption demand, aggregate private investment demand, and aggregate supply, respectively. The signs indicate the direction of the effects of the arguments and ... represent omitted arguments such as the state of technology and the initial stock of capital. Equation (2.3) implies that the interest rate increases to eliminate the positive excess demand created by the increase in temporary purchases. In sum, a temporary increase in government purchases leads to increases in output and the rate of interest.

In Barro's market clearing framework the price level is determined in the money market. The market clearing condition for this market is given by

$$M_s = P_sL(Y_t, R_t, G_t, ...)$$  \hspace{1cm} (2.4)$$

where $M_s$ represents the nominal supply of money, $L(.)$ is the demand for real money, $P_s$ is the general price level, $Y_t$ is total output, $R_t$ is the
nominal rate of interest, and $G_t$ is as defined earlier. The signs associated with the arguments in $L(.)$ indicate the direction of their effects on the demand for real money. As shown earlier, an increase in temporary purchases increases output and the real interest rate. Since the increase in the real interest rate leads to an increase in nominal interest rates, $L(.)$ decreases and, other things being equal, an increase in $P_t$ is required to keep the money market in equilibrium. A similar analysis indicates that the increase in $Y_t$ requires a fall in $P_t$.

Additionally, the increase in $G_t$ leads to a decrease in $L(.)$ since the increase in public services lowers total monetary transactions. Therefore, $P_t$ must increase. In general, the net effect on the price level depends on the strengths of the $G_t$ and $R_t$ effects relative to the $Y_t$ effect.

A current increase in permanent government purchases can be thought of as an increase in current purchases $G_t$ without any offsetting decrease in future periods. This means that a correct analysis of an increase in permanent purchases requires analyzing the effects of the increase in $G_t$ and of the resulting increase in $G_{P_t}$. Unlike an increase in temporary purchases, every one unit increase in permanent purchases means that total income available to households throughout their infinite planning horizons is reduced by one unit; therefore, permanent income decreases by one unit. However, since the flow of public services from the increase in government purchases yields benefits to the private sector equal to $(\alpha+\beta)$, the net decrease in permanent income is equal to $(1-\alpha-\beta)$. Further, since the marginal
propensity to consume out of permanent income is close to one, aggregate private consumption decreases by \((1-\alpha-\beta)\). At the same time, the increase in \(G\) leads to a substitution of public services for private consumption expenditures such that consumption expenditures decrease by \(\alpha\) units. Therefore, the net effect on aggregate private consumption demand is given by \(\alpha + (1-\alpha-\beta) = (1-\beta)\). Since the increase in \(G\) enters directly into aggregate demand on a one-to-one basis, the net effect on aggregate demand is \(1-(1-\beta) = \beta\). Additionally, since aggregate supply is increased by \(\beta\) units, aggregate excess demand is zero. Therefore, output increases and the interest rate remains unchanged. The effect of a permanent increase in government purchases on the price level differs from the effects of a temporary increase in that there is no change in nominal interest rates. This means that a permanent increase affects the price level only via its effects on \(Y\) and \(G\). Therefore, the net effect is still ambiguous although there is a greater likelihood of a net positive effect for temporary changes. Additionally, the model makes no predictions about the rate of inflation.

The primary empirical evidence on the theoretical literature reviewed in this section is contained in Barro (1981b). There, Barro divided government expenditures into defense and nondefense expenditures. Further, he decomposed defense expenditures into permanent and temporary components. However, his attempts to isolate temporary changes in nondefense expenditures were unsuccessful. This led him to conclude that nondefense expenditures were largely permanent.
in nature. Using a single equation framework, Barro regressed the log of output on a constant, a time trend, the contemporaneous and first lag of unanticipated money growth, current values of temporary and permanent defense purchases, and on nondefense purchases. The results indicate that a one unit increase in temporary defense purchases increases output by .99 while a similar increase in permanent defense purchases increases output by .55. For both of these estimates the associated t-statistics indicated significance at the 5 percent level. Further, the coefficient on nondefense purchases was .62 but its standard error of .45 indicated that it was imprecisely estimated. Barro argues that these results indicate that we are unable to reject the hypothesis that the coefficients on permanent defense and on nondefense purchases are insignificantly different from each other.

As is well known, the typical Keynesian analysis predicts that an increase in government purchases has a positive multiplier effect on aggregate expenditures. To the contrary, the market clearing approach predicts no such multiplier effect. The empirical results presented by Barro indicate the absence of a multiplier effect. Additionally, since a permanent increase in government purchases reduces permanent income while a temporary increase does not, it is reasonable to expect that a temporary increase will have a stronger effect on output than will a permanent increase. Here, too, the empirical results are consistent with the market clearing approach.
B. Macroeconomic Role of Marginal Tax Rates

In the traditional Keynesian model, an increase in marginal tax rates lowers disposable income, and thereby, private consumption expenditures. This leads to an inward shift in the IS curve which is associated with falls in the levels of interest rates and aggregate demand. Since the IS-LM framework is essentially an aggregate demand model, it does not capture the supply side effects of a tax increase. For this we turn to an aggregate supply - aggregate demand (AS-AD) framework.

As is well known, the introduction of tax rates has distortionary effects on economic agents' decision making processes. Specifically, since the presence of distortionary taxes alters the after tax marginal products of both labor and capital, higher marginal tax rates will induce reductions in work effort and investment, and ultimately, in aggregate supply. This means that in an AS-AD framework, an increase in marginal tax rates will lead to inward shifts in both supply and demand so that we get an unambiguous fall in equilibrium output and ambiguous price effects that depend on the relative sizes of the shifts in aggregate demand and supply. In summary, the traditional model predicts that an increase in marginal tax rates leads to lower levels of output and ambiguous effects on interest rates and the general level of prices; however, it makes no prediction about the rate of inflation.

Underlying the traditional model discussed above is the assumption that the appropriate scale variable to be used in specifying the money demand equation is an income measure such as GNP or permanent income.
However, Mankiw and Summers (1986) have presented strong evidence supportive of the view that consumer expenditures are the appropriate scale variable. Accordingly, these authors construct a modified IS-LM model in which the scale variable in the liquidity preference function is consumer expenditures. Within that framework, they demonstrate that an increase in taxes leads to a fall in disposable income, and thereby, consumption. Therefore, the IS curve shifts inwards as it would in the traditional model. However, in contrast to the traditional framework, the fall in consumption expenditures leads to a decrease in the demand for money and an expansionary shift in the LM curve. Since the IS and LM curves shift in opposite directions, interest rates will fall initially; however, the ultimate effect on interest rates depends on the effect on aggregate demand which is ambiguous, and depends on the relative size of the shifts and the interest elasticities of the demands for money and investment. In this regard, Mankiw and Summers present evidence demonstrating that empirical estimates of these parameters for the U.S. fall within the range of values for which a tax increase would have an expansionary effect on aggregate demand.

Since Mankiw and Summers' modified IS-LM model speaks only to the demand side effects of a tax change, it is useful to transfer the argument to an AS-AD framework. As in the traditional model, the disincentive effects of the increase in marginal tax rates leads to an inward shift in the aggregate supply curve. However, since the effect on aggregate demand is ambiguous, the effect on equilibrium output,
interest rates, and prices is ambiguous. Once again, we have no prediction with respect to the rate of inflation.

In Barro's market clearing approach, a permanent increase in the average marginal tax rate leads to a reduction in the after-tax marginal product of labor which causes a reduction in work effort and an accompanying decrease in the supply of goods. However, this effect is mitigated since the higher marginal tax rate causes a wealth reduction that elicits greater work effort. On the demand side, the higher marginal tax rate causes a decrease in permanent disposable income which leads to an almost equal reduction in consumption since the marginal propensity to consume out of permanent income is close to one. The reduction in aggregate demand is reinforced by a fall in investment spending in response to the lower after-tax rate of return to investment. This analysis implies that the decrease in the supply of goods will be less than that in aggregate demand so that at the initial after-tax real rate of interest there is an excess supply which is eliminated as the economy moves to a lower after-tax real rate of interest and lower output and prices.

The effect on the price level can be analyzed by replacing the nominal interest rate \( R \) in (2.4) with the after-tax nominal interest rate. The fall in output lowers the transactions demand for money so that an increase in the price level is required to keep the money market in equilibrium. However, the fall in the after-tax real rate of interest leads to a decrease in the after-tax nominal rate of interest.

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2See Barro (1987, pp.43-46) for a discussion of this effect.
3See Barro (1987, pp. 87-88) for some empirical evidence on this.
which leads to an increase in the real demand for money and necessitates a decrease in the price level. Since the results outlined place conflicting pressures on the price level, the net effect is ambiguous. Moreover, the model makes no predictions with respect to the rate of inflation.

The foregoing analysis is incomplete in that it fails to explicitly indicate the effect of the increase in marginal tax rates on the before-tax rate of interest. This is of some concern since the empirical results to be generated in later chapters are expressed in terms of the effects of higher marginal tax rates on the before tax rate of interest. If we take the view that the determination of the rate of interest can be summarized by the interaction of the demand and supply for money, it is possible to clarify this issue. Under the assumption that the nominal money supply is held constant, a decrease in aggregate demand decreases the transactions demand for money. Additionally, a decrease in the after-tax real rate of interest will induce households to substitute money balances for interest earning assets in their optimal portfolios and thereby increase the asset demand for money. It is therefore clear that net effect on the demand for money is ambiguous and so also is the effect on the pre-tax rate of interest.

V. The Macroeconomic Effects of Changes in the Supply of Money

It is well recognized that the theoretical literature on the macroeconomic effects of changes in the money supply has been and continues to be very controversial. Approaches in the literature vary
from the early quantity theory approach to the more recent real business cycles approach. Both the voluminous theoretical literature and an equally expansive empirical literature do not allow for any consensus on the role of money in the macroeconomy. Since the primary purpose of this section is to provide a basis for the empirical analysis of the role of money during the interwar period, the theoretical discussion attempts to briefly capture the state of the theoretical literature while the empirical discussion concentrates on the interwar period.

The early Keynesian and Monetarist approaches to the effects of money supply changes may be adequately captured within the framework of the traditional IS-LM model. In this model an increase in the money supply shifts the LM curve outwards leading to lower interest rates and higher levels of aggregate demand. As is well known, both Keynesians and Monetarists agreed that money supply changes affect equilibrium output, prices, and interest rates while noting that the effect on output is relegated to the short-run. However, proponents of these views disagree about the potency of monetary policy. In particular, Keynesians argue that the demand for money is highly interest elastic thereby yielding a rather flat LM curve. On the other hand Monetarists propose rather small estimates of the interest elasticity of the demand for money thereby arguing for a relatively vertical LM curve. In the Keynesian view monetary policy is one of several factors that affect aggregate demand while in the Monetarist view money supply
The discovery of the Phillips curve relationship by Phillips (1958) and the subsequently substantial literature on the subject helped to solidify the view that the monetary authority could systematically influence real economic activity in the short-run by manipulating the money supply. Later, Friedman (1968) and Phelps (1967) developed the natural rate hypothesis which led to acceptance of the empirical distinction between the short and long-run Phillips curve relationships. The central thesis of their argument was that while an identifiable Phillips curve relationship existed in the short-run, in the long-run the rate of unemployment tended towards the natural rate which was independent of the rate of inflation. This distinction between the short and long-runs was based on the view that in the short-run changes in the price level lowered workers’ real wages. While employers know the new real wage with certainty, workers overestimate the real wage and at prevailing wages they offer a supply of labor services that is greater than what they would supply if they knew the true value of the real wage. Therefore, an increase in the money supply increases prices which leads to a short-run increase in output. However, given enough time, workers become aware of the true real wage and reduce their supply of labor to the "correct" levels. Further, if the monetary authority persistently pursues such a policy, in the long-run, it leads to higher and higher rates of inflation with no fall in
the rate of unemployment. This view of the Phillips curve relationship came to be known as the accelerationist hypothesis.

The demonstration of the short-run non-neutrality of money by Friedman and Phelps was crucially dependent on the assumption that agents form their expectations adaptively. However, it is widely recognized that under adaptive expectations agents are presumed to make costly systematic errors. This implies that agents do not make full use of the information available to them and therefore suboptimize. Accordingly, several authors including Lucas (1973), Sargent and Wallace (1975), and Barro (1976) have argued that economic agents use all pertinent information available to them in the formation of expectations about economic variables. Along these lines it is possible to construct a Phillips curve model given by

$$Y_t = a + b(P_t - E_{t-1}P_t) + e_t \quad b > 0 \quad \ldots \quad (2.5)$$

where $a$ and $b$ are parameters, $Y_t$ represents the level of output, $P_t$ is the log of the price level, and $E_{t-1}$ denotes the expectation formed at the end of $t-1$. In this framework, monetary policy can influence output only by causing $P_t$ to diverge from $E_{t-1}P_t$. In a world of complete information where private agents have the same information set as the monetary authority, all the predictable effects of money supply changes would be captured in $E_{t-1}P_t$. Therefore, there is no opportunity for the Fed to systematically influence output. However, if it does the unexpected, a wedge may be driven between $P_t$ and $E_{t-1}P_t$. In order to demonstrate the short-run non-neutrality of money, proponents of rational expectations postulated the possibility that the
monetary authority's information is superior to that of private agents. In particular, it may be argued that the Fed receives information in a more timely fashion than private agents.

In response to the rational expectations incomplete information argument, Fischer (1977) has argued that it is unlikely that useful information will be available to the monetary authority but not to private agents for any period of time long enough to allow the Fed to affect output. This, he argues, is because individuals are likely to infer such information from Fed behavior. As an alternative to the incomplete information explanation, Fischer (1977) has demonstrated that the presence of long-term contracts in labor markets create wage and price rigidities that allow money to be non-neutral even when expectations are formed rationally. Specifically, he argues that monetary policy is fully anticipated in the current period; however, since it is based on information that becomes available subsequent to the formation of long-term contracts, agents are unable to adjust their expectations.

Friedman and Schwartz's (1963) documentation of the empirical relationship between money and income for the period 1867 - 1960 is the definitive work on this relationship. Both Keynesian and Monetarist theories suggest that money supply changes are causally prior to changes in output. Additionally, the more recent rational expectations-incomplete information hypothesis and imperfect market arguments of the type advanced by Fischer (1977) also imply that changes in money supply growth cause changes in real economic activity.
From an observational standpoint, there is no question that money supply changes are correlated with changes in income. However, substantial debate as to the true nature of this relationship persists. Of particular importance is the recent resurgence of competitive equilibrium business cycle theory as articulated by authors such as Black (1982), Kyland and Prescott (1982) and Long and Flosser (1983). These authors argue that fluctuations in macroeconomic activity are the result of real disturbances such as changes in technology, government purchases, and marginal tax rates. Further, they postulate that nominal shocks such as changes in the money supply have no effects on real economic activity. In attempting to reconcile these real business cycle models with the observed money - output correlation, Robert King and Charles Plosser (1984) have argued that the money supply responds endogenously to changes in current and/or expected future output. Therefore, there is no clear consensus on the precise role of money in macroeconomic fluctuations.

Sims (1972) used a bivariate model of GNP and money to demonstrate unidirectional causality from money to GNP in post war data. Later (see Sims (1980b)) he used a three variable vector autoregression comprised of M1, wholesale prices, and industrial production to show that similar results held for both the interwar and post war eras. However, when he added a short-term interest rate to the model, money ceased to be Granger causally prior in the post war period. Moreover, the interest rate explained substantially more of the variation in output than did money. For the interwar period, money explained
substantially less of the variation in output than it did in the three variable model; however, it explained a sufficiently large fraction of the forecast error variance in output to make it Granger causally prior to output.

Sims explained this dramatic change in the results for the postwar period by arguing that shocks to the interest rate are primarily reflective of new information about future profitability. Therefore, given profitability in the current period, a fall in expected future profits lowers capital asset prices and raises current interest rates. If agents' expectations are on average correct, an increase in interest rates will be followed by a decline in aggregate economic activity. In this framework, the observed money-output correlation reflects a fall in the demand for money due to the anticipated worsening of aggregate economic conditions. Additionally, Sims argues that the continued importance of money in the interwar period may reflect the importance of financial factors during that period. In this regard, it is instructive to examine the role of money in a model where these additional financial factors are accounted for.

Burbidge and Harrison (1985) define the interwar period as January 1920 - December 1941 and construct a four variable vector autoregression comprised of M1, wholesale prices, industrial production, and a short-term interest rate. Further, they use historical decompositions of output, interest rates, and prices to investigate the macroeconomic role of money during the Great Depression. These authors conclude that while monetary factors were of some importance, other
nonmonetary factors seemed to contribute substantially to the events of that period. This conclusion appears to be consistent with Sims (1980b, pp. 256) who in attempting to explain the disparity between the effects of money in the interwar and post war eras -- when a short-term interest rate was added to the model -- asked "Is this because monetary surprises were really more important in that period, or would the result evaporate in a model which treated monetary surprises symmetrically with a wider array of financial surprises?" In chapter III we present an extended discussion of the potential role of the financial factors alluded to by Sims.
CHAPTER III
FINANCIAL FACTORS AND AGGREGATE ECONOMIC ACTIVITY

I. Introduction

The purpose of this chapter is to provide a concise review of the literature on the effects of financial factors such as the quality and quantity of financial intermediation and private balance sheet characteristics on macroeconomic activity. While most of this literature focuses on the importance of accounting for changes in the level of bank assets (primarily loans) when analyzing fluctuations in aggregate activity, many of the results derived also hold for nonbank financial intermediaries. This point is of substantial import to students of the current era since innovations in financial markets have led to an increasingly important role for nonbank financial intermediaries. However, since the primary empirical focus of this dissertation is the interwar period during which banks overwhelmingly dominated the financial services industry, the term financial intermediaries will be loosely interpreted to mean banks. In light of the above description, financial intermediation may be characterized as encompassing those activities of banks which facilitate the transfer of funds from surplus spending units (ultimate lenders) to deficit spending units (ultimate borrowers). Additionally, financial disintermediation occurs when a deterioration in the level at which, or the efficiency with which, banks facilitate these transfers leads to (a) imperfect substitution of open market credit for bank credit,
and/or (b) an inability on the part of some bank customers who do not have access to open market sources of credit to obtain loans from their banks.

Traditionally, macroeconomists have refrained from giving explicit consideration to financial factors of the type mentioned in the previous paragraph because these factors were assumed to be implicit in households' and firms' consumption - saving and investment decisions. Therefore, for example, a household's demand for and supply of financial assets would be implicitly determined as the household determined its demand and supply of goods and services. In a general equilibrium setting, Walras' law applies and it is sufficient to look at only one of these markets. Like the Modigliani - Miller theorem which postulates that economic decisions are not dependent on financial structure, the traditional view assumes that capital markets are perfect. However, in the absence of perfect capital markets, a firm or household's ability to execute the borrowing and lending plans implied by its consumption - saving decision may be impaired. The extent of this impairment will depend on the quality and quantity of financial intermediation and on the quality of private balance sheets. Therefore, fluctuations in the relative availability and cost of securing bank credit would have real effects on the macroeconomy.

Some early authors, notably Fisher (1933), Gurley and Shaw (1955), and Tobin and Brainard (1963), attempted to direct attention to the asset side of financial intermediaries' balance sheets. However, the widespread promulgation and acceptance of Keynes' liquidity preference
theory, which assigned a prominent role to monetary factors in the
determination of interest rates and thereby the interaction of the
financial and real sectors, tended to dominate the profession's
attention. Additionally, the apparent empirical significance of money
in explaining real sector fluctuations (especially as adumbrated in the
definitive work of Friedman and Schwartz (1963)) served to further
enhance the view that failure to explicitly consider the aforementioned
financial factors was at best a trivial omission.

A number of developments in the literature have rekindled concern
about the nonmonetary effects of financial intermediation. These
developments include: (a) growth in the literature on informational
asymmetries, which provided an appropriate theoretical framework within
which it could be demonstrated that there are no substitutes for some
bank loans; (b) the demonstrated inability of money to explain both the
severity and length of the Great Depression and the empirical
observation by Sims (1980b) that money explained a lot more of the
variation in output in a model that did not include the interest rate
than in a model that did; and (c) the apparent breakdown of the
relationship between money and income in the 1980's, which led many in
the profession to seek alternative or additional financial quantity
variables to which monetary policy could be tied. All of these
developments caused greater attention to be focused on the
macroeconomic role of intermediaries with special focus on the effects
of shocks to the financial intermediation process as they affect bank
assets. At the same time, increased attention was also focused on the
In what follows an attempt is made to provide an annotated survey of the theoretical and empirical considerations surrounding these issues. In sections II and III, I review the theoretical literature while in section IV an attempt is made to present some of the existing empirical evidence on the usefulness of financial factors as explanators of aggregate economic fluctuations.

II. The Role of Bank Assets in Macroeconomic Equilibrium

The idea that the level and quality of financial intermediation may have macroeconomic effects separate from their effects via the money supply has been advanced in the literature by early authors such as Fisher (1933) and Keynes (1936). For example, in his General Theory, Keynes (1936 pp. 158) noted that "the weakening of credit is sufficient to bring about a collapse, its strengthening, though a necessary condition of recovery, is not a sufficient condition." In a variant of Fisher's debt deflation theory -- which argued that during the Great Depression falling prices increased the real value of household and firm debt, eroded their financial capacity, and thereby, their ability to make purchases-- Gurley and Shaw (1955) argued that financial intermediaries play an important role in the determination of the financial capacity of the private sector, and as such, have real effects on aggregate activity. In addition to the studies referred to above, other studies including those of Brainard and Tobin (1963) and Tobin (1975) espoused a similar viewpoint. However, the dominant
position accorded Keynes' liquidity preference theory and the seminal time series analysis of Friedman and Schwartz (1963) tended to sway the profession away from the position taken by Gurley and Shaw and others.

