MONETARY POLICY, INFLATION AND ECONOMIC ACTIVITY

(Monetair beleid, inflatie en economische activiteit)

PROEFSCHRIFT

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door

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PROMOTIECOMMISSIE

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Chapters 2 and 3 are based on articles published in *Weltwirtschaftliches Archiv* (Smant, 1996) and *Kredit und Kapital* (Smant and Melger, 1997). A version of chapter 4 has been accepted for publication in *Applied Economics* (Smant, forthcoming). A version of chapter 6 has been accepted for publication in *Journal of Policy Modeling* (De Ruiter and Smant, forthcoming). Chapter 6 also builds on previous work on the life-cycle and permanent-income consumption model in collaboration with Kees Koedijk and published in *De Economist* (Koedijk and Smant, 1994). Chapter 5 has been submitted for publication and is awaiting the results of the referee process.

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CHAPTER 1

Introduction

1.1 INTRODUCTION: ECONOMICS AND THE PURSUIT OF ECONOMIC PROSPERITY

The early post-World War II period abounded with optimism about future prosperity. Not only had the victory over Germany and Japan saved democracy for the western countries, but from an economic perspective the war effort had provided a significant push for the development of new technologies and production methods. In Europe and Japan, major reconstruction projects provided necessary jobs and allowed the modernization of industrial production capacity. In economic science and policy, the victory of Keynesian analysis offered the promise that in future macroeconomic processes could be reliably managed by an altruistic, actively involved government. A recurrence of the 1930s Great Depression could, and by all means should be avoided.¹ Some countries incorporated the macroeconomic responsibilities of governments into law and institutions. The United States enacted the Employment Act of 1946. The Netherlands established in September 1945 a Central Planning Bureau, dedicated to producing estimates and directives for the Dutch economy on which government policies could be based. Other countries soon established government departments to perform similar tasks. Tinbergen provided the foundations for modern macroeconometrics and policy evaluation when in 1936 he proposed a 24-equation quantitative model of the Dutch economy. Tinbergen's pioneering work on econometric modelling was followed in 1952 by a theoretical framework for economic policy, and in 1956 by an exposition of the use of econometric models.²

Economists in the 1940s and 1950s assumed that economics was rapidly converging on the discovery and understanding of the universal truth about all essential mechanisms in economic fluctuations. The highly optimistic view of the state of economics in the 1940s and 1950s is summarized in the following quote from Robert Solow (quotation in Brunner, 1989, p. 197):

¹ In fact, near the end of WW-II some economists feared the possibility of a return of the Great Depression. They emphasized that the end of massive government expenditures for the war effort would turn into economic collapse and massive deflation.

² A collection of reviews of Tinbergen's work and influence can be found in Knoester and Wellink (1993).
"I think that most economists feel that the short run macroeconomic theory is pretty well in hand... The basic outlines of the dominant theory have not changed in years. All that is left is the trivial job of filling in the empty boxes [the parameters to be estimated] and that will not take more than 50 years of concentrated effort at a maximum."

With the benefit of hindsight, it is now clear that this position was over-optimistic. Rather than producing a concerted effort aimed at filling in a few empty boxes, economists have created many new boxes, each half-full or half-empty, and each competing for the attention of students and policymakers. The current state of economics is that there exists "no unified theory guiding our interpretation of reality and offering a firm and generally accepted foundation for policy strategies" (Brunner, 1989, p. 197). For example, with respect to monetary economics, Benjamin Friedman (1995) recently emphasized the substantial "gulf between 'academic' research and 'practical' thinking". Whereas few practical economists doubt that monetary policy actions have important effects on the economy (on the real economy in the short run, and mostly nominal effects in the long run), much of current academic research still is on whether and if yes how monetary policy affects economic activity.

A large part of the problem in finding definitive answers is that economics is a science that must draw inferences without the benefit of many controlled experiments. Questions about causality and the importance of the ceteris paribus conditions are therefore very difficult to answer. Another important problem is that in our basic economic models, where all markets clear, uncertainty is limited, and no substantial frictions exist, money has no place and financial intermediaries do not exist -- the financial sector and money simply act as a "veil". Consequently, in these models monetary policy cannot be assumed to affect economic activity. Given that money exists and evidence is available to suggest that monetary policy is effective in the short run, the issue is how to modify the basic model to make it more realistic. On this subject economic theory provides very little guidance and many modifications appear ad hoc. Uncertainty, imperfect information, dynamics of adjustment appear to be crucial, but do not lead to simple, universally accepted models. B. Friedman's (1995) conclusion is that we still face a science in the early stages of theoretical development.

The purpose of this somewhat philosophical introduction is to emphasize that, apart from perhaps a few basic principles, much of economic analysis and policy recommendations remains disputed and is open for alternative interpretations. The essence of economics appears to be that it slowly progresses by examining a series of arguments, hypotheses, counterarguments and alternative hypotheses. It is in the spirit of alternative analyses, hypotheses and counterhypotheses that the chapters in this book have been written.

The five remaining chapters in this book cover a range of topics in monetary economics. Each chapter provides economic analysis and empirical results that can be used to help fill some of the empty boxes in monetary economics. Chapters 2 and 3 deal with the price level and inflation. Chapters 4, 5 and 6 deal with several aspects related to the transmission of domestic monetary policy. The next section provides a brief summary of the chapters.
1.2 AN OUTLINE OF THE REMAINING CHAPTERS

Chapter 2 examines the cyclical behaviour of prices and output. Recent studies have called into question the long-held consensus view in macroeconomics that procyclical prices are a major stylized fact of the business cycle. These studies have suggested that because prices and output are found to be negatively correlated, the evidence provides substantially more support for "real" or supply-side models of business cycles than for the traditional "nominal" or demand-side interpretation. The review of both macroeconomic theory and the empirical evidence in chapter 2 results in the following conclusions. (1) The usual price-output correlation analysis, when taken at face value, identifies the presence of only temporary supply and demand shocks. But this is inconsistent with the postwar experience of sustained inflation. Consequently, the methodology of these studies is suspect. (2) Business cycles linked to shocks in aggregate demand can very well produce time-varying and negative price-output correlations. (3) The negative price-output correlations presented in previous studies reflect a particular choice in detrending the price data. Macroeconomic theory suggests that the so-called "trend" in prices represents expected prices and inflation. The survey evidence on inflation expectations indicates that the frequently used Hodrick-Prescott filter or the first-differencing of price data may be questionable choices for "detrending" price levels. The issue of procyclical or countercyclical prices, real or nominal explanations of business cycles reduces to a debate about appropriate inflation expectations models.

Chapter 3 discusses alternative analyses of inflation. In particular, the question examined is whether the P-star model -- representing a textbook macroeconomic relationship between money and prices -- should be rejected in favour of a popular socio-political model based on cost-push factors. The conclusion is that the P-star model need not be rejected on theoretical grounds and that based on in-sample and out-of-sample forecasting results the monetary model is not outperformed by the socio-political model. Because the empirical performance of both models appears to be almost equal, but policy implications are very different, additional and alternative evidence must be used to select the proper inflation model. Chapter 3 ends with some observations on the political-economy aspects of the public debate on inflation and its determinants. It is argued that policymakers have an incentive to select economic models that allow them to shift at least part of responsibilities to other parties.

Chapter 4 returns to the debate about real and nominal models of business cycles. According to the money-multiplier approach examined in chapter 4, the importance of real and nominal influences can be determined from the two sources of the correlation between money aggregates and economic activity. Nominal monetary policy is assumed to be reflected in the monetary base and real determinants are reflected in the public's desired composition of money balances (i.e. the money multiplier). Real business cycle theory argues that real determinants and the money multiplier explain money-output correlations because nominal monetary policy is assumed impotent. In this chapter the key assumptions of the multiplier approach and the empirical evidence are re-examined. The main conclusions are as follows. First, nominal monetary policy represented by changes in base money does Granger-cause economic activity. Second, actual operating procedures of the monetary authorities prevent the suggested orthogonalization of base money and multiplier changes. Consequently, the
The distinction between real and nominal aspects of monetary policy proposed by the money-multiplier analysis is not very helpful for further analysis. The "credit view" of the transmission of monetary policy emphasizes the impact of monetary policy on the amount and conditions of credit supplied by the banking sector. A review of the existing literature shows that the view that banks are in some sense special credit intermediaries is widely accepted. However, whether the bank credit channel is an important part of the aggregate monetary transmission remains questionable. Cross-country evidence shows that the relationship between bank loans and economic activity is not very clear. The data show no evidence for the specific hypothesis of aggregate credit rationing. A main conclusion from chapter 5 is that much of the debate on a bank credit channel appears to deal with second-order and/or second-round effects of monetary policy actions. One of the crucial difficulties that appears in existing studies is the failure, both on a theoretical and an empirical level, to separate the credit-intermediation function of banks and the specialness of bank lending from the money-creating function of banks. To identify a bank lending channel of monetary policy it must be shown that the effects attributed to money-creation occur only when banks change the volume of loans and not when banks change their portfolio of marketable assets (reserves, bonds, shares). Because banks do not change the composition of their balance sheet randomly, but exhibit systematic asset-liability management related to the business cycle and monetary policy shocks it is nearly impossible to identify in a statistical analysis the relative importance of the bank lending channel. On the other hand, although theory and empirical evidence supports the view that disturbances in the credit-intermediation process (whether originating from monetary policy actions or not) affect the economy, monetary policy effectiveness does not necessarily depend on the specialness of bank credit.

Chapter 6 examines the relationship between the household balance sheet and consumer durables expenditures. A number of observers have pointed to the negative effects of balance sheet restructuring as an explanation for the slow recovery from the early-1990s recession in some OECD countries. The household balance sheet may also provide a channel of transmission of monetary policy. For the Netherlands, the evidence does not support the claim that "excessive" household debt ratios are directly responsible for slowing down consumer durables expenditures. The empirical results do provide some minor evidence for an extension of the life cycle - permanent income model, which includes the liquidity hypothesis developed by Mishkin (1976).
CHAPTER 2

Re-examining the cyclical behaviour of prices and output

2.1 INTRODUCTION

Recently, several studies have re-examined the time-series behaviour of the aggregate price level. The study of Kydland and Prescott (1990) into the "real facts" and "monetary myths" of business cycles started this strand of the literature. Kydland and Prescott concluded that the U.S. detrended price level had been clearly countercyclical with respect to detrended gross national product in the post-Korean period (1954-1989). They claim that the failure to document this fact and the continuation of the myth that procyclical prices were a business cycle regularity has led successive generations of economists astray in developing successful business cycle theories. Kydland and Prescott strongly "caution that any theory in which procyclical prices figure crucially in accounting for postwar business cycle fluctuations is doomed to failure." (p. 17) The evidence appeared to provide substantially more support for a "real" or supply-side model of business cycles than for "nominal" or demand-side models.

Fiorito and Kollintzas (1994) corroborated the empirical results of Kydland and Prescott for the G7 countries. Cooley and Ohanian (1991) examined the robustness of business cycle properties of U.S. prices with longer runs of data, starting as far back as 1822. They found that for significant lengths of time prices exhibited countercyclical and acyclical behaviour. The only episode where procyclical prices are considered a significant feature of the data is the period between the two world wars, particularly the period of the Great Depression. Smith (1992) explored the changes in cross-correlations between real output and prices with longer runs of data for other countries. He concluded that price level fluctuations were generally procyclical from the late nineteenth century until World War II and countercyclical for the post-Depression period, with the possible exception of a period in the 1950s or 1960s. Wolf (1991) showed that estimates of the correlation between detrended U.S. prices and output are not robust to subsamples within the postwar sample. Countercyclicality appears to be largely a feature of the post-1973 data. Prices probably returned to mild procyclicality in the mid-1980s. The most recent contribution is by Chadha and Prasad (1994). They show that it is crucial to make a clear distinction between the cyclical behaviour of the price level and the cyclical behaviour of inflation. Most strikingly, Chadha and Prasad find that inflation is pronouncedly procyclical for all countries, regardless of subperiods and method of detrending used for output.

It appears that, overall, at least the empirical evidence has been presented clearly and is more
However, not all issues have been explored fully. At least two questions still have to be addressed. First, how can we bring to bear the implications of macroeconomic theory to interpret the differences in price level and inflation evidence? How can we reconcile the evidence on countercyclical variation in the price level with equally strong evidence for procyclical variation in inflation? Second, what factors can account for the time variation in price-output correlations?

This paper re-examines the implications of macroeconomic theory for prices, output, and inflation, and provides an alternative interpretation of the empirical results. The main conclusions are: (1) The price-output correlations, when taken at face value, identify the presence of only temporary supply and demand shocks which is inconsistent with the postwar experience of sustained inflation. Consequently, the methodology of these studies is suspect. (2) Demand-induced business cycles can very well deliver time-varying and negative price-output correlations. (3) The negative price-output correlations presented in previous studies probably reflect a particular method of detrending the price data. Theory suggests that the method of detrending prices requires assumptions about the formation of price expectations.

The paper proceeds as follows. Section 2 of the paper presents an update of the statistical evidence. Section 3 reviews what macroeconomic theory implies for the (time-varying) correlations between prices, output and inflation. Section 4 offers a reinterpretation of the evidence consistent with macroeconomic theory. Section 5 contains the conclusions.

### 2.2 CORRELATIONS BETWEEN OUTPUT, THE PRICE LEVEL AND INFLATION

This section presents estimated correlations between detrended output and prices. Its purpose is to examine how robust the claims of procyclical, countercyclical, or acyclical prices are with respect to changes in data definitions, measurement and sample periods. First, I review the correlations between output and the detrended level of prices. Next, I will review how the correlations hold up when not the detrended level but the 4-quarter growth rate of prices (inflation) is used. The empirical results are partly a re-run of results presented in previous studies. I add to previous empirical results a direct comparison of results based on industrial production and GNP/GDP as alternative measures of output, and consumer prices (CPI), producer or wholesale prices (PPI) and the implicit GNP/GDP deflator as alternative measures of prices.

The dataset consists of six countries: France, Germany, Japan, the Netherlands, the United Kingdom and the United States. Generally, the quarterly data cover the postwar period 1957:1-1992:4. Note that quarterly data on GNP/GDP are limited to the more recent postwar period for some countries. 

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1. Kydland and Prescott's alleged taboo on reporting business cycle facts was apparently not a real problem.

2. Selecting combinations of output and price variables is admittedly somewhat ad hoc. On the other hand, ad hoc selection is precisely the reason behind robustness checks. An economic interpretation of price and output variables refers to alternative speeds of adjustment to shocks (industrial production and producer prices assumed to react more quickly than services and (partly imputed) prices/costs included in GNP and CPI) or the requirement of correspondence between goods baskets used (industrial production and PPI, vs. GNP and GNP deflator and CPI).
The cyclical behaviour of prices

countries, whereas the time series available for the United States are usually much longer. The data for GNP/GDP, industrial production, consumer price or cost-of-living index, wholesale or producer price index are mostly from standard international sources: UN- Monthly Bulletin of Statistics, OECD-Main Economic Indicators (MEI) Historical Statistics, IMF- International Financial Statistics (IMF-IFS), with some additions from national sources. Several series are ratio-spliced to create longer time series and to overcome the problem of rounding errors in long-run index data. The German data are for western Germany. No attempt was made to eliminate from the price and output data any special effects of German reunification.

Table 1 Cross-correlations of detrended output and price levels

A. Correlations of detrended industrial production with detrended CPI (first row) and PPI (second row)

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B. Correlations of detrended GDP/GNP with detrended GDP/GNP deflator

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<td>-0.28</td>
<td>-0.15</td>
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</tr>
</tbody>
</table>

Detrended output and prices refers to logs of the original data and the trend is estimated with the Hodrick-Prescott filter (using \( \lambda = 1600 \) for quarterly data).\(^3\)

### 2.2.1 Correlations between detrended output and detrended price levels

Parts A and B of table 1 display the average cross-correlations of different price indexes with industrial output and GNP/GDP respectively. Consider first the results for the U.S. with data for detrended GDP and the detrended GDP deflator (part B). These results correspond to the results in Kydland and Prescott (1990, table 4), and Cooley and Ohanian (1991, table 1) and instigated the subsequent research. A striking feature are the relatively large number of significantly negative correlations, including a negative contemporaneous correlation of \(-0.51\). (Depending on sample length the cutoff point for significance from zero at 5% is approx. 0.17-0.19.)

#### Table 2 Cross-correlations of detrended output and price levels until 1972:4

**A. Correlations of detrended industrial production with detrended CPI (first row) and PPI (second row)**

<table>
<thead>
<tr>
<th></th>
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<td>0.35</td>
<td>0.43</td>
<td>0.46</td>
<td>0.41</td>
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</table>

**B. Correlations of detrended GDP/GNP with detrended GDP/GNP deflator**

<table>
<thead>
<tr>
<th></th>
<th>t-5</th>
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<td>0.08</td>
<td>0.03</td>
<td>0.01</td>
<td>-0.06</td>
</tr>
</tbody>
</table>

Notes: See table 1.

\(^3\) See Cooley and Ohanian (1991), Smith (1992) and Chadha and Prasad (1994) for the sensitivity of the results to different methods of detrending.
Note that not only the U.S. but also all the other countries display a negative contemporaneous correlation between detrended GNP/GDP and its price deflator. Turning to the alternative measures of output and prices in part A, the pattern of negative contemporaneous correlations is generally confirmed. In some cases, however, the strength of this correlation and even its sign depends on exactly which price index is used. In France and Japan there is a decisive difference between the CPI and the PPI results; the contemporaneous correlation changes from significantly negative for the CPI into positive for the PPI. In Germany and the U.S. the size of the correlation coefficient clearly depends on the choice of CPI or PPI.

Table 2 is used to check whether or not the correlations presented in table 1 are robust to a change in the sample period. The data sample in table 2 ends in 1972:4. Motivation for the choice of this date is the final breakdown of the Bretton Woods system of fixed exchange rates and it is also the period before the first oil price shock. Start again with the GDP data for the U.S. in part B. It appears that although the contemporaneous correlation is still negative at -0.07, the estimate is apparently not very robust to changes in the sample period (note that 5% significance levels are now approx. 0.25-0.35). Furthermore, the correlation of GDP output with future prices has shifted from negative to mildly positive. In the sample period up to 1972:4 GNP/GDP price levels were generally procyclical in France, Germany, and Japan. Only the U.K. data exhibit clear countercyclical behaviour of the GDP price level. In part A the results for industrial output and CPI and PPI prices appear basically unchanged for Germany and the Netherlands when compared to the full sample results in table 1. The results for the other countries do show some changes, mostly for the correlations between output and lagged prices. But there is no clear pattern to these changes.

So far, the presentation and discussion of results has been rather commonplace and consistent with other studies. It has focused on the sign and size of the correlations in the data. At this stage I would like to introduce an observation on the pattern of correlations that I think has thus far escaped attention. This feature is important because the pattern of correlations provides an important clue to the dynamic relationship between output and prices. The interpretation of this pattern will be addressed when I return to this issue later.

The pattern of correlations is most clearly visible in the GNP/GDP data and the focus will be therefore on panels B of tables 1 and 2. First, note that the pattern of correlations invariably starts with negative values at time t-5 and ends with positive or nearly positive values at time t+5. Also note that going through time from t-5 to t+5 the correlations tend first to decline, becoming more negative, before rising and becoming positive and subsequently falling again. The tables can only show part of the cycle because it limits the cycle to observations between t-5 and t+5. Nevertheless, all countries appear to have this cyclical pattern of correlations, although the exact position of the peaks and troughs differs for each country.

### 2.2.2 The pattern of correlations between detrended output and inflation

Cooley and Ohanian (1991, pp. 28-29) state explicitly that there are different views on the "stylized fact" of procyclical prices. Following their example we can identify four main interpretations:

1. The detrended price level is correlated with the detrended level of output.
2. Inflation is correlated with the detrended level of output.
3. The change in inflation is correlated with the detrended level of output.
4. Unexpected inflation is correlated with the detrended level of output.

The options could be further expanded by replacing the detrended level of output with the growth rate of output, accelerations in the growth rate of output, the unemployment rate, etc.

Interpretation 1 was the subject of the previous section. Cooley and Ohanian chose to ignore interpretation 4 because they did not want to take a stance on an approach to model expectations. However, despite also identifying the stylized fact as a possible correlation between the change in prices and the level of output, their empirical investigation only focused on correlations between prices and output in either levels or growth rates.

### Table 3 Cross-correlations of detrended output level and price changes

#### A. Correlations of detrended industrial production with 4-qtr change in detrended CPI (first row) and PPI (second row)

<table>
<thead>
<tr>
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<th>t-4</th>
<th>t-3</th>
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#### B. Correlations of detrended GDP/GNP with 4-qtr change in detrended GDP/GNP deflator

<table>
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</table>

The cyclical behaviour of prices

Table 3 illustrates what a seemingly minor alteration in the measurement of the variables can do to the analysis.\(^4\) Table 3 presents correlations between the rate of inflation (measured as the 4-quarter rate of change in the detrended price index\(^5\)) and the detrended level of output. Contrary to the predominantly negative correlations between prices and output when both are measured in levels or growth rates (see table 1 and previous studies), the correlations in table 3 for inflation and the level of output appear predominantly positive.

### Table 4 Cross-correlations of detrended output level and price changes up to 1972:4

**A. Correlations of detrended industrial production with 4-qtr change in detrended CPI (first row) and PPI (second row)**

<table>
<thead>
<tr>
<th></th>
<th>t-5</th>
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**B. Correlations of detrended GDP/GNP with 4-qtr change in detrended GDP/GNP deflator**

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Notes: See table 3.