While the factors alluded to in the previous paragraph were indeed important in limiting the attention given to the nonmonetary role of financial intermediaries, the single biggest contributor to the failure of this view to gain more widespread acceptance and attention in the literature was the absence of a clear theoretical demonstration of the uniqueness of bank assets. Specifically, what was required was a theory that explained why open market debt instruments were, at best, only imperfect substitutes for bank loans. Such a theory would justify giving special attention to bank assets in the construction of macroeconomic models and give credence to the view that the quantity and quality of financial intermediation has nonmonetary effects on the macroeconomy. The recent development of theoretical models analyzing the effects of asymmetric information problems on financial market equilibria has allowed for the development of models that motivate financial intermediaries from first principles and for the identification of a special role for bank assets in the determination of aggregate economic activity. This literature may be placed into two broad categories. Firstly, a large number of studies approach the problem from banks' standpoint and attempt to identify factors that influence a bank's ability and or willingness to supply credit. Another set of studies focus on the influence of borrower balance sheets on
investment and other spending decisions, and attempt to identify those characteristics that enhance or hurt a borrower's ability to secure credit. In both cases it is demonstrated that financial structure is important in explaining fluctuations in economic activity. The remainder of this section reviews models of the first type while a discussion of borrower based models is presented in section III.

A. Asymmetric Information and Financial Intermediaries

In his seminal contribution on the economics of asymmetric information, Akerlof (1970) demonstrated that informational asymmetries about product quality between buyers and sellers may lead to market failure. More specifically, he argued that sellers know the true quality of their product; however, due to large variations in product quality, buyers are uncertain about quality. In such a framework product price will reflect average product quality. Therefore, sellers who supply high quality product receive an inferior price, while suppliers of low quality product sell their goods at a premium. In the absence of institutions or market mechanisms that alleviate the informational asymmetry, adverse selection results such that suppliers of high quality product exit the market while more and more suppliers of low quality product enter. Ultimately, the market may cease to exist.

Among the first studies to formally evaluate the effects of asymmetric information on financial markets was a paper by Leland and Pyle (1977) in which they examined the effects of informational asymmetries between entrepreneurs -- who have projects that require
outside financing -- and potential lenders. Specifically, entrepreneurs
know the quality of their projects while potential lenders are unable to
distinguish between high and low quality projects. As outlined in
Akerlof (1970), lenders observe the average project quality; therefore,
the market value of projects will reflect average quality. Under this
scenario, if average project cost is exceeded by average market value, a
disproportionately large number of low quality projects will be
attracted while high quality projects will leave the market. Over time,
average project quality will progressively deteriorate, until ultimately
only entrepreneurs with poor quality projects come to market. In the
absence of institutions or market mechanisms that alleviate the
informational problems indicated, complete market failure ensues.

In light of the above, it seems reasonable to argue that an
entrepreneur with an above average quality project will find it
desirable to communicate this information to potential lenders.
However, because of the inherent moral hazard problem involved here,
direct communication is ineffective. Leland and Pyle argue that while
this problem may be solved if entrepreneurs can find a mechanism to
signal the true quality of their projects, any appropriate mechanism
will be costly. Further, these authors suggest that an entrepreneur
may signal personal confidence in his project by investing a
significant fraction of his wealth in it. Such a signal is costly
because it forces entrepreneurs to devote a larger fraction of their
portfolios to their firms equity than they would in the absence of the
aforementioned informational asymmetries. The foregoing discussion
implies that certain firms with access to an information processing technology that allows them to gather and evaluate information on the viability of projects may serve as intermediaries between entrepreneurs and their ultimate lenders by repackaging entrepreneurs' information as to project quality in a manner that effectively eliminates or at worst alleviates the informational asymmetry. Specifically, the sale of information acquired by the intermediary is hampered by the ability of a purchaser of this information to resell it without any loss in the flow of services he derives from such information. Additionally, since potential lenders are unable to verify the reliability of the information generated, intermediaries face a moral hazard problem, which could lead to the type of market failure described by Akerlof (1970).

Leland and Pyle suggest that the intermediary can solve the appropriability and moral hazard problems by buying and holding assets offered by entrepreneurs on the basis of the information it wishes to earn a return on. Under this scenario, the appropriability problem is solved because the specialized information is embedded in the intermediary's portfolio. Additionally, the intermediary's owners can solve the moral hazard problem by holding a fraction of the entrepreneur's equity that is greater than what they would have held in the absence of the moral hazard problem. This would constitute a costly signal and would indicate the owners' confidence in the project and in the reliability of their intermediary's information.
The key implication of the foregoing analysis is that the willingness of the intermediary to hold assets issued by any firm or entrepreneur certifies its confidence in the quality of the project to be undertaken. Moreover, because of economies of scale in information processing it may be cheaper for a firm/entrepreneur with a high quality project to submit itself to certification by offering to sell its assets to financial intermediaries (i.e. apply for bank loans) instead of attempting to send costly signals to individual lenders. In general, there will be a direct relationship between the quality of the firm's project and its willingness to submit to certification. At the limit, firms with high quality projects will use financial intermediaries to alleviate informational asymmetries, while those with low quality projects will rely on more expensive costly signals to individual lenders. Under this scenario, it is clear that this certification process evolves into a sorting mechanism.

In attempting to explain the existence of financial intermediaries, Diamond (1984) considers a model where the information structure is such that it is necessary for lenders to undertake costly monitoring of borrowers' projects in order to observe the return on these projects. Since it is inefficient for lenders to incur monitoring costs in all states of nature, monitoring occurs only when borrowers default on the risky debt contracts that are the optimal financial arrangement in this framework. Additionally, since most projects are likely to be too large for a single lender (depositor) to finance, in the absence of financial intermediaries the typical borrower may enter into risky debt contracts.
with several lenders. Under this scenario, two unsatisfactory outcomes are possible. These are: (a) wasteful duplication occurs if all lenders monitor; and (b) a free rider problem ensues.

Diamond argues that an optimal solution to this monitoring problem requires that lenders (depositors) delegate these monitoring costs to financial intermediaries who have a comparative advantage in such activities. Lenders do this by depositing their funds with financial intermediaries who use these funds to make loans and pay depositors a "fair" return. However, this creates an additional problem in that it is now necessary to monitor the monitor. Diamond demonstrates that the financial intermediary will hold a heavily diversified portfolio that allows it to pay depositors (lenders) a return that is immune from any independent risks faced by individual borrowers.

In a variant of the models discussed above, Boyd and Prescott (1986) develop a model in which each individual is endowed with a finite amount of wealth and a project whose quality is assumed to be either good or bad. However, the true quality of an individual's project is private information. In this framework, Boyd and Prescott show that the existence of informational asymmetries leads to the emergence of financial intermediaries that use project evaluations and financial contract structure to construct incentive schemes that encourage individuals with bad projects to become savers while those with good projects pursue funding. Further, these authors show that diversification is useful since it allows the intermediary to perfectly implement the optimal incentive scheme.
The unifying characteristic of the models discussed above is that they all implicitly or explicitly demonstrate how financial intermediaries may emerge. Moreover, these models imply that the information processing activities of these intermediaries improve the allocative efficiency of financial markets, and thereby, that of the overall economy. This implies that any external shocks that hamper the ability of banks to deliver their intermediary services is likely to have real effects.

B. Credit Rationing and its Macroeconomic Implications

In addition to the allocative inefficiencies attributed to informational asymmetries in the previous section, several authors have argued that credit rationing in loan markets is a market response to informational problems in financial markets. In most markets, price movements ensure the equilibration of demand and supply. However, the market for bank loans is frequently characterized by rationing equilibria.

The traditional approach to credit rationing defines it as a situation in which there is excess demand for credit at the going interest rate. However, a more recent definition proposed by Stiglitz and Weiss (1981) recognizes that credit rationing occurs when borrowers with objective characteristics identical to those who receive credit are denied loans at prevailing interest rates and any higher rates they may offer. Additionally, these authors argue that credit is rationed if there are groups of individuals who, for a given supply of credit, fail to secure loans at any interest rate, although they would
with an increased supply of credit. The distinguishing feature of the
Stiglitz and Weiss definition is that it recognizes that the inability
of some individuals to secure loans is due to their unworthiness for
credit and not because credit is rationed. Later it will be apparent
that this recognition is important in explaining why interest rates may
not adjust to eliminate excess demand.

The primary purpose of the credit rationing literature is to
explain the seemingly anomalous behavior of the loan market. The early
textbook explanation suggests that in periods of tight credit banks'
prime customers receive preferential treatment while other less
preferred customers are rationed. As noted by Santomero (1984), this
approach requires the demonstration that banks earn higher returns
from loans made to their prime customers. However, this is unlikely to
be true since these prime customers are likely to have elastic demand
curves for bank credit due to their ability to tap open market sources.

Another approach to credit rationing focuses on the effects of
asymmetric information on bank lending policy. Jaffee and Russell
(1976) construct a model in which they assume that borrowers can be
lumped into honest and dishonest categories. Honest borrowers accept
only those loan contracts that they reasonably expect to conform with,
while dishonest borrowers will default on loans whenever the costs of
doing so is such that they experience an increase in utility. Because
lenders are unable to distinguish between honest and dishonest
borrowers on an a priori basis, Jaffee and Russell argue that the
equilibrium interest rate which prevails will reflect the probability of
default by dishonest borrowers. Further, these authors suggest that lenders (banks) can attract more honest borrowers and thereby reduce losses due to bad loans by reducing the fraction of investment projects that they finance.

In a provocative and highly influential paper, Stiglitz and Weiss (1981) argue that in pursuit of their profit maximization objective, banks are concerned about the rate of interest a loan pays and about its riskiness. However, the rate of interest that a bank charges on loans may affect the riskiness of the loan in one of two ways. Firstly, as banks increase the interest rate on loans the borrowers who are willing to pay high rates of interest are likely to have a high probability of default. Therefore, expected repayment on the bank's loan portfolio falls and with it expected return. Secondly, a higher interest rate on loans induces borrowers to undertake riskier projects since at higher interest rates the return on successful projects is lower. Under this scenario, banks find that the projects they finance are generally more risky and since the probability of repayment is closely linked to project success they may experience greater loan losses. The foregoing effects of interest rates on borrower behavior imply that there is a nonmonotonic relationship between the interest rate and the expected return on loans. Specifically, there is some optimal interest rate at which expected return is maximized and beyond which expected return falls. Since this optimal interest rate will in general not coincide with the rate at which demand is equal to supply, it is entirely possible for a rationing equilibrium to prevail.
In summary, the preceding discussion of the Jaffee and Russell and the Stiglitz and Weiss studies implies that rationing equilibria may emerge as a market response to the existence of informational asymmetries between borrowers and lenders as to the default probabilities of borrowers. When credit rationing as defined in Stiglitz and Weiss occurs, an unavoidable by-product is that borrowers/entrepreneurs with good projects are rationed and are thereby unable to undertake profitable investments. This implies that adverse shocks to credit supply or any shock that exacerbates informational problems of the type alluded to above will lead to more severe rationing and lower levels of investment expenditure. Effects of this type appear to have taken hold during the Great Depression when massive business failures increased the informational gap between borrowers and banks which led to the severe credit rationing documented in Bernanke (1983).

The studies by Leland and Pyle, Diamond, Jaffee and Russell, and Stiglitz and Weiss clearly demonstrate that the existence of asymmetric information in financial markets adversely affects the economy’s allocative efficiency. However, these studies and others like them are essentially microeconomic in nature and do not explicitly develop the link between the level and quality of financial intermediation and aggregate economic activity. In section II. C below a brief review of studies that attempt to more explicitly develop this link is presented.
C. Macroeconomic Linkages

In a recent paper, Barnanke and Gertler (B&G) (1987) develop a model that attempts to incorporate the essential features of the banking sector in a macroeconomic setting in order to demonstrate how shocks to the banking sector's ability to perform its intermediation function may influence aggregate economic activity. Specifically, these authors envisage a world with two types of investment technologies that convert an endowment good (input) into a consumption good (output). The first of these technologies is a liquid investment that converts one unit of input in period $t$ into one unit of the consumption good in period $t+1$. The other technology is an illiquid investment that yields a random quantity of the consumption good per unit of input two periods later. Further, B&G postulate that finding an illiquid project requires possession of an information gathering technology that allows for ex ante evaluation of the project and ex post monitoring of its returns. Because these evaluation and monitoring activities are costly, and prohibitively so for individuals, they are unable to directly invest in illiquid projects. This framework allows an opportunity for firms (i.e. banks) who have access to the information gathering technology to serve as intermediaries through which individuals may indirectly invest in illiquid projects. One of the key issues to be resolved before individuals' funds can be made available to intermediaries is the construction of an incentive compatible contract between individuals and intermediaries. This is necessary because the return that banks earn on illiquid investments is private
information that individuals are unable to observe. Therefore, a moral hazard problem emerges since banks will have every incentive to understate returns.

Several authors including Diamond (1964), Williamson (1987) and B&G argue that banks rely on noncontingent debt (i.e. demand deposits) because other contractual forms are contingent on unobservable returns to illiquid projects and are thereby incentive incompatible. In a framework where bank liabilities are essentially risk free, there are no additional incentive problems. However, if there is some probability that banks may default on these noncontingent debt contracts, it is useful to consider how bank liabilities may be made incentive-compatible. Since B&G assume that illiquid projects are large and that the information gathering technology is such that the number of projects the bank is able to handle is too small to allow for perfect diversification, bank liabilities are potentially risky. This implies that factors which affect the riskiness of bank liabilities, such as bank capital and the quality of bank assets, will limit the size of the banking industry and ultimately will have macroeconomic effects.

The foregoing highlights the need for some mechanism via which banks may secure their liabilities. As noted by B&G, a potentially useful arrangement that obviates the need to observe the return on bank portfolios is one that requires observation of the actual payments made by banks. Specifically, these payments may be made contingent on one of two states. If the bank makes the contractually specified payment, then it is considered to be in a nondefault state; however, if it fails
to make these payments it is considered to be in default. Diamond (1984) proposes some form of punishment for banks who fall into the default state while Townsend (1979) suggests having defaulting banks undertake costly auditing. However, B&G argue that the solutions proposed by Diamond and Townsend are unsatisfactory because they require that depositors have an implausible amount of information about bank assets and because they attribute little or no role to collateral such as bank capital in spite of its empirical relevance.

In attempting to come up with an alternative to the incentive schemes suggested by Diamond and Townsend, B&G assume that the minimum possible return from an illiquid project plus its scrap value is observable and can be thought of as its collateral value. Further, they argue that banks may use insider bank capital (i.e. equity obtained from the owner/manager or from retained earnings) to secure debt contracts. In this framework there is a direct relationship between the amount of insider capital that a bank holds and the noncontingent debt that it can issue. B&G propose an arrangement where banks rely on their supply of insider capital to perfectly collateralize their debt. Under this scenario, the optimal contract requires that the bank plan its illiquid and liquid investments such that it is able to service its deposit liabilities on a period by period basis even when its risky projects yield the minimum possible return. Operationally, this requires that the bank shift resources between liquid and illiquid investments as circumstances in its operating environment change. Further, in order to make this scheme incentive-compatible, B&G assume
that the collateral value of illiquid projects and the quantities of bank deposits, illiquid investments and storage are observable.

The crucial aspect of the B&G model is its demonstration that factors which adversely affect the quality and quantity of bank capital will lead to a contraction in the level of deposits banks are able to attract. Therefore, the volume of funds they are able to intermediate falls such that projects which are entirely dependent on bank credit may not be financed. Further, a significantly deleterious change in the collateral value of illiquid bank assets would seriously impair the banks ability to finance illiquid projects, since it would now be necessary to shift resources from illiquid to liquid assets in order to maintain perfect collateralization of its debt contracts. While it is difficult to think of an exogenous unfavorable shock to bank capital, endogenous shocks such as deterioration in business conditions may erode both bank capital and the value of its illiquid assets (loans) and lead to further deterioration of business conditions. It seems reasonable to argue that such a mechanism may well explain the persistence and severity of the economic fluctuations of the thirties. Additionally, B&G argue that their model is supportive of the view that certain government regulations -- which were introduced for microeconomic reasons -- such as deposit insurance, minimum capital requirements and public auditing that seek to ensure the quality of bank capital, may be justifiable on macroeconomic grounds.

While the foregoing analysis has focused on the macroeconomic effects of bank behavior in allocating credit, it is instructive to
investigate the implications of that literature for the manner in which bank participation in the credit supply process may affect the channels via which the changes in the supply of money affect the macroeconomy. The traditional view of this transmission mechanism holds that an increase in bank reserves initiated by the Fed allows banks to increase their money creation activities which increases overall liquidity and lowers market interest rates. Subsequently, the increased liquidity and lower interest rates lead to increases in private spending. In this view banks are singled out for special attention because of the role of their liabilities (i.e. demand deposits) in the money supply process while the role played by bank assets (primarily loans) is largely ignored on the presumption that open market securities are near perfect substitutes for bank loans.

Recently, several authors including Blinder and Stiglitz (1983), Bernanke (1986;1988) and Bernanke and Blinder (1988) have advocated a "credit view" of the monetary transmission mechanism. Specifically, these authors (particularly Blinder and Stiglitz) object to the presumption on the part of proponents of the traditional view that open market securities are perfect substitutes for bank loans. Instead, they argue that recent financial innovations have created many substitutes for money and that the uniqueness attributed to demand deposits by the traditional view is unwarranted. Further, they rely on the burgeoning literature on the effects of imperfect information on capital markets to demonstrate that bank assets deserve special attention because of the unique role they play in the credit supply process.
As implied by the discussion in preceding sections, imperfect information about default probabilities gives rise to financial intermediaries who are able to evaluate and monitor certain borrowers' projects at costs substantially lower than what individuals would incur if they attempted to lend directly. This implies that for some borrowers (primarily small firms and individuals) the informational costs associated with securing open market credit are prohibitively high, thereby forcing these firms to rely almost exclusively on bank credit. Also, for large well established firms, the evaluation and monitoring costs may be such that it is more efficient for individuals to lend directly to these firms by purchasing their open market securities. As noted by Stiglitz and Weiss (1981) and Blinder and Stiglitz (1983), imperfect information in capital markets leads to a clientele effect such that very low risk borrowers (or firms for which the informational asymmetry is minimal) depend on open market credit while higher risk firms (or firms for which the informational asymmetry is substantial) depend on banks for their credit needs. Therefore, it is reasonable to conclude that bank assets deserve special mention since open market securities are at best imperfect substitutes for bank loans.

In light of the above, Bernanke and Blinder (1988) develop an augmented IS-LM model of aggregate demand that attempts to capture the effects of both money and credit. In contrast to the traditional framework, in their augmented model individuals achieve portfolio balance among money, bonds, and loans. A simple bank resource
constraint that ignores net worth requires that bank asset holdings (i.e. the sum of excess reserves, loans, and bond holdings) equal total deposits less required reserves. Further, bank portfolio proportions are assumed to depend on the rates of return on the assets held. This allows specification of a loan supply function where loan supply depends positively on the rate of return on loans and total deposits net of required reserves and negatively on the interest rate on bonds. More formally, \( L^* = \lambda(p, i)D(1-r) \) where \( p \) and \( i \) are the interest rates on loans and bonds respectively while \( D \) represents total demand deposits and \( rD \) is required reserves. Additionally, the demand for loans depends positively on the rate of interest on bonds and on output and negatively on the interest rate on loans and is given by \( L^* = L(p, i, y) \) with \( y \) denoting GDP. Under this scenario, equilibrium in the loan market is given by

\[
L(p, i, y) = \lambda(p, i)D(1-r). (3.1)
\]

Bernanke and Blinder ignore cash holdings and specify the LM curve as the locus of points for which the demand for money given by total deposits is equal to the supply of deposits. This market clearing condition is given by

\[
D(i, y) = m(i)R \tag{3.2}
\]

where \( m(i) \) is the money multiplier and \( R \) denotes bank reserves. By Walras' law, (3.1) and (3.2) implicitly define equilibrium in the bond market. Equilibrium in the goods market may be summarized as

\[
y = Y(i, p) \tag{3.3}
\]

with both elements of \( Y \) entering negatively.
In order to integrate the equilibrium condition in the loan market with the traditional IS curve given by (3.3), these authors use the market clearing condition in (3.2) to substitute \( m(1)R \) for \( D \) in (3.1). Further, they note that (3.1) can then be used to solve for \( p \) such that
\[
\rho = \rho(1, y, R) \quad (3.4)
\]
Finally, substitution of (3.4) into (3.3) yields
\[
y = Y(1, \rho(1, y, R)) \quad (3.5)
\]
which is a negatively sloped CC curve (i.e., commodities and credit in goods and market interest rate space) that is shifted by monetary policy and shocks to the loan demand and supply functions. This CC curve is interpreted as a locus of interest rate and output combinations for which the goods and credit markets are in equilibrium.

While most shocks have similar effects in the IS-LM and CC-LM models, the superior explanatory power of the CC-LM model may be demonstrated by examining the effects of monetary policy and shocks to the credit supply curve in the two models. Firstly, an expansionary monetary policy such as an increase in bank reserves by the Fed leads to an outward shift in the LM curve attended by lower interest rates and an increase in output in both models. However, since the CC-LM model gives explicit consideration to bank loans, to the extent that banks devote their additional reserves to loans as opposed to bonds or excess reserves, the increased supply of bank credit leads to lower rates on bank loans, increased investment and other spending and,

"Equations (3.1) - (3.5) are exactly the same as Bernanke and Blinder's equations (1) - (5)."
therefore, an outward shift in the CC curve. Since both the CC and LM curves shift outwards in the CC-LM model, monetary policy has a bigger impact on output and ambiguous effects on market interest rates. This, of course, is in contrast to the IS-LM framework where only the LM curve would shift outwards and we would get an unambiguous fall in open market rates. Additionally, it is instructive to note that shocks to the credit supply curve that induce banks to make portfolio substitutions into or out of loans will shift the CC curve and potentially alter open market interest rates and output. Historical examples of this kind of phenomena include the financial crisis of the 1930's that induced banks to make portfolio adjustments out of loans into safer assets and the more recent credit controls imposed by the Carter administration in 1980. Both of these shocks to credit supply led to an inward shift in the CC curve attended by falls in output and market interest rates.

In addition to the models reviewed above, a growing literature attempts to integrate financial factors of the type discussed previously into business cycle models. For example, Sheinkman and Weiss (1986) construct a model in which individuals face negatively correlated productivity risk but are unable to insure or diversify this risk due to incomplete or imperfect financial markets. These authors go on to demonstrate that under these circumstances individuals will attempt to self insure by varying their consumption, saving, and labor supply. At the aggregate level these alterations in individual behavior will cause fluctuations in aggregate activity. Additionally, Williamson
(1987) attempts to motivate financial intermediation and credit rationing within a business cycle framework and proceeds to demonstrate that productivity shocks may alter default probabilities, thereby affecting the amount of credit rationing and ultimately the levels of investment and output.

III. Borrower Balance Sheets, Investment, and Aggregate Activity

Using a theoretical framework very similar to real business cycle models such as that in King and Plosser (1984), Bernanke and Gertler (1989) show that in the absence of informational asymmetries between borrowers and lenders the Modigliani-Miller theorem attesting to the irrelevance of financial structure holds. This result is consistent with real business cycle models of the economy which generally assume that financial structure is irrelevant. However, when B&G (1989) allow for asymmetric information between entrepreneurs (who need external financing) and lenders, they find that financial structure is relevant. Specifically, they demonstrate that in the presence of informational asymmetries, the optimal financial contracts that emerge entail agency costs whose size is reflected in the differential between the costs of internal and external financing. B&G (1989) argue that in this framework borrower net worth is inversely correlated with the aforementioned agency costs. Further, this inverse relationship implies that: (a) since borrower net worth tends to be procyclical, agency costs are likely to be countercyclical and lead to persistent fluctuations in investment and output; and (b) independent disturbances to borrower net worth may initiate fluctuations in real activity. A
potentially important source of independent shocks to borrower net worth is identified in Fisher's debt deflation theory where unanticipated price declines resulted in a progressive worsening of borrower balance sheets as the real value of their debt increased.

In a recent paper Gertler and Hubbard (G&H) (1986) construct a simple partial equilibrium model of investment that incorporates the more salient features of models such as that in B&G(1989) that attempt to capture interactions between the real and financial sectors. The central feature of the G&H model is the existence of asymmetric information between entrepreneurs and lenders. Specifically, the entrepreneur knows more about the investment project than does the lender from which he seeks to obtain credit. This poses a moral hazard problem that may be rectified if the two parties settle on an incentive compatible contractual form. Since the contractual arrangements that emerge will generally force the entrepreneur's investment behavior to differ from that under symmetric information, agency costs are incurred and the Modigliani-Miller theorem does not hold.

G&H suggest a two period model where entrepreneurs use mandatory hard capital and optional soft capital in period zero to produce output which they sell in period one. Since the technology used to convert input into output is risky, the outcome in period one may be either good or bad. Taking hard capital to refer to machinery and soft capital to represent inputs such as maintenance and organizational expenditures that, ceteris paribus, improve the probability of a good
outcome, G&H argue that in the absence of informational problems the entrepreneur will choose the optimal levels of both types of capital. However, if informational asymmetries exist, he has an incentive to divert funds intended for soft capital for other uses from which he benefits. In response to this incentive problem, rational lenders require that debt payments be contingent upon the productive outcome. Further, an incentive constraint ensures that the expected gain to the entrepreneur from honesty exceeds his gain from diverting funds intended for investment in soft capital.

Another way to ensure incentive compatibility is to increase the payment that the entrepreneur must make if the productive outcome is bad. In this case the higher the amount the lower will be the expected gain from cheating. However, the size of the payment that the entrepreneur can contract to pay in the event of a bad outcome is limited by his net worth where his net worth is defined as the sum of his initial liquid asset position in period zero and the value of his profit stream in period one. In this framework his incentive to cheat will be negatively correlated with his net worth and therefore his ability to secure credit. The foregoing clearly implies that factors which adversely affect borrowers net worth positions will circumscribe their ability to obtain credit and thereby lead to a constriction in investment. If financial conditions are such that a substantial number of borrowers experience significant deterioration in their net worth positions, aggregate investment and output are likely to decline. As examples of this kind of phenomena, G&H cite recent drops in the price
of farm products and oil that served to erode the net worth of borrowers in these sectors.

IV. Empirical Review

The empirical evidence on the issues discussed in this chapter is at best sketchy. Two types of evidence may be cited. Firstly, there are studies such as Bernanke (1983), Benjamin Friedman (1966), and Stephen King (1985) that present time series evidence documenting the importance or unimportance of financial factors in explaining fluctuations in aggregate economic activity. Secondly, several authors including Fazzari and Athey (1987), Fazzari, Hubbard, and Petersen (1988), and Gertler and Hubbard (1988) use cross sectional data to investigate the effects of financial structure on investment. In general both types of studies provide evidence in support of the view that financial factors of the type addressed in this chapter have a substantial impact on macroeconomic activity.

Perhaps the most poignant historical example of the types of financial shocks alluded to throughout this paper may be found during the Great Depression. In a rather influential paper, Bernanke (1983) carefully outlines the state of financial markets during that period. Firstly, he compiled impressive evidence of the widespread fear of runs that led banks to shift their resources out of risky assets (loans) into safe and more liquid assets such as high grade bonds and excess reserves. This action led to severe credit rationing so that borrowers who were exclusively reliant on bank credit were unable to finance their projects. Additionally, widespread insolvency among nonfinancial
firms further exacerbated problems of asymmetric information and made it more difficult for banks to perform the evaluation and monitoring functions attributed to them in the theoretical discussion above. At the same time, the price deflation increased the real burden of an already unusually high level of private debt, thereby reducing that sector's capacity to finance new projects.

While it may be argued that the financial system reacts passively to changes in aggregate output, the historical record indicates that crisis in the financial system tends to precede downturns in economic activity. Friedman and Schwartz (1963) have suggested two ways in which the causal priority of the health of the financial system may be explained. These are: (a) changes in the fortunes of banks affect the wealth of their shareholders; and (b) the now widely acknowledged effect on the money supply. Using Barro's (1978) two step procedure to estimate the effect of unanticipated shocks in the money supply on output from 1929 to 1933, Bernanke (1983) found that money supply shocks tended to influence output. However, dynamic simulations of the path of output for the period between mid-1930 and March 1933 captured only half of the decline in output during that period. On the basis of the foregoing empiricism, Bernanke argues that the explanations presented by Friedman and Schwartz should be supplemented by possible nonmonetary effects of financial crisis on output. The theoretical basis for these nonmonetary effects operates via the effect of the health of the financial system on the cost of credit intermediation (CCI), where adverse conditions in the financial sector
increase the CCI, which in turn leads to credit contraction, the rejection of otherwise profitable projects, and subsequent falls in output.

In order to test the hypothesis that financial crisis causes reductions in output separate from its effects via the money supply, Bernanke included current and lagged first differences of the deposits of failing banks and the liabilities of failing businesses in a Barro-type output equation that included unanticipated money. Both variables entered with the expected negative sign, and, taken jointly, were highly significant. Additionally, he regressed the rate of growth in bank loans against the deposits of suspended banks and the liabilities of failing businesses. Recognizing these independent variables as indicative of the degree of financial crisis, he proceeded to use the fitted series from this regression as representative of the independent nonmonetary effect of financial crisis on credit contraction, and therefore as a proxy for the CCI. Subsequent inclusion of current and lagged values of the fitted series and unanticipated money in an output equation of the Barro-type referred to earlier, confirmed the statistical significance of the proxy. Moreover, dynamic simulations of the path of output for the period between mid-1930 to March 1933 accounted for substantially more of the actual decrease in output than was captured when only unanticipated money was included in the output equation. In addition to the above proxy, Bernanke used the following alternatives: (a) the yield differential between Baa corporate bonds and U.S government bonds; and (b) the fitted series from a regression of
the yield differential on the deposits of suspended banks and the liabilities of failing businesses. In all cases, entry of the proxy for the costs of credit intermediation substantially increased the percentage of the decline in output that was captured.

Bernanke's results are largely consistent with the predictions of the theoretical literature reviewed in sections II and III above and should alert us to the possibility that macroeconomic models which do not account for the nonmonetary effects of financial factors may be misspecified. However, at least three caveats should be noted. Firstly, by using a single equation model the author assumes the exogeneity of money and his various proxies for the CCI and therefore restricts the pattern of interaction among the variables. Secondly, and following Lutkepohl (1982), it seems appropriate to examine this issue in an expanded framework that includes other important macro variables such as the interest rate, prices, etc. Finally, since Bernanke's research was primarily concerned with the Great Depression, it is instructive to investigate the applicability of his results to longer periods and different eras. In chapter VI an attempt is made to address these issues.

Benjamin Friedman (1983) argues that including monetary aggregates in models that are intended to capture aggregate economic activity to the exclusion of other financial quantities such as credit is justifiable if it can be demonstrated that money incrementally explains real economic activity in a manner that a credit quantity does not. In order to investigate this issue, he used quarterly data from 1953 -
1978 to conduct Granger causality tests of the importance of money and credit within the framework of two trivariate vector autoregressive (VAR) models. Output and prices entered both models while one included credit and the other M1. Friedman found that neither variable incrementally explains real economic activity. However, in a four variable VAR that included prices, output, money and credit he found that both money and credit incrementally explained output. This result suggests that it is the interrelationship between money and credit that affects real activity and raises serious questions about the ability of macroeconomic models that ignore credit aggregates to adequately account for the transmission of monetary impulses.

In an attempt to verify the existence of equilibrium credit rationing by U.S. banks in the post-war era, Stephen King (1986) tested three observable implications of that hypothesis. These are: (a) banks should behave as though they are liquidity constrained; (b) the loan market should be characterized by excess demand; and (c) the response of loan supply to changes in the loan rate should approach zero. King found evidence supportive of (a) and (b) but his estimates of the elasticity of loan supply with respect to the loan rate were positive and substantially so. Therefore, there is some but not overwhelming evidence of equilibrium credit rationing in the U.S.

Additionally, King argues that if the existence of equilibrium credit rationing is an important factor in the determination of aggregate economic activity, bank credit aggregates should have significant predictive power for GNP. Using quarterly data from the
first quarter of 1950 to the third quarter of 1979, he conducted bivariate Granger causality tests of the effects of demand deposits on GNP growth and of various credit aggregates such as the sum of commercial and industrial loans, the sum of real estate and consumer credit, and total loans, on GNP growth. In general, his results indicate that the predictive content of demand deposits for GNP is far greater than the relatively insignificant estimates for the credit aggregates. These results were further supported by variance decompositions of GNP growth in a model that included the aforementioned credit aggregates, the loan rate, and the three-month Treasury bill rate. Therefore, King (1986) concludes that a significant macroeconomic role cannot be assigned to these credit aggregates and thereby to credit rationing.

In addition to the time series evidence presented above, Fazzari, Hubbard and Petersen (FHP) (1988) present cross sectional evidence supportive of the theoretical models discussed in section III above. Specifically, FHP argue that for some firms asymmetric information in capital markets causes the cost of externally obtained funds to exceed the opportunity cost of internal funds. Since their investment expenditures will depend rather heavily on the availability of internal funds these firms will retain a very large fraction of their earnings. On the other hand, the differential between the costs of internal and external funds for firms who do not face severe informational problems will approximate zero. Therefore, these firms will smooth their investment spending streams with external funds.
The foregoing implies that while theories of investment that ignore financial structure may be a reasonable approximation for larger more established firms, the same will not hold for firms that face substantial informational problems. PHP place firms into classes based on their retention ratios and empirically examine their investment spending to see how it is affected by cash flow and liquidity measures that influence availability of internal finance. Their results indicate that the investment of firms with high retention ratios is more sensitive to cash flow fluctuations than that of more mature low retention firms. Additionally, investment expenditures of low retention ratio firms show a lot less sensitivity to changes in liquidity measures. This evidence is clearly supportive of the view that financial constraints should be accounted for in theories of investment and ultimately in analyzing macroeconomic fluctuations.

Relying on a theoretical base similar to that described in PHP, Fazzari and Athey (1987) estimate investment functions for a large sample of firms. Included among the regressors were the firm's interest expense and a measure of internal cash flow. If informational asymmetries make financial structure relevant for investment decisions, an increase in internal funding should lead to higher levels of investment while higher levels of interest expense should be associated with lower levels of new investment. The empirical results indicate that these variables entered the investment equation with the expected sign and were statistically significant. Once again these results are strongly supportive of the view that financial structure matters.
Gertler and Hubbard (1988) estimate investment functions that incorporate Tobin’s q and include firm cash flow as a proxy for net worth for high, medium, and low retention firms. They find economically and statistically significant differences in the coefficients on the cash flow variable across retention classes. Additionally, the link between internal finance (as proxied by the cash flow variable) and investment becomes closer as retention increases. Gertler and Hubbard interpret these results as supportive of the imperfect information literature which suggests that for many firms external finance is an imperfect substitute for internal finance.

Further, to the extent that the accumulation of debt in the private sector detracts from its ability to secure additional credit that may be necessary for new investment or other spending, Gertler and Hubbard show that financial factors of the type described here may be asymmetrically important during economic downturns.

In summary, it seems reasonable to conclude that the sparse empirical evidence on the role of financial factors in the macroeconomy suggests that macroeconomists should pay greater attention to these factors when attempting to explain or forecast aggregate economic fluctuations.
CHAPTER IV

VECTOR AUTOREGRESSIONS: TECHNIQUE, INTERPRETATION AND USES

1. Introduction

As noted in chapter I, the purpose of this dissertation is to investigate the empirical role of fiscal and monetary policy variables and of financial crisis in the interwar period. While it is possible to examine these issues within the framework of a structural model, it is firstly necessary to choose a particular macro model among several that may be considered. Since there is no consensus on which among many structural models is most appropriate and since choosing a particular structural model over others necessarily implies a priori rejection of at least some aspects of the models that are not chosen, using a structural model in this dissertation would be contentious and require adherence to one among several plausible theoretical viewpoints.

In addition to the above considerations, Sims (1980a) has argued that many of the restrictions used in the specification of structural models are "incredible" in that they are inadequately supported by theoretical and/or institutional considerations. Among the most widely used "incredible" restrictions is the assertion that variables are exogenous when they may actually be endogenous. In this regard, Sims (1980a) and Lucas and Sargent (1979) have suggested the use of Granger causality tests to determine the exogeneity or endogeneity of variables before they are specified as such in the construction of structural models. However, several authors including Cooley and LeRoy
(1985), Leamer (1985), and Eichenbaum (1985) have questioned the ability of tests of Granger causality to establish exogeneity. Therefore, the feasibility of avoiding Sims' criticisms of structural models by allowing the data to determine what exogeneity restrictions are to be employed does not appear to be a viable option. Given the absence of agreement among macroeconomists as to the appropriate macro model, Sims' criticisms, and the difficulty surrounding the use of Granger causality tests as a means of finding appropriate exogeneity restrictions, I elect to employ vector autoregression (VAR) models of the type suggested by Sims (1980a) to investigate the issues of concern in this dissertation.

A VAR model is a multivariate reduced form that treats all variables as jointly determined and thereby avoids the imposition of potentially spurious exogeneity restrictions in the estimation of the VAR. Of course, theoretical considerations enter into the selection of the variables in the VAR. As discussed later in this chapter, the reduced form nature of the VAR makes it difficult to interpret its parameters. Therefore, the interpretation of the model is based on complicated functions of the VAR's parameters called impulse response functions (IRFs) and variance decompositions (VDCs).

In accordance with our previously mentioned intentions, the purpose of this chapter is to provide a summary of the statistical and theoretical issues that are pertinent to the specification, interpretation, and use of vector autoregressions (VARs). In section II a discussion of the methodology involved in specifying a VAR is
undertaken. Section III describes the procedures employed in interpreting the parameters of the estimated model, while section IV is devoted to a discussion of the appropriateness of the VAR techniques outlined in sections II and III to the purposes of this study.

II. Specification of Vector Autoregression Models

A. The Basic Model

As noted in section I, the VAR models suggested by Sims avoid the use of possibly incorrect identifying restrictions by treating all variables in the model as jointly dependent. This means that the typical VAR model is a system of equations with each equation describing the evolution of the time series on one of the systems variables as a multivariate autoregressive process where the independent variables are lagged values of the dependent variable and that of all the other variables in the model. Moreover, the lag lengths on the independent variables are taken to be identical in all equations for all variables. Implicit in this formulation is the view that the data generation process which yields the set of time series under consideration can be represented as a vector process of finite order.

For heuristic purposes, consider a bivariate vector process where the systems variables are $\pi_1$ and $\pi_2$. Given a common lag length of two, the process may be described as a second order vector autoregressive process (VAR(2)), and may be written as:

$$\pi_{1t} = c_1 + \pi_{11,1}\pi_{1,t-1} + \pi_{11,2}\pi_{1,t-2} + \pi_{12,1}\pi_{2t-1} + \pi_{12,2}\pi_{1t-2} + \nu_{1t}$$

$$\pi_{2t} = c_2 + \pi_{21,1}\pi_{1,t-1} + \pi_{21,2}\pi_{1,t-2} + \pi_{22,1}\pi_{2t-1} + \pi_{22,2}\pi_{1t-2} + \nu_{2t}$$

(4.1)
where $c_1$ and $c_2$ are constants, the $\gamma$'s are parameters, and the $u$'s are white noise error terms.

In order to arrive at a more general formulation of the VAR model, let $\Pi = [\Pi_1, \Pi_2, \ldots, \Pi_n]'$ represent a column vector of the system's variables. Assuming that we have $T$ observations on each time series, then any of the components of $\Pi$, say $\Pi_1$, can be expressed as

$$
\Pi_1 = [\Pi_{11}, \Pi_{12}, \ldots, \Pi_{1n}]'.
$$

Additionally, let $u = [u_1, u_2, \ldots, u_n]'$ represent an $n \times 1$ vector of white noise error vectors such that the $i^{th}$ element of $u$ can be represented as $u_i = [u_{i1}, u_{i2}, \ldots, u_{in}]'$. Given the above definitions the model may be expressed as

$$
\Pi_1 = X\Gamma_1 + u_1
$$
$$
\Pi_2 = X\Gamma_2 + u_2
$$
$$
\vdots
$$
$$
\Pi_n = X\Gamma_n + u_n
$$

(4.2)

where

$$
X = [j, \Pi_{1t-1}, \ldots, \Pi_{nt-1}, \ldots, \Pi_{1t-p}, \ldots, \Pi_{nt-p}]
$$

$j$ is a $T \times 1$ vector of ones, while $p$ is the common lag length. Further, $\Gamma_i$ for $i = 1, 2, \ldots, n$ may be written as

$$
\Gamma_i = [c_i, \gamma_{i1}, \ldots, \gamma_{i1}, \gamma_{i2}, \ldots, \gamma_{i2}, \ldots, \gamma_{in}, \ldots, \gamma_{in}]'
$$

where $c_i$ is a constant and the $\gamma$'s are interpreted such that $\gamma_{i1}$ is the coefficient on the first lag of the first variable in the $i^{th}$ equation. The system of equations in (4.2) may be consolidated as

$$
\Pi = (L, sX)\Gamma + u
$$

(4.3)

"Time subscripts are omitted wherever such omission does not affect the clarity of the discussion."
where $\Gamma = (\Gamma_1, \Gamma_2, \ldots, \Gamma_n)$, $\otimes$ is the Kronecker product, and $I_n$ is an $n$-dimensional identity matrix.

B. Stationarity

Before considering the estimation of the VAR model, it is important to note that the efficiency of the estimator of $\Gamma(L)$ and the stability of the system are crucially dependent on the assumption that the vector process is stationary. Specifically, $\mathbf{W}_t$ is stationary if

(a) $E(\mathbf{W}_t) = \mu$ for all $t$, i.e., the mean of the vector process is constant over time;

(b) $\text{Var}(\mathbf{W}_t) < \infty$ for $1 = 1, 2, \ldots, n$ i.e. each of the time series that together form the vector process have finite variances; and

(c) $\text{Cov}(\mathbf{W}_t, \mathbf{W}_{t-k}) = E((\mathbf{W}_t - \mu)(\mathbf{W}_{t-k} - \mu)') = \Sigma_k$, i.e., the covariance matrices of realizations of the vector process that are $k$ periods apart do not depend on time $t$ but only on $k$. Additionally, this implies that for $k=0$, $\text{Cov}(\mathbf{W}_t, \mathbf{W}_t) = E((\mathbf{W}_t - \mu)(\mathbf{W}_t - \mu)') = \Sigma_0$.

At a more intuitive level, several authors including Granger and Newbold (1974), Plosser and Schwert (1978), and Nelson and Plosser (1982) have documented the deleterious effects of using nonstationary data for statistical inference from regression equations. Specifically, these authors assert that regressions estimated among nonstationary variables yield autocorrelated residuals as evidenced by low Durbin - Watson statistics. Further, and as is well known and carefully documented by Granger and Newbold (1974), autocorrelated residuals lead to: (a) inefficient estimates of the regression coefficients; (b) suboptimal forecasts based on these coefficients; and (c) an increase
in the likelihood of incorrectly rejecting the null hypothesis that coefficients are zero (Type I error).

In order to account for the nonstationarity that is widely recognized to exist in most macro series, it is customary to include a time trend in the regression model or to use the first differences of the series. The inclusion of a time trend is consistent with the view that the observed nonstationarity is due to a deterministic trend while the latter reflects the view that a stochastic trend is responsible. Chan, Hayya, and Ord (1977) and Nelson and Kang (1981) have documented some of the deleterious effects of using the inappropriate transformation to detrend the data. Additionally, Nelson and Plosser (1982) have shown that the assumption and use of a deterministic trend greatly restricts the relevance of the past to the future. It is therefore clear that the method used to detrend the data is of nontrivial importance.