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\(^4\) Compare Chadha and Prasad (1994).

\(^5\) I prefer to use the detrended price and inflation data, because the assumption of a constant mean for actual inflation data is clearly questionable. Using detrended inflation data increases the correlations and strengthens the procyclical results. However, the results remain qualitatively the same for actual inflation data.
In particular, the evidence clearly suggests a very strong positive correlation between current levels of output and future inflation (here centred around time t+4 correlations).

Table 4 presents the results of the same analysis for the truncated period that ends in 1972:4. Generally, the observations of the previous section still apply. Note that with respect to GNP/GDP output and price changes, in the period up to 1972:4 positive correlations appear to peak closer to time t. The U.K. again provides the exception to this general observation.

The results presented in the tables 1 to 4 capture the basic evidence that has so far featured in the debate on the cyclical behaviour of prices. Unfortunately these results are both inconclusive and unsatisfactory. The results are inconclusive because there is as yet no clear guidance on how to choose between the countercyclical results for detrended output and price levels, and the basically procyclical results for detrended output and (future) inflation. The results are unsatisfactory because simple correlations between two variables, especially when averaged over long sample periods, cannot do justice to plausible and obvious changes in the economic system.

2.3 PRICES AND OUTPUT IN MACROECONOMIC THEORY

2.3.1 Demand shocks in mainstream textbook analysis
Kydland and Prescott (1990), Cooley and Ohanian (1991), among others, concluded that for significant lengths of time U.S. prices exhibited countercyclical and acyclical behaviour. These findings, they state, are at variance with the general procyclical behaviour incorporated in mainstream descriptions of the stylized business cycle facts.

Macroeconomic analysis in modern mainstream textbooks follows the expectations-augmented aggregate demand - aggregate supply (AD-AS) model. The familiar diagram of the AD-AS model is presented in figure 1. It displays the aggregate price-output combinations that correspond to a downwards-sloping aggregate demand curve, an upwards-sloping short-run aggregate supply curve, and a vertical long-run aggregate supply (LRAS) curve.\(^6\) For any vector of expected values of the exogenous variables, the long-run or perfect-foresight equilibrium of aggregate supply and demand determines the expected price level and therefore also the location of the expectations-augmented aggregate supply (EAS) curve which dictates the behaviour of aggregate supply in the short run. Unexpected movements in aggregate demand induce short-term changes in aggregate supply, either because there exist information problems or because existing structures of nominal (wage-) contracts prevent immediate adjustment of all prices. The intersection of EAS and AD curves determines the actual level of output and prices in the short run.

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\(^6\) Economists differ on the economic decision models underlying this framework. For example, compare the New Keynesian version (Mankiw 1991) and the intertemporal New Classical version (Barro 1989).
The cyclical behaviour of prices

Figure 1 The aggregate demand and supply model
When the premise is that the behaviour of prices is essentially procyclical, the textbook macroeconomic model appears to emphasize aggregate demand disturbances as the main source of economic fluctuations. As is shown in part b of figure 1, a positive demand shock shifts the aggregate demand curve from AD to AD'. And output and prices rise together. To be more precise, at time t the actually observed price level is higher than its previously expected value and output is higher than its long-run or full-employment equilibrium. It is also true that the time t price change or inflation is higher than expected and output growth exceeds its natural growth rate. Therefore, correlations between prices and output, and output growth and inflation are positive.

In the next period the economy is assumed to move to its new long-run equilibrium. Exactly what this new equilibrium is depends on whether the initial shock turns out to be temporary or permanent. If the shock was merely temporary, at time t+1 output returns to its initial level and the price level falls to its previously expected value. Growth rates of both variables are negative.

If the demand shock turns out to be permanent, output will again return to its initial level but the price level continues to rise to a new and permanently higher level. Another way of looking at this case is to see that although at time t the price level is above its previously expected level, the time t price level is below its new permanent, long run or currently expected level. Ultimately, deviations from long-run equilibrium or expected values are zero just as in the case of temporary disturbances, but the correlation between growth rates of output and prices is different. The (future) change in output is negative whereas the (future) change in prices is positive. At the same time, last period's output level predicts future price changes or inflation. Apparently, when the demand shock is permanent the correlations between different variables can shift, depending on their measurement and the state of the business cycle.

2.3.2 Supply shocks and real business cycle models
Since the experience with "stagflation" in the 1970s - when high and persistent inflation coincided with low and stagnating levels of real economic activity - supply shocks have forcefully entered our stylized view of the macroeconomy. In the mainstream model, a positive supply shock shifts the short- and long-run supply curves to the right (figure 1(c)). In this case, time t output and prices move in opposite directions, because output increases while prices fall. If the supply shock was only temporary, both output and prices return to their original levels: output falls and prices rise. If the supply shock proves to be permanent, output continues to increase and prices continue to fall. In all cases prices and output prove to be countercyclical.

Real business cycle (RBC) theory emerged from fundamental dissatisfaction with a perceived lack of theoretical (microeconomic) foundations for some assumptions in the mainstream AD-AS model. The RBC analysis is based on a continuous general equilibrium in an economy with

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7 Many textbooks refer to Burns and Mitchell (1946) who formalized the concept of procyclical prices in their account of the stylized facts of the U.S. business cycle.

8 For example, Bayoumi and Eichengreen (1994, p.817, note 4) apparently recognize the possibility of unstable correlations and misidentification of supply and demand shocks in their VAR approach to the AD-AS model. Nevertheless, they ignore the subject in the remainder of their paper.

9 Mainly the microeconomic rationality of long-term nominal contracts and the persistent effects of
The cyclical behaviour of prices

intertemporally optimizing economic agents. The mechanisms in the propagation of business cycles involve the intertemporal decisions faced by economic agents (usually modeled as the intertemporal substitution of consumption and leisure). At a theoretical level RBC analysis distinguishes technology, or supply shocks, and preferences, or demand shocks. But, empirical analyses usually focus on the so-called Solow residuals and emphasize supply shocks that affect the production function.\(^\text{10}\)

Because RBC theory deals with real variables, there is usually no explicit statement on the general price level. However, if the demand for real money balances depends positively on economic activity, King and Plosser (1984) argue that prices should exhibit countercyclical behaviour if the economy experiences exogenous shocks to real output.

Take the following equation:

\[
m_t - p_t = c + \alpha_y y_t - \theta_i i_t + \varepsilon_t.
\]

This simple demand for money equation in logs, where the demand for real money balances \((m-p)\) is a function of real activity \((y)\) and a vector of interest rates \((i)\) makes this argument readily apparent. If the money stock is not very well correlated with real activity, it follows that prices must be countercyclical. This conclusion corresponds to the influence of supply shocks in the mainstream AD-AS model. On the other hand, even in this real business cycle approach a procyclical monetary reaction function could produce a procyclical price level. Evidence suggests that monetary aggregates are procyclical.\(^\text{11}\) Within the RBC approach, however, it is not clear why monetary authorities would seek to pursue such a policy.

2.4 RE-EXAMINING THE EMPIRICAL EVIDENCE

2.4.1 Correlations between detrended output, prices and inflation, and the distribution of demand and supply shocks

Table 5 summarizes the textbook model's hypothesized effects of unanticipated demand and supply shocks on output \(y\) and prices \(p\). Table 5 clearly shows that a fully developed AD-AS model with temporary and permanent demand and supply shocks, and completed with non-zero economic growth and with non-zero expected inflation, allows a complex set of correlations between actual period-to-period price changes and output changes.

The problem of properly identifying the actual composition of macroeconomic shocks is more difficult to solve than by merely measuring simple price-output correlations. To distinguish between temporary and permanent demand and supply shocks the combination of at least two pieces of evidence is required (see table 6): (1) the correlation between shocks to current price and output unexpected nominal shocks.

\(^\text{10}\) Plosser (1989) strongly opposes an aggregate demand and supply interpretation of the RBC theory, arguing that in general equilibrium models demand and supply decisions interact. I would argue, that general equilibrium models state interactions between demand and supply schedules that remain largely implicit in the mainstream macro model.

\(^\text{11}\) In their text Fiorito and Kollintzas (1994) appear to disagree with this conclusion. The evidence in their own table 2 suggests that monetary aggregates are procyclical. Also compare Van Els (1995), Serletis and Krause (1996).
levels, and (2) the correlation between current output and future inflation.

Table 5  Shocks and the co-movement of output and prices in the textbook model

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<td>permanent</td>
<td>(y_0 &gt; y_0^*, \ p_0 &lt; p_0^e)</td>
<td>(y_1 &lt; 0), (\delta p &gt; 0)</td>
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<tr>
<td>positive supply shocks</td>
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<td>temporary</td>
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</table>

Table 6  Identifying shocks with correlations between output and prices

<table>
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<th>with future inflation negative</th>
</tr>
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<tr>
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Figure 2 shows some typical results. To conserve space I will only present the results for the United States. In figure 2 I compare (a) the contemporaneous correlation of detrended output and detrended price levels with (b) the correlation between detrended output and future inflation (measured as the 4-quarter rate of change from period t to t+4). All correlations were estimated with a 5-year (20 quarters) moving window.

The general result is that this method indicates that only two alternating states of the world exist: (a) periods with positive correlation between current price and output levels, and negative correlation between current output and future inflation, and (b) periods with negative correlation between current price and output levels, and positive correlation between current output and future inflation. Thus, according to this method the world appears to alternate between periods dominated by temporary supply shocks and periods dominated by temporary demand shocks.
Figure 2  Price-output correlations for the U.S. (5-year moving window estimates)

Notes: taip, tapp are trend-adjusted industrial production and producer prices; dpp(t+4) is rate of change of detrended producer price index between time t and t+4.
If this methodology were correct the analysis could end here. However, these results are to some extent puzzling. First, it is puzzling to see such a complete and persistent alternation in the correlations of output with price levels and inflation. Second, if only temporary supply and demand shocks exist in the post-WW II data, what has caused the large and persistent rise in the general price level?

2.4.2 The relationship between detrending and expected prices

Following previous studies, a crucial assumption that has been maintained until now is that the use of detrended data for both output and prices is correct. This section re-examines this assumption. Recall that modern economic theory actually suggests a relationship between unexpected price movements and deviations from equilibrium output. Kydland and Prescott (1990) and others do not even mention price expectations, whereas Cooley and Ohanian (1991) ignored this element because of their hesitation to model expectations. Instead, all previous studies chose to detrend the price level using either a deterministic time trend, the Hodrick Prescott filter, or first differences of the (log) data.

However, if macroeconomic theory is correct these approaches are not capable of circumventing the problem of price expectations; each approach actually imposes a particular expectations mechanism. In fact, Cooley and Ohanian, as well as others, have implicitly defined price expectations as following either the Hodrick-Prescott filter estimates or a pure random walk in (log) price levels. It is appropriate to examine what the type of expectations model implies, how they correspond to the data, and how they may affect the empirical results.

Figure 3 shows part of actual inflation history in the U.S., focusing on the 1970s. The figure also shows the expected price levels and rates of inflation implied by the HP filter and an alternative expectations mechanism. The chosen hypothesis under adaptive expectations or "learning" is that the expected price level for time t equals the actual price level observed in time t-1 plus the average rate of inflation observed in the preceding two years (8 quarters).12 The upper part of figure 3 shows the trend-like character of the HP-filtered data. The trend clearly cuts through all cyclical movements in the price level to obtain a smooth, slow-moving time series. To emphasize the consequences of using the HP-filtered price series, it is illustrative to examine the 1972-1975 period. Note that in the 1972-1973 period the HP filter already discounts the high post-1973 inflation rates as the HP-filtered series lies above the actual price series. Similarly, in the 1974-1974 period the HP filter already discounts the subsequent fall in inflation and the HP-filtered series lies below the actual price series. The HP filter therefore can be considered as incorporating a substantial element of "perfect foresight" expectations. On the other hand, the adaptive expectations mechanism makes the 1973 acceleration and the 1975 deceleration largely unanticipated movements in inflation.

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12 The usual representation of adaptive expectations is actually a more complex distributed lag of past inflation rates. The formula in this paper is adaptive in the sense that expectations are updated with recent information. I prefer the term adaptive to backward looking because it suggests learning rather than merely ignorance and irrational behaviour.
The cyclical behaviour of prices

Figure 3 U.S. CPI price index and inflation

US: CPI level (logs)

US: CPI inflation (4-qrt change)
This paper does not cover the selection of most appropriate, or "rational" expectations mechanisms (but see some brief comments in the section below on the price adjustment model). The particular expectations formula used here serves only an illustrative purpose. But it turns out that the mixture of detrending methods and expected prices is a crucial element in evaluating the cyclical behaviour of prices. Suffice it to note that survey evidence on expectations usually shows that actual market expectations are better described by adaptive mechanisms (for the U.S., see for example the results of the Livingstone and SRC surveys in figure 1 in Evans and Wachtel, 1993).

Table 7 Cross-correlations of detrended output and unexpected prices

A. Correlations of detrended industrial production with unexpected CPI (first row) and PPI (second row)

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B. Correlations of detrended GDP/GNP with unexpected GDP/GNP deflator

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The cyclical behaviour of prices

All market participants appear to have a very limited ability to accurately forecast economic time series in general, and inflation in particular (for a review of official U.S. inflation forecasts in the 1970s see for example Cullison, 1988). Because of its implied "perfect foresight" there is probably serious reason to question the HP filter as an appropriate method of detrending prices.

Table 7 presents the correlations between output and (unexpected) prices when the HP filter is replaced with an adaptive expectations mechanism. It is readily apparent that these correlations offer no support for the claim that prices are largely countercyclical. On the contrary, price movements are clearly procyclical. Note that, arguably, the procyclical results in this section are not due to the precise formula used for price expectations. The results appear to depend entirely on the difference between adaptive and perfect foresight models of expectations.

2.4.3 Lead-lag relationships and a simple model of price adjustments

Contrary to the simple representation in the AD-AS model, actual correlations between prices and output probably do not reflect just the instantaneous effects of either aggregate demand or aggregate supply shocks. The data also reflect the dynamic relationships created by economic agents who, due to information and transaction costs, may find it efficient practice to introduce a lag between the time when disturbances are observed and the time when adjustments in behaviour are made. Incorrectly perceived or confused signals are after all a major underpinning of the short-run aggregate supply curve. This section demonstrates what happens to price-output correlations in a dynamic model where prices, output, and expectations adjust with different time lags.

(i) The pattern of correlations with lead-lag relationships

I now return to the empirical findings presented above, which featured a particular pattern of correlations (the correlation function) and a positive relationship between current levels of output and future inflation.

Figure 4 presents a very simple example of how the dynamics of cyclical variables affect the pattern of cross-correlations. Consider two time series of the cyclical variables x and y presented in figure 4. The values of variable x lead those of variable y, but the time series is shifted forward in time by two time periods. Movements in variable x lead variable y by two periods. The bivariate correlations between y and x lead variable x lead variable y and x lead variable y are also shown.

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13 Since I started work on this paper several other papers have appeared that make more or less similar arguments. Compare Chadha and Prasad (1993), Judd and Trehan (1995) and Hall (1995).

14 In fact, Bayoumi and Eichengreen (1995) implement a VAR-model strategy to derive empirical estimates of demand and supply shocks using specific assumptions on appropriate dynamic impulse-response relationships.

15 I do not suggest that actual economic time series conform to orderly, mathematical sine/cosine functions, for example like a piano-string in motion. The business cycle in economics is irregular and not periodic. However, the cyclical behaviour exists. This stylized representation also ignores the problem of appropriately detrending nonstationary variables to obtain the cyclical series.
Figure 4 Leading and lagging cyclical variables and their cross-correlations

(a) 2 lead-lag cyclical variables y and x
(b) Cross-correlations y(t) and x(t+i)
Observe that the correlations exhibit a definite cyclical pattern. Going from left to right there are negative correlations between $y$ and lags of variable $x_1$. The contemporaneous correlation is positive and reaches a peak at a lead time of variable $y$ on variable $x_1$ of 2 time periods. The other panels in figure 4 show how different lengths between movements in $y$ and $x$ (i.e. 4 and 5 time periods) shift the pattern of correlations but do not change the pattern itself.

There is a critical value of the time shift between $y$ and $x$ for which the calculated contemporaneous correlations change from positive to negative. It is tempting to suggest that figure 4 is a stylized representation of the patterns of correlations in tables 1 and 2. The actual price-output data are noisy cyclical data and in reality the lead and lag times are not fixed parameters, but the similarity is obvious. One might argue that the data in table 1 correspond to the long-lag example (shift=5) in figure 4, whereas the data in table 2 correspond to the short-lag example (shift=2).

One possible reconciliation of the seemingly different results in tables 1-2 compared to tables 3-4 consists of two steps. First, detrended prices and output are cyclical variables with prices lagging movements in output. Second, the transformation of the price variable from levels to growth rates (inflation) shifts the cyclical time series backwards in time and reduces the time lag with output movements. Due to the longer lag between movements in levels of prices and output the calculated correlations are negative, whereas the calculated correlations between inflation and the detrended level of output are positive.

In their study of price and output correlations, Friedman and Schwartz (1982, p.403) referred to 'the difference in the temporal reaction pattern of output and prices to autonomous changes in nominal income' as follows.

'In general, output is affected sooner than prices: an acceleration in nominal income, for example, leads to an acceleration in output after a brief lag (about six to nine months for the United States and the United Kingdom) and has little effect initially on prices. Later the impact shifts to prices (after about another fifteen to twenty months for the United States and the United Kingdom). As prices take over, output decelerates in response. The positive correlation between prices and output imparted by a change in nominal income thus tends to be offset by the temporal differences in response.

It follows from these considerations that a positive correlation is to be expected only when the autonomous forces affecting nominal income are sufficiently dominant to overcome both the statistical and the economic forces making for a negative relation.'

(ii) A simple model of price adjustments and expectations
Consider the following representation of a business cycle generated by a simple macroeconomic model.\textsuperscript{16, 17}

\textsuperscript{16} The model is related to early monetarist models of price-output behaviour developed in the 1970s and the following discussion closely follows the description in Laidler (1973) and Laidler and Parkin (1975). The updated model presented in this paper incorporates explicitly both the AD and EAS elements of modern macroeconomic models. The dynamics of the model depend almost entirely on the "adaptive" expectations mechanism. In their survey of inflation, Laidler and Parkin (1975) refer to
In this model, $p_t$ is the log rate of price changes (inflation), $\gamma_t$ is the average level of excess demand measured as the log of the ratio of actual to trend output, $\hat{p}_t$ is the expected rate of inflation held by economic agents at the end of the previous period about the current rate of inflation, and $m_t$ is the log rate of change of the nominal money stock.

In equation 1 monetary policy is the exogenous determinant of the nominal growth of this economy, noting that nominal growth, by definition, can be divided in (detrended) growth of the real economy $y_t$ and price changes $p_t$. For any given change in prices, excess money growth (i.e. real money growth) will be reflected in a change in real output. (Note that with $d = 1$, equation 1 is a simple version of the quantity theory's equation of exchange that assumes constant money velocity.) Assuming a positive growth rate of the money supply, all shifts in the level of nominal demand in this economy are permanent. However, the public is assumed to be uncertain whether changes in money growth rates are permanent or temporary. Equation 2 is the short-run aggregate supply curve. Most importantly, equations 3 and 4 describe the dynamics of price expectations. The expected price change for time $t+1$ consist of two components. The first component of the expected future price change is the adjustment that follows the (unexpected) current demand shock -- represented by the slope of the AD curve and the current output gap, $\gamma_t$. The second component of the expected price changes is the expected future shift in the demand curve $\Delta AD_{t+1}^e$. With respect to $\Delta AD_{t+1}^e$ economic agents attempt to infer from the new information provided by the currently perceived demand shock whether they face a permanent change in the money growth rate or merely a one-period, temporary change. The weight attributed to the case of a permanent change is captured by the $\beta$ coefficient. Uncertainty and learning requires that the public in our simulation makes a series of positively correlated expectation errors. Note, however, that except for the confusion about temporary and permanent changes in money growth rates, expectations are completely rational (although not modeled according to the more

\begin{align*}
(1) \quad & \Delta y_t = \delta (\Delta m_t - \Delta p_t) \\
(2) \quad & \Delta p_t = \Delta p_t^e + \lambda y_t \\
(3) \quad & \Delta p_{t+1}^e = \gamma y_t + \Delta AD_{t+1}^e \\
(4) \quad & \Delta AD_{t+1}^e = \Delta p_t^e + \beta (\Delta p_t - \Delta p_t^e)
\end{align*}

In several empirical studies that showed that (a simple version of) this model fits the broad facts of the major industrial countries in the period from the mid-1950s to the early 1970s.

17 In recent papers, Hall (1995) and Judd and Threhan (1995) also addressed some of these issues and they reached conclusions that are similar. Scope and theoretical framework of our papers are somewhat different. For example, they chose to re-examine the implications from a traditional Phillips curve based model and thus ignored the role of inflation expectations in current economic models. Also, Hall merely criticized the use of detrended price data as highly inappropriate for nominal variables. This paper explicitly interprets the use of price "trends" as providing a measure of expected price levels.
The cyclical behaviour of prices commonly used strong version of the "rational expectations hypothesis"). Changes in uncertainty that affect $\beta$ also affect the persistence of actual inflation and output cycles, or, in other words, the temporal reaction pattern of prices and output to shocks.

The behaviour of this model economy can be illustrated by the following experiment (see figure 5(a)). Suppose the economy is initially in full equilibrium with the actual and expected rates of inflation equal to the growth rate of the money stock (initially assumed to be zero). In this situation excess demand will be zero. At time $t=0$ let the rate of monetary expansion rise as a one-time, permanent increase in the growth rate. The increase in nominal demand will be divided in price and output components, both as a fraction of the change in the money growth rate, depending on the slope of the short-run aggregate supply curve. The inflation rate will rise but the inflation rate will be less than the money growth rate, hence real money balances rise and additional excess demand is generated. When inflation reaches the money growth rate the change in excess demand is zero but the level of excess demand continues to increase inflation. At this time inflation higher than money growth causes real money balances and excess demand to fall. The actual and expected inflation rates and excess demand will continue to cycle in a damped fashion towards a full equilibrium in which excess demand is zero and the actual and expected inflation rates are equal to the new and higher money growth rate.

It is easy to see that in economies represented by the simulation, simple price - output correlations turn out to be negative despite the fact that prices and inflation are positively related to output and despite the fact that the economy is purely demand driven.

Figure 5(b) shows the stylized view of the previous simulation: an economy that experiences cyclical movements in the supply of money and therefore aggregate demand. This cyclical representation reflects the macroeconomic consequences of so-called stop-go monetary policies attributed to monetary authorities who follow discretionary policies. The close correspondence between figure 5 and figure 4 is very suggestive of a possible demand shock explanation for the empirical correlations between output and prices presented in this paper and in other studies.

(iii) One other possible cause of time-varying correlations

Wolf (1991) and Smith (1992) show that the estimates of price-output correlations are not robust, but change over time. One explanation for these changes, consistent with the previous view of cyclical output and prices, is a shift in the cycle phase of prices relative to output.

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18 There is a large literature on the "rationality" of expectations. Rational alternatives to the simple textbook "rational expectations hypothesis" or "perfect foresight plus error" model are usually motivated by learning in the presence of uncertainty with respect to economic structure, or, in the broadest of terms, changes in regime. See for example, Frenkel (1975), Mussa (1975), Brunner, Cukierman and Meltzer (1980), Evans and Wachtel (1993), Meltzer (1995).

19 Note that although there exists in figure (b) a close correlation between money, price and output cycles, in figure (a) there is no close correlation between money on the one hand and prices and output on the other hand. Apparently in some cases a monetary origin of business cycles can remain undiscovered in statistical analyses.
Figure 5  Cyclical output and prices in a demand driven economy with lagged adjustments

(a) values from a simulated monetary model

(b) stylized view of cyclical movements in money, output and prices
\( dM, dP, y \)

Note: see the main text for details of the simulated model.
Price-output correlations must reflect the dynamics of economic agents who, due to information and transaction costs, find it efficient practice to introduce a lag between the timing of observed disturbances and adjustments according to the (ex post known) optimal or rational change in behaviour. Changes in the adaptive behaviour of agents result in changes in the various coefficients and therefore in the dynamic adjustment of the variables in the model in response to shocks. One research strategy could be to model these changes explicitly, using for example estimates of the distribution of permanent and temporary aggregate demand and aggregate supply shocks. One might also identify coefficient changes with major macroeconomic events that could likely have caused changes in adaptive behaviour. For example, recent work by Alogoskoufis and Smith (1991) and Alogoskoufis (1992) illustrates that changes in the persistence of inflation follow changes in exchange rate regimes. Alogoskoufis and Smith show that a change in the data generating process for inflation is reflected in a change in the inflation pass-through effect on nominal wages.

2.5 CONCLUSION

The stylized business cycle fact that prices are procyclical has recently been called into question. It is suggested that recent periods with negative correlations between prices and output provide substantially more support for "real" or supply-side interpretations than for "nominal" or demand-side interpretations of business cycles. This paper has re-examined the issues.

Macroeconomic theory offers a number of possible relationships between prices, output, and (future) inflation. When taken at face value, the existing evidence on negative correlations between (detrended) price and output levels and positive correlations between current output and future inflation suggests that only temporary supply and demand shocks are present in the data. This presents a problem because these shocks cannot explain our experience with sustained inflation in the postwar period. Consequently, the methodology of simple correlations is suspect.

Contrary to initial suggestions about the differences between supply- and demand-shock oriented models, it is now clear that economies experiencing demand induced business cycles can very well deliver time-varying and negative price-output correlations. The strict contrast between countercyclical prices in the case of supply shocks and procyclical prices in the case of demand shocks only holds when all shocks are considered to be temporary, or if the time periods following initial disturbances -- when the economy adjusts to a new equilibrium -- are ignored. Simulation of a small model with lagged adjustments shows how in a purely demand driven economy negative contemporaneous correlations between price and output levels coincide with positive correlations between current output and future inflation. Consequently, the existing evidence on correlations does not particularly favour RBC models of business cycles.

This paper also argues in a more technical approach to the measurement of correlations that the detrending methods used in previous studies are not neutral with respect to the problem of adjusting for inflation expectations. The HP-filtered and first-differenced (log) price data impose particular expectations mechanisms. The HP filter imposes a substantial element of perfect foresight. This element of perfect foresight appears to conflict with survey evidence on actual inflation expectations. Alternative empirical results demonstrate that the negative price-output correlations presented in
previous studies appear to be mainly caused by the specific and probably inappropriate detrending of the price data. Using an alternative measure of expectations adjusted ("detrended") price data, this paper shows that unexpected price movements are procyclical.

The conclusion from this re-examination must be that the correlation evidence does not particularly favour the class of RBC models.
APPENDIX 2 THE HODRICK-PREScott FILTER

Time-series econometrics is characterized by two extreme positions on nonstationary or trending
variables: trendstationarity and difference stationarity (see Stock and Watson (1988) for an
introduction). The Hodrick-Prescott (HP) filter developed in Hodrick and Prescott (1980) can be
viewed as a pragmatic intermediate view of trends. The HP filter allows a flexible, time-varying trend
growth rate (contrary to most implementations of trendstationarity) but assumes that there exists an
equilibrium or trend value to which a variable would ultimately converge (contrary to the assumption of
difference stationarity).

Formally, for a variable $y$ the HP filter trend value at time $t$, $\tau_t$, is derived from the problem

$$\min_{\tau_t} \sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=1}^{T-1} ((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1}))^2$$

Prescott (1986, p.10) describes the procedure as a curve-fitting method which minimizes the sum of
the squared deviations from a given series $y$ subject to the constraint that the sum of the squared
second differences (i.e. changes in the growth rate) not be too large. In the literature common values
for the penalty on changes in the trend rate are $\lambda = 100$ for annual data, and $\lambda = 1600$ for quarterly
data. No formal analysis justifies these choices, merely the observation of adequate trending
behaviour.

The choice of a method to remove trends from nonstationary variables is not trivial. King and Rebelo
(1993), Cogley and Nason (1995), for example, show that the choice of a filter substantially influences
the perception of the cyclical component in variables.

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CHAPTER 3

Monetary and non-monetary analyses of inflation in a small open country

3.1 INTRODUCTION

Inflation and price stability provide a recurrent topic for articles in the popular and scientific press. Since the disturbing experience with seemingly run-away inflation in the mid and late 1970s, the main themes have been the desirability of price stability and early warnings against (perceived) inflationary developments. Three recent articles illustrate the nature of the debate on inflation in the Netherlands. For example, Berndsen (1993) called for a restructuring of wage negotiations as an essential part of a strategy to maintain price stability. Berk (1994) suggested that in order to maintain price stability, the Dutch government should limit its own contribution to inflation; i.e. compensate increases in government controlled energy prices, housing rents and prices of public sector services with reductions in indirect taxes. Berk and Winder (1994) examined the cointegration of Dutch and German consumer prices. They conclude that "a price shock in The Netherlands is eventually adjusted, in so far as it deviates from that in Germany" (p.72). Their results might suggest that we can somehow blame inflation on foreign influences.

Almost every student in monetary economics is taught the long-held consensus view that inflation -- properly defined as the long run upward drift of the general price level -- is primarily a monetary phenomenon. This does not mean that even in the short-term every change in prices is or needs to be caused by a change in the supply of money. However, macroeconomic theory and the empirical evidence show that a long-run drift of the general price level cannot occur without accommodation by the monetary authorities.

It is puzzling, therefore, to observe that economists frequently enter the public debate with only minor reference to the basic monetary aspects of inflation. This probably means that one of the three following cases must be true: (1) There merely exists a confusion about the definition of inflation. Whereas the economic theory of inflation emphasizes the long-run, secular nature of price changes, many authors frequently use the term "inflation" for all changes in the general price index. It is true that in the short-run changes in the general price index can be traced to a wide range of initial disturbances. These do not, however, constitute a theory of inflation. (2) There may exist a fundamental disagreement about macroeconomic theory and evidence. Some authors reject the monetary approach to inflation. For example, post-Keynesian economics provides an entirely different
approach, because it is assumed that the monetary authorities have absolutely no control over the money supply. This remains, however, a minority view among economists. (3) Because the Netherlands represents a small open economy that operates within a fixed exchange rate regime, other authors may have concluded that the monetary approach is an inappropriate framework for policy analysis. After all, does the standard IS-LM type model not suggest that with fixed exchange rates the domestic money supply and inflation are effectively under the control of foreign central banks?

This paper (re)evaluates monetary and non-monetary inflation models for the Netherlands. In particular, both theory and empirical evidence are used to examine whether a P-star model -- representing a textbook macroeconomic relationship between money and prices -- should be rejected in favour of a popular socio-political model based on cost-push factors. Section 2 develops and discusses both models. Arguments are presented that the P-star model can be used for a small economy with fixed exchange rates and that the P-star model need not be rejected on theoretical grounds. Section 3 presents the empirical results. In in-sample and out-of-sample forecasting the monetary model is not outperformed by the socio-political model. Thus, the P-star model need not be rejected on empirical grounds. Section 4 contains concluding remarks. Because policy implications depend on the proper inflation model a final choice must be made. Basic monetary economics suggests that we should prefer the monetary inflation model. Section 4 concludes with some observations on the political-economy aspects that affect the public debate on inflation and its determinants.

### 3.2 P-STAR AND SOCIO-POLITICAL MODELS OF INFLATION

#### 3.2.1 The P-star model

The P-star model that has recently been (re)introduced by Hallman, Porter and Small (HPS, 1989) relies on two fundamental concepts: (1) a long-run view of the equation of exchange \( M \cdot V = P \cdot Q \), and (2) the lagged adjustment of prices to their long-run equilibrium level. The equation of exchange states that the general price level, \( P \), equals the product of money per unit of real output, \( M/Q \), and the velocity of money, \( V \). In the long run, output is assumed to equal the economy's potential or trend output \( Q^* \). Furthermore, in the long run, the equilibrium value of velocity \( V^* \) is assumed to be independent of potential output and the money stock (though not necessarily independent of its rate of change). The actual price level will adjust toward a value consistent with the money stock.\(^1\)

HPS (1989, 1991) define the long-run equilibrium of the price level at time \( t \) as the price level that is consistent with the current value of the money stock and the current equilibrium values of velocity and output. Two equations are derived: one for the actual price level \( P \) and one for the equilibrium value \( P^* \)

\[ 1 \quad p_t = m_t + v_t \cdot q_t \]

\[ 2 \quad p_t^* = m_t + v_t^* \cdot q_t^* \]

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\(^1\) Humphrey (1989) shows that the P-star model is certainly not a new model, but can be traced as far as the early quantity theorists, for example David Hume (1711-76).
where lower-case variables p, m, v and q denote the logarithms of the price level, money, velocity and real output. Assume that the actual price level adjusts towards its long run level at a constant rate of adjustment. In addition, because theory does not provide full insight into the dynamics of the equilibrium mechanism, also assume that the rate of price change \( \Delta p_t \) depends on past changes \( \Delta p_{t-i} \). A general dynamic equation can thus be written as \( \alpha > 0 \)

\[
\Delta p_t = -\alpha (p_{t-1} - p_{t-1}^*) + \sum_{i=1}^{n} \beta_i \Delta p_{t-i}
\]

HPS (1989) applied the P-star approach to the U.S. and concluded that 'Over periods of one year or longer, the model tracks inflationary developments rather well despite these strong assumptions; over shorter periods, factors outside the model play an important role.' (p.2) Subsequently, the model has also been empirically tested for other countries (for example, Hoeller and Poret, 1991; Kole and Leahy, 1991; Tödter and Reimers, 1994; Groeneveld, Koedijk and Kool, 1995), generally with positive results.

So far, derivation of the general model seemed straightforward enough and firmly based on monetary theory. However, the next subsections address some possibly critical elements in the standard P-star model.

(i) dynamic specification

HPS examined the process of price adjustment in some detail and concluded that a specification using second differences of the price level, or first differences of the rate of change, i.e. \( \Delta^2 p_t \), is appropriate for the United States. The use of second differences of the price level may circumvent econometric problems associated with possible nonstationarity of inflation. On the other hand, some authors have criticized the second-difference specification because it results in implausibly long periods of price adjustment and implausible overshooting or cyclical behaviour of price changes (Tatom, 1990; Pecchenino and Rasche, 1990). Simulations by HPS (1989) showed that in some cases a shock to the system required adjustment periods of more than 100 years before price levels and inflation appear to converge to within a reasonable distance from their new equilibrium values. Recent analyses suggest that the problematic specification in second differences is not an unavoidable component of the P-star model. First, our view on (non)stationarity of inflation is not robust to changes in the sample period. For example, it is highly improbable that 100 or 150 years of U.S. inflation data would return a verdict of nonstationarity, although inflation would exhibit very strong nonstationarity if the sample period is dominated by observations from the 1970s. A second consideration is that unit-root tests for nonstationarity are known to have very low power in small samples. It has become common practice to if not ignore the formal econometric results from unit-root tests, then at least qualify the results with economic insights (for example, see Cochrane, 1991; McCallum, 1993). (In fact, empirical estimates reject the differenced specification for inflation for the Netherlands.)

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2 Exactly what time period constitutes an implausibly long adjustment period is open for debate. Empirical evidence for purchasing power parity indicates that certain price adjustments can take decades.
(ii) inflation expectations

Another critical issue is the implicit treatment of expectations in the proposed adjustment process. Since the Friedman-Phelps critique on traditional Phillips curves, textbook models of price behaviour assume that price changes consist of expected inflation, plus a term capturing unanticipated shocks or price disequilibrium leading to subsequent updating of future expected inflation. The expectations-augmented Phillips curve would be

$$\Delta p_t = \Delta p^*_{t-1} + \lambda z_{t-1}$$

where z usually denotes some measure of excess demand.

Price-adjustment models based only on lagged values of price changes and the lagged price gap ($p_{t-1} - p^*_{t-1}$) can easily conflict with the hypothesis of rational expectations (at least in its normal textbook interpretation). The adaptive expectations mechanism used implicitly by HPS is optimal only for specific, stationary ARIMA processes (a classical reference is Muth, 1960).

The standard P-star specification is (arguably) most suitable to the case where m, v and q are random walks without drift. It is doubtful whether this is in fact an accurate description of the actual time-series processes. When it is not, rational expectations imply that prices adjust to future values of M, V*, and Q* rather than only the current values of M, V*, and Q*. An alternative formulation of the model would then be (compare also Tödter and Reimers, 1994)

$$\Delta p_t = \Delta p^*_{t-1} - \alpha ( p_{t-1} - p^*_{t-1} )$$

$$\Delta p^* = f ( \Delta m_{t+i}, \Delta v^*_{t+i}, \Delta q^*_{t+i}, ... )$$

where the expectations of underlying inflation $p^*$ depend on expectations of future money growth, future changes in velocity and future changes in potential output.

Although the textbook interpretation of the rational expectations hypothesis is "perfect foresight with random expectation error", it is important to note that lagged adjustment processes are fully consistent with rational behaviour if economic agents are uncertain about the past, current, and future state of the economy. We have only limited information about the relative importance of nominal versus real and temporary versus permanent shocks and economists strongly disagree on appropriate macroeconomic models. This uncertainty affects the optimal response to new information (for a more thorough exposition of this line of reasoning see, for example, Meltzer, 1982, 1995; Brunner and Meltzer, 1993; and also Mussa, 1975). Lagged adjustments may simply capture an unavoidable process of gradual learning about the actual importance of past events.\(^3\)

(iii) small open economies with fixed exchange rates

Some authors have argued that the P-star model cannot be applied to small open economies where the

\(^3\) Note that this interpretation of lagged adjustments suggests that the adjustment process is unstable. The optimal speed of adjustment is linked to the degree of uncertainty about the economic environment.
Monetary and non-monetary analyses of inflation

Monetary authorities maintain a fixed exchange rate. In the P-star model the general price level adjusts towards the level consistent with a particular money stock. However, textbook IS-LM models suggest that with fixed exchange rates the money supply becomes endogenous and is no longer available as an independent instrument of monetary policy. Money follows rather than causes price changes. In the usual analysis, domestic prices are predetermined by foreign prices, the fixed exchange rate, and the 'law of one price' incorporated in purchasing power parity (equation 7). The interest rate is fixed by the foreign interest rate through (uncovered) interest rate parity (equation 8). And, because the economy tends to fluctuate randomly around its natural rate of growth, the money supply must automatically follow the demand for money (equation 9, where the income elasticity is unity and c is the intercept of the equation).

\[ p_t = p_t^e + e_t \]  
(7)

\[ i_t = i_t^e + E_t(\Delta e_{t+1}) \text{, with } E_t(\Delta e_{t+1}) = 0 \]  
(8)

\[ m_t - p_t = c + q_t - \Theta i_t \]  
(9)

Kool and Tatom (1994) developed a P-star model for small open economies with fixed exchange rates. They argue that with fixed exchange rates the equilibrium value P* should be derived from a dominant large country in the exchange rate system (for example, Germany within the EMS). Their empirical results indicate that a foreign-based price gap can indeed outperform the purely domestic price gap in the P-star model.\(^4\)

Although the foreign price-gap approach appears to provide empirical success, there is no reason to discard the P-star model with a domestic price gap as a possible description of price level dynamics. The textbook IS-LM model on which most of the criticism rests, with only a single interest rate and with perfect integration between all goods and financial markets, is not necessarily a relevant model. There are two main points of criticism. It is a well-known empirical result that purchasing power parity is not a good description of short-term price behaviour. A credible fixed exchange rate must act as a long-run constraint on money and prices. But in empirical studies purchasing power parity can only be established as a long-run phenomenon (see Froot and Rogoff, 1994). Therefore, domestic prices are not continuously predetermined by foreign prices but can move within some unspecified band around purchasing power parity. This result requires an alternative explanation for the behaviour of domestic prices in the short to intermediate run. Alternatively, one could argue that purchasing power parity only applies to internationally traded goods. Nontradables are however also part of the domestic general price level. Purchasing power parity has therefore some implications for relative prices, but is not a complete theory of the general price level.

The second point of criticism is that fixing short-term interest rates according to interest rate

\(^4\) Kool and Tatom (1994) refer to monetary transmission (balance of payments effects) in their foreign-price-gap model rather than the direct inflation transmission mechanism (continuous purchasing power parity). The discussion below places more emphasis on domestic money and price gaps, at least as a possible indicator of the combined influence of international and a number of domestic influences on money growth.
parity and zero expected exchange rate depreciation will not automatically stabilize the economy (compare the familiar Poole (1970) analysis where interest rate targeting stabilizes the real economy when money demand shifts dominate the system). Even in the IS-LM model stabilization depends on the shocks to the IS curve. However, perhaps more importantly, since the 1960s monetarists such as Brunner and Meltzer have argued that the IS-LM analysis ignores disturbances that can occur in many other financial markets. Recently, Bernanke and Blinder (1988) have rekindled attention for this line of argument by illustrating the effects of the addition of a market for bank credit to the IS-LM model. Also, while discussing the 1992 crisis in the ERM, Svensson (1994) has argued that interest rate policy and a fixed exchange rate target can conflict with price stability because it induces procyclical destabilizing monetary policy.

In short, an alternative story on monetary policy, prices and the exchange rate based on imperfect substitution between several financial markets is as follows. Like central banks in most other industrial countries, the Dutch central bank uses its leverage over the short-term interest rate as its main policy instrument. In particular, the short-term interest rate is employed to maintain a fixed DMark/Guilder exchange rate. The required level of the interest rate follows directly from interest rate parity vis-à-vis Germany when the expected rate of depreciation is zero (ignoring risk premiums). However, whereas the policy related short-term interest rate applies to the market for monetary base or bank reserves, the demand and supply of money as well as the demand and supply of bank credit to the private sector do not depend on this short-term interest rate alone. They depend on the entire spectrum of interest rates, including interest rates on bank loans, rates of return on investments in physical capital, real estate, commodities, gold, etc. In a simple alternative to the IS-LM model, all that is needed is a second financial market with a second interest rate. For example, consider a second, long-term interest rate that is representative of consumption, saving, investment decisions in the real economy.6

---

5 To limit the size of the paper there is no detailed model, but references to other authors are given. The arguments that follow represent a more or less straightforward application of the monetarist theory of money, credit, output, and prices associated with Brunner and Meltzer (for example, Brunner and Meltzer, 1993; also see Bordo, Choudhri and Schwartz, 1987 for some empirical support). Compared to the IS-LM model, the Brunner-Meltzer analysis allows a wider range of economic disturbances to cause base drift of monetary aggregates and price-level non-stationarity. The analysis here is also related to the work of Goodfriend (1987, 1991) and others on interest-rate smoothing and price level stationarity. Interest-rate smoothing is what remains of traditional fixed-exchange-rate open-economy models once the assumption of continuous purchasing power parity fails. Compare Daniels and VanHoose (1995) on base drift and price level stationarity in open economies. The discussion by Svensson (1994) of the ERM and price stability and the Walters' critique of UK participation in the ERM should also be noted.