In order to determine whether a series follows a deterministic or stochastic trend, Nelson and Plosser have recommended ordinary least squares (OLS) estimation of an equation of the form

$$Z_t = \alpha + \beta t + \rho_1 Z_{t-1} + \rho_2 V_{t-1} + \ldots + \rho_k V_{t-k} + e_t \quad (4.4)$$

where $Z_t$ is the log of the time series under consideration, $V_t$ is the first difference of $Z_t$; $e_t$ is a white noise error term; $t$ is time; and $\alpha$, $\beta$, and $\rho_1, \ldots, \rho_k$ are parameters. These authors proceed to show that hypothesizing $\rho_1 = 1$ is equivalent to postulating that the series under consideration exhibits stochastic nonstationarity and that first differencing is the appropriate transformation.\(^2\)
Dickey (1976), Fuller (1976), and Dickey and Fuller (1979) have noted that under the null hypothesis that $p_i = 1$, the usual t-ratios do not follow the t-distribution. In particular, they note that the distribution of the least squares estimator of $p_i$ is biased towards zero and is skewed to the left when $\alpha = 0$. Accordingly, Monte Carlo experiments conducted by Nelson and Plosser (1982) indicate that standard testing procedures are strongly biased towards rejecting the null hypothesis that $p_i = 1$. Therefore, Dickey and Fuller provide tabulations of the empirical distribution of the t-ratio for testing the hypothesis that $p_i = 1$ (see Fuller (1976, pp. 373, table 6.5.1)).

It is important to choose the correct order $k$ in equation 4.3 since the validity of the unit root test is dependent on the assumption that the autoregressive process described is a good approximation to the true data generation process. While various procedures may be used to select $k$, it is important to test the sensitivity of the test to variations in $k$. Additionally, it is instructive to consider higher as opposed to lower orders since choosing an order that is lower than the

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Nelson and Plosser among others have expressed concern about the power of these unit root tests when $p_i$ is close to but not equal to 1. To the extent that the test lacks power, it may incorrectly accept the null, indicating first differencing when the inclusion of a time trend is the appropriate transformation. While this consideration should prompt caution in the use of these tests, it need not indicate that the model should be estimated using alternative transformations. This view stems from the work of Plosser and Schwert (1978), who demonstrate that the deleterious effects of overdifferencing are far less severe than that of underdifferencing. Additionally, and in response to the criticism by some authors that differencing removes some of the relationship between variables, Plosser and Schwert show that differencing a correctly specified model does not change the nature of the results. Therefore, they argue that radical changes in results are more likely due to model misspecification.
true order will lead to bias while an order that is higher than the correct order will only lead to a reduction in the efficiency of the estimates. Since our primary concern in equation (4.4) is with hypothesis testing, a loss of efficiency is the lesser of the two evils.3

C. Choice of Variables and Lag Length Determination

Two of the most crucial aspects of specifying a VAR model are the choice of variables that define the vector process and the determination of the number of lags with which these variables enter the system. While vector autoregressive models are generally considered to be atheoretical, the choice of variables that define the vector process is usually based on theoretical considerations. Lutkephol (1982) has demonstrated that omitted variables problems make it difficult if not impossible to accurately draw conclusions about the relationships among a small number of variables on the basis of a time series model that includes only these variables. This is because many economic variables interact so that the exclusion of a variable from the system is tantamount to assuming on a priori grounds that it does not affect interactions among the variables of interest. However, given the constraints imposed by the modelling technology, it is advisable to limit the number of variables entering the system on the basis of

3If the choice of k in equation (4.4) is correct, it is reasonable to expect \( e_t \) to be a white noise error term. Therefore, a useful check on model adequacy is to calculate the Ljung - Box Q-statistic. This statistic is distributed as a \( \chi^2 \) and rejects the null hypothesis that \( e_t \) is white noise and thereby that the model is adequate when Q takes on high values. (see Ljung and Box (1978) for more details).
economic theory.

The order of the vector autoregressive process is usually determined on the basis of some criteria that in general attempts to achieve a trade-off between goodness of fit and parsimony. Judge et. al (1988, pp. 762) have noted the availability of a wide range of criteria, each of which may select a different order for the same sample. As is well known, the exclusion of relevant regressors is likely to lead to biased estimates while the inclusion of irrelevant regressors results in unbiased but less efficient estimates. This suggests that the choice of criterion may be partially guided by the intended use of the estimated VAR model. Specifically, if the key concern is with hypothesis testing or inference, it is crucially important to have unbiased estimates. However, if the primary objective is forecasting, efficiency becomes more important than the unbiasedness of the estimates. In this regard, the use of a criterion that tends to select generous lags and hence avoids bias due to underestimation of the lag length is well suited to the inferential purposes of this study. On this basis, Akaike's information criterion (AIC) will be employed.

Akaike's information criterion requires that the order chosen be the one that minimizes

$$AIC(j) = \ln \det I_s + (2d^2j) / T \text{ for } j = 1, 2, \ldots, m$$

where: $\det I_s$ is determinant of $I_s$; $I_s$ is the estimated variance-covariance matrix of residuals for the $j^{th}$ order vector autoregression; $d$ is the number of variables in the system; $m$ is the maximum lag
length considered; and \( T \) is the number of observations. Since the choice of an order selection criterion does not ensure that the model specified is the appropriate model it is instructive to conduct checks on model adequacy. In this regard the Q-statistic discussed in footnote 3 above is suggested.

D. Estimation of VAR Models

Since the \( X \) matrix in the system of equations in (4.2) does not include contemporary terms, any contemporaneous effects are captured within the error terms. Therefore, if the variables in the model are contemporaneously correlated, the components of \( u \) will show contemporaneous correlation. The likelihood of this correlation would suggest use of seemingly unrelated regression (SUR) techniques in estimation of the system; however, it is well known that since the \( X \) matrix is identical for all the models equations, the least squares estimator is identical to the generalized least squares estimator. Therefore, the system may be consistently estimated on an equation by equation basis using OLS. In particular, the parameter vector for the \( i^{th} \) equation is given by

\[
\hat{\Gamma}_i = (X'X)^{-1}X'u_i
\]  

(4.6)

while for the complete system given in equation (4.3) the estimator is given by

\[
\hat{\Gamma} = [ L \phi (X'X)^{-1}X']\Upsilon
\]  

(4.7)

Under the assumptions that (a) \( u \) is distributed as a multivariate normal given by \( \mathbb{N}(0,\Sigma) \), (b) \( u_0 \) and \( u_t \) are independent for \( t \neq s \) and (c) \( \Upsilon \) is a stationary process, it can be shown that the estimator of \( \Gamma \) is
consistent. Additionally, as noted by Judge et. al, since \( u \) is assumed to be normally distributed, \( \Gamma \) is asymptotically equivalent to the maximum likelihood estimator and is therefore asymptotically efficient and normally distributed. That is

\[
(\Gamma - \Gamma) \sim N(0, L) (4.8)
\]

where \( L = LQ^{-1} \) with \( Q = \text{plim} (T)^{-1} (X'X) \)

III. Interpretation of VAR Models

A. Impulse Response Functions and Variance Decompositions

Interpretation of the coefficients given in equation (4.6) is difficult since the VAR model is a reduced form and therefore it may have several observationally equivalent representations. As a result of this difficulty, the interpretation of a VAR is usually based on the vector moving average (VMA) representation of the model. In order to elucidate the relationship between the autoregressive representation and the VMA representation, an alternative formulation of the basic VAR model is presented below. In particular, the model of equation (4.3) can be written as

\[
H_t = \Delta_0 + \Gamma (L) H_{t-1} + u_t (4.9)
\]

where, \( H_t = n \times 1 \) column vector of the systems variables representable as \( [H_1, ..., H_n]' \), \( \Delta_0 = n \times 1 \) vector of constants, \( u_t = n \times 1 \) column vector of white noise error terms representable as \( [u_{1t}, ..., u_{nt}]' \), and \( \Gamma (L) = n \times n \) matrix of polynomials in the lag operator, \( L \), such that:
\[
\Gamma(L) = \begin{bmatrix}
\Gamma_{11}(L) & \ldots & \Gamma_{1n}(L) \\
\vdots & \ddots & \vdots \\
\vdots & & \ddots \\
\Gamma_{n1}(L) & \ldots & \Gamma_{nn}(L)
\end{bmatrix}
\]

\(\Gamma_{ij}(L) = \Gamma_{i}\gamma_{j}L^i\) for \(i = 1,2,\ldots,j\); \(\gamma_{j}L^i\) is the coefficient on the \(i\)th lag of variable \(\gamma_{j}\) in equation 1; and \(L^j\gamma_{j} = \gamma_{j}L^{j-1}\). All other elements of \(\Gamma(L)\) are similarly defined. Additionally, \(j\) is the common lag length. Given a stationary vector process, \(\Gamma(L)\) is invertible and if we use the innocuous assumption that the constant terms in (4.9) are all zero, (4.9) has a VMA representation given by,

\[
\Pi_t = \Gamma_{i}\Pi_{t-1}u_{t-1} \quad i = 0,1,2,\ldots,n \quad (4.10)
\]

where \(\Pi_{t}\) is as defined previously, \(u_{t-1}\) is a column vector of shocks to the systems variables in period \(t-1\), and \(\Pi_{t}\) is a matrix of impulse response coefficients such that its \(kj\) element is the response of the \(k\)th variable to an unpredicted innovation in the \(j\)th variable in period \(t-1\) (i.e. the \(j\)th element of \(u_{t-1}\)). However, it is frequently misleading to interpret the elements of \(\Pi_{t}\) in this fashion since the presence of contemporaneous correlation among the elements of \(u_{t-1}\) make it difficult to isolate the response of the \(k\)th variable to innovations in the \(j\)th variable. More compactly, \(L_{c} = E\Pi_{t}u_{t}\) is not diagonal.

In order to more accurately interpret the elements of \(\Pi_{t}\), it is instructive to work with orthogonalized innovations. Since the
stationarity of the vector process ensures that $L_t$ is positive definite, this can be achieved by finding a nonsingular matrix $P$ such that $P P^T = I$. This implies that (4.10) can be written as

$$W_t = L_1 N_t P^{-1} P v_{t-1} = L_1 Q_t v_{t-1} \quad i = 0, 1, 2, \ldots, m$$

(4.11)

and that the $kj$th element of $Q_t$ can be correctly interpreted as the uncontaminated response of the $k$th variable in $W_t$ to a surprise innovation in the $j$th element of $v_{t-1}$. In general the matrix $P$ is not unique; therefore, the elements of $Q_t$ -- which are the impulse response functions (IRFs) -- will tend to vary with $P$. For our purposes, orthogonalization is achieved using the Choleski decomposition. This decomposition is based on the principle that there is only one factorization of $L_t$ into $SS^T$ such that $S$ is a lower triangular matrix with positive numbers along the diagonal. However, as the rows or columns of $L_t$ are rearranged $S$ will also tend to vary. This means that $Q_t$ will vary as the ordering of the variables change. It should be noted, however, that the choice of ordering matters only to the extent that there is contemporaneous correlation between the model's variables.

At a more intuitive level, it is instructive to note that the Choleski decomposition assigns credit for any contemporaneous correlation among the variables to variables higher in the ordering. Therefore, when a variable higher in the ordering changes, variables that follow it in the ordering are assumed to change. This has prompted Bernanke (1986) to argue that use of the Choleski decomposition imposes assumptions about economic causality on the
model. Therefore, he recommends that institutional and theoretical considerations should guide the choice of orderings.

In order to provide some additional intuition, it is instructive to view the IRFs as the end result of a simulation exercise where one of the system's variables is subject to a shock of given magnitude. Subsequently, the direct and indirect effects of this shock on the variable itself and on the other variables in the system are traced through future periods or horizons. The size and direction of these effects are given by the elements of $\Omega$, which are the IRFs. Therefore, the IRFs are really the dynamic multipliers of the system. Further, it is instructive to note that the magnitude of the shock to the system is usually chosen to be equal to one standard deviation; however, this choice is, in general, arbitrary.

In addition to the IRFs, the VMA representation provides another opportunity to interpret a VAR. This is so because the mean square error (MSE) or forecast error covariance matrix from an $h$-step forecast of the system can be decomposed into the portions accounted for by innovations in the individual variables. Since these variance decompositions (VDCs) rely on the VMA representation, they will tend to vary with the ordering of the variables in $L$.

To see this let $I(h)$ denote the mean square error matrix of an $h$-step forecast of $H$. Then

$$I(h) = E[(H_{T+h} - \bar{H}_T(h))(H_{T+h} - \bar{H}_T(h))^\prime]$$

(4.12)

where $H_{T+h}$ is the actual value of $H$ at period $T+h$ and $\bar{H}_T(h)$ is the forecast for period $T+h$. Since our earlier discussion implies that the
forecast \( W_T(h) \) is unbiased, \( I(h) \) is equal to the forecast error covariance matrix. It can be shown that

\[
I(h) = L_0 + H_1 L_1 H_1' + \ldots + L_{-1} L_{-1} L_{-1}'
\]  

(4.13)

where the \( H_i \)'s are the complicated functions of the autoregressive parameters of the VAR defined in (4.10) and \( L_0 \) is as defined earlier. Additionally, the previously defined \( P \) matrix can be used to orthogonalize the innovations in (4.13) so that (4.13) may be rewritten as

\[
I(h) = Q_0 Q_0' + Q_1 Q_1 + \ldots + Q_{-1} Q_{-1}'
\]  

(4.14)

where \( Q_i \) is as defined earlier. The \( n^{th} \) diagonal element of \( Q_i Q_i' \) is the sum of squares of the elements in the \( n^{th} \) row of \( Q_i \). The forecast error variance of the \( h \)-step forecast of the \( n^{th} \) variable in \( W \) is given by the sum of the \( n^{th} \) diagonal elements of \( Q_0 Q_0', \ldots, Q_{-1} Q_{-1}' \).

Further, the forecast error variance of the \( n^{th} \) variable can be decomposed into the fractions attributable to innovations in the individual variables. This decomposition yields the variance decompositions (VDCs) which give an indication of the relative importance of innovations in the \( j^{th} \) variable in explaining fluctuations in the \( n^{th} \) variable. Additionally, Sims (1982) has noted that the VDCs give some indication of the strength of Granger causal relationships. However, it should be noted that VDCs do not give any indication of the direction of the effect of one variable on another. Further, it bears reemphasizing that the VDCs as captured within equation (4.14) depend on the \( P \) matrix and as such are affected by the ordering of the variables in \( L_0 \).
B. Measures of Confidence for VDCs and IRFs

It is customary for IRFs and VDCs to be reported without confidence intervals or standard errors. However, Runkle (1987) has noted that this is equivalent to reporting regression coefficients without t-statistics and has outlined procedures that may be used to calculate empirical standard errors for the point estimates of IRFs and VDCs.

Several authors including Genberg, Salemi, and Swoboda (1987) and Christiano (1986) have used a Monte Carlo integration procedure outlined in Doan and Litterman (1984) to compute standard errors and means for the VDCs and IRFs. The procedure used in this study to compute standard errors for the VDCs and IRFs is based upon example 19.1 of Doan and Litterman (1984). Given these standard errors and means, confidence intervals may be constructed for the IRFs and VDCs by taking two standard deviations on each of the mean.

IV. Innovation Accounting

The two most widely encountered uses of vector autoregressions are Granger causality testing and innovation accounting. While these techniques have received significant acceptance in the literature, substantial debate persists as to the appropriate uses of these techniques in macroeconomic analysis. As a result of this ongoing debate, a number of "legitimate" uses of these techniques have been identified. Since the primary empirical technique used in the following empirical chapters is innovation accounting, in what follows I attempt
to clarify the appropriateness of this technique for the purposes of this dissertation.

Innovation accounting refers to the use of IRFs and VDCs to analyze the dynamic effects of innovations in the system's variables on the other variables in the model. As noted in section III, the VAR model is a reduced form, and as such, it may be one of several observationally equivalent representations of a whole class of structural models. Therefore, it is generally difficult to distinguish among structural hypotheses by examining IRFs and VDCs. Cooley and LeRoy (1985, pp 304) have observed that "The exclusive purpose of nonstructural modeling is to capture the probabilistic characteristics of the data under examination and to answer questions that can be answered with that information".

As noted in section III, the presence of contemporaneous correlation among the variables in a VAR necessitates the use of orthogonalized innovations in the calculation of IRFs and VDCs. The most common decomposition used to achieve orthogonal innovations is the Choleski decomposition. Bernanke (1986) and Gordon and King (1982) have shown that the manner in which the variables are ordered in the variance covariance matrix of residuals imposes a recursive structure on the model. In particular, Bernanke has cautioned against the use of an ordering if the analyst does not have theoretical and/or institutional reasons to believe that the system under investigation exhibits the recursive structure implied by that ordering. Additionally, it is instructive to point out, as do Gordon and King,
that choosing a particular ordering is equivalent to distributing zero restrictions on the contemporaneous values of the model's variables. The above considerations indicate that the validity of the IRFs and VDCs may be subject to the theoretical and institutional considerations that guide the choice of ordering. Throughout the empirical discussion that follows in chapters V and VI every attempt is made to allow these considerations to influence the choice of ordering.

Based on the analysis in Cooley and LeRoy (1985), Leamer (1985), and Elchenbaum (1985), several appropriate uses of VARs are recommended. These include: (a) testing theories that imply Granger causal relationships without interpreting the results in terms of the exogeneity or endogeneity of the variables concerned; (b) establishing empirical regularities against which the predictions of existing theories may be compared or which may be used as a guide in the formulation of new theories and their attendant structural models; (c) describing the time series behavior of the economy; and (d) forecasting. In the empirical analysis conducted in chapters V and VI, my primary purpose is to generate empirical regularities against which the predictions of competing theories may be compared. Therefore, use of the innovation accounting techniques outlined in this chapter is clearly appropriate.
CHAPTER V

THE MACROECONOMIC EFFECTS OF FISCAL AND MONETARY IMPULSES:

EMPIRICAL EVIDENCE FROM THE INTERWAR PERIOD

I. Introduction

The purpose of this chapter is to evaluate the macroeconomic role of fiscal and monetary policy variables such as deficits, average personal marginal tax rates, government expenditures, and the money supply in the interwar period in order to generate empirical regularities against which the predictions of competing macroeconomic theories may be compared. In order to do this we employ vector autoregressive techniques and monthly data from July 1921 - June 1938.

In chapters I and II several shortcomings of the empirical literature on the issues of concern here were identified. The analysis in this chapter attempts to rectify these shortcomings and thereby make some meaningful contributions to the literature in this area. This is done by: (a) concentrating on the interwar period; (b) using vector autoregressive techniques of the type described in chapter IV; (c) including a measure of average personal marginal tax rates and government expenditures in the VAR model; and (d) presenting measures that allow a judgement as to the precision with which the impulse response functions (IRFs) and variance decompositions (VDCs) are estimated. Additionally, the inclusion of the tax measure allows us to evaluate the infrequently analyzed empirical role of changes in marginal tax rates.
In what follows, the model employed is specified in section II while section III is devoted to a description of the empirical methodology. Section IV presents the empirical results and their interpretation. Finally, section V summarizes the conclusions drawn from the analysis that precedes it.

II. Model Specification

In order to evaluate the macroeconomic effects of fiscal policy, it is assumed that the macroeconomy can be represented by a vector process defined by seven variables: namely, the interest rate (RCP); the money supply (M2); deficits (DEF); government expenditures (EXP); wholesale prices (VPI); industrial production (IP); and average personal marginal tax rates (XTAX). Following Sims (1980a), a vector autoregressive model is specified and estimated. This vector process approach is used in lieu of a structural approach in order to avoid using restrictions that are inadequately supported by economic theory. As noted in chapter IV, VARs may be legitimately used to establish empirical regularities that may be compared to existing theories or used as a guide in formulating new theories. Additionally, Fischer (1981) and Genberg, Salami, and Swoboda (1987) note that VARs are useful devices in studying the channels through which a variable operates since very few a priori restrictions are imposed on the interactions among the variables of the system. Since my primary purpose is to establish empirical regularities for the interwar period and to examine the macroeconomic role of the policy variables in the model, the use of a VAR is clearly appropriate.
A. Choice of Variables

As noted in chapter IV, the key steps in the specification of a VAR model are the choice of variables that enter the system and determination of the common lag length. In this regard, the variables that enter the system used here were chosen because of their macroeconomic interest and to avoid omitted variables problems of the type described by Lutkephol (1982). Since this approach could lead to models that exhaust our technological capabilities, the choice of variables was also guided by economic theory. Accordingly, the rate of interest summarizes conditions in the financial markets while industrial production and prices reflect the state of the goods market. Additionally, monetary policy is represented by the money supply while the stance of fiscal policy is indicated by government expenditures, deficits, and average personal marginal tax rates.

Further, and in order to better understand the role of government expenditures and average personal marginal tax rates in the model, it is instructive to compare the set of fiscal actions considered to be expansionary in the conventional (Keynesian) view to that in the Ricardian view. Within the Ricardian framework, expansionary fiscal policies are limited to increases in government spending and reductions in average marginal tax rates. However, in the conventional paradigm, the set of expansionary fiscal policies is expanded to include the substitution of debt for tax finance for a given level of government expenditures. Therefore, in order to evaluate empirically the role of deficits in the macroeconomy, it is necessary to isolate its effects
from that of other fiscal variables. Within the framework of the model used here, this is achieved by inclusion of government expenditures and average personal marginal tax rates in the model.

B. Data Sources

As noted in subsection II. A above, the list of variables to be used in this chapter include the rate of interest, prices, the supply of money, industrial production, deficits, federal government expenditures, and average marginal personal tax rates. Monthly observations on the empirical counterparts to these variables are used throughout the dissertation. These empirical counterparts were chosen as follows.

The interest rate series (RCP) is the 4-6 month rate on prime commercial paper and comes from *Banking and Monetary Statistics 1914 - 1941* (Board of Governors of the Federal Reserve System, 1943). The price measure (VPI) is the wholesale price index and comes from the 1933, 1938, and 1943 editions of the *Statistical Abstract of the United States*. Data for the industrial production series (IP) with 1977 as

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' Ideally, it would be preferable to use a more general measure of income taxes that incorporates personal social security and corporate income tax rates. However, such a measure is currently unavailable. Sasser (1985) has calculated separate series of average personal and corporate marginal income tax rates, but it is difficult to consolidate them. This means that a choice must be made between the personal and corporate tax measures. However, since these taxes accounted for a roughly equal percentage of tax revenue during the interwar period – see *Annual Reports of the Secretary of the Treasury on the State of Finances* (1940, pp. 466-534) -- there is no objective criterion upon which to base this choice. Subsequent analysis indicates that the first differences of these variables should enter the model. Since there is very little variation in the corporate series, taking first differences makes approximately 90 percent of the observations zero. Therefore, the only viable tax measure is the average personal marginal tax rate which includes an adjustment for social security taxes for 1937 - 38.'
base year is taken from the 1985 revision of *Industrial Production* (Board of Governors of the Federal Reserve, 1985). Money (M2) is represented by Friedman and Schwartz's (1963) measure of M2 from their table A-1. The deficit (DBF) is calculated on a cash basis as receipts minus expenditures so that an increase in DBF is really an increase in the surplus. Government expenditures (EXP) includes transfer payments but these are very small relative to expenditures. Finally, both deficits and government expenditures are measured in billions of dollars and come from Firestone (1960), table A-3.