6 The imperfect substitution approach discussed here should not be confused with the very simplistic historical view of segmented markets. For example, the Dutch central bank for some time believed that it could target long-term capital market and short-term money market interest rates as two independent policy instruments. Arbitrage relationships between markets do exist, but the imperfect substitution approach stresses that besides a number of common determinants (which as emphasize in the textbook models would lead to a collapse of markets into a single representative market) there are also market specific determinants causing widespread portfolio adjustments and "risk premiums".
In this alternative model with a little more detail of different financial markets, the results from the standard IS-LM model tend to break down. The central bank must accommodate any increase in the demand for reserves in order to stabilize the short-term interest rate around its target predetermined by the commitment to fixed exchange rates. The important point is that inflationary booms can start from disturbances that occur in a wide range of real and financial markets. Furthermore, money and credit can expand to finance inflationary booms, even when the demand for money is stable. In the end, the monetary approach to inflation states that any money growth in excess of the economy’s long-run growth potential ultimately causes the general price level to drift upward. In the long run, a gap between domestic and foreign prices will result in current-account problems and possibly a speculative attack in the foreign-exchange market. However, purchasing power parity is a long-run constraint and cannot be employed as a short-term anchor for domestic prices.

To summarize the previous discussion, the conclusion is that with fixed exchange rates the central bank loses its instrument(s) to control the growth rate of the money stock. The short-term interest rate that corresponds to a short-run target for the exchange rate need not coincide with the interest rate that corresponds to long-run inflation objectives for the domestic economy. Most importantly, in some models other than the standard IS-LM type model the growth rate of money can still be a primary determinant (and at least necessary requirement) for the drift in the general price level. Therefore, it is legitimate to at least evaluate the empirical relevance of the P-star model.

### 3.2.2 The socio-political model

According to the socio-political view inflation results from processes largely exogenous to economic markets. Social groups compete to capture larger shares of national income. Conflicting expectations and conflicting views about the distribution of national wealth cause social unrest and increase militant behaviour of workers and their labour union representatives. The conflict over income distribution and differences in expected future inflation lead to upward pressure on wages. Price inflation results from the wage-push hypothesis: prices are set by a more or less fixed mark-up over unit labour costs and are automatically accommodated by an endogenous money supply beyond the control of monetary authorities.

As more or less representative for the socio-political approach to inflation, consider the following small model that consists of a wage equation (10), a price equation (11) and a price expectations hypothesis (equation 12).⁷

⁷ There exists no single theoretical framework for the socio-political model, and therefore the socio-political model as such does not exist. Within the constraints of this paper, there is no space to provide an extensive review of all possible approaches. A wide range of possibilities exist for different assumptions about workers’ behaviour, trade-union policy and objectives, wage-bargaining functions, etc. For more details on socio-political models see, for example, Laidler and Purdy (1974), Laidler (1976), Gordon (1981), Addison and Burton (1984), Nickell (1987), and Schnabel (1990). Keizer (1982) is a traditional reference for the socio-political model in the Netherlands. Further references to research on wage models and their relationship with economic performance can be found in the surveys by Bean (1994) and Nickell (1990).
The wage equation contains the expected rate of price changes \( \Delta p^e \), unemployment rate \( U \), labour-union militancy \( MIL \) and a vector of other determinants \( Z^w \). The direct influence of workers and labour unions on wage-price inflation is frequently represented by an index of labour militancy (see for example Schnabel, 1990). In the literature there are three frequently used indices: membership of labour unions (in absolute numbers or relative to labour force), labour disputes or strikes (number of strikes or working days lost), and dummy variables. Other studies have attempted to introduce more details of the process of wage determination by adding further explanatory variables such as changes in tax rates, contributions to social security, hysteresis in unemployment, etc. These variables are regarded as typical wage bargaining factors, highly relevant for wage determination when an economy is characterized by centralized wage negotiations between employers' organizations and labour unions. In the socio-political model of inflation these factors also enter the reduced form equation for price changes. Much research has been done on the best way to include effects of unemployment and forward shifting of tax burdens. The evidence is not conclusive. It is beyond the scope of this paper to search for the best wage equation. The specifications here conform to "best practice" exemplified in other studies.

The price equation contains the growth rate of labour productivity \( \Delta x \), the rate of change of import prices \( \Delta im \), the rate of change of wages \( \Delta w \), and also a vector of other price determinants. For example, unemployment can also enter the price equation because mark-up behaviour of firms depends on the state of the economy.

Expectations are frequently assumed to accord to the rational expectations hypothesis: the expected rate of change of prices equals the actual rate of change, plus or minus a serially uncorrelated forecasting error with expectation zero. As discussed above, this hypothesis is almost certainly too strong, because the presence of fundamental uncertainty forces economic agents to learn gradually about current and past economic shocks and future developments. A combination of fundamental economic uncertainty and rational behaviour tends to result in extrapolation or partial adjustment. This means that lags of price changes and other variables enter the price equation.

A general reduced form equation for price changes can then be written as

\[
\Delta p_t = c_0 + c_1 \Delta p_{t-1} + c_2 \Delta x_t + c_3 \Delta im_t + c_4 U_t + c_5 MIL_t + c_6 Z_t
\]

Before turning to the empirical results for the P-star and socio-political models, the next subsections first address some critical issues in the socio-political model.

(i) necessary monetary validation in cost-push theories of inflation

Addison and Burton (1984, p.113) state that 'Sociopolitical analysis may in some ways be seen as a reincarnation of cost-push analysis in suitably modified form.' In an earlier review article on the demise
of "demand-pull" and "cost-push" in inflation theory they concluded that, given that monetarists have clearly demonstrated the empirical link between money and prices in the long run, socio-political analysis must provide a rationale for the accommodative monetary policy. One strand of the economic literature (post-Keynesian or radical-Keynesian) denies that monetary authorities have any control over the money supply. The empirical evidence on the link between monetary policy actions, changes in the money supply, and subsequent economic results strongly contradicts this view.

A more fruitful approach then is to conclude that, for a given set of political and institutional parameters, the socio-political model provides a theory on some social determinants of monetary policy. Of course, without monetary accommodation changes in real wages only affect the distribution of income among labour income and profits. High real wages result in unemployment and unemployment induces market pressures to return real wages to labour market equilibrium values.

(ii) measuring the exogenous wage-push factor
Some previous studies of the socio-political model have tested the influence of labour union militancy variables on prices (most recently, Schnabel, 1990). The existing literature has discovered a number of conceptual problems with the militancy variables, but these will not be extensively reviewed here. Important to note is that a typical result of the earlier empirical studies is that the indices constructed to measure militancy do not yield correct and significant coefficients in wage and price equations. It is likely, therefore, that straightforward hypothesis testing in this paper would lead to a quick rejection of the socio-political model. The empirical results would not rule out, however, that trade unions are able to exert a significant wage push that is not accounted for by the militancy variables.

Problems with traditional measures of labour union militancy present us with a serious data problem. It is inappropriate to simply enter current wages as a determinant of current prices, because lagged and contemporaneous correlation between wages and prices is perfectly consistent with versions of both monetary and socio-political models of inflation.

In the empirical analysis below two alternative measures of exogenous wage pressure are examined. These variables are denoted \( w^* \). A first hypothesis is that inflation could result from persistent attempts by labour to raise expected real wages in excess of expected productivity gains.

\[
\Delta w^*_{t,1} = \Delta w^*_{t} - \Delta p^*_{t} - \Delta x^*_{t}
\]

A second hypothesis is that inflation could result from the fact that in the previous period nominal wages increased more than prices. As a result, real wages have increased and, if not compensated by gains in labour productivity this year, firms will attempt to raise prices and reclaim their profit share of production.

\[
\Delta w^*_{t,2} = \Delta w_{t-1} - \Delta p_{t-1}
\]

The next section compares the in-sample and out-of-sample performance of the alternative inflation models.

---

8 See Ward and Zis (1974), Laidler and Purdy (1974) and Schnabel (1990) for criteria and a review of different indices.
3.3 EMPIRICAL RESULTS

3.3.1 The P-star model
To estimate the P-star model, long-run equilibrium values of real activity $Q^*$ and velocity $V^*$ are needed to construct a measure of the long-run equilibrium level of prices $P^*$. A standard approach to obtain values for $Q^*$ is to fit a moving-average trend to actual values of $Q$: here the Hodrick-Prescott (HP) filter is used as a standard way of handling stochastic trends.\(^9\) The HP-filter is also used to obtain estimates for $V^*$ although the use of a mechanical approach to estimate long-run equilibrium values for the velocity of money is contestable. Theory and empirical research suggest two fundamental long-run determinants of money velocity: institutional developments (Bordo and Jonung, 1987), and inflation or nominal interest rates (see for example Lucas, 1988). Although it is possible that the influence of institutional developments can be described by mechanical time trends, the same does not apply to the influence of inflation, because, being a monetary phenomenon, inflation is a policy variable. Nevertheless, despite the obvious drawbacks, the HP-filter is used for $V^*$. It is a reasonably flexible filter and has the additional benefit that it yields stationary price, velocity and output gaps for the P-star analysis.

The P-star model is estimated with annual data for real and nominal GNP. The money stock is the broad money definition from the International Monetary Fund's International Financial Statistics which includes currency, sight deposits, time deposits and savings deposits and is comparable with the M3 definition of money (for further details see the data appendix.)

\(^9\) The HP filter estimates were obtained with $\lambda=100$. Although the HP filter is a popular way of handling nonstationary series, its use is not without controversy. The choice of $\lambda$ is arbitrary and the HP filter, like every moving-average type filter, results in misleading analyses when applied to time series with permanent shifts in the level or significant changes in trends. More advanced statistical techniques such as the Kalman filter offer solutions (for example, see Bomhoff, 1994). Other estimates of potential or trend output can be derived from production functions, capacity utilization, actual and natural rates of unemployment.
### Table 1  OLS estimates of the P-star model for the Netherlands, 1953-1994. a

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<td>-0.252</td>
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<td>(3.11)</td>
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#### Regr.stat.

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Notes: a  Absolute t-values in parentheses. The dependent variable is the log rate of change of the implicit GNP deflator.

Table 1 presents the estimates of the P-star model for the period 1953-1994. This period is a sizable extension of the annual dataset used in Hoeller and Poret (1991) and Kool and Tatom (1994). The first column presents the basic equation. The price-gap variable is significant and appears with the correct negative sign necessary to achieve the error correction mechanism. The other columns in table 1 introduce additional explanatory variables to account for exogenous and temporary changes in the price level.

---

10 The HPS(1989, p.11-12) test for the specification in first or second differences of the price level rejects the use of second differences (sample period 1953-94).

\[
\Delta^2 p_t = 0.996 - 0.256 ( p_{t-1} - p^{*}_{t-1} ) + 0.053 \Delta^2 p_{t-1} - 0.236 \Delta p_{t-1} \\
(2.08) \quad (2.94) \quad (0.44) \quad (2.44)
\]

\[
R^2 = 0.244 \quad SE = 1.603 \quad DW = 2.10
\]
disturbances. The second column introduces the lagged change in the relative price of energy (PE). Columns 3 and 4 introduce the difference between short-term (KR) and long-term interest rates (LR) in the Netherlands and Germany.

The results with the two interest-rate differentials deserve some further evaluation. The initial reason to include interest-rate differentials was to capture the effects of, mostly short-term, money and capital movements or currency substitution between Germany and the Netherlands. If currency substitution is a serious problem it could distort the behaviour of the money velocity and therefore our measure of $p^*$. The empirical results show that it is the long-term interest-rate differential with Germany that is important for Dutch price changes. Generally, currency substitution effects are expected to be associated with short-rate differentials, but many estimates of money demand equations also show a tendency to favour the long-term interest rate. Because long-term interest rate differentials reflect mainly (expected) inflation differentials the interest-rate effect could also be attributed to the required cointegration between Dutch and German prices. This would make the model a special version of the model in Kool and Tatom (1994). However, some importance could be attached to the possibility that interest rates provide a closer view on expected inflation, which potentially captures more than the purely mechanical operation of purchasing power parity.

Overall, the model in column 4 is selected as the best fit for the Dutch $P^*$-star model. Finally, several specification tests were employed. The model does not exhibit significant serial correlation of residuals. White and ARCH tests for heteroscedasticity remained insignificant. A CUSUM squared test did not suggest problems with structural breaks in the equation.

3.3.2 The socio-political model
Table 2 presents the estimates of the socio-political model. The first two columns of table 2 contain simple OLS estimates of what could be called the structural equations of the socio-political model. Column 1 of table 2 contains the estimated price equation. Most of the results carry straightforward interpretations. Prices adjust with a lag, are negatively related to gains in labour productivity which reduce unit labour costs, and are positively related to import prices and wage costs. Unemployment and changes in taxes and social security contributions do not contribute to the explanation of price changes. The change in the unemployment rate rather than the level of the unemployment rate is used in the estimated equations. Experiments showed that the level of the unemployment rate obtained coefficients with a lower level of significance than the change in unemployment. Using the change in the unemployment rate is consistent with the results for the wage equation and corresponds to results in other studies.

---

11 Because of possible simultaneous equation bias, the estimates must surely be viewed with caution. According to econometric theory instrumental variables or TSLS provide a solution to simultaneous equation bias. In practice instrumental variables estimators exhibit poor finite-sample performance because we lack a suitable method to judge instrument relevance. The results were checked with TSLS, assuming all variables to be exogenous except current prices and wages. Substituting one lag of prices and wages as instruments did not qualitatively change the results in table 2.
Table 2 OLS estimates of the socio-political model for the Netherlands, 1953-1994. \(^a\)

<table>
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<th>(2) (?w_t)</th>
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<td>(2.61)</td>
<td>(3.19)</td>
<td>(3.15)</td>
<td>(3.34)</td>
</tr>
<tr>
<td>(?U_t)</td>
<td>0.327</td>
<td>-0.939</td>
<td>-0.493</td>
<td>-0.694</td>
<td>0.244</td>
<td>0.085</td>
<td>0.072</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>(1.68)</td>
<td>(2.78)</td>
<td>(1.29)</td>
<td>(1.94)</td>
<td>(0.79)</td>
<td>(0.31)</td>
<td>(0.24)</td>
<td>...</td>
</tr>
<tr>
<td>(?TAX_t)</td>
<td>0.022</td>
<td>0.014</td>
<td>0.070</td>
<td>0.061</td>
<td>0.100</td>
<td>0.046</td>
<td>0.043</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.08)</td>
<td>(0.43)</td>
<td>(0.38)</td>
<td>(0.75)</td>
<td>(0.37)</td>
<td>(0.33)</td>
<td>...</td>
</tr>
<tr>
<td>(?w_t)</td>
<td>0.444</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>0.332</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>(7.98)</td>
<td></td>
<td></td>
<td></td>
<td>(2.50)</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>(?p_t)</td>
<td>...</td>
<td>1.224</td>
<td>1.226</td>
<td>1.244</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>0.387</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.60)</td>
<td>(5.40)</td>
<td>(5.84)</td>
<td>(3.63)</td>
<td>...</td>
<td>...</td>
<td>(4.04)</td>
</tr>
<tr>
<td>(?D_t)</td>
<td>...</td>
<td>...</td>
<td>-0.003</td>
<td>...</td>
<td>?(w_t^{*,1})</td>
<td>...</td>
<td>0.387</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.37)</td>
<td></td>
<td></td>
<td>(3.44)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(?T_t)</td>
<td>...</td>
<td>...</td>
<td>0.149</td>
<td>...</td>
<td>Sn(_t)</td>
<td>...</td>
<td>-0.001</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.75)</td>
<td></td>
<td></td>
<td>(0.14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regr. stat.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj R(^2)</td>
<td>0.866</td>
<td>0.776</td>
<td>0.791</td>
<td>0.788</td>
<td>0.679</td>
<td>0.725</td>
<td>0.717</td>
<td>0.745</td>
</tr>
<tr>
<td>S.E.</td>
<td>1.007</td>
<td>1.887</td>
<td>1.823</td>
<td>1.837</td>
<td>1.558</td>
<td>1.442</td>
<td>1.463</td>
<td>1.388</td>
</tr>
<tr>
<td>D.W.</td>
<td>1.99</td>
<td>1.57</td>
<td>1.59</td>
<td>1.60</td>
<td>2.27</td>
<td>2.36</td>
<td>2.35</td>
<td>2.39</td>
</tr>
<tr>
<td>LM4 Prob</td>
<td>0.673</td>
<td>0.480</td>
<td>0.621</td>
<td>0.752</td>
<td>0.344</td>
<td>0.533</td>
<td>0.531</td>
<td>0.454</td>
</tr>
<tr>
<td>ARCH4 Prob</td>
<td>0.184</td>
<td>0.797</td>
<td>0.406</td>
<td>0.423</td>
<td>0.981</td>
<td>0.771</td>
<td>0.781</td>
<td>0.802</td>
</tr>
</tbody>
</table>

Notes. \(^a\) Absolute t-values in parentheses. \(^b\) Wage pressure on prices \(?w^{*,1}\) equals current nominal wage growth in excess of expected price change and expected productivity gains. Expectations accord to rational expectations hypothesis and thus are proxied by actual values. \(^c\) Wage pressure on prices \(?w^{*,2}\) equals last year's nominal wage growth in excess of last year's price change.
Column 2 contains the wage equation. It appears that wages do not adjust with a lag. Nominal wages incorporate full compensation for price increases: the hypothesis that the coefficient of nominal wage changes with respect to price changes is one is not rejected. Therefore, column 2 is essentially a real wage equation. Real wages incorporate part of the gains in labour productivity and are negatively correlated with changes in unemployment. A feature that returns in all estimates is that there appears to be no significant forward shifting of taxes and social security contributions. These findings contradict results reported in other studies of Dutch wages (for example, Knoester and van der Windt, 1987; Graafland, 1992; current macroeconomic models of the Dutch Central Planning Bureau). On the other hand, reports of insignificant coefficients are not uncommon in the literature (for example, Bean, Layard and Nickell, 1986; Graafland, 1990). One explanation for these different findings might be the use of alternative definitions for prices and/or taxes. A different explanation centres on sample periods and time series characteristics. For the period 1958 - 1975 both inflation and the tax rate exhibited an upward sloping trend. However, whereas inflation measured by the implicit GNP deflator dropped sharply between 1975 and 1987, the tax rate remained approximately stable between 1975 and 1988-89. These observations suggest some possible spurious regression problems in short sample periods.

According to the socio-political model labour militancy is an important determinant of wages and prices. Five indices of labour union militancy were examined: the percentage rate of change of labour union membership (?T), membership of labour unions relative to labour force (levels D, changes ?D), number of strikes (Sn) and working days lost due to strikes (Sd). If these indices of labour union militancy are measures of the same phenomenon, the indices must be expected to exhibit a high degree of positive correlation. Table 3 shows that this is not the case however. Only in one case does the correlation coefficient between indices of militancy exceed 0.5.

<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th>?D</th>
<th>Sn</th>
<th>Sd</th>
<th>U</th>
<th>?U</th>
</tr>
</thead>
<tbody>
<tr>
<td>?T</td>
<td>0.300</td>
<td>0.716</td>
<td>0.200</td>
<td>0.065</td>
<td>-0.573</td>
<td>-0.308</td>
</tr>
<tr>
<td>D</td>
<td>...</td>
<td>0.203</td>
<td>0.387</td>
<td>0.058</td>
<td>-0.838</td>
<td>0.075</td>
</tr>
<tr>
<td>?D</td>
<td>...</td>
<td>...</td>
<td>0.004</td>
<td>-0.067</td>
<td>-0.397</td>
<td>-0.261</td>
</tr>
<tr>
<td>Sn</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>0.380</td>
<td>-0.498</td>
<td>-0.374</td>
</tr>
<tr>
<td>Sd</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>-0.087</td>
<td>-0.058</td>
</tr>
<tr>
<td>U</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>0.202</td>
</tr>
</tbody>
</table>

Notes: variables definitions in the main text

Table 3 shows that labour union membership tends to fall when unemployment is higher. Also, strike activity measured by Sn is lower when unemployment is higher. One obvious problem with these correlations is that it may be very difficult to distinguish clearly between the influence of labour union

12 The absolute level of labour union membership (T) was ignored because it is a seriously nonstationary variable. Moreover, the activity of unions related to year to year changes in wage rates is more likely to be reflected in the rate of change of membership than its absolute level.
militancy and normal labour market pressure on (real) wages because of multicollinearity in the wage equation. Furthermore, the empirical results do not support the view that strikes raise real wages and cause higher unemployment (the correlation between strike activity and unemployment is negative). The results are more or less consistent with a relationship running from adverse business conditions, business restructuring and higher unemployment in the previous year, to lower protest strikes and lower (real) wages for fear of job losses.

In the extended wage equation in column 3 of table 2 only the number of strikes Sn yields a significant coefficient and carries the correct sign. Also observe, however, that because of multicollinearity the militancy variables reduce the significance of the unemployment rate. Estimates do not yield significant coefficients for the other labour union militancy indices.

The estimates in table 2 indicate that wage changes are the most important explanatory variable for prices (column 1). As indicated before, these results cannot tell us whether these results must be interpreted in terms of a monetary model, where nominal wages are only part of a general transmission mechanism, or whether wages represent an independent cost-push element associated with socio-political models of inflation. Columns 5 to 8 of table 2 contain quasi-reduced-form equations for prices. In each column the measure of wage pressures on prices is redefined in order to attempt to obtain additional information on wage-price behaviour. In column 5 the hypothesis is that inflation could result from persistent attempts by labour unions to raise expected real wages in excess of expected productivity gains: i.e. \( w_t^{*1} = (w_t^e - p_t^e - x_t^e) \). The estimates provide some support for this view. If we assume that expectations accord with the rational expectations hypothesis, prices react positively to excess wage claims. In column 6 the hypothesis is that firms raise prices, because in the previous period nominal wages increased more than prices: \( w_t^{*2} = (w_{t-1} - p_{t-1}) \). Thus, real wages have increased and if not compensated by gains in labour productivity this year, firms will attempt to raise prices and reclaim their profit share of production. This interpretation of wage-price behaviour is supported by the significant coefficient of the lagged real-wage change. Unfortunately, there is no significant coefficient for labour productivity in this case and labour productivity does not enter the price equation with the correct negative sign. One interpretation could be that, in fact, last period's change in real wages correctly anticipates or otherwise induces current gains in labour productivity.

If, according to the socio-political model, labour militancy is an important determinant of wages, militancy variables should also be considered as important explanatory variables for prices. The estimates in column 7 show that there is no independent effect of militancy variables on prices.

Overall, the price model in column 6, using \( w_t^{*2} \) as the exogenous wage shock, appears to provide the best model in statistical terms and is therefore assumed to be representative of the socio-political approach to inflation. As a final step, some last refinements are made in column 8. The insignificant variables for labour productivity and the tax burden are eliminated. Furthermore, despite its strong theoretical appeal, the unemployment rate is also eliminated from the final model for the following reason.
Figure 1 Actual and fitted values P-star model and socio-political model

A. Actual and fitted inflation from the P-star model (table 1, column 4), 1953-1994.

B. Actual and fitted inflation from the socio-political model (table 2, column 8), 1953-1994.
In the socio-political model the unemployment rate functions as a measure of the bargaining strength of labour. Higher unemployment lowers union power, moderates wage claims and should therefore imply lower rates of price changes. The actual estimated effects of unemployment are simply implausible in the context of the normal wage model (yielding a marginally significant, positive coefficient).

The estimated positive correlation between unemployment and inflation is of course typical for "stagflation" in the 1970s and can be interpreted as showing the influence of aggregate supply side shocks to the macroeconomy. The positive correlation can also be a manifestation of insider-outsider problems in the labour market. According to the insider-outsider theory of unemployment, insiders (workers being employed and therefore inside the firm) can claim large wage increases or avoid wage decreases, but at the expense of high(er) unemployment. The high unemployment rate of outsiders (workers unemployed and therefore outside the firm) has no mitigating influence on wages which would allow them to return to employment at competitive (lower) real wage levels. In fact, outsiders become part of what is alternatively labelled the structural, natural, or the non-accelerating-inflation rate of unemployment. As a result, high unemployment and wage pressures can co-exist. The insider-outsider problem is considered one important factor in causing hysteresis in unemployment.

3.3.3 An evaluation of the P-star and socio-political models

3.3.3.1 In-sample evaluation

Figures 1a and b show the actual and fitted price changes from the two rival inflation models. Their explanatory value as measured by the adjusted R-squared is basically the same: 0.73 for the P-star model (table 1, column 4) and 0.75 for the socio-political model (table 2, column 8).

J-tests can be employed to test whether one rival model contains information over and above the information contained in another model. The test consists of adding fitted values from one rival model as an explanatory variable to the other model. The null hypothesis of not rejecting model i in favour of model j is tested by examining the t-values for the coefficient of fitted values of model i added to model j. If the coefficient of fitted values from model i is significantly different from zero, model i is not rejected by model j.

For the null hypothesis that the P-star model (j) does not reject the socio-political model (i), the t-value for the full sample 1953-92 is 3.82. The null hypothesis that the P-star model (i) cannot be rejected by the socio-political model (j) is also accepted with a t-value of 2.74.

An alternative test statistic is based on the Davidson-MacKinnon encompassing test. Fitted values yfit\textsubscript{1} and yfit\textsubscript{2} from 2 rival models are used as regressors to explain actual values of inflation:

\[ y = d \cdot yfit_1 + (1-d) \cdot yfit_2. \]

If model 1 is true (false), then the true value of d is one (zero). The coefficient for the fitted values of

\[ ^{13} \text{Note that the insider-outsider problem does not imply that higher unemployment "causes" wage and price increases. It explains why high unemployment and wage and price increases can co-exist whereas traditional theory suggests that high unemployment would automatically lower wages and prices.} \]
the P-star model is 0.398 with a t-statistic of 2.33. The coefficient for the fitted values of the socio-political model is 0.617 with a t-statistic of 3.64.

Generally, these results attribute about equal weight to both models. It appears that for the period 1953-94 neither model is able to reject the other as a description of price behaviour.

**Table 4** In-sample tests of rival inflation models, 1953-94

<table>
<thead>
<tr>
<th>J-tests inflation model</th>
<th>Encompassing test a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PSTAR</td>
</tr>
<tr>
<td>(t-value)</td>
<td></td>
</tr>
<tr>
<td>FITPSTAR</td>
<td>0.561</td>
</tr>
<tr>
<td></td>
<td>(2.74)</td>
</tr>
<tr>
<td>FITSOCPOL</td>
<td>0.774</td>
</tr>
<tr>
<td>(t-value)</td>
<td>(3.82)</td>
</tr>
</tbody>
</table>

Note: Encompassing test standardised-beta coeff. $\beta^* = \beta \left( \frac{\sigma_{yfit}}{\sigma_y} \right)$ are 0.343 and 0.539 respectively.

### 3.3.3.2 Out-of-sample evaluation

Another way to compare alternative models is to examine their relative out-of-sample performance. Both models were re-estimated for the shorter period 1953-1982 and the following equations were obtained

\[
\begin{align*}
?p_t & = 0.854 - 0.344 (p - p^*)_{t-1} + 0.769 \ ?p_{t-1} + 0.026 \ ?p_{e,t-1} - 0.429 (LR^\text{nl} - LR^\text{du})_{t-1} \\
(14) & \quad (1.02) \quad (3.16) \quad (5.82) \quad (1.56) \quad (1.66) \\
\text{Adj } R^2 & = 0.589 \quad \text{S.E.} = 1.623 \quad \text{D.W.} = 2.03
\end{align*}
\]

\[
\begin{align*}
?p_t & = 1.298 + 0.504 \ ?p_{t-1} + 0.113 \ ?im_t + 0.352 \ ?(w-p)_{t-1} \\
(15) & \quad (1.91) \quad (4.18) \quad (2.58) \quad (3.19) \\
\text{Adj } R^2 & = 0.647 \quad \text{S.E.} = 1.505 \quad \text{D.W.} = 2.19
\end{align*}
\]

When the change in the unemployment rate is included in the socio-political model its coefficient for the 1953-1982 period is +0.442 (t-statistic 1.19). As suggested above, this "stagflation"-type of result appears to contradict the theoretical interpretation of the unemployment rate in the socio-political model. For this reason the strong theoretical appeal to include unemployment effects on wages and prices is ignored (but some results are provided for comparison, and these results show that the conclusions remain qualitatively the same).

Figure 2 presents the actual and fitted price changes in the out-of-sample period 1983-1994 (using actual values for the explanatory variables). Both models capture the general time pattern of price changes.
On average, however, the out-of-sample prediction errors of the P-star model are better than those of the socio-political model. Mean absolute error and root mean squared error of the P-star prediction errors are lower. Also, the mean prediction error of the socio-political model is significantly different from zero and therefore biased.

Table 5 Summary of out-of-sample prediction errors.

<table>
<thead>
<tr>
<th></th>
<th>MEAN</th>
<th>MAE</th>
<th>RMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-star model</td>
<td>1.832</td>
<td>1.235</td>
<td>1.434</td>
</tr>
<tr>
<td>Socio-political model</td>
<td>3.281</td>
<td>1.740</td>
<td>1.952</td>
</tr>
<tr>
<td>(incl. $U_1$)</td>
<td>(3.119)</td>
<td>(1.624)</td>
<td>(1.925)</td>
</tr>
</tbody>
</table>

Notes: Fitted values from equations (14) and (15) in the main text, estimated for the period 1953-82.
Chapter 3

explained by predictions from another model. The prediction errors of model i are regressed on \((f_j - f_i)\), the difference between the predictions from model j and i

\[ e^i_t = \beta_{ij} (f_j - f_i) + u_t. \]

Model i provides better predictions than model j if \(\beta_{ij}\) is not significantly different from zero, while at the same time \(\beta_{ji}\) does differ significantly from zero. With P-star as model (i) and socio-political model being model (j), the t-value for \(\beta_{ij}\) is 2.48 and for \(\beta_{ji}\) the t-value is 4.56. Thus, the out-of-sample performance of the P-star model is somewhat but not significantly better than the out-of-sample performance of the socio-political model.

### Table 6 Out-of-sample J-tests

<table>
<thead>
<tr>
<th></th>
<th>P-star errors</th>
<th>Socpol errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\beta_{ij})</td>
<td>-0.353 (2.48)</td>
<td>-0.647 (4.56)</td>
</tr>
<tr>
<td>(\beta_{ji})</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 3.4 CONCLUDING REMARKS

This paper started with the observation that contrary to the monetary approach to inflation emphasized in economic textbooks, most of the public debate about (the prevention of higher) inflation usually refers to the effects of wage costs, public sector price increases, etc. This is puzzling because monetary economics refers to this line of thinking as the cost-push myth (see for example Batten, 1981). The essence of the well-known statement "inflation is a monetary phenomenon" is that inflation, defined as the long run upward drift of the general price level, cannot occur without a corresponding increase in money. This statement rests on the strong relationship between money and prices which has long been established. Because central banks are able to control the rate of growth of money, if and when they really want to, they bear the primary responsibility for inflation.

It is also frequently suggested that monetary models of inflation are not relevant for small open economies with fixed exchange rates. For example, within the European Monetary System of fixed exchange rates the Dutch central bank has effectively relinquished control over its monetary instruments to the German Bundesbank and standard macroeconomic analysis assumes that prices are predetermined by purchasing power parity. It is true that if the objective of a fixed exchange rate is to remain credible, inflation in the Netherlands must ultimately equal inflation in Germany.\(^{14}\) But fixed

\(^{14}\) The implicit assumption being that the Dutch and German economies are similar with respect to import/export or tradable/nontradable goods baskets and similar with respect to productivity growth in these sectors.
exchange rates and purchasing power parity act only as a long-run constraint on prices. Imperfect integration of real and financial markets still requires a domestic explanation for price behaviour in the short to intermediate period. As a result, it is possible to examine the P-star model with the domestic price gap, even though the central bank no longer controls the money supply.

The P-star model is not necessarily the best model for inflation that can be derived from the long history of monetary economics. Nevertheless, having examined the empirical content of the P-star model for the Netherlands, this paper finds no reason to discard this monetary model in favour of a socio-political model based on notions of cost-push inflation. Because the different models generate different policy implications it is important to select the correct inflation model for analysis. Consistent with alternative evidence on the determinants of inflation (see, among others, Laidler and Parkin, 1975; Gordon, 1981; and more recently, Parkin, 1993; Bomhoff 1993) the major advantage of the P-star model is that it does continue to emphasize the basic monetary content of the inflationary process.

Much previous empirical research has actually preferred the cost-push approach. The positive results for the P-star model contrast with these previous results in the literature on short-term relationships between money and inflation (or perhaps better, price changes). One of the reasons is the use of annual observations rather than monthly or quarterly observations.\footnote{See also the observation of HPS (1989). Some additional experiments for models of inflation measured over horizons longer than one year did not improve the P-star results presented here. The one-year horizon appears to be decisive.} For a helpful insight into the role of wages and other cost factors in the short-run dynamics of the inflation process the following quote from Bomhoff (1993) is given:

"the rate of growth of the money supply is correlated with the rate of inflation, but usually with a long and variable lag. Hence, in a forecasting context, it is likely that regressions of inflation on current or immediate past rates of change in prices, wages and other cost factors together with measures of demand in the goods or labor markets will produce more explanatory power. This explains why professional forecasters tend to emphasize cost factors and the state of "excess demand" rather than monetary developments."

Thus, although cost-push factors may be effective short-run indicators of price pressures they are not to be regarded as sufficient or necessary conditions for inflation.

Finally, the concerns which other authors have expressed for autonomous increases in wage costs, autonomous increases in public sector prices, and the interaction between domestic and foreign prices in a system of fixed exchange rates are certainly justified. The political-economy aspects of this debate must however be clearly spelled out. A number of participants in the inflation debate have other than purely academic interests to select economic models. With a fixed target for exchange rates, the monetary authorities must achieve certain key (long-run) equilibrium conditions: i.e. interest rate parity and purchasing power parity. When excessive wage demands and large public sector price rises threaten to create upward pressures on the general price level, the monetary authorities face a difficult challenge. One option is to raise the short-term interest rate at an early stage to prevent the automatic monetary accommodation of inflation which would conflict with purchasing power parity in the long
run. The likely consequences are twofold. A restrictive monetary policy to reverse upward price pressures is likely to carry short-run economic costs in terms of a small (growth) recession. At the same time, by increasing interest-rate differentials the monetary authorities risk losing out on their short-term exchange rate objective (unless the interest-rate differential matches perfectly an increase in risk premiums associated with the possibility of future devaluation). The second option is not to change interest rates and concentrate on the short-term exchange rate objective, hoping therefore that the shocks to the economy are temporary and will reverse themselves in the future. In this alternative, the central bank accepts the risk of future speculative attacks on the currency, once it becomes clear that economic shocks have not reversed themselves and the prospect of a devaluation or a recession is near. In a political context it is clear that any central bank should want to shift or at least share responsibility with other parties by highlighting their role in price changes.
APPENDIX 3A DATA

The definitions and sources of the variables used are as follows.


\( p \) = implicit GNP deflator.

\( m \) = IMF-IFS money plus quasi money, IFS series 34 and 35. IFS quasi-money data before 1960 increased with savings deposits at savings banks.

\( pe \) = average wholesale price of heavy fuel oil (gld/1000kg) deflated by implicit GNP deflator. Source: CBS, Energy Accounts of the Netherlands. Constant real price before 1958.

\( KR^{nl} \) = money market rate Netherlands, IFS series 60b. Before 1960 Dutch Treasury bill rate, IFS series 60c.

\( LR^{nl} \) = government bond yield Netherlands, IFS series 61.

\( KR^{ge} \) = money market rate Germany, IFS series 60b.


\( x \) = productivity of labour calculated as real GNP divided by labour volume. Source: CBS, National Accounts.

\( im \) = deflator of imports. Source: CBS, National Accounts.

\( w \) = wages, hourly rates, IFS series 65.

\( u \) = unemployment rate. Source: CBS

\( T \) = membership of trade unions (mlns). Source: CBS

\( D \) = organised labour as a percentage of labour force. Source: CBS

\( Sn \) = number of strikes. Source: CBS

\( Sd \) = number of working days lost due to strikes. Source: CBS

\( TAX \) = government receipts of direct taxes on income and wealth plus social security contributions as a percentage of wages and salaries plus social security contributions. Source: CBS, National Accounts and government reports. (Alternative definition of government receipts of direct taxes on income and wealth plus social security contributions paid by households as a percentage of wages and salaries did not significantly change our results.)

Preliminary testing of data for (non-) stationarity, 1953-94

<table>
<thead>
<tr>
<th>Variable</th>
<th>Augmented Dickey-Fuller test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>constant term, one lag: U(C,1)</td>
</tr>
<tr>
<td>( ?p )</td>
<td>I(1)</td>
</tr>
<tr>
<td>( p - p^* )</td>
<td>I(1)</td>
</tr>
<tr>
<td>( ?pe )</td>
<td>I(1)</td>
</tr>
<tr>
<td>( KR^{nl} - KR^{ge} )</td>
<td>I(1)</td>
</tr>
<tr>
<td>( LR^{nl} - LR^{ge} )</td>
<td>I(1)</td>
</tr>
<tr>
<td>( ?x )</td>
<td>I(1)</td>
</tr>
<tr>
<td>( ?im )</td>
<td>I(1)</td>
</tr>
<tr>
<td>( ?w )</td>
<td>I(1)</td>
</tr>
<tr>
<td>( u )</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

Notes: Augmented Dickey-Fuller test, t-statistics. MacKinnon critical values for 1% (**), 5% (*) and 10% (+) are -3.593, -2.932, and -2.604.
APPENDIX 3B OUT-OF-SAMPLE FORECASTING COMPARISONS

In discussions about the comparison of the out-of-sample performance of the P-star and socio-political models of inflation, the question was raised whether the procedure used to estimate equilibrium velocity (v*) and output (y*) did not bias the forecasting performance in favour of the P-star model (Hallman, Porter and Small (1991) also discuss this issue). First, the estimates of v* and y* were based on the full sample of data, including the sample later designated for out-of-sample testing of the models. Second, the H-P filter estimated trend \( t \) for a variable \( y \) is derived from the problem

\[
\min_{t, \tau} \sum_{i=1}^{T} (y_i - \tau_i)^2 + \lambda \sum_{i=2}^{T} [((\tau_{i+1} - \tau_i) \cdot (\tau_i - \tau_{i-1}))^2]
\]

The H-P filter is a forward-looking procedure that fits a curve to minimize the sum of the squared deviations from a given series \( y \), subject to the constraint that the sum of squared second differences (i.e. changes in the growth rate) are not too large. The constraint on future changes in the trend growth rate implies that the H-P filter uses information from the future to estimate current trend values.

Here, the forward-looking character of the H-P filter, implied by its emphasis on limiting future changes, is not the most serious problem. Note that using the HP filtered data is no more serious than fitting a straight trend line through the same full-sample set of data. In this case also, the estimated trend values at the beginning of the sample are influenced by the "future" observations at the end of the sample. Any problem that may exist therefore results from using the full sample data set to estimate trend values. Many authors invoke the hypothesis of rational expectations to include actual future values of variables in the estimated models. One other argument in defense of using the full-sample trend values is that the equilibrium values v* and y* are considered exogenous. V* and y* are assumed to remain unaffected by the dynamics of any model to be estimated, unaffected by possible changes in expectations, etc.

Another issue is the precise role of out-of-sample forecasting tests. In the literature there are two different uses of out-of-sample forecasting and prediction.

First, in econometric tests the appropriateness of estimated models is frequently determined by simulating the model over a period for which it was not optimized. An econometric out-of-sample forecasting test tests the robustness of the estimates and the stability of the parameters of the model. The forecasting tests used in the main text fall in this category.

A second use of out-of-sample forecasting is to examine the value of alternative econometric models for use by policymakers, financial market participants, business managers, etc. who would like to have advance information about future developments in certain variables of interest. Their preferred model is a model that produces out-of-sample, real time predictions with the smallest forecast error.

Whether or not the use of the full sample values v* and y* in the P-star model has biased the "forecasting" performance relative to the socio-political model depends on two considerations. On the one hand, the purely econometric robustness tests are not affected. It is common practice to use actual, realized values to perform these tests. On the other hand, any real-time and truly ex ante forecasting exercises should not use future information. Note, however, that because actual values for the contemporaneous variables are used in the socio-political model as well there is no direct evidence of a systematic bias towards the P-star model.

To examine the performance of both models in truly ex ante forecasting the following additional experiment was done. In the P-star model the values for v* and q* in the out-of-sample period 1983-1994 were replaced with recursive estimates from the HP-filter using only the information up to time t-1. All the other explanatory variables were already lagged one period. In the socio-political model, the contemporaneous import prices were replaced with their one-period lagged values.

The 1953-1982 equations are now
(A14) \[ p = 1.007 - 0.355 (p - p^*)_{t-1} + 0.758 p_{t-1} + 0.029 p_{t-1} c - 0.372 (LR_{nl} - LR_{du})_{t-1} \]
\[
\text{AdjR}^2 = 0.601 \quad \text{S.E.} = 1.600 \quad \text{D.W.} = 2.08
\]

(A15) \[ p = 1.226 + 0.537 p_{t-1} + 0.062 im_{t-1} + 0.372 (w-p)_{t-1} \]
\[
\text{AdjR}^2 = 0.560 \quad \text{S.E.} = 1.642 \quad \text{D.W.} = 2.12
\]

Using truly ex ante prediction, the summary statistics of out-of-sample prediction errors remain more or less the same for both models (table A5). The prediction error J-tests now provide significant results in favour of the P-star model (table A6). Recall, however, that neither of these models has been optimized in the sense that they represent the best possible forecast of inflation. Following the line of argument used in the main text, the results merely show that there is no substantial evidence to discard the monetary approach to inflation.

**TABLE A5 Summary of out-of-sample prediction errors**

<table>
<thead>
<tr>
<th>Model</th>
<th>Mean error (MEAN)</th>
<th>Mean absolute error (MAE)</th>
<th>Root mean squared error (RMSE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-star model</td>
<td>2.697</td>
<td>1.162</td>
<td>1.476</td>
</tr>
<tr>
<td>Socio-political model (incl. ( U_{t-1} ))</td>
<td>3.549</td>
<td>2.009</td>
<td>2.274</td>
</tr>
<tr>
<td></td>
<td>(4.151)</td>
<td>(2.610)</td>
<td>(2.894)</td>
</tr>
</tbody>
</table>

**TABLE A6 Out-of-sample J-tests**

<table>
<thead>
<tr>
<th>Model</th>
<th>P-star errors</th>
<th>Socpol errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>coefficient</td>
<td>( -0.082 )</td>
<td>( -0.918 )</td>
</tr>
<tr>
<td>(t-statistic)</td>
<td>( (0.35) )</td>
<td>( (3.92) )</td>
</tr>
</tbody>
</table>
CHAPTER 4

Real and nominal explanations of business cycles: The multiplier approach to money-output correlations

4.1 INTRODUCTION

Around the mid 1970s most economists accepted the idea that changes in money and monetary policy have significant influences on economic activity, at least in the short run. Since the seminal work of Friedman and Schwartz (1963), the basic relationship between (real) money and (real) output had been a subject of increasingly sophisticated statistical tests. Around the early 1980s the most prominent issue was whether there exists a sufficiently stable relationship between money and the real economy to be useful for countercyclical monetary policy, and how much of the effectiveness of monetary policy depends on it being anticipated or unanticipated by the private sector.¹

In recent years, the view of causality running from money to economic activity has (again) been challenged by the theory of real business cycles (RBC). Several economists who were dissatisfied with the microeconomic foundations for the nonneutrality of money, started to construct models that explain output fluctuations without any important role for money.² ³ Money in the basic

¹ There being a stable relationship and the existence of real effects from monetary policy are of course two separate issues. Remember Milton Friedman's "long and variable lags". A cautionary note that follows is that the possibility of time-varying effects of monetary policy could severely hamper our econometric investigations.