The monthly measures of the average personal marginal tax rates used here are derived from the yearly rates calculated by Seater (1982; 1985a). Following Boschen and Talbot (1987), the monthly data for month n of year t is represented as:

\[
MTAX_{tn} = \frac{(12-n)}{12} MTAX_{t-1} + \frac{n}{12} MTAX_t
\]

where \(MTAX_{tn}\) = the average marginal tax rate for the nth month of year t; \(MTAX_t\) = Seater's measure of the average marginal tax rate for year t; \(MTAX_{t-1}\) = Seater's measure of the average marginal tax rate for year t-

A potential objection to the use of M2 instead of M1 is that in contrast to M1 which contains only items that are media of exchange, M2 contains time deposits which can be used as a medium of exchange only after conversion into currency or demand deposits. However, Friedman and Schwartz (1963 pp. 649-53) have noted that this criticism may hold for very large denominations of currency. Further, they argue that the choice of monetary aggregate should depend on "the empirical stability and regularity of relationships between the chosen total and other variables."

In light of the portfolio approaches to the demand for money, it seems reasonable to include time deposits in the monetary aggregate since there is a greater degree of substitutability between time deposits and demand deposits than there is between time deposits and other financial assets.
year \( t-1 \); for \( n = 1, 2, \ldots, 12 \) and \( t = 1921, 1922, \ldots, 1938 \). This procedure was used to generate monthly data for average personal marginal tax rates from July 1921 to June 1938.

Use of the above procedure is intuitively appealing since it allows the value for month \( n \) of year \( t \) to be more heavily influenced by the yearly observation closest to it in time. Additionally, this method yields a fairly smooth series which appears to be consistent with the view that monthly changes in marginal tax rates are not dramatic.

C. Stationarity and Lag Length Selection

In chapter IV we noted that a crucial requirement of the VAR approach is that the time series under consideration be stationary. However, it is well known that most macro series are nonstationary. In order to determine the form of this nonstationarity, and thereby, the appropriate transformation required, unit root tests of the type suggested by Nelson and Plosser (1982) and described in chapter IV were implemented for all the variables chosen to enter the model. Further, the sensitivity of the results to the choice of order \( (k) \) in (4.4) was tested by conducting these tests for \( k = 3, 6, \) and 12. In all cases and for all variables the null hypothesis that these series exhibit stochastic nonstationarity \( (p_i=1) \) and that first differencing is the appropriate transformation could not be rejected.\(^2\) Therefore,

\(^2\)Equation (4.4) requires taking the logs of the series in question except with respect to RCP, DBF and MTAX. Taking the first differences of the log of RCP and MTAX would convert these rates to rates of rates of growth, which would be rather difficult to interpret. Additionally, we are unable to take the log of DBF since the series contains some negative numbers.
the empirical analysis proceeded with all variables entering the model in their first differences.

Following Lutkepohl (1982), McMillin (1988), McMillin and Beard (1988), and McMillin and Koray (1989), the lag length is specified using Akaike's AIC criterion. (This criterion is formally specified in chapter IV, equation (4.5)). Taking the maximum lag length considered to be twelve (i.e. $m = 12$ in (4.5)), this criterion indicated an optimal lag length of six.

In summary, the model specification requires that we use DLX2, DLIP, DLEXP, DLWPI, DRCP, DMTAX, and DDBF as the system variables, where DLX2, DLIP, DLEXP and DLWPI are the first differences of the log of M2, IP, EXP and WPI, respectively, and DRCP, DMTAX, and DDBF are the first differences of RCP, MTAX and DBF. After accounting for observations lost due to the maximum lag length of twelve used in choosing the optimal lag length and that due to taking first differences, the model was estimated for the period August 1922 to June 1938. The empirical methodology and interpretation of the results to be derived are presented in section III below.

III. Empirical Methodology

The primary purpose of the empirical analysis conducted here is to evaluate the macroeconomic role of the fiscal and monetary policy variables included in the model. Specifically, concern centers on the consistency of the Ricardian equivalence and debt monetization hypotheses with the empirical regularities that emerge from the analysis. Further, special attention is paid to the role of average
personal marginal tax rates, government expenditures, and money in the macroeconomy. In order to examine these issues, the VAR model outlined in the previous section was estimated on an equation by equation basis using OLS. Examination of the Ljung-Box Q-statistic for each of the model's equations indicated that the model is well specified. Since the resulting parameter estimates are difficult to interpret, IRFs and VDCs are computed and used to evaluate the issues under consideration. As noted in chapter IV, it is important to decompose the variance covariance matrix of residuals such that the innovations are orthogonal. Accordingly, we use the Choleski decomposition to achieve this. Since the IRFs and VDCs are sensitive to the manner in which the variables are ordered in the variance covariance matrix of residuals, and since the Choleski decomposition imposes a recursive structure on the model, it is instructive to try different orderings and to allow theoretical and institutional considerations to influence the choice of orderings.

In light of the foregoing and in order to effectively interpret the model, five distinct orderings were considered. These are: (1) DLXIP, DMXAI, DDBF, DLM2, DRCP, DLIP, DLVPI; (2) DMXAI, DLXIP, DDBF, DLM2, DRCP, DLIP, DLVPI; (3) DLM2, DLXIP, DMXAI, DDBF, DRCP, DLIP, DLVPI; (4) DLXIP, DMXAI, DDBF, DLM2, DRCP, DLVPI, DLIP; and (5) DLXIP, DMXAI, DDBF, DLM2, DLIP, DLVPI, DRCP.

The rationale for these orderings is as follows. Firstly, the model's variables are considered to be in two blocks. Block one is comprised of the fiscal and monetary policy variables, namely, DLXIP,
DNTAX, DDEF and DLM2. Block two includes DRCP and the goods market variables namely, DLIP and DLWPI. In accordance with the widely used rational expectations models of the macroeconomy, contemporaneous values of the variables in block two are assumed not to influence the variables in block one while innovations in the policy variables affect the goods and financial markets. This view implies that the variables in block one should precede those in block two. This general principle is adhered to throughout this chapter and is reflected in the alternative orderings listed above.

In ordering (1) the fiscal policy variables precede the monetary policy variable in order to reflect those theories which advocate that the monetary authority responds to innovations in the fiscal policy variables, particularly DDEF. Since one of the concerns of this chapter is to investigate the empirical validity of the debt monetization hypothesis, it seems reasonable to allow every opportunity for innovations in DDEF to influence DLM2. Among the fiscal variables, DLEXP and DNTAX are placed first in order to reflect the predominant theoretical view that these variables are more likely influenced by factors outside the model and that they influence other key variables in the system. Additionally, since the level of deficits depends on the difference between tax revenues and government expenditures, it appears reasonable to argue that DDEF is likely to be contemporaneously influenced by these variables.

Ordering (2) is motivated by the virtual impossibility of determining on a priori grounds the order in which DLEXP and DNTAX
should enter the model. Therefore, ordering (2) differs from ordering (1) in that DMTAX precedes DLEXP. Since examination of the IRFs and VDCs for both orderings indicate no substantial difference in the results, I conclude that the manner in which the set of fiscal variables are ordered in relation to each other does not matter. Therefore, the analysis proceeded with the set of fiscal variables ordered as in (1).

For ordering (3) attention is paid to the possibility that monetary policy is conducted independently of fiscal policy and that the fiscal authority, because of the difficulty it faces in arriving at a policy consensus, uses the positions taken by the FED as a common starting point for the formulation of fiscal policy. In order to allow for this, DLM2 is placed before the fiscal policy variables in (3). Since the VDCs and IRFs for (3) are not materially different from that in (1), it is concluded that the ordering of the policy variables is of little importance and so we proceed with (1).

Throughout the foregoing discussion and in orderings (1) to (3), the variables in block two were ordered as DRCP, DLIP, and DLVPI. This ordering is consistent with the usual IS-LM approach to the macroeconomy where innovations in policy variables affect interest rates which in turn influences industrial production and prices. However, it is not clear that DLIP should precede DLVPI since it is possible to argue that the two are determined simultaneously. Therefore, in order to allow for the possibility that this uncertainty is important, DLVPI is placed before DLIP in (4).
As noted by Gordon and Veitch (1986), the efficient markets hypothesis implies that the interest rate responds instantaneously to innovations in other pertinent variables. This suggests that DRCP should be placed last so that it is contemporaneously influenced by all variables in the model. Consequently, DRCP is placed after the goods market variables in ordering (5). In all cases (i.e. orderings (1) through (5)) the choice of ordering did not materially affect the results. Therefore, I report only the results derived from ordering (1).

In order to provide some indication of the precision with which the IRFs and VDCs are estimated, and thereby a measure of the confidence that may be placed in these estimates, I use the Monte Carlo integration procedure outlined in Doan and Litterman (1984) to calculate their means and standard errors from 500 draws. Further, assuming that the parameters of the IRFs and VDCs are approximately normally distributed, we can make the following interpretations. For the VDCs, the ratio of a point estimate to its standard error provides an intuitive guide to the "significance" of that estimate. Therefore, a quasi t-value of at least 2 will be interpreted as indicating that the point estimate is "significantly" different from zero at the 5 percent level while a quasi t of at least 1.65 will be taken to indicate "significance" at the 10 percent level. Further, under the assumption that the IRFs are distributed approximately normal, I calculated 95 percent confidence intervals for the IRFs by taking 1.96 standard deviations on each side of the mean. The upper and lower bounds of the
confidence intervals were then plotted together with the point estimates. The point estimate is then considered to be significantly different from zero at a particular horizon if for that horizon it falls within the confidence bands and the confidence intervals do not include zero. If the confidence bands include zero at a particular horizon the point estimate at that horizon is taken to be insignificantly different from zero. These results are reported in figures 5.1 through 5.5. Point estimates of the VDCs together with standard errors are presented in table 5.1.

IV. Empirical Results

A. Ricardian Equivalence

The Ricardian equivalence hypothesis leads us to expect that an increase in the deficit, holding government spending and tax rates constant, has no real effects on the macroeconomy. Within the framework of the VAR model this means that variance decompositions of interest rates, industrial production and prices should show that the percentage of the forecast error variance of these variables attributable to innovations in deficits is statistically insignificantly different from zero. Moreover, the impulse responses of these variables to a one standard deviation shock to deficits should not be significantly different from zero.

In table 5.1 the variance decomposition of DRCP shows that the percentage of the forecast error variance attributable to DDEF varies from 0.7 in the first horizon to 2.0 in the forty-eighth. Moreover, our quasi t-test indicates that these point estimates are not significantly
different from zero at either the 5 or 10 percent level of significance. The first graph in figure 5.1 plots the impulse responses of DRCP to a one standard deviation innovation in DDEF together with the upper (DRCPUB) and lower (DRCPLB) bounds of a 95 percent confidence interval constructed by taking 1.96 standard deviations on each side of the mean. The inclusion of zero within this confidence interval is interpreted to mean that the response is insignificantly different from zero. Therefore, for example, since DRCP falls within the area bounded by DRCPUB and DRCPLB which includes zero throughout the forty-eight month forecast horizon, we conclude that the response of DRCP to innovations in DDEF is not significantly different from zero.

Point estimates of the forecast error variance of DLIP attributable to deficits vary from 0.9 percent in the first horizon to 2.6 in the twenty-fourth, thirty-sixth and forty-eighth horizons. In all cases the ratio of the point estimate to the standard error indicates that the point estimates are statistically insignificant at the 5 and 10 percent levels. The plot of the IRFs of DLIP to a one standard deviation innovation in DDEF together with upper (DLIPUB) and lower (DLIPLB) bounds of confidence intervals constructed as described for DRCP above is shown in the second graph of figure 5.1. This shows that there is no significant response of DLIP to changes in DDEF.

The VDCs of DLVPI in table 5.1 show that the portion of its forecast error variance that can be attributed to innovations in DDEF
Table 5.1: VDCs and Standard Errors*

<table>
<thead>
<tr>
<th>FEV in Months Later</th>
<th>DLEXP</th>
<th>DMTAX</th>
<th>DDEF</th>
<th>DLM2</th>
<th>DRCP</th>
<th>DLIP</th>
<th>DLWPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLEXP 1</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
</tr>
<tr>
<td>12</td>
<td>91.6*</td>
<td>0.9</td>
<td>2.2</td>
<td>1.3</td>
<td>0.9</td>
<td>1.4</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>(5.3)</td>
<td>(1.8)</td>
<td>(2.3)</td>
<td>(2.1)</td>
<td>(2.1)</td>
<td>(2.0)</td>
<td>(2.0)</td>
</tr>
<tr>
<td>24</td>
<td>91.1*</td>
<td>0.9</td>
<td>2.2</td>
<td>1.4</td>
<td>1.0</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>(5.7)</td>
<td>(1.8)</td>
<td>(2.4)</td>
<td>(2.1)</td>
<td>(2.2)</td>
<td>(2.1)</td>
<td>(2.0)</td>
</tr>
<tr>
<td>36</td>
<td>91.0*</td>
<td>1.0</td>
<td>2.2</td>
<td>1.4</td>
<td>1.0</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>(5.7)</td>
<td>(1.8)</td>
<td>(2.4)</td>
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*In table 5.1 the first row for a horizon (e.g. 12) is the point estimate of the VDC for that horizon while the standard errors are in parentheses. Additionally, a * indicates significance at the 5 percent level while a ** indicates significance at the 10 percent level.

**FEV stands for forecast error variance.
## Table 5.1 cont'd. VDCs and Standard Errors

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FIG 5.1 RESPONSES TO DOEF INNOVATION

1. RESPONSES TO DOEF Innovations in Partial Correlation of 
   (1.1) F = 0

2. RESPONSES TO DOEF Innovations in Partial Correlation of 
   (1.1) F = 0

3. RESPONSES TO DOEF Innovations in Partial Correlation of 
   (1.1) F = 0

4. RESPONSES TO DOEF Innovations in Partial Correlation of 
   (1.1) F = 0
varies from 2.9 percent in the first horizon to 3.4 in the twelfth, and 4.7 in the twenty-fourth, thirty-sixth and forty-eighth horizons. While our rough measure of significance indicates that the point estimates for the twelfth through forty-eighth horizons are statistically significantly different from zero at the 10 percent level, the magnitude of these effects are so small, it seems reasonable to judge them to be economically insignificant. In addition to the VDCs, the impulse responses of DLVPI to a one standard deviation shock to DDEF together with the upper (DLVPIUB) and lower (DLVPILB) bounds of the confidence intervals constructed as described for DRCP above is plotted in the third graph in figure 5.1. The plots indicate that the response of DLVPI to a surprise in DDEF is insignificantly different from zero throughout the forty-eight month forecast horizon.

The results outlined above provide no support for conventional macroeconomic models which suggest that an increase in deficits due to a switch between lump-sum tax and debt finance for a given level of expenditures will have a significantly positive effect on interest rates, output, and prices. These results demonstrate that DDEF had no significant effects on DRCP, DLIP, and DLVPI during the interwar period. This is consistent with McMillin and Beard (1988) who found no important effects of deficits on these variables for a sample period identical to that used here. Additionally, the results of this paper are similar to that of Evans (1985;1987) who found no significantly positive effects of deficits on interest rates for samples that included the interwar period. On the basis of the foregoing, it seems
reasonable to conclude that the Ricardian equivalence hypothesis is not inconsistent with the empirical regularities generated in this paper for the interwar period.

B. Debt Monetization

In a regime where the debt monetization hypothesis holds, one would expect that within the framework of the VAR model used here innovations in DDBF would account for a statistically significant percentage of the forecast error variance in the money supply (DLM2). Additionally, we would expect an unexpected one standard deviation innovation in DDBF to elicit a positively significant response in the DLM2. Therefore, the empirical validity of this hypothesis can be evaluated by looking at the appropriate VDCs and IRFs. The VDCs for DLM2 presented in table 5.1 show that the forecast error variance in DLM2 attributable to DDBF varies from 1.7 percent in the first horizon to a maximum of 3.0 in the forty-eighth horizon. Further, our rough measure of significance indicates that these point estimates are not significantly different from zero at either the 5 or 10 percent level. The point estimates of the impulse responses of DLM2 to a one standard deviation innovation in DDBF together with confidence bands constructed in a manner analogous to that described in section A above are presented in figure 5.2. Since the confidence bands include zero at all horizons, it is clear that impulse responses of DLM2 to surprise innovations in DDEF are insignificantly different from zero for the entire forty-eight month forecast horizon.
FIG 5.2 RESPONSE TO OOEI INNOVATION
The foregoing analysis provides no support for the debt monetization hypothesis. This result is directly consistent with the results of Joines (1985) and McKinnin and Beard (1988) who find no evidence of monetary accommodation in the interwar period.

C. Effects of Government Expenditures

As noted in chapter II, Barro's market clearing approach distinguishes between the effects of increases in permanent and temporary government purchases. Since temporary purchases are usually associated with war cycles, we note that the exclusion of war cycles from the sample used here allows us to interpret innovations in DLBXP as primarily shocks to permanent government purchases. Keynesian macroeconomic theory ignores the foregoing distinction and postulates that an increase in government purchases leads to increases in output, interest rates, and the general level of prices. On the other hand, the market clearing approach predicts that an increase in permanent purchases leads to an increase in output, no effect on interest rates, and ambiguous effects on the price level.

The VDCs of DRCP, DLIP, and DLVPI reported in table 5.1 indicate that only a small and statistically insignificant portion of the forecast error variance in DRCP and DLVPI can be attributed to DLBXP. A much larger and statistically significant portion of the forecast error variance in DLIP that ranges from 9.8 percent in the twelfth horizon, to 10.8 in the forty-eighth may be assigned to surprises in DLBXP. The IRPs and their corresponding confidence bands presented in figure 5.3, indicate that the responses of DRCP and DLVPI to DLBXP are
FIG 5. RESPONSES TO OLEXP INNOVATION

IRF OF DRCP

0 2 4 6
-2 -4

FORECAST HORIZONS

x10^-2

IRF OF DLIP

0 1 2 3
-1 -2

FORECAST HORIZONS

x10^-2

IRF OF DLWI

0 1 2 3
-1 -2

FORECAST HORIZONS

x10^-2
Initially positive but insignificant throughout the forty-eight month forecast horizon while those of DLIP are significantly positive from about the second through the fifth horizons, and insignificantly different from zero henceforth.

To the extent that the initial effects of DLEXP on DRCP, DLIP, and DLVPI are of the correct sign, it is reasonable to argue that these results are weakly consistent with the Keynesian view. This consistency is further reinforced by the statistical significance of the effects of DLEXP on DLIP. Further, it is clear that the empirical regularities generated with respect to the effects of DLEXP coincide exactly with what one would expect under Barro's market clearing approach. It is therefore reasonable to conclude that these empirical results are not inconsistent with the theory.

D. Role of Average Personal Marginal Tax Rates

The theoretical discussion in chapter II identified three theoretical approaches to the macroeconomic effects of changes in marginal tax rates. These were the Keynesian, Mankiw - Summers, and market clearing approaches. The Keynesian approach predicts that an increase in marginal tax rates will lead to a fall in output and ambiguous effects on interest rates, the price level, and the rate of inflation. The Mankiw - Summers framework postulates ambiguous effects on output, interest rates, the price level, and the rate of inflation. In Barro's market clearing approach the increase in marginal tax rates leads to falls in output and the after-tax real rate of
interest and ambiguous effects on the price level, inflation, and the before-tax real rate of interest.

As noted earlier, data constraints forced us to use the average marginal tax rate on personal income to the exclusion of marginal tax rates on corporate income. Consequently, the model used here does not capture the effects of innovations in marginal corporate marginal tax rates on corporate investment behavior. This is an important omission since an overwhelming percentage of investment expenditures is undertaken by corporations. It is therefore reasonable to expect that the response of aggregate demand to changes in DMTAX will be much weaker than it would be if DMTAX incorporated changes in corporate income taxes. In general this means that the empirical effects of DMTAX can be expected to be substantially weaker than what the theoretical models discussed above would lead us to expect.

Examination of the appropriate VDCs presented in table 5.1 shows that the fraction of variation in DRCP assignable to innovations in DMTAX varies from 0.4 percent in the first horizon to a maximum of 4.8 percent in the twenty-fourth, thirty-sixth and forty-eighth horizons. Additionally, our rough measure of significance indicates that these point estimates are insignificantly different from zero. The impulse responses of DRCP to a one standard deviation in DMTAX together with confidence bands constructed as described in the previous sections are plotted in the first graph in figure 5.4. Since the confidence bands include zero for all horizons, it is safe to conclude that the responses of DRCP to DMTAX are insignificantly different from
zero. This result is not inconsistent with any of the theoretical approaches considered above.

As shown in table 5.1, innovations in DNTAX account for statistically significant portions of the forecast error variance in DLIP that ranges from 10.0 percent twelve periods later to 11.2 percent by the forty-eighth period. The impulse responses of DLIP to DNTAX together with the appropriate confidence intervals are plotted in the second graph in figure 5.4. The plot shows that a one standard deviation shock to DNTAX elicits a significantly positive response from DLIP from the eighth through the thirteenth horizons and no significant response henceforth. This result is inconsistent with both the Keynesian and market clearing approaches; however, it is not inconsistent with the Mankiw - Summers model.

Finally, significant portions of the forecast error variance in DLVPI varying from 11.3 percent in the twelfth horizon to 17.4 in the forty-eighth, can be assigned to innovations in DNTAX. Additionally, the third graph in figure 5.4 plots the response of DLVPI to a one standard deviation shock to DNTAX. The response is significantly positive from the seventh through the nineteenth horizons and insignificant everywhere else. The behavior of DLVPI is not inconsistent with the theoretical approaches considered above since all three approaches fail to predict the effects of taxes on both the price level and the rate of inflation. Furthermore, the positive effects of the increase in DNTAX on both output and prices is consistent with the
FIG 5. RESPONSES TO OMTAX INNOVATION

- DACP
- DACPUB
- DACPLB

DLIP
DLIPUB
DLIPLB

V

DLWP
DLWPUB
DLWPILB

X10^2
realization of a positive effect on aggregate demand in the Mankiw-Summers framework.

E. Effects of Money Supply Shocks on the Macroeconomy

Traditional Keynesian and Monetarist together with the more recent incomplete information rational expectations and imperfect markets rational expectations models all indicate that money is non-neutral in the short-run. This means that an increase in the money supply is expected to cause an increase in output and prices and a fall in interest rates in the short-run. In the long-run money is generally considered to be neutral so that it has no effects on real variables.

Within the specific framework of this chapter, the theoretical views summarized above lead us to expect that the portion of the forecast error variances of DLIP, DRCP, and DLVPI attributable to variation in DLM2 should be statistically and economically significant. Additionally, a surprise innovation in DLM2 should elicit significantly positive responses in DLIP and DLVPI and significantly negative responses from DRCP. Moreover, these effects should be relatively short-lived reflecting the long-run neutrality of money.

The VDCs for DRCP reported in table 5.1 show that the fraction of its forecast error variance attributable to DLM2 is statistically significant for all horizons and is 14.3 percent in the first forecast horizon, reaches a peak of 16.1 in the twelfth horizon and falls to 15.7 by the forty-eighth. Additionally, the first graph in figure 5.5 shows that a one standard deviation innovation in DLM2 elicits significantly negative responses from DRCP in the first and second months following
the shock. Further, the confidence bands include zero in all other horizons indicating that the responses in those periods are insignificantly different from zero. These results are not inconsistent with the theory both with respect to the persistence and direction of the effects of DLK2 on DRCP.

In Table 5.1 the VDCs reported for DLIP show that the fraction of the forecast error variance in DLIP explained by variation in DLN2 ranges from 11.5 percent in the first horizon to 15.8 in the twelfth and falls to 14.9 percent by the forty-eighth horizon. The point estimates for all horizons are significant at the 5 percent level. In addition to the VDCs, the IRFs reported in the second graph of Figure 5.5 show that DLIP's response to a one standard deviation shock to DLN2 is significantly positive in the first and second months following the shock, becomes significantly negative between the third and fifth months, and is significantly positive from the seventh through ninth months. In all other horizons the responses were insignificantly different from zero. Since two out of three of the significant effects are positive and therefore of expected sign, and since it is possible to argue that the significant negative effects between the third and fifth horizons reflect the dynamic response of the system to the initial fall in DRCP and that it subsequently rebounds, it seems reasonable to argue that these results are roughly consistent with the theory.

The VDCs for DLWPI show that the percent of its forecast error variance explained by variation in DLH2 varied from a low of 0.0 in the
FIG 5.5: RESPONSES TO DLM2 INNOVATION

IRF of DRCP

-12
-8
-4
0
4
8
x10^-2
4 8 12 16 20 24 28 32 36 40 44 48
FORECAST HORIZONS

IRF of DLIP

-10
-6
-2
0
2
6
10
x10^-2
4 8 12 16 20 24 28 32 36 40 44 48
FORECAST HORIZONS

IRF of DLWPI

-3
-2
-1
0
1
2
3
x10^-2
4 8 12 16 20 24 28 32 36 40 44 48
FORECAST HORIZONS
first horizon to a maximum of 4.0 in the forty-eighth. Moreover, our rough measure of significance indicates that all of the point estimates were insignificantly different from zero. The corresponding impulse responses together with their confidence bands are reported in the last graph in figure 5.5. With the exception of a marginally significant positive effect in the first forecast horizon, the confidence bands include zero at all other horizons indicating that the responses in those horizons are insignificantly different from zero. These results indicate that growth in the money supply did not have much effect on prices and the rate of inflation during the interwar period. However, the work of Friedman and Schwartz (1963) leads us to expect much stronger effects on prices.

Given the nature of the period under investigation in this dissertation, it is instructive to explore the possibility that the seemingly anomalous results reported in the preceding paragraph may be reflective of the prevailing aggregate supply curve. Specifically, if the aggregate supply curve was relatively flat for most of the interwar period, shocks to variables that shift aggregate demand and leave aggregate supply unchanged would have large effects on output and smaller effects on the price level, and thereby, on inflation. However, a shock like an increase in marginal tax rates which has the potential to increase aggregate demand in the Mankiw - Summers framework and which shifts the aggregate supply curve inwards will lead to much larger increases in the price level, and potentially, in inflation. In this regard, examination of the VDCs for DLWPI show that shocks to
variables such as DLXIP and DLM2 which are expected to affect only aggregate demand, jointly account for only 7.2 percent of the forecast error variance in DLVPI in the forty-eighth forecast horizon. Moreover, these effects are insignificantly different from zero. In contrast the percent of the forecast error variance in DLVPI explained by innovations to DMTAX is significant at all horizons and varies from 11.3 percent in the twelfth horizon to 17.4 percent in the forty-eighth. In light of the Mankiw - Summers framework, these results appear to be supportive of the view that the aggregate supply curve for the United States during the interwar period was rather flat so that purely demand shocks had very little effect on the price level.

F. Potential Caveats

Several factors require that the results presented here should be interpreted with caution. The most obvious example is the interpretation of the effects of average personal marginal tax rates on the macroeconomy. Since the measure employed is clearly not the ideal measure, there is the possibility that the results are plagued by measurement error. Additionally, the absence of corporate taxes does not allow us to fully impose the world of lump sum taxes that Barro envisioned in his resuscitation of the Ricardian equivalence hypothesis. All of these caveats aside, it bears emphasizing that the inclusion of a tax measure in this model is a significant though incomplete step in the right direction.

One of the assumptions underlying the use of the VAR model is that of structural homogeneity over the sample considered. To the extent
that this assumption fails to approximate reality, the results derived ought to be less convincing. Therefore, it would be useful to split the sample and estimate the model for both subsamples and then compare the results across subsamples. If these results are similar to those derived for the full sample, we could interpret this as evidence in support of structural homogeneity. However, due to the large number of parameters estimated in this model it is clear that we would run out of degrees of freedom. Additionally, it would be difficult to decide where to split the sample since the interwar period was characterized by so many events around which a structural shift could have occurred. While these problems preclude direct evaluation of the possibility of structural nonhomogeneity, some indirect evidence may be brought to bear on this question. Specifically, McMillin and Beard (1988) using a smaller model than that employed here, found little change in their results when they split a sample identical to that used here. This result appears to tilt the evidence in favor of structural homogeneity.

Hsiao (1979;1981) has specified a procedure that uses the FPE criterion to specify the lag lengths for each variable in each equation in a VAR model. This procedure allows different variables to enter each equation with different lag lengths and therefore saves degrees of freedom. As a further test of robustness, I evaluated the role of the fiscal policy variables within the framework of a VAR of the type proposed by Hsiao. In all cases the results were very similar to that reported for the Sims system. This similarity while not conclusive is encouraging.
V. Concluding Comments

The foregoing analysis uses a Sims-type VAR to evaluate the role of fiscal and monetary policy in the interwar period. Attention is focused on the effects of deficits, government expenditures, average personal marginal tax rates, and money on the macroeconomy. Within the credibility bounds articulated in the previous section, several empirical regularities emerge.

Deficits are found to have no significant positive effects on interest rates, industrial production, and prices. While these results are inconsistent with the conventional (Keynesian) theoretical view, they are fully consistent with the Ricardian equivalence hypothesis. Additionally, I find no evidence of monetary accommodation in the interwar period.

Average personal marginal tax rates were found to have no significant effects on interest rates and small but significantly positive effects on industrial production and the rate of inflation. In comparing these results to Keynesian predictions, we find that DNTAX's effect on output is inconsistent, while its effect on interest rates and the rate of inflation are not inconsistent. Further, comparison to the predictions of the Mankiw - Summers model reveals that the behaviors of output, interest rates, and the rate of inflation are not inconsistent. The responses of both interest rates and prices are not inconsistent with Barro's market clearing approach. However, the positive response of output is inconsistent with this approach.
In addition to the tax effects, we find that the effects of government expenditures are consistent with Barro’s market clearing approach — when changes in government expenditures can be interpreted as permanent — and are weakly consistent with the more traditional Keynesian approach. Further, the effects of money supply shocks on output, interest rates, and prices are of expected sign and duration. The effects on DLVPI were surprisingly weak, but it appears reasonable to argue that this was probably due to a rather flat aggregate supply curve during the interwar period.

The results presented in the foregoing discussion allow us to make some comparisons among the theoretical frameworks considered. In particular, the empirical regularities generated with respect to the effects of deficits and government expenditures suggests that a Barro-type model in which government bonds are not net wealth provides a reasonably consistent explanation of the empirical facts. To the contrary, traditional models that treat government bonds as net wealth fail to explain the apparent insignificance of deficits and are only weakly consistent with the empiricism on the effects of government expenditures. Both the Keynesian and market clearing approaches were unable to explain the empirical effects of DMTAX; however, these tax effects appeared to be more supportive of the Mankiw-Summers framework. In sum, it seems reasonable to conclude that the empirical regularities generated in this chapter for the interwar period do not provide overwhelming support for any of the theoretical frameworks considered; however, when taken as a whole it provides more support for
Barro's market clearing approach when bonds are not net wealth than for any other theoretical framework.

At least four distinct contributions to the literature can be identified from the analysis in this paper. Firstly, our focus on the interwar period broadens the scope of the empirical evidence in the manner suggested by Brunner. Secondly, because inclusion of a tax measure in the model makes it less susceptible to criticism for omitted variables bias, these results reinforce the burgeoning literature in support of the equivalence hypothesis. Thirdly, unlike most previous studies that have employed VAR models, the conclusions arrived at in this chapter have been tempered by our presentation of, and reliance upon, measures of the precision with which the IRFs and VDCs have been estimated. Finally, the demonstrated importance of average personal marginal tax rates in this model suggests that model builders seeking to evaluate the effects of macroeconomic policy variables should include a tax measure in their models. In spite of these contributions, it is instructive to note that this research agenda is not complete. Specifically, additional research effort must be directed at demonstrating the robustness of these results across empirical techniques, time periods, and institutional arrangements. More urgently, further research attention should be devoted to constructing more comprehensive tax measures.
CHAPTER VI

FINANCIAL FACTORS AND AGGREGATE ECONOMIC ACTIVITY IN THE INTERWAR PERIOD: AN EMPIRICAL ANALYSIS

I. Introduction

The purpose of this chapter is to investigate the macroeconomic role of a proxy for financial crisis during the interwar period. While the primary emphasis of the analysis will be on the independent nonmonetary effects of financial crisis on aggregate economic activity, substantial attention will be focused on the manner in which the proxy for financial crisis interacts with other variables in the model. In this regard, it will be instructive to explore how the inclusion of the proxy affects the results in the previous chapter especially with respect to hypotheses such as debt monetization and Ricardian equivalence. Additionally, the cross model behavior of taxes, government spending, and the money supply will be a key focus of the discussion.

The need to analyze the macroeconomic effects of financial crisis is motivated by a burgeoning theoretical literature that identifies an important role for financial factors in the determination of the level of aggregate economic activity. As noted in chapter III, this increased attention is motivated in large part by the failure of traditional models -- which assume that financial effects are adequately captured by the money supply and an interest rate -- to sufficiently explain macroeconomic fluctuations such as the Great Depression.
While the theoretical literature has progressed rather rapidly, the empirical work on this issue is at best sparse (see section IV of chapter III). Perhaps the most noteworthy study in this area is the work of Bernanke (1983) who demonstrated that financial crisis had a substantial nonmonetary role in the determination of aggregate activity during the Great Depression. However, and as noted in chapter III, before Bernanke’s results can be construed as conclusive evidence in support of the financial – factors – matter hypothesis, at least three caveats should be noted. Firstly, by using a single equation model, Bernanke implicitly assumes that money and his proxy for financial crisis are exogenous to output. Secondly, and following Lutkephol (1982), it seems appropriate to examine this issue in an expanded framework that includes other important macrovariables like the interest rate, prices, etc. Finally, since Bernanke’s research was primarily concerned with the Great Depression, it is instructive to investigate the applicability of his results to longer periods and different eras.

The analysis of this chapter avoids making possibly spurious assumptions about the exogeniety or endogeniety of the variables that enter the model by using a vector autoregression of the type suggested by Sims (1980a) and reviewed in chapter IV. Additionally, a much wider array of variables than that which entered the model in Bernanke (1983) enters the VAR model used here. This is in order to avoid the possibility of omitted variables bias and to allow us to analyze the
robustness of the results presented in chapter V to the inclusion of a proxy for financial crisis.

In addition to the above considerations, the analysis in this chapter is further distinguished from that in Bernanke by our choice of the interwar period -- defined as July 1921 to June 1938 -- as the appropriate sample. The use of this broader sample may allow us to determine whether Bernanke's results were sample specific. In addition to the justifications provided for the choice of this period in earlier chapters, it bears emphasizing that the interwar period was characterized by extensive volatility in the financial sector and as such is a natural sample within which to examine the issues of concern here.

In what follows, I specify the model used in section II while in section III I describe the empirical methodology employed. Section IV is devoted to the presentation and interpretation of the empirical results while in section V, the conclusions drawn from the analysis are summarized.

II. Model Specification

In accordance with the discussion in chapter V, the analysis in this chapter assumes that the macroeconomy is adequately summarized by an eight variable vector process. The variables that define the vector process are the interest rate, the money supply, deficits, government expenditures, prices, industrial production, average personal marginal tax rates, and a proxy for financial crisis of the type described in chapter III. The use of this vector process approach allows us to
avoid assuming that variables such as money and the proxy for financial crisis are exogenous as is done in Bernanke (1983).

In light of the discussion presented in chapters IV and V about the factors which should be considered in choosing the variables that enter the VAR model, the variables that define the vector process in this chapter were chosen for the following reasons. The rate of interest and the proxy for financial crisis were chosen to summarize conditions in the financial markets. This differs from the model in the previous chapter in that the financial market description is augmented by the inclusion of a proxy for financial crisis. Further, the state of the goods market is reflected by industrial production and prices. Additionally, and as in chapter V, the stance of monetary policy is summarized by the money supply while fiscal policy is indicated by government expenditures, deficits, and average personal marginal tax rates. With the exception of the proxy for financial crisis, the empirical counterparts for these variables are as described in chapter V.

In order to discuss a proxy for financial crisis meaningfully, it is instructive to precisely indicate what constitutes financial crisis. Therefore, for the purposes of this dissertation and as in Bernanke (1983), financial crisis involves two major components. These are: (a) loss of confidence in financial institutions (particularly banks) and widespread fear of runs on the part of banks that leads to severe credit rationing and disintermediation as banks make portfolio substitutions away from loans into safer assets such as government
bonds and excess reserves; and (b) widespread borrower insolvency and erosion of debtors' collateral relative to their debt burdens that hampers their ability to secure bank credit and to invest in profitable projects. Since a useful proxy must be linked in some identifiable way to the variable for which it stands, it is imperative that we understand the manner in which financial crisis affects the economy. While the analysis in chapter III goes a long way in this regard, a closer look at Bernanke's perception of the manner in which financial crisis affected the economy during the Great Depression should further clarify this issue.

Bernanke (1983) argues that banks face two types of borrowers, namely, good and bad. However, because of informational imperfections banks are unable to distinguish the good from the bad. Therefore, banks incur costs due to their ex-ante evaluation and ex post monitoring of borrowers and costs due to expected losses from loans made to bad borrowers. Bernanke interprets these costs as the cost of transferring funds from ultimate savers/lenders (bank depositors) to worthy borrowers and calls it the cost of credit intermediation (CCI). Banks, in pursuit of their profit maximization objective, develop expertise at evaluating potential borrowers, establish long-term relationships with customers, and offer loan contracts that induce potential borrowers to self select in the manner described in Jaffee and Russell (1976) and in Stiglitz and Weiss (1981). These characteristics of bank operations serve to alleviate or adjust for the aforementioned informational asymmetry and thereby minimizes the CCI.
Therefore, any event that disrupts banks' ability to perform in these ways or that exacerbates the informational problem leads to increases in the CCI. It is clear from the foregoing discussion that financial crisis as defined in a previous paragraph leads to increases in the CCI. So, for example, the erosion of debtors' collateral relative to debt burden caused by the unanticipated price deflation of the Great Depression increased the real value of debt, which led to higher monitoring costs and thereby increased the CCI. Therefore, it is reasonable to argue that the CCI is a sufficient summary of the degree of financial crisis. Since the CCI is not observable, a proxy for it may effectively capture the effects of financial crisis.

At the most general level at least two basic criteria may be identified in defining the ideal proxy for an unobservable variable. These are: (a) the proxy should be influenced in a rather predictable fashion by the set of shocks that influence the unobservable variable; and (b) the proxy should not be influenced by shocks that have no influence on the unobservable variable. It should be noted, however, that these criteria are indeed very stringent and may well make it impossible to find an ideal proxy. Therefore, the search for an acceptable proxy is frequently an attempt to find a variable which comes as close as possible to fulfilling the aforementioned criteria. Because of the difficulty involved in picking the "best" proxy, it is not uncommon for the analyst to pick several proxies and present results for all of them.
In accordance with the above criteria, the yield differential between Baa corporate and long-term U.S. government bonds was selected to proxy for the CCI and thereby for financial crisis during the period under consideration. In order to demonstrate adherence to criterion (a) above, it is important to explore the theoretical linkages between the yield differential and the CCI, and, thereby, financial crisis. As discussed in chapter III and noted in Bernanke and Blinder (1988), shocks to the financial system such as a perceived increase in the riskiness of bank loans or widespread fear of runs, will induce banks to make portfolio substitutions away from loans and lower grade securities into excess reserves and safer corporate or government bonds. These substitutions widen the yield differential so that its size can be construed as a reasonable indicator of the degree of financial crisis. Further, since the CCI increases as financial crisis worsens, it is reasonable to conclude that the yield differential and the CCI will tend to move together. Since banks undertake the aforementioned substitutions in order to achieve safer and more liquid portfolios, it is instructive to note that the opportunity costs of this safety or liquidity are the higher rates of return that they forego. This of course is an addition to the CCI. On the borrower side of this problem, individuals and firms will draw down their demand and time deposits due to lack of confidence in banks and invest in safer assets such as government bonds and cash. To the extent that they invest in safe government bonds the yield differential will widen. More fundamentally, however, the yield differential is indicative of the level
of default risk that economic agents perceive. Since many of the models discussed in chapter III postulate a direct relationship between borrower's net worth or collateral and default probabilities, and since collateral is directly related to financial capacity and the ability to undertake investment expenditures, it seems reasonable to argue that movement in the yield differential may be indicative of the effects of financial crisis on borrower balance sheet positions. In light of the foregoing arguments, it is reasonable to argue that the choice of the yield differential as the appropriate proxy is consistent with the first criterion discussed in the previous paragraph.'

As noted by Bernanke (1983), a potential drawback to using the yield differential as a proxy for the CCI was that the yield differential may reflect pure financial market anticipation of changes in future output, and as such, its use as a proxy for the CCI would not

'A potential problem with the yield differential between Baa and long-term US government bonds is that corporate bonds are generally convertible while government bonds are not. The convertibility of corporate bonds means that they will sell at premium in order to reflect the value of the option to convert into shares of stock in the event that the conversion price is exceeded by the stock's market value. (See Van Horne (1984, pp. 249-271) for an intuitive description of this effect.) Since US government bonds are not convertible, comparing these yields may be a little tenuous. However, since the description of these series at their source does not clearly indicate that the corporate series used was actually convertible, there is some doubt as to the relevance of this issue. In order to address these concerns, I estimated the model and calculated variance decompositions using the yield differential between Baa and Aaa corporate bonds. The results derived were virtually identical to that derived using the yield differential between Baa and long term US government bonds. Further, since one of our key concerns is to capture the effects of bank substitution of safer and more liquid assets for relatively risky and less liquid assets, the choice of the yield differential between Baa corporate and the ultimately safe and marketable US government bonds appears to be appropriate.
be consistent with the second of the two criteria discussed above. While this observation may indeed be correct, we argue below that alternative proxies considered are in general subject to the same criticism. Therefore, while this is clearly an important consideration, it does not allow us to distinguish among alternative proxies. In order to further clarify this point and to distinguish the yield differential from other alternatives, it is instructive to examine the alternative proxies used by Bernanke.

Bernanke used proxies of two general types. Firstly, he used the deposits of failing banks and the liabilities of failing businesses to capture the effects of financial crisis in the banking system and of the debt crisis among borrowers. These proxies are assumed to jointly capture the total effect on the CCI and thereby on macroeconomic activity. Secondly, he used the growth rate of bank loans and the differential between the yields on Baa corporate bonds and on long term US government bonds. These proxies are assumed to singly capture the total effect of financial crisis on the CCI and thereby on real activity. It should be noted that, perhaps in an attempt to more closely conform with the second criteria listed in the previous paragraph, Bernanke used only the fitted series from a regression of the rate of growth of bank loans on the liabilities of failing banks and businesses. However, he presented results for the pure yield differential and for the fitted series derived from a regression of the yield differential on the liabilities of failing banks and businesses. Since Bernanke placed much greater emphasis on the results he obtained
using deposits of failing banks and the liabilities of failing
businesses, and since he made no attempt to remove extraneous effects
as he did with the growth rate of bank loans and the yield
differential, it is instructive to examine these measures in light of
the criteria laid out above.

The deposits of failing banks is intended to capture the effects of
financial crisis on bank behavior and performance. While this series
captures or is highly correlated with the credit contraction that
resulted from bank failures, it does not capture the credit rationing
behavior of banks that remained solvent. This is an important
omission, since as shown in Bernanke and Blinder (1988), shocks to
credit supply induce portfolio substitutions away from loans into
excess reserves or safe bonds and ultimately affect aggregate demand.
It is therefore reasonable to conclude that the deposits of failing
banks do not completely capture the effects of financial crisis from
the standpoint of banks.