² For an interesting perspective on the issues and the debate see B. Friedman (1995).

³ For a review of real business cycle models, methodology, and implications see Lucas (1987), McCallum (1989), Mankiw (1989), Plosser (1989), Stadler (1995). Recently, there have been attempts to re-introduce monetary policy effects into "real" general equilibrium models. For example, see Lucas (1987), Lucas and Stokey (1987) on cash-in-advance models, and Christiano and Eichenbaum (1992), Fuerst (1992) on liquidity effects. In these models monetary shocks are generally short-lived and propagation mechanisms very weak. As a result monetary shocks are found to contribute very little to economic fluctuations. To some extent this is of course not a very surprising result. After all, it was from the basic dissatisfaction with weak monetary effects in the new-classical predecessor models that RBC theory originated. It is very tempting to conclude that RBC models have eventually come full circle, with the main contribution being the very rigorous mathematical formulation of the theory and a new econometric approach to estimating (or calibrating) and evaluating economic models.
RBC models respond endogenously to changes in the production possibilities in the economy and is, at most, merely a leading indicator for economic activity. Nominal actions by the monetary authorities, i.e. changes in the supply of base money, play no or only a minor role.

Establishing the correct cause and effect relationships between monetary policy and the economy is of course extremely important. Expanding on King and Plosser (1984), Plosser (1991) has recently (re)proposed a test of the monetary theory and the real theory of business cycles. Plosser first redefined the boundaries of monetary and real theories: a monetary theory is assumed to relate to the importance of independent changes in some nominal quantity of outside money, whereas a real theory incorporates all changes to the real opportunities of the banking system. Next, he suggested that the relative importance of changes in the nominal quantity of outside money and of the money multiplier for fluctuations in economic activity should be used to evaluate the competing nominal and real business cycle models. From his examination of postwar quarterly data for the United States, Plosser concluded that 'variations in nominal [monetary base or outside money] explain little of the subsequent movements in real activity' and 'that what explanatory power [of monetary aggregates] exists arises from variations in endogenous components of money.' (p.270) Therefore, the case for a monetary theory of the business cycle loses against the alternative of a "real" interpretation of the business cycle. Manchester (1989) also concluded that the monetary base plays a relatively minor role in influencing output growth in the United States. Ahmed and Murthy (1994) interpret their results for Canada as supporting a RBC model of money-output correlations. On the other hand, Scheide (1993) applied the basic multiplier approach to German data and his results oppose the conclusion reached for the U.S. For Germany Scheide found that changes in the monetary base do affect economic activity. Moreover, although the money-multiplier effects are stronger, the multiplier variables themselves are influenced by nominal monetary policy. Also, multiplier changes do not appear to reflect sufficiently certain measures of the underlying real shocks that feature in real business cycle models (such as the terms of trade for an open economy).

This paper extends this literature in two directions. The first objective of the paper is to critically examine the key assumptions of the multiplier approach. Second, the contradictory results of Plosser (1991) and Scheide (1993) illustrate that there is a case for further analysis. This paper uses data for five countries and examines whether the empirical results are sensitive to circumstances prevailing in one country or a particular sample period. An important part of money-multiplier analyses is the adjustment of base money for changes in reserve requirements. Because only the United States publishes semi-official adjusted monetary base data, this paper uses specially constructed adjusted monetary base series for the other countries.

One key result of the review of the theoretical foundations of the multiplier approach is that the assumption that monetary policy can be neatly divided into a nominal (monetary base) and a real (multiplier) component does not necessarily hold. In fact, the way monetary policy is actually implemented in the market for bank reserves makes it very likely that this assumption does not hold.

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4 The German central-bank-money-stock concept is not a true adjusted monetary base series, although it comes very close. The U.K. M0 excludes (supplementary) special deposits and current cash reserve deposits, but ignores the effects of earlier cash reserve requirement schemes (they were voluntary and the BoE argues that there is no monetary control purpose associated with reserve deposits).
Consequently, as a matter of principle the multiplier approach is not able to discriminate between exogenous (nominal) policy actions and private sector influences. Furthermore, the empirical evidence confirms that nominal policy can Granger-cause changes in the multiplier. The empirical results also show that changes in outside money do affect real economic activity in the sense of Granger causality. Evidence for this is however not always easy to recover from the data. Results from Granger-causality tests depend on the country and the time period examined.

The rest of this paper is structured as follows. Section 2 describes the basic theoretical framework and critically examines key assumptions of the multiplier approach. Section 3 introduces the statistical framework for the Granger-causality tests in the empirical part of the paper. Section 4 introduces the data and presents empirical results for the basic multiplier approach. Section 5 examines the key assumption that nominal policy and multiplier changes are independent. Concluding remarks are in section 6.

4.2 THE MONEY-MULTIPLIER APPROACH

4.2.1 Basic theory

If movements in money balances correlate with changes in output and if money is under effective control of the monetary authorities, monetary policy must be held responsible for some, if not a major part of the cyclical fluctuations in economic activity. Given that the comovement of money and economic activity is a stylized fact of business cycles, the empirical question then becomes: How and how well do monetary authorities control the money supply? To answer this question a model of the money-supply process is needed.

The first model of the money supply to be considered is the textbook multiplier model, written as

\[ M = \text{mm} \cdot MB \]

where \( M \) is the monetary aggregate defined as currency in circulation with the public (C) and deposits (D), \( MB \) is the monetary base defined as currency (C) and bank reserves (R), and \( \text{mm} \) is the money multiplier defined as \( \text{mm} = \frac{(1+c)}{(r+c)} \) with \( c = \frac{C}{D} \) and \( r = \frac{R}{D} \). When the monetary aggregate is not simply narrow money M1 (covering only bank demand deposits D) but a broader money aggregate such as M2 or M3 (also including time deposits, savings deposits, etc., together simply denoted as T) the multiplier for the broad money aggregate becomes \( \text{mm} = \frac{(1+c+t)}{(r+c)} \) with \( t = \frac{T}{D} \).

Because the monetary base consists of liabilities of the monetary authorities, the supply of which can be controlled, the monetary authorities are able, in principle, to control the monetary aggregate \( M \). The degree of actual control depends on (i) the willingness or ability of the monetary authorities to force the banking system into adjusting its balance sheet to the exogenous supply of monetary base, and (ii) the ability of the monetary authorities to forecast and offset changes in the...
money multiplier. The first element represents an important policy choice, whereas the second element is an empirical matter (for a study of the evidence, see Rasche and Johannes, 1987). In principle, however, this simple model suggests that money is, or at least can be closely controlled by the monetary authorities.

Among others, King and Plosser (1984) suggest that the supply of money is endogenous and simply cannot be controlled by the monetary authorities. Economic activity and prices determine the demand for financial services by firms and households, and real factors determine the desired composition of their balance sheets. "Real" central bank actions such as changes in the structure of reserve requirements affect the real costs of providing financial services. But nominal actions such as changes in the supply of outside money determine only the general price level and do not affect real variables. The only exception is that nominal monetary policy through its effect on inflation can affect the demand for real balances of outside money and change the time allocated to transaction services. The corresponding change in the use of available resources would generate a real effect.

In the context of the multiplier model, the proposition of RBC theory is that the C/D ratio is the main determinant of movements in aggregate money and that the correlation between money and output reflects reversed causality. In real business cycles it is the change or planned change in real activity that generates an increased demand for loans and transaction services supplied by the financial system.

The macroeconomic framework of the multiplier analysis is as follows. The key equation of the quantity theory of money is \( M \cdot V = P \cdot Y \). Using a first-differenced log transformation, the relationship between money aggregates (\( M \)) and economic activity (\( Y \)) can be written as

\[
\frac{\Delta \log(Y)}{} = \frac{\Delta \log(M)}{} - \frac{\Delta \log(P)}{} + \frac{\Delta \log(V)}{}
\]

The velocity of money (\( V \)) links economic activity with real money balances. If the time series behaviour of velocity is independent of movements in output and real money balances -- e.g. velocity is constant or follows a (stochastic) trend with \( \Delta \log(V_t) = \text{constant} + \text{disturbance} \) -- there is a direct linear relationship between the (log) growth rate of output and real money balances. Money (\( M \)) can be divided into a monetary base (\( MB \)) and multiplier (\( mm \)) component.

\[
\frac{\Delta \log(M)}{} = \frac{\Delta \log(mm)}{} + \frac{\Delta \log(MB)}{}
\]

In this set-up monetary policy exogenously determines the monetary base. Real factors that influence the preferred ratio of deposits to currency held by the public and the required and excess reserves against bank deposits determine the money multiplier.

---

5. Note that monetary authorities cannot predetermine the monetary base if they target interest rates or a fixed exchange rate.

6. For a closer examination of the long-run behaviour of velocity see Bordo and Jonung (1987). In the long run, secular developments in institutions affect velocity and appear to create a U-shape pattern. Univariate models for small sample periods usually confirm that the time series behaviour of velocity resembles a random walk.
Thus, the multiplier model suggests that it is possible to test alternative hypotheses on the
comovement between money and output by examining the explanatory power of changes in the
multiplier and the monetary base. The null hypothesis provided by RBC theory is that nominal policy in
terms of monetary base changes does not affect real activity, and that the tendency for output and
money aggregates to move together is purely a multiplier phenomenon.

4.2.2 A critical review of the money-multiplier approach
The money-multiplier approach appears straightforward and simple. However, because the approach
is simple it may also ignore, or at least oversimplify, important aspects. A critical review of the
multiplier approach suggests two possible problems. First, the new classification of business cycle
theories proposed by Plosser (1991) does not correspond to traditional interpretations of business cycle
theories. Second, the idea that changes in money can be orthogonalized into nominal and real
influences along the lines of base money and money multiplier is not necessarily correct.

(i) A new classification of theories
As a starting point, it is important to note that Plosser (1991) introduces a radically new classification
of business cycle theories. RBC models traditionally focus on shocks to technology, preferences,
of the "real" theories to major parts of monetary policy, including changes in reserve requirements and
changes in interest rates. The crucial distinction that is now introduced, is between real and nominal
sources of business cycles. However, this distinction does not correspond to traditional divisions
between monetary theories -- as in monetarist or new classical models -- and real theories -- as in
RBC models. Monetary or monetary policy explanations do not equate with nominal explanations as
defined by Plosser.

A useful example of the implications of the proposed change in the definition of monetary
policy centres on the 1929-1933 episode of the Great Depression in the United States. Remember that
Friedman and Schwartz (1963), among others, ascribed the seriousness of the depression to a failure
of the monetary authorities to prevent the substantial fall in the supply of money. This fall was entirely
due to an increase in the currency-to-deposit ratio, following a series of bank runs and bank failures.
Focusing on the behaviour of the currency-deposit ratio, the multiplier approach would lead to the
conclusion that the depression was entirely a real phenomenon. Focusing on the failure of the
monetary authorities to engineer an adequate increase in base money with the aim of maintaining the
total money stock, Friedman and Schwartz and others conclude that the depression was largely a
monetary phenomenon. (Note that the emphasis on the use of the monetary base is not a crucial
aspect of their analysis.) Mankiw in his 1991 commentary on Plosser emphasized that in cases like this
it is not the observation of actual comovement that counts, but the fact that monetary authorities could,
if they tried, cause a change in economic activity by changing the quantity of nominal money.

To avoid confusion, therefore, a careful use of concepts is required.

Following this line of argument one might argue that the results of Evans (1992), showing that
productivity shocks used in real business cycle models are Granger-caused by M1 money, are due to
the "real" components of money and monetary policy.
(ii) Base money and the multiplier

The second aspect of the proposed multiplier approach is the separation of real and nominal policy actions. The simplicity of the multiplier approach depends in a crucial way on the possibility to obtain strict orthogonalization of monetary base and multiplier changes. However, it may be impossible to separate real and nominal components. I will discuss two channels through which the money multiplier may enter the money-output relationship as a consequence of purely nominal policy actions.

(ii a) Exogenous demand for currency

The textbook multiplier-model assumes that the private-sector determines an optimal ratio between currency and deposits. The private sector deposits currency and withdraws deposits depending on certain key variables. The main determinants of deposits relative to currency and other assets are (a) substitution effects based on relative rates of return and (b) the constraints imposed by reserve requirements (see for example the Brunner-Meltzer version of the multiplier analysis, pioneered in Brunner, 1961 and Brunner and Meltzer, 1964).

Empirical observation quickly confirms that the currency-deposit ratio is certainly not constant. In fact, in the United States the currency ratio exhibits significant movements over time. These movements reflect mainly changes in deposits, because currency is a secularly increasing variable. Garfinkel and Thornton (1991) show that when the demand for currency is exogenous to the multiplier model, the supply of reserves affects the multiplier. The actual relationship between money and nominal monetary policy results from simple rearrangement

\[ M = MB + (h-1).R , \text{ or} \]

\[ M = h.MB + (1-h).C \]

where parameter \( h \) is the reciprocal of the reserve requirement ratio. Of course, a deposit-currency ratio always exists and can be obtained by simply dividing two observations. Its analytical content is unclear, however, when currency demand is exogenous.

These observations on the deposit-currency ratio affect the multiplier approach. First, note that the revised money supply model suggests that the monetary base by itself may not provide all the useful information to measure nominal monetary policy. To capture the total effect it is necessary to look at both the monetary base and reserves. Second, note that the model implies that the supply of reserves determines the money multiplier

\[ M/MB = 1 + (h-1).R/MB \]

The multiplier was supposed to capture the effects of private sector behaviour alone. But now nominal monetary policy affects the multiplier, because the volume of bank deposits and bank credit is directly constrained by available reserves.

For the United States, Garfinkel and Thornton (1991) show that the relationship between changes in total reserves and M1-deposits is significant, but especially strong in the post-1984 period
Real and nominal explanations of business cycles

when the implementation of the Monetary Control Act 1980 extended the coverage of Federal reserve requirements to all depository institutions, and when also a system of (nearly) contemporaneous reserve accounting was introduced. The relationship between reserves and non-M1 deposits in M2 is not very strong (Thornton, 1992). Gaps in the system of reserve requirements, e.g. different reserve requirements for different types of deposits and different parts of the banking system, can have distortionary effects on money aggregates and multipliers when the private sector shifts deposits between banks and between different types of deposits.

(ii b) The market for reserves and interest-rate targeting
The basic multiplier model assumes that monetary authorities implement monetary policy using a monetary base or a total reserves operating procedure. Following such operating procedures, the central bank supplies a predetermined amount of reserves to the banking system and forces banks to adjust their balance sheets to comply with existing reserve requirements. This is not, however, a correct representation of actual monetary policy procedures in most industrialized countries.\(^8\) A more accurate view of actual monetary policy consists of medium or long-term target zones for monetary aggregates, and the market for bank reserves as a framework for short-term policy implementation.

Historically, because of their original function as lenders of last resort to the banking system, central banks have tended to focus on stabilisation of financial markets in general and interest rates in particular. Postwar Keynesian views on macroeconomics and economic policy increased the role of interest rates as a primary objective of monetary policy. Currently, the Federal Reserve in the United States and the central banks in most other industrialized countries continue to rely on their influence over money-market interest rates as the main instrument of monetary policy.

A review of the market for reserves shows (i) that monetary base or reserves changes are a misleading indicator of monetary policy actions, and (ii) that nominal actions affect interest rates and the multiplier.

\(^8\) Monetary base control has always been a strong policy recommendation by monetarist economists to facilitate tighter control of the money supply and to avoid problems of base drift. It would require certain institutional changes. Central banks have always rejected its practicability, with the Swiss central bank being a lonely exception.
Figure 1 Stylized view of the market for bank reserves

a. Total reserves targeting

b. Interest rate targeting

c. Upper-lower interest rate

d. US federal funds market
Part (a) of figure 1 shows a stylized version of the market for bank reserves, with a downwards sloping demand schedule (TRd) and a predetermined, vertical supply of reserves (TRs). The supply of total reserves can be divided into nonborrowed reserves (NBR), supplied through central bank open-market operations, and borrowed reserves (BR), supplied through the central bank's discount window. The money stock that corresponds to this constellation of demand and supply can be traced through the reserves money-multiplier. In most countries, monetary authorities do not keep total reserves fixed, but attempt to stabilize short-term interest rates. In the United Kingdom, the Bank of England supplies and withdraws reserves at predetermined interest rates (effectively a horizontal supply curve as in figure 1 part (b)). In Germany, the Bundesbank limits interest rate fluctuations by offering banks access to a restricted low-cost and an unlimited high-cost borrowing facility (effectively setting a lower and upper limit for market interest rates as in figure 1 part (c)). In the United States, the Federal Reserve allows banks to borrow at the discount window but increases the nonpecuniary costs of borrowing when banks borrow larger amounts and for longer periods of time (in other words, the supply curve of borrowed reserves is upward sloping as in figure 1 part (d)).

This exposition of the money-market model serves two purposes. First, it can be used to show that it is problematic to identify restrictive and expansionary policy with reductions and increases in total reserves or base money. Second, it can be used to show that nominal actions tend to be associated with balance sheet adjustments and multiplier changes, because nominal actions change interest rates.

Consider first the possibilities of an outside observer to identify monetary policy actions with changes in total reserves. Identification of monetary policy actions becomes very complicated when two complications are introduced: (i) shocks to the demand for reserves (or, equivalently, shocks to the demand for money or the demand for bank loans), and (ii) the possibility that the banking sector acquires borrowed reserves from the central bank. In these cases it is no longer possible to identify monetary policy actions with only the observation of a change in base money or bank reserves.

---

9 The demand for reserves is approximately a linear transformation of the economy's demand for money. The multiplier model implies \( R = \frac{r}{1+c} \).M. Because money demand is negatively related to interest rates, the demand for reserves is also negatively related to interest rates. In addition, interest rates also directly influence the volume of excess reserves voluntarily held by banks (reserves in excess of required reserves).

10 Note that although the actual amount of borrowed reserves supplied through the discount window is frequently demand determined, borrowed reserves are nevertheless considered part of the supply of reserves because the central bank sets the conditions for using borrowed reserves (price and/or maximum volume).

11 Whereas the monetary base multiplier equals \( \frac{1+c}{r+c} \), the reserves multiplier equals \( \frac{1+c}{r} \). A frequently used, but not undisputed alternative is to solve the money-demand equation for the money stock associated with the equilibrium money-market interest rate. This approach fails if the demand for money is not related to a single, representative money-market interest rate, but also to the long-term interest rate, multiple interest-rate differentials, stock market returns, etc. and/or if monetary policy actions affect income or prices in the current period.

12 For a review of central bank operating procedures and institutional arrangements for central bank lending facilities see Kneeshaw and Van den Bergh, 1989; Batten et al., 1990.
Suppose that the monetary authorities do not accommodate an exogenous increase in demand for reserves, but keep the target for total reserves fixed. Now, monetary policy is in fact restrictive, but this is reflected in higher interest rates, not in a change in total reserves that serves as the nominal policy indicator.\[13\] With the possibility of discount-window borrowing, the selection of an appropriate indicator of monetary policy also becomes more complicated. If the quantity of total reserves increases, it is then no longer clear whether the source of this change is active monetary policy (open-market operations that increase the supply of nonborrowed reserves) or passive, accommodative behaviour that allows the quantity of reserves to be demand determined by increased reserve borrowing. The use of the discount rate as a policy instrument complicates our identification problem even further, because it destroys the unidirectional interpretation of changes in borrowed reserves as exogenous changes in demand. Observed changes in borrowed reserves may now be indicators of shocks to the demand for reserves or indicators of demand responses to policy induced changes in the cost of reserve borrowing.

Essentially, the analysis has turned into a familiar issue in empirical examinations of monetary policy: What is the informational value of money aggregates versus interest rates as indicators of monetary policy? Sims (1980) showed that interest rates tend to outperform money as a predictor of output in the postwar U.S. data. Empirically, Bernanke and Blinder (1992) recently confirmed that the federal funds rate clearly outperforms M1, M2, Treasury bill and bond rates in forecasting real variables. On the other hand, McCallum (1983), Bernanke and Blinder (1992) and others have suggested that the correct interpretation of these results is that interest rates are simply better indicators of monetary policy, given the interaction between money demand shocks and open-market and discount-window operations. The direction of monetary policy is indicated by policy decisions to change the money-market rate. Note that this evidence does not necessarily mean that the interest rate is the more important element in the transmission of monetary policy.