As outlined in chapter III, Bernanke and Gertler (1989) and Gertler
and Hubbard (1988) present models that clearly demonstrate that the
erosion of borrowers' collateral relative to their debt burdens makes
their financing constraints more binding, lowers their investment
spending, and has macroeconomic effects even if they manage to avoid
bankruptcy. Since the liabilities of failing businesses is intended to
summarize the borrower's side of the financial crisis, it is reasonable
to require that it capture both the state of borrower insolvency and
the erosion of debtors' collateral relative to their debt burden.
However, since only the liabilities of failing businesses are included, it does not capture these effects for firms that remain solvent.

The cumulative implication of the discussion in the above paragraphs is that the liabilities of failing banks and businesses will jointly fail to capture some important effects of financial crisis. Therefore, taking the predicted values of the growth rate of bank loans and the yield differential from regressing these variables against the liabilities of failing banks and businesses will also omit important aspects of financial crisis.

At the statistical level, use of the fitted values mentioned above in an output equation may pose generated regressor problems of the type discussed in Pagan (1984). Specifically, Pagan investigates the econometric properties of estimators obtained from regressions with regressors that have been generated from taking the predicted value from a prior regression. The two principle issues analyzed by Pagan are the consistency and efficiency of the estimators and the validity of the inferences that may be made with the standard errors from the second stage regression. He notes that most two step estimators of the type under discussion here are consistent and efficient but fail to provide valid inferences. Additionally, he recommends joint estimation of the equations involved using maximum likelihood methods in order to improve the inferential properties of the estimator. Since Bernanke's attempt to remove extraneous effects from the growth rate of bank loans and from the yield differential is an attempt to generate
regressors, the use of these generated regressors introduces problems of the type discussed in Pagan.

Since Bernanke also used the actual series for the yield differential, it is instructive to critically examine why he did not consider it to be as good a proxy as the liabilities of failing banks and businesses taken jointly. In this regard he expressed two principle reservations about the effectiveness of the yield differential as a proxy for the CCI, and thereby, for financial crisis. The first of these centered upon the link between his theoretical construct and the associated empiricism. Specifically, in attempting to generate the uniqueness of bank assets and thereby the possibility that disruptions in the banking system will have real effects, Bernanke assumed that banks have unique access to certain projects because bank customers are small and do not have access to open market credit. Consequently in evaluating the appropriateness of the yield differential as a proxy for the CCI, Bernanke argues that it is not consistent with his story. However, in a later study Bernanke and Gertler (1987 pp. 91) make the following observation.

* The specialness of bank assets, due to the exclusive access of banks to a class of projects, is obviously going to be an important reason why changes in the level of intermediation will have real effects in this analysis. What is important here, however, is not that the banking system has unique access to certain projects; rather only that specialization gives banks some cost advantage, perhaps only a temporary one, in making certain types of loans. There is considerable evidence that this lending advantage, reflected in the imperfect substitutability between certain types of bank loans and open market credit, is an important characteristic of banking. (see, e.g., Fama (1985).)"
Given the above quote, it seems reasonable to suggest that its authors would not object to the proposition that Bernanke's (1983) assumption is perhaps too restrictive.

Bernanke's second reservation about the appropriateness of the yield differential as a proxy for the CCI was that the yield differential may reflect pure financial market anticipation of changes in future output. While it is difficult to determine which of these reservations Bernanke considered to be most debilitating, this second reservation appears to have contributed substantially to his choice of preferred proxy. In particular, while Bernanke recognized the possibility that his preferred proxies may also reflect anticipatory output effects, he argued that business bankruptcies are more likely due to past business conditions than to anticipations of unfavorable conditions in the future. Further, he notes that Friedman and Schwartz, among others, have documented specific events that precipitated bank runs. Therefore, he argues that it is likely that bank failures are roughly independent of expectations of future output and that factors other than current and past output performance contributed significantly to bank failures. However, in later papers, Bernanke and Gertler (1987,1989) construct theoretical models in which the quality and quantity of intermediation that banks are able to perform depends on their level of insider capital while firms' financial capacities are dependent on their net worth positions. Along the same lines, Gertler and Hubbard (1988) construct a two period model in which a firm's net worth position is equal to the sum of its liquid asset position in the
initial period and the present value of its collateralizable expected future profits in the subsequent period. To the extent that expected future profits depend on expected output, it may be argued that the deposits of failing banks and the liabilities of failing businesses reflect anticipated output fluctuations. Therefore, the possibility that any of the proxies considered here may reflect future output movements does not appear to provide sufficient basis upon which one proxy may be chosen over another.

The foregoing discussion on the proxies considered by Bernanke has attempted to critically evaluate the appropriateness of these proxies for the purpose at hand. With respect to the liabilities of failing banks and businesses, we have shown that these measures do not capture some important aspects of financial crisis. For the generated regressors discussed above we have shown that in addition to being subject to the same criticisms levelled at the liabilities of failing banks and businesses, they may be subject to generated regressor problems of the type discussed in Pagan (1984). Finally, we have shown that some of Bernanke’s reservations about the usefulness of the pure yield differential between Baa corporate and long term US government bonds may not be as debilitating as Bernanke suggests. Specifically, we have shown that less restrictive assumptions about banks’ clientele would continue to yield output effects in the theoretical model. Further, it should be emphasized that there is no generated regressor problem with the pure yield differential and that it is a more general reflector of financial crisis than the other measures discussed here.
Therefore, while the imperfection of the yield differential as a proxy for financial crisis is acknowledged, it is instructive to note that its attributes far outweigh its drawbacks.

Use of the VAR model requires stationary data. However, since most macro time series exhibit nonstationarity, it is necessary to conduct unit root tests that indicate the appropriate transformation. Implementation of these unit root tests for the variables in chapter V indicated that they should all enter in their first differences. Therefore, it is only necessary to conduct a unit root test for the yield differential in this chapter. The results of this test indicate that the nonstationarity is due to a stochastic trend; therefore, first differencing is the recommended transformation. Since the model used here is a Sims-type VAR, all variables enter each equation with a common lag length. Therefore, the next step in the specification of the model is the choice of this common lag length. Following the analysis in the previous chapter, the optimal lag length is specified using Akaike's AIC criterion. Using a maximum lag length of twelve, this criterion indicates an optimal common lag length of eleven.

In summary, the foregoing analysis requires that we use DLM2, DLIP, DLEXP, DLWPI, DRCP, DMTAX, DDEF, and DRPM as the system's variables, where the first seven variables are as specified in chapter V and DRPM is the first difference of the yield differential between Baa corporate and long term US government bonds obtained from *Banking and Monetary Statistics, 1914 - 1941* (Board of Governors of the Federal Reserve System, 1943). The model to be estimated is comprised of eight
equations with eleven lags of all eight variables entering each equation. Since specification of the lag length and the use of first differences used up thirteen observations, as in chapter V, the model was estimated for the period August 1922 to June 1938. The empirical methodology and interpretation of the model's parameters are presented in section III below.

III. Empirical Methodology and Interpretation

The empirical analysis in this chapter is concerned primarily with documenting the macroeconomic role of financial crisis during the interwar period. Specifically, concern centers on the effects of financial crisis as captured by the yield differential on output, interest rates and prices. Further, the empirical validity of hypotheses such as Ricardian equivalence and debt monetization are investigated and the results are compared to that in chapter V. A similar comparative analysis is undertaken with respect to the macroeconomic effects of government spending, average personal marginal tax rates and changes in the money supply. In order to analyze these issues the VAR model outlined in section II was estimated and interpreted. In all cases examination of the Q-statistics for each equation indicated support for the hypothesis that the model is well specified.

In order to interpret the model, I calculated IRFs and VDCs using the Choleski decomposition and five distinct orderings. These are: (1) DLEXP, DMTAX, DDEF, DLM2, DRPM, DRCP, DLIP, DLWPI; (2) DLEXP, DMTAX, DDEF, DRPM, DLM2, DRCP, DLIP, DLWPI; (3) DLEXP, DMTAX, DDEF, DLM2, DRCP,
DRPM, DLIP, DLWPI; (4) DLEXP, DMTAX, DDBF, DLM2, DLIP, DLWPI, DRPM, DRCP; and (5) DRPM, DLEXP, DMTAX, DDBF, DLM2, DRCP, DLIP, DLWPI.

The above orderings are based on the general principle that the model's variables can be divided into three conceptual groups. The policy group is comprised of DLEXP, DMTAX, DDBF, and DLM2 while the goods market group includes DLIP and DLWPI. Additionally, the transmission group is made up of DRCP and DRPM. This grouping is in accordance with rational expectations models of the macroeconomy which postulate that surprise innovations in the policy variables affect the other variables in the model without feedback and with monetary transmission theories which argue that monetary impulses are transmitted to the goods market variables by the transmission variables with no contemporaneous feedback. This view of the macroeconomy suggests that the policy variables should be placed first in the ordering followed by the transmission variables and, finally, by the goods market variables.

In ordering (1) the variables within the policy group are placed in that particular order on the basis of the analysis in the previous chapter where changing the ordering among these variables did not change the results. Since this is indicative of the absence of contemporaneous correlation among these variables, it is unreasonable to expect the ordering among them to matter in this model. Further, it is important to note that the placement of DLM2 before DRPM is of some significance since, as argued by Bernanke and Blinder (1988) and Blinder and Stiglitz (1983), monetary impulses may be included among the
exogenous shocks that affect bank credit behavior. Additionally, among the transmission variables, DRPM is placed before DRCP to allow for the possibility that financial crisis as measured by DRPM leads to lower short term interest rates as agents in search of liquidity increase their demand for short term assets causing an increase in price and a fall in the associated rates of return. Finally, in the goods market, DLIP precedes DLVPI to reflect the analysis of the previous chapter which indicates the absence of substantial contemporaneous correlation between these variables.

Ordering (2) differs from ordering (1) in that DRPM is placed before DLIP2. Since banks play a crucial role in the money supply process and since some prominent authors including Friedman and Schwartz (1963) have argued that the primary effect of financial crisis on the macroeconomy is via the constriction of the money supply that results from banking collapse, it is instructive to allow every opportunity for DRPM to affect money. While examination of the IRFs and VDCs for orderings (1) and (2) indicates a small difference in the results, this difference was judged to be immaterial.

A clear implication of the analysis in Bernanke and Blinder (1988) is that the banking sectors' credit supply function depends on open market interest rates. For example, an increase in open market interest rates causes banks to increase their holdings of assets such as commercial paper and to decrease their supply of loans. This implies that DRCP should precede DRPM in the ordering. This view is reflected in ordering (3) which differs from ordering (1) in that DRCP
is placed before DRPM. Once again, evaluation of the IRFs and VDCs for ordering (3) indicates that the results are roughly equivalent to that derived for orderings (1) and (2).

As the discussion of an appropriate proxy for financial crisis in section II above indicates, it is distinctly possible that fluctuations in output contemporaneously influence financial market conditions. In order to allow for this possibility, the goods market block is placed before the financial market or transmission group in ordering (4). Additionally, since DRCP is placed last in this ordering it gives consideration to the implication of the efficient markets hypothesis that the interest rate responds instantaneously to innovations in the other variables of the model. As in the previous cases, the IRFs and VDCs for this ordering did not materially differ from those for orderings (1) to (3).

In ordering (5), DRPM is placed first in order to explore the possibility that shocks to the financial system are largely exogenous and as such DRPM contemporaneously influences the other variables in the model with no feedback. This is of some interest since possible influences of financial crisis on fiscal policy have been largely ignored. For ordering (5), the effects of DRPM were a little stronger than that in the previous orderings. However, since the pattern of effects remained largely similar and since these stronger effects are due in large part to DRPM's position in the ordering, we judge this difference to be immaterial. Since the ordering chosen appears to have no material influence on the IRFs and VDCs, I report only the results
for ordering 2. This choice is partially out of deference to the long standing view that the primary influence of financial crisis is via its effects on the money supply. However, it bears reemphasizing that the ordering chosen failed to materially alter the results.

In order to provide some measure of the confidence that can be placed in the IRFs and VDCs presented, the mean and standard errors of these statistics were calculated using Doan and Litterman's (1984) Monte Carlo integration procedure. For the VDCs, if the ratio of a point estimate to its standard error is greater than or equal to 2, the point estimate is considered to be significantly different from zero at the 5 percent level while a ratio of at least 1.65 indicates significance at the 10 percent level. Under the assumption that the IRFs are approximately normally distributed, 95 percent confidence intervals are constructed by taking 1.96 standard deviations on each side of the mean. The confidence bands are then plotted together with the point estimates. In accordance with the interpretation in chapter five, if the confidence bands include zero at a particular horizon the point estimate at that horizon is considered to be insignificantly different from zero. In section IV below the VDCs are presented in table 6.1 while the IRFs are plotted in figures 6.1 to 6.7.

IV. Empirical Results

A. Macroeconomic Effects of Financial Crisis

The essence of the theory underlying the analysis in this chapter is that financial crisis leads to increases in the CCI which leads to a deterioration in the quantity and quality of financial intermediation
that banks undertake. This deterioration in financial intermediation is manifested primarily via an increase in the severity of credit rationing in loan markets. In Bernanke and Blinder's (1988) CC-LM model, an adverse loan supply shock leads to an inward shift in the CC curve which leads to a fall in aggregate demand and open market interest rates. Transferring this analysis to an AD - AS framework we have a fall in aggregate demand and a decrease in aggregate supply. The inward shift in the aggregate supply curve is due to the overall tightening of credit and the likely inability of some firms to obtain financing for profitable projects. Under this scenario the effects on the price level, interest rates, and the rate of inflation are ambiguous.

As shown in table 6.1, the percent of the forecast error variance in DRCP attributable to innovations in DRPM is significantly different from zero and ranges from 11.96 percent in the twelfth horizon to 13.15 percent in the forty-eighth. The corresponding IRFs in the first graph in figure 6.1 show that a one standard deviation shock to DRPM elicits a significantly positive response from DRCP in the first through second horizons and significantly negative responses around the seventh and eighth and at the fourteenth horizons. Since the confidence bands include zero at all other horizons, the responses in these horizons are interpreted to be insignificantly different from zero. Since two out of three of the significant effects carry the correct sign and since the initial positive effect may be reflective of dynamic adjustment of the system, greater weight is placed on the subsequent negative effects. This leads to the conclusion that the response of interest rates to
Table 6.1 VDCs and Standard Errors*

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*In Table 6.1 the first row for a horizon (e.g., 12) is the point estimate of the VDC for that horizon while the standard errors are in parentheses. Additionally, a * indicates significance at the 5 percent level while a ** indicates significance at the 10 percent level.

**FEV stands for forecast error variance.
Table 6.1 cont'd. VDCs and Standard Errors

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Table 6.1 cont'd. VDCs and Standard Errors

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FIG 6.1 RESPONSES TO ORPM INNOVATION

1. IRF of ORCP
2. IRF of DLIP
3. IRF of DLU1

Forecast Horizons

Legend:
- ORCP
- ORCPUB
- ORCPILB
- DLIP
- DLIPUB
- DLIPILB
- DLU1
- DLU1UB
- DLU1ILB
DRPM shocks is not inconsistent with the theoretical discussion in the previous paragraph.

The VDCs for DLIP in table 6.1 show that the percent of its forecast error variance explained by variation in DRPM varied from an insignificant 3.76 percent in the first horizon to 17.13 and 16.83 percent in the twelfth and forty-eighth horizons. Moreover, these effects were significant at the 5 percent level. The second graph in figure 6.1 plots the actual response of DLIP to a one standard deviation innovation in DRPM, together with the upper (DLIPUB) and lower (DLIPLB) bounds of its 95 percent confidence interval. These plots show that DLIP's response was significantly negative in the first through fourth and the seventh through twelfth horizons. For all other horizons the confidence bands included zero, indicating insignificance at the 5 percent level. Once again, these results are not inconsistent with the theoretical discussion.

Examination of the VDCs for DLWPI in table 6.1 indicates that the percent of its forecast error variance explained by variation in DRPM varied from an insignificant 1.99 percent in horizon one to 11.63 and 10.9 percent in the twelfth and forty-eighth horizons. Further, our rough measure of significance indicates that these latter effects are significantly different from zero at the 5 percent level. Additionally, the impulse responses of DLWPI to a one standard deviation shock to DRPM plotted together with its confidence bands in the third graph in figure 6.1 show that the DRPM innovation elicits a significantly positive response from DLWPI for the fourth and fifth horizons and
significantly negative responses in the seventh and eighth, and the ninth through eleventh horizons. Since the confidence bands include zero in all other horizons, the effects in these horizons are interpreted to be insignificantly different from zero. These results are not inconsistent with the theoretical view that the effects of financial crisis on prices are ambiguous.

In addition to the foregoing effects, it is useful to examine the effects of the proxy for financial crisis on the money supply. It is well known that bank liabilities and assets play a crucial role in the money supply process; therefore, adverse shocks to the banking system are likely to lead to constriction of the money supply in the manner documented by Friedman and Schwartz (1963) for the interwar period.

In table 6.1 the VDCs for DLNM2 show that innovations in DRPM accounted for 7.96, 14.1, and 13.81 percent of the forecast error variance in DLNM2 for the first, twelfth, and forty-eighth horizons, respectively. Moreover, our quasi $t$-statistics indicate that these effects are all significantly different from zero at the 5 percent level. Additionally, the corresponding IRFs and their confidence intervals plotted in figure 6.2 shows that the shock to DRPM leads to a significantly negative response in DLNM2 from the first through fourth and the ninth through eleventh horizons. The responses in all other horizons are insignificant. These results are consistent with our theoretical expectations and allow for a little more confidence in the choice of DRPM as the appropriate proxy for the CCI and thereby financial crisis.
FIG 6.2 RESPONSE TO DAPM INNOVATION

RESPONSE OF DLM2

FORECAST HORIZONS

X10^-2 4 8 12 16 20 24 28 32 36 40 44 48

DLM2
DLM2UB
DLM2LB
B. Ricardian Equivalence in the Presence of Financial Considerations

In the seven variable model of chapter V, we found that both the VDCs and IRFs for interest rates, prices, and output indicated that deficits had no significant effects on the real economy. These results were interpreted as not inconsistent with the Ricardian equivalence hypothesis which postulates that a substitution of debt for tax financing holding government spending constant has no real effects on aggregate economic activity. However, since the analysis in subsections IV. A and B indicates that DRFX has substantial effects on the macroeconomy, it can be reasonably argued that an important variable was omitted from the model in chapter V. Accordingly, it is important to compare the results from this chapter's model to those from chapter V.

Examination of the VDCs for DRCP in table 6.1 shows that variation in DDBF was responsible for 0.52 and 3.26 percent of its forecast error variance in horizons one and twelve respectively, and that these effects were insignificantly different from zero. In horizon twenty-four, this percentage was significant at the five percent level and increased to 4.54. While the percent of the forecast error variance explained by DDBF remained roughly the same in the thirty-sixth and forty-eighth horizons, our quasi t-statistics imply that they were significantly different from zero only at the 10 percent level. However, since these effects are all rather small, we judge them to be economically insignificant. Additionally, the plot of the impulse responses of DRCP to a one standard deviation innovation in DDBF
FIG 6.3 RESPONSES TO DDEF INNOVATION

- IRF of DRCPU
- IRF of ORCPLB
- IRF of OLIPLB
- IRF of DLUP
- IRF of DLIPLB
- IRF of DLWPI
- IRF of DLWPIUB
- IRF of DLWPILB
together with their confidence bands indicate that these responses were insignificantly different from zero for all horizons. These results are roughly consistent with those derived in the previous chapter except that none of the point estimates were significant.

The VDC of DLIP shows that the fraction of its forecast error variance attributable to variation in DDBF varied from an insignificant 1.85 percent in the first horizon, to 5.7 and 7.07 percent in the twelfth and forty-eighth horizons. Moreover, these latter effects were significant at the 10 and 5 percent levels, respectively. The plot of the point estimates of the impulse responses of DLIP together with its confidence bands in figure 6.3 indicates that a one standard deviation innovation in DDBF elicits small significantly negative responses in DLIP from the eighth through tenth horizons and a marginally significant negative response at the fourteenth horizon. Since the confidence bands include zero at all other horizons, the response in these horizons were interpreted to be insignificantly different from zero. These results differ from the results in the previous chapter where deficits had no significant effects on output. However, the effects in this chapter are rather small and may be too weak to justify attaching too much importance to them.

The effects of DDBF on DLWPI are summarized in the VDCs in table 6.1 and the IRFs plotted in the third graph of figure 6.3. The VDCs show that the percentage of the forecast error variance in DLWPI explained by shocks to DDBF was significant from the twelfth through forty-eighth horizons and ranged from 6.83 to 6.75 percent.
Examination of the corresponding IRFs indicates that the shock to DDBF elicits small significantly negative effects from DLWPI in horizons one and two and from the ninth through eleventh horizons. The responses in all other horizons were insignificantly different from zero. While these effects are a little stronger than those in the previous chapter, they are of similar sign.

The Ricardian equivalence hypothesis leads us to expect that an increase in deficits should have no real effects on aggregate economic activity while the traditional (Keynesian) view suggests expansionary effects. Recalling that DDBF is measured as receipts minus expenditures, an increase in DDBF is really an increase in the surplus. Therefore, the negative effects of the DDBF shock on prices and output indicates that an increase in the surplus had contractionary effects during the interwar period. These results are not inconsistent with traditional models. Additionally, while they may seem to be inconsistent with the notion that bonds are not net wealth, it is reasonable to argue as do Barsky, Mankiw, and Zeldes (1984) that in the presence of uncertainty with respect to future income, a substitution of debt for tax financing may lower the risk of adverse fluctuations in future income so that agents reduce their precautionary demands for savings and increase real consumption. This argument implies that in a framework where bonds are not net wealth, an increase in the surplus may lead to a fall in output as agents increase their precautionary demands for savings in response to the increased risk of adverse fluctuations in future income.
Given the above arguments, it becomes important to explain why these negative effects are more prominent in this model than they were in the seven variable model. A potential explanation may be that previous results were biased due to an omitted variable and that the inclusion of the yield differential as a proxy for financial crisis in this chapter's model alleviates the problem.

C. Debt Monetization

The other area in which there is some concern about the effects of deficits is with respect to their effects on the money supply. In chapter V, both the VDCs and IRFs indicated that deficits had no effect on money supply growth. In this chapter, the variance decomposition of DLM2 shows that variation in DDEF accounted for an insignificant fraction of its forecast error variance in the first through twelfth horizons. However, this percentage is significantly different from zero at the 10 percent level for the twenty-fourth through forty-eighth horizons. The impulse responses reported in figure 6.4 show that these responses are insignificantly different from zero for all forecast horizons. These results are entirely consistent with the conclusion arrived at in chapter V, namely, that there is no evidence of debt monetization during the interwar period. Additionally, we may conclude that the introduction of financial crisis leaves that conclusion intact.

D. The Role of Government Expenditures

In the empirical analysis of the previous chapter, the combined evidence of the VDCs and IRFs indicated that government expenditures
FIG 6.4 RESPONSE TO DDEF INNOVATION

RESPONSE OF
DLM2

DLH2

DLM2UB

DLM2LB

X10^-2

FORECAST HORIZONS
had no significant effects on prices and the rate of interest but had significantly positive effects on output. In this chapter, the relevant VDCs in Table 6.1 show that the percent of the forecast error variance in DRCP assignable to variation in DLEXP varied from 1.32 percent in the first horizon to 4.37 and 4.68 percent in the twenty-fourth and forty-eighth horizons. Additionally, the quasi t-statistics indicate that the point estimates for the twenty-fourth horizon and beyond are significantly different from zero at the 10 percent level. The corresponding IRFs show that the confidence bands include zero at all horizons, thereby indicating that the point estimates are all insignificantly different from zero. Since the significant VDCs are very small and the IRFs show no significant effects it seems reasonable to conclude that DLEXP has little effect on DRCP in this model. This is consistent with the results in the seven variable model of Chapter V and with the theoretical explanation given there.

The VDCs for DLIP show that the percent of its forecast error variance explained by variation in DLEXP varied from 12.46 percent in the twelfth forecast period to 16.73 percent in the forty-eighth period. The IRFs reported in the second graph of Figure 6.5 show that a one standard deviation shock to DLEXP elicits initially positive but insignificant effects on DLIP and significantly negative effects from the fifth through tenth horizons and from the nineteenth through twenty-first horizons. These results differ from those in the previous chapter. In that chapter, the initial positive effects were insignificant. This pattern of significance is essentially reversed
FIG 6.5 RESPONSES TO OLEXP INNOVATION

![Graphs showing responses to OLEXP innovation](image-url)
here, and there is no apparent reason for this reversal.

In table 6.1, the VDCs for DLWPI show that DLEXP was responsible for 6.42, 8.40, and 8.76 percent of the forecast error variance in the rate of inflation in the twelfth, twenty-fourth, and forty-eighth horizons, respectively. Moreover, our measure of significance indicates that these point estimates were all significant at the 5 percent level. The plot of the point estimates of the impulse responses of DLWPI to a surprise innovation in DLEXP, together with its confidence bands, indicates that with the exception of a minutely significant positive effect at the third horizon the point estimates are not significantly different from zero. As indicated in chapters II and V five, the theoretical analysis predicts ambiguous effects on the price level but makes no prediction about the rate of inflation. Therefore, the results of this chapter are not inconsistent with the theory and with the results derived in the seven variable model.

E. Role of Average Personal Marginal Tax Rates

In chapter V, we examined three theoretical approaches to evaluation of the macroeconomic effects of taxes. Under the traditional or Keynesian approach a tax rate increase leads to a fall in output and ambiguous effects on interest rates, prices, and inflation. Barro's neoclassical approach predicts that a tax increase has ambiguous effects on interest rates and prices and contractionary effects on output. Finally, the Mankiw-Summers approach predicts ambiguous effects on output and prices and an unambiguous fall in interest rates. While the introduction of the yield differential as a proxy for the CCI
and thereby financial crisis may alter the effects of a tax increase in this chapter, there is no a priori reason to expect such a change.

As shown in table 6.1 the percent of the forecast error variance in DRCP assignable to variation in DMTAX ranges from an insignificant 1.94 percent in the twelfth horizon to significant portions in the twenty-fourth, thirty-sixth, and forty-eighth horizons ranging from 7.46 to 7.98 percent. This is in contrast to the results in the previous model where the corresponding VDCs were much smaller and insignificant. The IRFs plotted in the first graph in figure 6.6 show that, with the exception of the fourteenth through sixteenth horizons where the impulse response of DRCP to a one standard deviation in DMTAX is significantly positive, the innovation in DMTAX fails to elicit significant responses in DRCP. Once again, these results are in contrast to those in chapter V where a DMTAX innovation resulted in only a marginally significant negative effect at the third horizon. These results are not inconsistent with any of the three theoretical frameworks considered above.

The percent of the forecast error variance in DLIP explained by variation in DMTAX varies from 14.26 in the twelfth to 12.31 in the forty-eighth forecast period. Moreover, our quasi t-statistics indicate significance at the 5 percent level. The IRFs plotted in the second graph in figure 6.6 shows that a surprise innovation in DMTAX elicits significantly positive responses from DLIP in the seventh through twelfth horizons. Since the confidence bands in all other forecast horizons include zero, the responses in those horizons are interpreted
FIG 6.6 RESPONSES TO DMTAX INNOVATION

IRF OF DRCP

IRF OF DLIP

IRF OF DLWP
to be insignificantly different from zero. These results are consistent with the Mankiw-Summers framework and are largely similar to the results generated in the previous chapter. However, as in the previous chapter, they are inconsistent with the predictions of both the Keynesian and Barro models.

Variation in DMTAX accounted for 12.45 and 16.35 percent of the forecast error variance in DLWPI for twelfth and forty-eighth horizons. Additionally, our rough measure of significance indicates that these effects were significant at the 5 percent level. These results are roughly similar to those in chapter V. Additionally, the appropriate IRFs plotted in the third graph of figure 6.6 indicate that a one standard deviation innovation in DMTAX elicits significantly positive effects in DLWPI from the seventh through eighth, and the tenth through thirteenth horizons. The response in all other horizons were judged to be insignificantly different from zero since the confidence bands included zero for those horizons. Once again these results are roughly similar to those in the previous chapter and are not inconsistent with any of the three models discussed above.

It is apparent from the preceding discussion that the responses of prices, interest rates, and output to surprise increases in average personal marginal tax rates can be consistently explained within Mankiw and Summers' theoretical framework. However, the positive effect on output is anomalous within Barro's market clearing approach and the Keynesian framework.
F. The Macroeconomic Effects of Money Supply Changes

In chapter V we found that the effects of shocks to the money supply on interest rates, output, and prices were roughly consistent with our theoretical expectations. In the current chapter it is useful to analyze the effects of money supply changes on the macroeconomy in order to determine whether the inclusion of the yield differential as a proxy for the CCI, and thereby for financial crisis, substantially alters the role of money in this model. As noted in chapter III, Bernanke and Blinder (1988) have argued that an increase in the money supply is likely to be more expansionary in their CC-LM model -- which attempts to account for the role played by bank assets in the credit allocation process -- than it would be in the traditional IS-LM model. Therefore, in addition to examining the results for consistency with the theory, one of our key concerns in this section will be to see if money's effects are stronger in this model than they were in the seven variable model.

The VDCs for DRCP in table 6.1 show that DLM2 was responsible for 6.74 and 6.70 percent of the forecast error variance in DRCP in the twelfth and forty-eighth horizons. Additionally, these effects were significantly different from zero at the 5 percent level. Further, they are substantially weaker than those in the seven variable model where they were significant at the 5 percent level and ranged from 16.1 to 15.7 percent in the twelfth and forty-eighth horizons. This result appears to be consistent with Bernanke and Blinder's CC-LM model where a positive shock to money shifts the LM curve outwards and lowers
Interest rates. However, at the same time the CC curve shifts outwards causing output to increase by more than it would in the traditional model, thereby mitigating the increase in interest rates. To the extent that the yield differential captures the effect of monetary policy on bank loans, it is reasonable to expect that monetary shocks would have smaller effects on interest rates in this model. The impulse responses of DRCP to an innovation in DLM2 together with its confidence bands are plotted in the first graph of figure 6.7. These indicate that a one standard deviation innovation in DLM2 elicits significantly negative effects around the first horizon and insignificant effects in all other horizons. These latter effects are essentially identical to that in chapter V.

The effect of shocks to DLM2 on output are examined by looking at the VDCs for DLIP in table 6.1. These VDCs show that the percent of the forecast error variance in DLIP attributable to DLM2 ranged from 7.77 percent in the twelfth horizon to 8.91 percent in the forty-eighth. Although these effects are significant at the 5 percent level, they are substantially weaker than those in the seven variable model, where the forecast error variance in DLIP explained by variation in DLM2 varied between 15.8 and 14.9 percent. The corresponding IRFs indicate that the response of DLIP to a surprise innovation in DLM2 is significantly positive around the first horizon and insignificant in all other horizons. In general these effects are consistent with the theory in that they carry the right sign and are very short-lived. However, since the effects of changes in money on output are weaker in this
FIG 6.7 RESPONSES TO DLM2 INNOVATION

IRF OF DRC/  
-6 -4 -2 0 2 4 6  
X 10^-2 4 8 12 16 20 24 28 32 36 40 44 48  
FORECAST HORIZONS

IRF OF DLIP  
-7 -5 -3 -1 1 3 5 7  
X 10^-2 4 6 12 16 20 24 28 32 36 40 44 48  
FORECAST HORIZONS

IRF OF DLWI  
-3 -2 -1 0 1 2  
X 10^-2 4 8 12 16 20 24 28 32 36 40 44 48  
FORECAST HORIZONS

Legend:  
DRC/  
DRCPUB  
DRCPLB  
DLIP  
DLIPUB  
DLIPLB  
DLWI  
DLWPIUB  
DLWPIPLB
model, this result is inconsistent with the predictions of the Bernanke-Blinder model.

The appropriate VDCs in table 6.1 show that variation in DLX2 accounted for 5.62 percent of the forecast error variance in DLWPI in the twelfth horizon and that it increased to 6.12 percent by the forty-eighth horizon. These effects were all significant at the 10 percent level and are marginally stronger than the insignificant effects in the seven variable model. The IRFs reported in the third graph of figure 6.7 indicates the direction of these effects. Specifically, a surprise innovation in DLX2 engenders significantly positive responses in DLWPI around the first forecast month and insignificant effects in all other horizons. As noted in chapter V, it seems reasonable to argue that the aggregate supply curve was relatively flat during the interwar period. Therefore, since money supply shocks affect aggregate demand but not aggregate supply, they are likely to have had only small effects on the price level during that period.

V. Summary

The analysis of this chapter has been an attempt to add empirical content to the burgeoning literature that attributes an important role to financial factors in the determination of aggregate economic activity. Specifically, concern was centered on the macroeconomic effects of a proxy for the CCI and thereby of financial crisis on interest rates, output, and prices. Further, the effects of introducing the yield differential between Baa corporate and long-term US government bonds (as a proxy for financial crisis) on the consistency
of the empirical regularities generated in the previous chapter were examined.

As outlined in section IV. A, a deterioration in the quantity and quality of financial intermediation as proxied by the yield differential leads to significantly negative effects on output, and the supply of money. Further, with the exception of a short-lived initial positive effect, it had significantly negative effects on both interest rates and the rate of inflation. These results constitute empirical evidence in support of theoretical models which hold forth the view that financial factors have important macroeconomic effects. Further, the results presented here are not inconsistent with the empirical evidence presented by Bernanke (1983), who found that financial factors played a key role in explaining the duration and severity of the Great Depression. Additionally, it seems reasonable to conclude that the importance of financial factors as an explanator of macroeconomic fluctuations in the interwar period is strongly suggestive of the necessity to include this variable in macroeconomic models that propose to analyze or forecast aggregate economic behavior.

The inclusion of a proxy for financial crisis in this chapter's model did not alter our conclusions with respect to the Ricardian equivalence and debt monetization hypotheses in the previous chapter. However, the inclusion of the yield differential seemed to induce some slightly significant negative effects on output and prices. Since DDEF is measured as receipts minus expenditures, this implies that an increase in the deficit has expansionary effects. This result is not
inconsistent with either the Ricardian equivalence hypothesis (when the risk associated with adverse fluctuations in future income is accounted for) or with traditional models. This, of course, is an example of the difficulty that surrounds attempting to distinguish among structural hypotheses with reduced form models.

The effects of government expenditures in this model differed substantially from its effects in the seven variable model. This result is difficult to explain on the basis of the theory. Further, the effects of average personal marginal tax rates were essentially the same as in the previous model. Additionally, and as in chapter V, the Mankiw - Summers framework was the only theoretical framework capable of consistently explaining the effects of DMTAX on output, prices, and interest rates. Finally, the effects of money in this model were almost identical to its effects in the previous model. This result does not appear to be consistent with the Bernanke-Blinder model which led us to expect stronger effects on output in this chapter's model.

In addition to the caveats noted in chapter V, the usefulness of the conclusions arrived at in this chapter depends crucially on the appropriateness of the yield differential as a proxy for the CCI and thereby for financial crisis. Given the arguments presented in section II, the yield differential appears to be as good a proxy as any. Therefore, while our proxy for financial crisis is not perfect, the analysis in this chapter indicates rather strongly that macroeconomic models which do not include some proxy for the effects of financial
factors of the type discussed in chapter III and the current chapter may be seriously misspecified.
As outlined in chapter I, the purpose of this dissertation was to improve our knowledge and understanding of the effects of monetary and fiscal policy and the role of financial factors such as disruptions in financial intermediation and deterioration in the quality of private balance sheets in the macroeconomy. Because there is substantial disagreement on these issues and since the extensive literature on fiscal and monetary policy has concentrated on the post war era to the exclusion of the interwar period, we chose the interwar period defined as July 1921 - June 1936 as the appropriate sample. Additionally, we noted that certain characteristics of that era such as the occurrence of both deficits and surpluses and widespread volatility in the financial sector make it ideally suited to the investigation of issues such as Ricardian equivalence and the macroeconomic effects of financial crisis.

In order to achieve the broad objectives outlined above, vector autoregression models were specified and estimated. Additionally, IRFs and VDCs were calculated from the moving average representations of the VAR models and were used to interpret the models. Furthermore, and in order to give some indication of the precision with which the IRFs and VDCs are estimated, a Monte Carlo integration procedure was used to calculate standard errors and means for these parameters. In the first of the VAR models used, seven variables were selected to enter the
These were short-term interest rates, the money supply, government expenditures, deficits, industrial production, wholesale prices, and average personal marginal tax rates.

In the survey of the literature on fiscal and monetary policy effects presented in chapter II, the fact that substantial discord about the macroeconomic roles of monetary and fiscal policy variables persists at both the theoretical and empirical levels was highlighted. In addition to the excessive concentration on the postwar period, some limitations in the empirical literature were identified. These included: (a) most of the studies reviewed involved the use of structural models that necessitate the use of potentially incorrect restrictions on the parameter space; (b) the models used in these studies did not include a measure of average marginal tax rates which is necessary if the pure effects of fiscal policy variables such as deficits are to be isolated; and (c) those studies that avoid use of the incorrect restrictions mentioned above by employing a VAR model do not provide measures of the precision with which the IRFs and VDCs were estimated. Accordingly, the choice of time period, the use of VAR techniques that avoid making possibly spurious exogeneity assumptions, the inclusion of a measure of average personal marginal tax rates, and the presentation of standard errors for the IRFs and VDCs, are all potentially useful additions to the literature.

The results from the seven variable model were presented in chapter V. In conformity with the discussion on the appropriate uses of VARs in section IV of chapter IV, the results presented were in the
form of empirical regularities which were subsequently compared to the predictions of various theories on these effects. Particular attention was focused on the empirical regularities generated with respect to the effects of deficits, government expenditures, average personal marginal tax rates, and the money supply on interest rates, output, and prices. We found that deficits had no significant effects on interest rates, output, and prices, and concluded that these regularities were not inconsistent with the Ricardian equivalence hypothesis. Additionally, we found no evidence of debt monetization in the interwar period.

Further, our examination of the role of government expenditures in the interwar period showed that the regularities generated were weakly consistent with Keynesian predictions and were not inconsistent with the predictions of Barro's market clearing approach when it is assumed that innovations in government expenditures for the period under consideration were largely permanent. The empirical regularities generated with respect to the effects of innovations in average personal marginal tax rates on the macroeconomy did not permit easy comparisons. In particular, we found that an increase in DNTAX had no significant effects on interest rates. When this result was compared to predictions from the theoretical approaches outlined in chapter II, we found that it was not inconsistent with any of the theoretical approaches considered since all of them predict ambiguous effects on interest rates. The effects of an increase in DNTAX on output were positive and significant. Our comparison of this regularity with the theoretical approaches indicates that this result is not consistent
with the Keynesian and market clearing approaches. However, it was not inconsistent with the predictions of the Mankiw - Summers model which allows for the possibility that a tax increase will have expansionary effects on output. Finally, DMTAX innovations were found to elicit significantly positive responses in prices for the interwar period. This result is not inconsistent with any of the approaches considered since all of them make ambiguous predictions about the effects of DMTAX on the price level and the rate of inflation.

The role of money in the interwar period was largely consistent with the view that shocks to the money supply lead to increases in output and prices and to a fall in interest rates. Moreover, these effects were very short-lived and consistent with the notion that money is neutral in the long-run.

More generally, when the foregoing results are considered as a whole, they appear to provide strong support for the Barro's market clearing approach when government bonds are not considered to be net wealth. The Mankiw - Summers model provided the most consistent explanation of the effects of marginal tax rates, however, since it differs from the Keynesian model only with respect to tax effects, like the Keynesian model it fails to consistently explain the empirical regularities on the effects of deficits and government expenditures.

One of the objectives of this dissertation was to evaluate the importance of financial crisis as manifested by deterioration in the quantity and quality of financial intermediation and in the quality of private balance sheets during the interwar period. In order to achieve
this, the vector autoregressive methodology discussed in chapter IV and applied to the seven variable model in chapter V, was applied to an eight variable model comprised of the seven variables in chapter V's model and a proxy for financial crisis. As the analysis in chapter VI indicates, the yield differential between Baa corporate and long-term U.S. government bonds was chosen to be the appropriate proxy.

The empirical regularities generated with respect to the effects of financial crisis on key macroeconomic variables such as the interest rate, prices, output, and the money supply indicate that the proxy for financial crisis was a dominant variable in the model. In particular, a worsening of financial crisis as proxied by an increase in the yield differential leads to significantly negative effects on output and the supply of money. Further, with the exception of initial short-lived positive effects, it had significantly negative effects on both interest rates and the rate of inflation. These results were judged to be not inconsistent with what the theoretical discussion in chapter III would lead us to expect.

As noted in chapter VI, the demonstrated importance of the proxy for financial crisis forces us to question the validity of the results derived in chapter V on the suspicion that an important variable was omitted from the seven variable model. Therefore, the empirical regularities on the effects of the fiscal and monetary policy variables on interest rates, output, and prices generated in chapter V were compared to those generated in the eight variable model. The results were essentially similar for deficits, taxes, and money. However, as
indicated by the IRFs, the pattern of significance of the effects of an increase in government spending on output was reversed from positive in the previous model to negative in the eight variable model. This latter result is difficult to explain. Additionally, it weakens the support found for Barro’s market clearing approach without enhancing that found for either the Mankiw - Summers or Keynesian approaches.

In chapters V and VI we observed that the results presented in this dissertation are subject to several caveats. Of particular importance was the recognition that the tax measure used was imperfect and that the proxy for financial crisis, as with any other proxy, leaves some doubt as to its efficacy. These and other caveats aside, it is particularly important to note that the importance of the tax measure in both the seven and eight variable models raises some serious questions about the efficacy of macroeconomic models that do not include a measure of marginal tax rates. Along the same lines, the dominance of the proxy for financial crisis in the eight variable model forces one to question the results of models that ignore these effects.

In light of the foregoing discussion it seems reasonable to argue that one of the key contributions of this dissertation is that it has empirically identified two key variables that should not be ignored in the construction of models that purport to capture the essence of macroeconomic behavior.

In addition, it is possible to identify at least four other important contributions of this dissertation to the literature. Firstly, the demonstration that the Ricardian equivalence hypothesis is
not inconsistent with the empirical regularities generated by a model
that includes a measure of marginal tax rates and government
expenditures and with those generated by a model that takes financial
factors into consideration provides substantial reinforcement for those
studies that have found empirical support for the equivalence
hypothesis. Secondly, the choice of the interwar period as the
appropriate sample period enhances the literature on these issues in
the manner advocated by Brunner. Thirdly, since the model used in
chapter VI included a wide array of macro variables and the analysis
covered the entire interwar period, the demonstrated importance of the
proxy for financial crisis in the VAR model used there reinforces
Bernanke’s results. This is particularly so when it is recognized that
Bernanke’s results were derived for the Great Depression in a limited
framework that is subject to criticism for possible omitted variables
bias and for the use of unsubstantiated restrictions on the parameter
space. Our results are supportive of the now burgeoning theoretical
literature which identifies an important role for financial factors in
the determination of aggregate economic activity. Finally, our
presentation of, and reliance on, measures of significance for the IRFs
and VDCs is relatively unique since previous VAR studies that yield
results similar to those presented here have not provided any
indication of the precision with which the point estimates they
present (i.e. IRFs and VDCs) are estimated.

It is instructive to note that this research agenda is not
complete. Specifically, additional research effort must be directed at
the construction of comprehensive measures of marginal tax rates. Also, it is important to reexamine the substantial body of empirical literature on fiscal policy in the post-war era using models that include measures of marginal tax rates. Additionally, and since the empirical evidence on the effects of financial factors on macroeconomic performance is so sparse, examination of this issue for other time periods and the presentation of cross-country evidence appears necessary. Finally, it seems important to explore the importance of these financial factors relative to that of money as the degree of economic development and thereby reliance on financial markets varies.
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