The interaction of prices and quantities in the money market suggests, that the money multiplier cannot be assumed to be independent from changes in base money. For plausible values of the parameters, the multiplier will most likely increase (fall) when interest rates rise (fall)\[14\]. Whether or not this possibility is important is entirely an empirical question. Depending on such factors as the interest-elasticity of the supply of reserves and the interest-elasticity of the multiplier -- which in turn depends on the availability of close substitutes for bank deposits, and the payment of market

\[13\] Note that in a system with a lagged reserve requirement, the demand for reserves is largely fixed at a level determined by bank behaviour in previous periods. If demand and supply of reserves do not coincide, either one of two things can happen. Either the central bank offers a discount borrowing facility to supply the required amount of reserves - which makes the monetary base an endogenous variable and inadequate as an instrument of monetary policy - or the banking system must attract additional reserves by offering higher interest rates and induce the public to change its desired ratio between currency and deposits. This mechanism makes the money multiplier dependent on nominal monetary policy.

\[14\] The ratio of currency to demand deposits (c) and time deposits to demand deposits (t) are likely to fall and rise resp. when interest rates increase. The effect on the multiplier defined as \( mm = \frac{(1+c+t)}{r+c} \) is positive for \( r < 1 \). The evidence in for example Christiano and Eichenbaum (1992) supports the so-called liquidity effect of changes in (nonborrowed) reserves on interest rates.
determined interest rates on bank deposits -- changes in base money may or may not interact with the multiplier.

4.2.3 Concluding remarks
The multiplier approach to testing real-business-cycle versus nominal-monetary theories of money-output correlations relies on three conditions. First, the correlation between money and economic activity results from money-multiplier changes and not from changes in the monetary base, because monetary policy through changes in base money is assumed impotent in real business cycle theories. Second, multiplier movements are not themselves in some way "caused" by monetary policy, because this would destroy the test. Third, multiplier changes must reflect real shocks that underlie movements in economic activity, because money is endogenous. The rest of this paper concentrates on a close re-examination of the first and second conditions.

4.3 THE STATISTICAL FRAMEWORK FOR CAUSALITY TESTS

The quantity equation can be rewritten as a noisy linear relationship between (logs of) real money balances \( M/P \) and real activity \( Y \)

\[
\Delta \log( Y ) = \alpha + \Delta \log( M / P ) + \varepsilon
\]

In empirical studies, the direction of causality between two or more variables is routinely examined with Granger-causality tests in the context of vector autoregression models (VARs). In the principle equations of a VAR an indicator of monetary policy, such as a monetary aggregate, is given a predictive role for industrial production or real gross national/domestic product (GNP/GDP), consumer price inflation, etc. A variable \( x \) is said to exhibit Granger-causality towards variable \( y \) if lagged values of \( x \) contribute to the explanation of future values of \( y \), over and above the contribution of lagged values of the dependent variable itself and lags of any other explanatory variable. For our purposes, a representative VAR equation would be

\[
\Delta \log( Y_t ) = a + b(L) \Delta \log( Y_{t-1} ) + c(L) \Delta \log(M / P_{t-1} ) + d(L) \Delta Z_t + \varepsilon_t,
\]

where \( Z \) is a vector of additional explanatory variables, including any contemporaneous (exogenous) disturbances to the real economy. \( b(L) \), \( c(L) \) and \( d(L) \) are functions for the lag operator \( L \).

\[15\] Obviously, this is a reduced form model of the relationship between output and money. The structural details of the transmission from monetary policy to economic activity remain unspecified. Although it restricts some parts of the analysis, it is a convenient starting point and well suited for so-called atheoretical or VAR type modelling and causality testing. Interpretation of VAR models and Granger-causality tests is not without controversy. Classical references are Leamer (1985) and Cooley and LeRoy (1985). Regarding the issue of inside and outside money one might want to compare Freeman and Huffman (1991) and Lacker (1988).
Note that although macroeconomic theory suggests a relationship between output and real money balances, a usual assumption is that monetary authorities influence only nominal money balances. Many studies test for causality between nominal money and output without a correction for price changes (this is the approach taken in Plosser, 1991). It is possible that those results are affected by this specification error. But to include real money balances as the monetary impulse in the equation for real output requires an explanation as to how monetary authorities affect real money balances. I offer two possible interpretations. First, if prices adjust only slowly to shocks it is possible to argue that therefore by changing nominal money monetary authorities also directly affect real money balances, at least in the short run. This interpretation corresponds to standard assumptions of sticky prices. The second interpretation is that if at the start of each new period prices are fully adjusted to anticipated monetary policy, observed changes in real money balances approximate the unanticipated or unexpected component of monetary policy. This interpretation corresponds to standard new-classical models of the business cycle. Because there can be no suggestion that monetary authorities control real money balances in the long run, the use of real money balances is restricted to short-term analyses only.

In comments on an earlier version of this paper, it was suggested that while it may be correct to emphasize the difference between real and nominal money from one perspective, a role of real money balances in explaining economic activity would be unconvincing evidence for RBC proponents. Real money balances may increase because a positive real shock leads to a decline in the price level. If output increases as a consequence, it is not because of an action by the central bank but because of the real shock. One could counterargue that the implied countercyclical behaviour of prices is not a stylized fact of business cycles. However, a recent debate about the cyclical behaviour of prices can be considered inconclusive. Cooley and Ohanian (1991), Fiorito and Kollintzas (1994) find countercyclical behaviour in the data, while Wolf (1991), Chadha and Prasad (1993, 1994), Hall (1995), Judd and Trehan (1995), Smant (1996) argue against. In order to take into account the possible effects of price shocks I included prices as an additional explanatory variable and let the data decide whether price shocks dominate movements in real money. An alternative would be to examine nominal money and prices separately. The results of this analysis were very similar, except for Germany. The German data exhibit a strong preference for real money, but this appears not to be related to a dominance of price shocks.16

A next issue to be addressed is the number of lags to be included in the VAR equation. Theory does not provide us with a-priori optimal lag lengths and the optimal number of lags is not necessarily the same for all variables. The selection of lag lengths does, however, affect the statistical significance of the tests (Thornton and Batten, 1985; Spencer, 1989). Here the optimal lag length is selected using a search procedure based on the final prediction error (FPE) criterion (see for example Hsiao, 1981). The FPE is defined as

---

16 I therefore assume that in Germany the contribution of monetary cycles is limited and that the loss of degrees of freedom by including money and prices separately precludes them showing significant effects.
where $N$ is the number of observations, $k$ is the number of coefficients estimated, and $SSR$ is the sum of squared residuals. It can be shown that the FPE selection criterion is related to a sequence of F-tests where the critical value increases with the lag length. It limits pretesting biases by increasing the acceptance criteria as the number of lags increases. The search procedure for a multivariate model works as follows.\(^\dagger\)

1. In a univariate autoregression the minimum FPE value from a range of lag lengths determines the lag length $n_1$ for the dependent variable.
2. Individual variables are added to the selected univariate model with different lag lengths and the different lag lengths are ranked according to their minimum FPE values. One variable with optimal lag length $n_2$ is added to the system to obtain the largest reduction in the FPE value of the equation.
3. Step 2 is repeated for the remaining, not yet included variables. Individual variables are added until no further reduction in the FPE can be attained with any of the remaining variables and any lag length.

In this case a variable is said to Granger-cause the dependent variable if its contribution to lowering the FPE of the equation causes it to be included in the final equation. But the FPE criterion is only one of several criteria that can be used to determine the significance of a particular (set of) variable(s) (see Judge et al., 1988 for a discussion of selection strategies).\(^\dagger\) To provide additional information on the behaviour of the FPE criterion the tables also present significance levels for conventional exclusion F-tests for the lagged observations of the selected variables in the final equations. In this case the F-test is not an independent, additional exclusion test, but it allows a comparison with most other studies on money-output Granger causality.

A final note on the statistical framework concerns issues of nonstationarity and (vector)cointegration. As a matter of principle, stationary data series are needed for the estimations. For this reason all variables are included as (log) first-differences. Many previous studies have

\(^\dagger\) The computer software is adapted from the FPE.SRC source code supplied with the RATS statistical package. Note that in general a strategy of model expansion (adding lags and variables) does not yield the same results as a strategy of model reduction (removing lags and variables). Econometric theory does not provide a definitive solution. The literature provides only personal preferences.

\(^\dagger\) The FPE is generally considered to be a more permissive selection criterion than AIC or SIC. However, each criterion relies on a different objective function putting different weights on the amount of bias (ignoring relevant variables) and efficiency (including irrelevant variables). There is no definitive answer to the question of what is the best selection criterion. Particularly in the context of distributed lag models, the presence of much multicollinearity between lags of variables would lead a more restrictive criterion to exclude more lags. The choice of combining the FPE with the F-tests used in almost all other studies (albeit with only ad hoc selection of lag lengths) appears a reasonable compromise.
reported formal tests of non-stationarity or unit roots for the variables used here. No new tests are reported here, especially since the available tests are known to have low power. MV = PY relationships appear very well suited to apply cointegration and error correction methods (for example, see Konishi, Granger and Ramey, 1993). If cointegration exists it is possible to increase the efficiency of the statistical results. The available evidence on cointegration relationships tends to be dominated by the results for U.S. M2 money. Hoffman, Rasche and Tieslau (1995) present multi-country evidence of cointegration in M1 models, but only after including several dummy variables to correct for breaks. In this paper I will not pursue the issue of cointegrating relationships.¹⁹

4.4 DATA AND A FIRST ROUND OF EMPIRICAL RESULTS

4.4.1 The data
The empirical results are for a set of five countries: Germany, Japan, the Netherlands, the United Kingdom and the United States. The quarterly data cover the sample 1957:1 to 1993:4, except for the German national accounts data starting in 1960:1 and the German sample being truncated in 1990:4 because of the possible distortion effect of German unification. Quarterly data are quarterly averages of monthly observations, except the money data for Japan which are end-of-quarter. Money and output data were seasonally adjusted where necessary. Output and price data are from standard sources such as OECD and IMF. The money data are constructed from national sources (sources and other details are in a separate data appendix).

Two considerations affect the choice of a measure of economic activity. First, in (small) open economies domestic expenditures (GDE = GDP or GNP minus net exports) may be more closely related to domestic monetary impulses than gross domestic product. Exports are probably more influenced by foreign policies than domestic policies. Second, Von Hagen (1984) argued that to test monetary models of business cycles, the data must be closely related to private sector production and pricing decisions. Therefore, production, sales, and price data should exclude goods traded on heavily protected and regulated markets. This applies for example to public sector production, because it is usually valued in terms of costs rather than output. Basically, a measure of public sector production only reflects public wage and employment policies. Sectors such as agriculture, energy, transport, health, etc. should be excluded because they are heavily influenced by public regulation and public remuneration schemes. In the short run, there is no reason to expect changes in output and prices in these sectors to be caused by changes in money.²⁰ Existing research with respect to the money-output link is split between monthly data using industrial production and quarterly data using GNP/GDP for output. The arguments of Von Hagen suggest that perhaps industrial production should be preferred over GNP data, which after all includes more of the unresponsive sectors of the economy. The main disadvantage is that industrial production represents a decreasing component of economic activity. The

¹⁹ Note that in our flexible-lag estimation of the VARs, cointegration and error correction implies certain restrictions on the coefficients to be estimated. In general, in a VAR the MA element of the cointegration effect can be approximated with an alternative AR process. Because the number of lags is determined by the data, the problem of misspecification due to a missing error-correction term is limited.

²⁰ In the longer run however it is unlikely that the public sector can escape the pressures from for example a national labour market.
complete set of results shows that qualitatively the conclusions of this paper do not depend on the measure of economic activity. Across countries en money aggregates there are however differences in significance levels for money in the estimated relationships.\footnote{Cross correlations of output with the different real money aggregates show that on average money and output are positively correlated (tables not presented). For Germany, Japan, and the Netherlands, industrial production produces higher correlations than domestic expenditure; only slightly so for Germany and Japan, but substantially for the Netherlands. These are countries which are relatively more dependent on exports. Generally speaking, the positive correlations between money and output tend to peak somewhat earlier in time for industrial production than for domestic expenditure.}

Four money aggregates are used: narrow money M1, a broad money aggregate (either M2, M2+CD, or M3 depending on the country), the monetary base MB and the source base SB. Monetary base and source base are concepts linked to monetary analysis pioneered at the Federal Reserve Bank of St. Louis. The source base sums currency held by the public and reserves currently held by the banking sector (vault cash plus central bank deposits). The monetary base incorporates an adjustment for changes in reserve requirement ratios. For example, if reserve requirements are lowered the reserve adjustment increases the adjusted monetary base relative to the underlying source base. The idea is of course that a reduction in reserve requirements is equivalent to a corresponding increase in base money through open market operations.\footnote{In a "real" interpretation one could argue that the change in the reserve requirement ratio equals a change in the tax rate for banks. Plosser (1991) argues therefore that "The monetary base numbers are a peculiar mixture of real and nominal elements of monetary policy." (p.261) Haslag and Hein (1995) find, that empirically the dynamic macroeconomic responses to base changes and reserve adjustments are not always identical.} Whereas for the United States two readily available measures of the adjusted monetary base exist (one from the FRB St. Louis, which is used here, and one from the Federal Reserve Board), no other country publishes an adjusted monetary base series. The monetary base series used in this paper are constructed using information from available national sources. Real money balances are constructed by deflating nominal money with the consumer price index.

### 4.4.2 Empirical results

Table 1 presents causality tests for industrial production and the real money aggregates. Panel A presents the results for the full sample period, and panel B presents the results for the post-1980 sample.
Table 1 Causality tests for industrial production and money aggregates

A. Full sample period

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<th>sign a</th>
<th>prices FPE lags</th>
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Notes: All variables are quarterly (log) percentage changes, expressed at annual rates. Output is industrial production. Real money is nominal money deflated with the CPI index. A final prediction error based search procedure was used to add to the univariate output equation an optimal number of lags (incl. zero) of the other variables. * The column headed sign presents significance levels of a standard exclusion F-test for the indicated lags. b Causality Y→RM refers to FPE based inclusion of output in an auxiliary money equation (details not shown).
Table 2  Causality tests for base money and multiplier components

A. Full sample period

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<th>Prices</th>
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<th>T/D ratio</th>
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### Table 2 (continued)

#### B. Post-1980 subperiod

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Notes: See table 1. FPE values initial univariate output (industrial production) as in table 1.
Panel A of table 1 shows that in Germany, Japan, the U.K., and the U.S., industrial production is Granger-caused by M1, broad-money and the monetary base. In the Netherlands only the M1 money definition Granger-causes industrial production. Note that the U.S. results here differ from those reported in Plosser (1991). Plosser found that neither the monetary base nor the source base Granger-caused real GNP in the post-1959 period. The final column shows that test results for Granger-causality going from output to money are mixed. This mixed result is somewhat puzzling from the RBC perspective on money-output correlations. If changes in money are always merely an endogenous response to movements in economic activity, would we not have expected a more decisive pattern of causality going from output to money?

Table 2 presents the dynamic relationships between industrial production, base money, and the two main components of the money multiplier. The purpose of table 2 is to examine more closely exactly which of the components of the M1 and broad money aggregates are significantly related to subsequent movements in output. Both the adjusted monetary base and the unadjusted source base are used, because there is some debate on whether the adjustment for changes in reserve requirements is to be considered a partially "real" or purely "monetary" effect (see Plosser, 1991). The multiplier elements used in the analysis are the ratio of currency to demand deposits (C/D) and the ratio of other deposits to demand deposits (T/D). The C/D ratio is the main determinant of the M1 multiplier, whereas C/D and T/D ratios together determine the multiplier for the broad money aggregates.

The results show that both the monetary base and the source base Granger-cause industrial production, independent of movements in the multiplier ratios. The results also show that the evidence is not equally strong across countries (and time periods, see below). The explanatory power of the equations is fairly low. It is important to remember, however, that the purpose of these tests is not to determine the share of monetary impulses in economic fluctuations, but merely to establish that there are or can be significant effects from monetary policy actions.

Panels B in tables 1 and 2 provide some insight into the temporal stability of the causality tests. Differences between the full-sample estimates and the post-1980 sample in table 1 are that in the more recent data (i) German M3 does not exhibit Granger-causality and (ii) source base and/or monetary base do exhibit Granger-causality for industrial production in Japan and the Netherlands. Table 2 shows that changing the data sample also affects the multiplier ratios. In the U.S. and Germany neither the M1 nor the M2 deposit components affect economic activity since 1980. There is one puzzling aspect of the results for the Netherlands. Table 2B shows that base money and the T/D ratio cause

---

23 Additional results show that the real monetary base, but not the real source base Granger-causes U.S. real domestic expenditures.

24 The precise definition of the ratios is $C/D =$ ratio of currency to non-currency component of M1 and $T/D =$ ratio of non-M1 deposit component of the broad money aggregate (M2, M2+CD, or M3) to the non-currency component of M1.

25 For this reason I do not present variance decompositions, which are a traditional element of VAR modelling.

26 In the post-1980 sample C/D and T/D ratios Granger-cause domestic expenditures in combination with the real source base, but not when the monetary base is included.
Real and nominal explanations of business cycles

output. This suggests an important role for the M3 aggregate. Table 1B however indicates that it is M1 and not M3 that causes output.

4.4.3 Conclusions
According to Plosser (1991) the empirical results for the U.S. "confirm the general view that endogenous elements of money are the major contributors to the predictive value of money to real activity. The evidence that exogenous variations in the nominal quantity of outside money is important for subsequent movements in real output is very weak." (p.267) A reexamination of the issues suggests that these results are not robust. International data for five countries show that economic activity is significantly related to changes in the (real) monetary base and source base.

4.5 DOES MONETARY POLICY GRANGER-CAUSE THE MONEY MULTIPLIER?

The empirical results presented above show that base money changes do Granger-cause economic activity. These results already contradict the assumptions and implications of pure RBC models. This section provides some additional evidence on the usefulness of the multiplier approach.

Plosser (1991) stressed that 'Distinguishing real theories of the business cycle from monetary theories requires a more careful analysis of Federal Reserve actions than is typically offered' (p. 241). Unfortunately, his proposed multiplier approach also risks being in contradiction with the experience of actual implementation of monetary policy. There are reasons to suspect that nominal monetary policy is not orthogonal with respect to the multiplier. One hypothesis developed in previous sections was that base money changes may interact with the multiplier because they affect short-term interest rates. Table 3 provides some empirical evidence on this issue.

Table 3 presents a summary of the results for three equations that supplement the output equations of table 2 in a VAR system. Part A of table 3 corresponds to the full sample results for output in table 2. Part B corresponds to the subsample results for output in table 2. (In the presence of reserve requirement changes the monetary base is a better measure of changes in the market for reserves so only monetary base and not source base results are reported.)

A number of comments are useful to interpret the empirical relationships between monetary base changes and other variables. First, effects of lagged output may reflect policy reactions to observed changes in economic activity, depending on the perception of their implications for future output and inflation targets. Monetary authorities frequently embark on countercyclical policy by 'leaning against the wind'. They may attempt to correct previous movements in economic activity (using growth or unemployment as indicators), interest rates (long and short rates that proxy for expected inflation and real interest rates), or money aggregates (long-run inflationary pressures) by altering target levels of their policy variables: the monetary base and money-market interest rates.
Table 3 Granger-causality between base money and multiplier components

A. Full-sample period

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Table 3 (continued)

B. Subsample, post-1980 period

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Notes: See table 1. Variable Y is industrial production. To economize on space FPE values are not shown.
Second, in a banking system with lagged reserve requirements there is an intertemporal relationship running from the creation of bank deposits to the demand for reserves. Central banks usually maintain a safety valve by offering the banking system the opportunity to borrow reserves in order to comply with current reserve requirements.

Third, in periods with infrequent changes in interest rate targets, economic activity affects the demand for bank credit, bank deposits and the demand for reserves. Total reserves and base money expand while there is no effect on interest rates.

More important than the monetary base equations are the equations for the multiplier components \( C/D \) and \( T/D \). An essential precondition for using multiplier effects on output as evidence in favour of real business cycle theories, is that the multiplier must be completely exogenous with respect to nominal monetary policy. The evidence in table 3 shows that this condition does not hold. It depends on the country, on the time period, and the type of money aggregate examined, but the evidence shows that money multipliers are not exogenous with respect to changes in nominal policy. The interest-rate sensitivity of the multiplier (components) depends on institutional details which may affect the behaviour of interest-rate differentials. But when interest rates change they affect the demand for money, credit, reserves and base money, and also the money multiplier.

### 4.6 SUMMARY AND CONCLUDING REMARKS

Plosser (1991) proposed an empirical approach to resolve a long-standing dispute over monetary and real sources of business cycles. This money-multiplier approach suggests three conditions for a real business cycle interpretation of money-output correlations. First, that the correlation between money and economic activity results from money-multiplier changes and not the monetary base, because monetary policy through changes in base money is assumed impotent in RBC models. Second, multiplier movements are not themselves in some way "caused" by nominal monetary policy. Third, multiplier changes must reflect real shocks that underlie movements in economic activity, because money is endogenous. In this paper we examined the first two of these conditions.

The Granger-causality results in this paper contradict the implications of the pure real business cycle model. The empirical evidence shows that both the monetary base (or outside money) and the money multiplier (or inside money) exhibit Granger-causality towards real activity. Furthermore, the empirical evidence shows that monetary base changes also exhibit Granger-causality towards the money multiplier. Monetary shocks apparently do play their part in economic fluctuations. How large the relative contributions of monetary and real shocks are to recent business cycles is a different matter. Whether there exists a sufficiently stable relationship to allow a large degree of economic fine-tuning through monetary policy is also not an issue here.

A serious general problem with the multiplier approach is that the distinction between real and nominal policy elements appears not to be very helpful. We know that monetarists in the tradition of Friedman and Schwartz, as well as more mainstream economists, who argued that nominal money shocks affect real activity, never conditioned their arguments on a specific set monetary policy instruments. A stylized review of actual monetary policy operating procedures also clearly shows that there is no clear-cut distinction possible between nominal and real components of monetary policy.
Although reserve requirements and discount rate changes are obvious examples of "real" elements in monetary policy, decisions on "nominal" elements such as the supply of base money and/or bank reserves affect the market for reserves and the money supply in ways that can also be accomplished by supposedly real changes. Open-market operations change the supply of reserves and influence money-market interest rates. The effect on the real interest rate may be only short-lived and disappears when an increased rate of inflation is incorporated into market expectations. But, at least for a period of time that is likely to be relevant for empirical analysis (e.g. with quarterly data), there might be a real effect of nominal policy actions. Whether real or nominal actions are used is primarily a matter of choice.

An important message linked to the proposed multiplier approach, and one that takes an increasingly important part in recent research, is that examinations of the causal relationships between money, monetary policy and business cycles require a careful analysis of how monetary policy is actually implemented. To examine the effects of monetary policy it is crucial to identify exogenous monetary policy actions. The assumption that monetary authorities actually closely control movements in money aggregates is certainly an oversimplification. This also applies to the broader spectrum of different interest rates. Such oversimplifications tend to hamper most empirical analyses of monetary policy, especially those using high frequency data. Our understanding would benefit substantially from an accurate identification of monetary policy changes and a more detailed analysis of the subsequent transmission mechanism. One important key to a better understanding of monetary relations is the market for bank reserves where the actual implementation of monetary policy takes place. (Important recent empirical studies in this direction are Bernanke and Blinder (1992), Gordon and Leeper (1994), and the narrative approaches reviewed in Boschen and Mills (1995)).
APPENDIX 4 DATA

1. The monetary base
The adjusted monetary base corrects the monetary base data for changes in reserve requirements. Several differences in adjustment procedures of a more or less practical nature, such as a simplification of reserve requirement structures or seasonal adjustment, are ignored here. In the U.S. the FRB of St.Louis calculates its adjusted monetary base using a constant base period reserve requirement structure. Staff of the Board of Governors of the Federal Reserve calculate an adjusted monetary base using the current reserve requirement structure. There is no a-priori reason to prefer one of these methods, but empirical results may be affected by the choice of reserve adjustment.

In the St. Louis procedure, the reserve adjustment magnitude (RAM) is constructed as
\[ \text{RAM}_t = (r_0 - r_t)' D_t, \]
where \( r \) denotes a (column) vector of reserve requirement ratios and \( D \) denotes a (column) vector of deposit types against which reserves must be held. Subscripts \( t \) and \( 0 \) denote a given time period and the base period. The adjusted monetary base equals the unadjusted base (called source base) plus the reserve adjustment magnitude, or \( \text{MB}_t = \text{SB}_t + \text{RAM}_t \).

The Federal Reserve Board updates historical reserve levels every time changes in reserve requirement ratios take place. The total reserves adjusted for reserve requirement changes (TRA) is constructed as
\[ \text{TRA}_{t-s} = r_t' D_{t-s} \left( r_t' D_t / r_{t-s}' D_{t-s} \right), \quad \text{for } s = 1, 2, 3, \ldots \]
Adding currency held by the non-bank public yields the Board's adjusted monetary base. The Board's counterpart to the St. Louis RAM can be written as \( \text{BAF}_{t-s} = (r_t - r_{t-s})' D_{t-s} \), where BAF is the base adjustment factor. BAF equals RAM if \( r_0 \) equals \( r_t \).

Monetary base series can be constructed in two ways. Which one is most useful depends on data availability. The source base equals currency plus current required reserves plus excess reserves: thus, \( \text{SB} = C + r_t' D + \text{ER} \), and \( \text{MB} = \text{SB} + \text{RAM} \) where \( \text{RAM} = (r_0 - r_t)' D \). Rearranging gives
1* \( \text{MB} = C + r_0 D + \text{ER} \): calculated reserve req. at fixed reserve ratios plus excess reserves
2* \( \text{MB} = \text{SB} + (r_0 - r_t)' D \): (changes in) reserve req. removed from the source base

2. Country details on reserve requirements and money aggregates
Germany: Since July 1948 German credit institutions are required to hold non-interest bearing deposits at the Bundesbank (before May 1957 the Bank Deutscher Länder). The exemption of institutions mainly engaged in long-term business and of building and loan associations was abolished January 1, 1984. Between 1978 and August 1, 1995 (part of) vault cash holdings could be deducted from deposit requirements. The major liability types subject to reserve requirements are sight deposits, time deposits and savings deposits. Different ratios apply to residents' and non-residents' deposits. The March 1977 revision introduced progressive reserve requirements for each deposit type (before, single reserve ratios were used depending on total deposit size and therefore the size of the bank). Maintenance period is one month (half-month overlap with accounting period) and reserves averaging is allowed.

M1: currency in circulation with the public, plus
domestic non-banks' sight deposits

M3: M1, plus
domestic non-banks' time deposits for less than 4 years, plus
domestic non-banks' savings deposits at 3 months' notice (before June 1993 at statutory notice).

MB: currency in circulation with the public, plus
0.166* residents' sight deposits subject to reserve requirements, plus
0.124* residents' term deposits subject to reserve requirements, plus
0.081* residents' savings deposits subject to reserve requirements, plus
banks domestic cash balances, plus
banks excess reserves
Note: Source is Datastream Bundesbank section with updates from Monthly Reports. MB deposit ratios are the January 1974 average reserve ratios used by the Bundesbank in its Central Bank Money Stock. Before 1960.12 deposit data are for residents+nonresidents due to data availability. Money series for West Germany are linked in 1990.06 to data for unified Germany.

Japan: Since September 1959 Japanese banks are required to hold non-interest bearing deposits at the Bank of Japan. Vault cash is not included. The major liability types subject to progressive reserve requirements are time deposits (incl. CDs), other deposits, and bank debentures of the long-term credit banks. Different ratios apply to residents’ and non-residents’ deposits, and domestic and foreign currency deposits. Maintenance period is one month (half-month overlap with accounting period) and reserves averaging is allowed.

M1: currency, plus demand deposits (IFS line 34)
M2+CDs: M1, plus quasi-money, plus CDs (IFS lines 34, 35, 36aa)
MB: currency in circulation with the public (IFS line 14a), plus
0.013* non-currency component of M1
0.012* non-M1 component of M2+CDs

Note: MB deposit ratios are highest ratios applicable to time deposits and other deposits effective October 1, 1991. Due to data availability MB ignores banks' excess reserves and vault cash; this makes it the Japanese equivalent of the German Central Bank Money Stock.

Netherlands: From 1954 until September 1969 a number of large commercial banks and other institutions accepted a voluntary scheme to hold a proportion of their short-term deposit liabilities on deposit with the Dutch central bank. The scheme was reactivated in selected months from 1972-1977. The scheme was largely superseded by the imposition of a liquid-asset reserve requirement from July 1973. A new cash reserve requirement scheme was introduced in July 1988. Its purpose is to create deliberate money-market shortages and to facilitate central bank control over interest rates. Maintenance period and reserve ratio are flexible, usually 2-3 weeks. Reserves averaging is not allowed. Occasional use turned into continuous use in March 1989. Since May 1989 these reserve deposits earn an interest rate equal to the average cost of central bank lending facilities.

M1: currency, plus demand deposits
M3: M1, plus
  domestic non-banks’ time deposits, plus
  domestic non-banks’ foreign currency deposits, plus
  domestic non-banks savings deposits
MB: currency in circulation, plus
  banks' cash balances, plus
  banks' central bank deposits, excluding
  cash-reserve deposit requirements

Note: Source is the Bank of the Netherlands data sheets and Quarterly Bulletin.

United Kingdom: Since the end of 1946, based on a gentlemen agreement, the large and dominating London Clearing banks (LCBs) were supposed to maintain a minimum 8 percent reserves ratio (vault cash plus deposits at the Bank of England) against total deposits. From September 1971 LCBs faced a voluntary 1.5 percent minimum deposit requirement against total eligible liabilities. Since August 1981 a special non-interest-bearing deposit requirement applies to all deposit-taking institutions (defined by the Banking Act 1979). Maintenance period is six months (no overlap with accounting period) and no reserves averaging is allowed.

M1: currency in circulation with M3 public,
  domestic private sector Sterling sight deposits (excl. 60 percent of transit items)
M3: M1, plus
  domestic non-banks’ Sterling time deposits (incl. CDs), plus
  domestic non-banks’ other currency deposits
Chapter 4

MB: currency in circulation, vault cash, and banks' operational deposits (M0), plus
banks' cash ratio deposits, plus
cash ratio reserve adjustment magnitude: (0.08 base period - current cash ratio)* eligible
liabilities

Note: Source is Bank of England Statistical Abstract and Quarterly Bulletin. Most recent data for
monthly reporting banks are linked in 1989.06 to series from money stock tables and in 1971.10 to
deposit data and eligible liabilities for London Clearing banks, Scottish banks and Northern Ireland
banks. Due to data availability public sector sight and time deposits are included in M3. Bank of
England M0 data are mid-month before 1969.07 and monthly average data since. MB excludes special
deposits and supplementary special deposits (zero reserve requirement).

United States: The Federal Reserve has used progressive reserve requirements, but before 1980 it
applied to member banks only. Before November 1980 the major liability types subject to reserve
requirements were net demand deposits, savings deposits, and other time deposits; since November
1980 these are net transaction deposits, and non-personal time deposits. Since end November 1960
(transition period from December 1959) all vault cash is again included in reserve holdings. Since
November 1972 the Federal Reserve no longer distinguishes between reserve city and country banks.
With the MCA 1980 (phase-in period ending September 1987) all depository institutions including
nonmember banks and thrift institutions became subject to Federal Reserve reserve requirements.
From September 1968 until February 1984, maintenance period was one week (two-week lag with
accounting period) with reserves averaging. Since February 1984, maintenance period is two weeks
(two-day lag, or 12-day overlap with accounting period) with reserves averaging.

Note: Money data M1, M2, and the St. Louis monetary base MB are from Citibase. M1 and M2 are
linked in 1959.01 to money data from Federal Reserve Bulletin December 1970.
CHAPTER 5

Bank credit in the transmission of monetary policy

5.1 INTRODUCTION

For modern industrial countries the usual starting point for a discussion of monetary transmission channels is the impact of monetary policy upon interest rates. Policy changes are transmitted from money market rates to aggregate demand through the following channels. First, increases in various interest rates reduce the expenditures of the private nonfinancial sector by raising the cost of obtaining funds. Second, the expenditures of the private nonfinancial sector are curbed by negative wealth effects as increases in various interest rates reduce the value of such assets as bonds, equities, and land. Third, interest rates affect the exchange rate and stimulate or restrain the economy by changing the international price competitiveness of domestic firms. These combined channels of monetary policy have become known as the "money view" of monetary policy. The term is perhaps somewhat unfortunate, but results from the fact that in traditional ISLM models monetary policy is seen to affect interest rates by changing money supply relative to money demand.¹

Recently, an alternative channel of monetary policy has (again) received increasing attention in the literature. The "credit view" emphasizes the impact of monetary policy on the amount and conditions of credit supplied by the banking sector. The theoretical premise is based on informational failures in the financial markets. Banks are credit institutions that specialize in project screening and develop long-term relationships with individual clients to overcome these informational failures. As a result, banks provide financing to worthy borrowers who perhaps would not otherwise have had access to external finance. Monetary policy actions that affect the loan supply behaviour of banks, either by inducing credit rationing or other mechanisms of price rationing, can alter the transmission of monetary policy: the speed and effectiveness of monetary policy can change, or the relative effects on different sectors in the economy can change.²

¹ Some unfortunate confusion might arise when the "money view" is identified with the monetarist approach to macroeconomics. This is not correct. For example, the monetarist model developed by Brunner and Meltzer (see for example, 1993) incorporates both "money" and "lending" views (see also Neumann, 1995).

² Romer and Romer (1990) provide a different perspective on money versus credit. In their view it is not a dichotomy between interest rate versus credit effects, but a different
Empirical testing of the credit channel is subject to a number of problems. The main difficulty is to solve the well-known "identification problem". Theory and evidence suggests that monetary policy is a main determinant of the supply of money and bank credit. It is however extremely difficult to distinguish whether changes in credit (and money) quantities and prices are due to changes in supply and that economic effects follow from these supply changes, or whether economic changes cause changes in the demand for credit and money. The main conclusion of this paper is that bank credit is unlikely to be an independent channel of monetary policy. Establishing bank credit as an additional, independent instrument requires that credit is quantity rationed. The evidence in the literature and the view that bank loan shocks (other than through monetary policy) appear frequently to be demand related suggest that bank credit, at least at the macro level, is not rationed. In general, credit market imperfections and the financial accelerator mechanism are in fact likely to affect the strength of monetary policy effects. However, it appears that much of the debate on a bank credit channel deals with second-order effects. Existing studies fail to separate the specialness of bank lending from the money-creating function of commercial banks. In practice, identifying and measuring the second-order effects is extremely difficult. Other than academic interest in transmission channels, nothing is lost, however, in the normal evaluation of monetary policy effects.

The paper proceeds as follows. The next section briefly reviews the relevant theoretical background concerning the bank credit channel for monetary policy. Section 3 discusses the existing literature and presents some additional empirical results for the role of bank loans in a set of four countries: the United States, Germany, the Netherlands and the United Kingdom. Section 4 reviews the issues and asks whether we will ever know and need to know the specialness of bank loans in the transmission of monetary policy. Section 5 contains concluding remarks.

5.2 THE SPECIALNESS OF BANK CREDIT

This section provides a brief review of the theoretical background concerning the specialness of bank credit and the existence of a bank credit channel for monetary policy.

5.2.1 Banks and the economics of imperfect information

Traditional macroeconomic analysis assumes that credit markets work reasonably smoothly and can usually be ignored. Important exceptions in the literature are the studies dealing with special circumstances such as the Great Depression (for example, Fisher, 1933; Bernanke, 1983) or episodes of "credit crunches" (for example, Wojnilowner, 1980). Recently, the economics of imperfect information and credit markets has gained a more prominent position in macroeconomic analysis. Approach to the source of interest rate changes. The money view is that a fall in bank reserves causes interest rates to rise because a lower supply of transaction deposits faces a stable demand for money. Imperfect substitution between different sources of credit is not a major problem. The lending view is that a fall in bank reserves causes interest rate to rise because a lower supply of bank loans faces a stable demand based on the uniqueness of bank credit. In this case, money is merely a financial asset with many close substitutes.
Much research effort is now being spent on examining whether credit markets and imperfect information play an important systematic role in macroeconomic fluctuations.

Financial intermediaries (such as banks, investment companies, pension funds, life insurance companies, brokers/dealers) specialize in gathering information, evaluating projects, and monitoring performance. If banks are able to create economies of specialization, economies of scale, or economies of scope, banks can play a special role in the process of credit creation.

But financial intermediation is not merely a matter of efficiency and low costs of obtaining credit. Akerlof (1970) showed that imperfect, asymmetric information affects the outcome of otherwise free and competitive markets. Asymmetric information between suppliers and demanders about the quality (and therefore price) of goods and services may result in a complete breakdown of markets, with absolutely no trading at all or only a limited amount of trading being accomplished. Establishing borrower creditworthiness is a prime example of asymmetric information. Without the means to establish the ability and inclination of a borrower to repay principal and interest at some future date, potential lenders are unlikely to entrust them with their savings.

Stiglitz and Weiss (1981) show that because banks cannot screen out bad borrowers sufficiently, interest rates are not necessarily the equilibrating mechanism in the credit market. Basically, the profits of a bank (? \( P \)) are a function of the spread between loan and deposit interest rates \( (i_L \) and \( i_D \)) earned on loans extended \( (L) \), after correction for the proportion of defaults on loan and interest payments \( (d) \) and bank overhead costs \( (O) \)

\[
\begin{align*}
? &= \{ (1-d)(1+i_L) - (1+i_D) \} L - O.
\end{align*}
\]

As interest rates rise, the riskiness of a bank's loan portfolio increases if relatively safe borrowers, unwilling to pay high rates, drop out of the loan market (the adverse selection problem). Additionally, borrowers who are willing to borrow at high interest rates may do so only because their probability of repayment is low (the moral hazard problem). With a riskier loan portfolio expected profits for the bank do not necessarily rise when interest rates are higher. On the contrary, expected profits could easily fall because \( \partial d / \partial i_L > 0 \). To avoid such a scenario, banks would choose not to use interest rates to equilibrate loan supply with loan demand but to ration borrowers instead by increasing minimum qualifications for loan applicants. Note, however, that even without the assumption of credit rationing, changes in the allocation of credit can affect the real economy. If bonds and bank loans are imperfect substitutes, shocks that reduce the supply of bank credit will reduce the economy-wide total amount of credit extended.

Because imperfect, asymmetric information problems are taken as an obvious fact of real life, there appears to be a broad consensus among economists on the idea that the interaction between risk, net worth, and the composition of financial balance sheets reduces the prospects for external finance. There is however much less consensus on whether this reflects shifts in supply or perhaps also shifts in demand. The case for a change in the supply of for example bank credit is evident from the previous discussion. It is also true however that uncertainty and balance sheet conditions affect the demand for external finance. Risk averse agents who face substantial costs of default or bankruptcy reduce the demand for external finance when uncertainty increases and/or when their balance sheets comprise relatively few liquid and relatively many illiquid assets. In the following discussion, identifying the
supply and demand changes proves to be the main problem in research on the credit channel.

5.2.2 Bank credit in the transmission of monetary policy

Table 1 displays stylized balance sheets of the two main constituents of the banking sector: the central bank and the commercial banks. The assets on the commercial banks' balance sheet are reserves (vault cash and deposits with the central bank), tradable securities (bills, bonds, shares), and nontradable bank loans. The liabilities consist of different types of deposits (demand and "time" deposits), in practice usually carrying different reserve requirements, and bank borrowing, including commercial banks' equity. Central bank assets consist of gold, foreign reserves and securities (public and/or private). The liabilities are reserves held by commercial banks and currency in circulation with the nonbank public.

Table 1  Simplified balance sheets of the banking sector

<table>
<thead>
<tr>
<th>Central bank</th>
<th>Commercial banks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td><strong>Liabilities</strong></td>
</tr>
<tr>
<td>Gold</td>
<td>Bank reserves</td>
</tr>
<tr>
<td>Foreign reserves</td>
<td>Currency w/public</td>
</tr>
<tr>
<td>Securities w/cbank</td>
<td>Loans</td>
</tr>
<tr>
<td></td>
<td>Demand deposits</td>
</tr>
<tr>
<td></td>
<td>Time deposits</td>
</tr>
<tr>
<td></td>
<td>Borrowing</td>
</tr>
</tbody>
</table>

At an operational level, monetary policy can be implemented in several ways, but the key element is always a change in bank reserves. For example, open market purchases of securities by the central bank increase bank reserves as well as demand deposits of the former holders of those securities. Similar interbank operations increase bank reserves and reduce bank holdings of securities. Discount window operations change bank reserves and bank borrowing. Each one of these operations changes the ratio between bank reserves and deposits, and bank reserves and loans. Theories of optimal portfolio selection suggest that the resulting situation requires a portfolio adjustment by the bank. Banks will increase their loans and securities.

Several necessary conditions must be present simultaneously for a bank credit channel of monetary policy to operate (Kashyap and Stein, 1994). First, monetary policy must be able to affect the total volume of bank intermediation. Reserve requirements (regulatory or voluntary) imposed on deposit liabilities are frequently invoked as an argument for monetary control. However, not all bank liabilities are subject to reserve requirements. Banks can borrow (CDs, equity, bonds, loans) to finance their credit intermediation activities. Even if bank credit is special, the leverage of monetary policy over banks' ability to lend may be limited (Romer and Romer, 1990). At some point, banks may choose to start to operate like many other credit intermediaries, for example finance companies. But still a limit on credit expansion will be reached when competition for alternative sources of funds raises interest rates and reduces demand for credit or when the risk of borrower default reaches a threshold and induces credit rationing.

A second element necessary for the credit channel to exist, is the link between the banks' total
volume of intermediation and the supply of bank loans. A necessary condition is that banks must view loans and securities as imperfect substitutes. Standard theory of the banking firm supports this view (see for example Baltensperger, 1980). A profit maximizing bank chooses its balance sheet structure knowing that loans provide a high return on their informational advantages and economies of scale and scope. However, because loans are highly illiquid assets, banks operating with uncertainty also hold marketable securities with a somewhat lower return but higher liquidity. In general, in response to a change in circumstances, banks may reduce their holdings of government and private securities to protect their loan portfolio. In fact, precisely because banks hold securities in part for their liquidity, some degree of insulation is very likely (Bernanke and Blinder, 1992).

Third, on a macroeconomic level the bank credit channel depends crucially on the "uniqueness" of banks as providers of funds for a significant number of borrowers. This requires that alternative sources of financing (private bond and stock markets, international credit markets, commercial paper, selling liquid assets) are not readily available or that their substitutability with bank loans is very limited. In these circumstances, a credit squeeze results from quantity rationing or increases in the spread between lending rates and market interest rates. A particularly important question is how much banks differ from other financial intermediaries. Firstly, it is one thing to believe that certain firms are dependent on the services of financial intermediaries because they have no or only limited access to capital markets. It is quite another to believe that these firms fully depend on bank credit. Banks are only one in a range of possible credit intermediaries. Secondly, although on a microeconomic level certain firms may be identified that depend on bank credit, their macroeconomic importance may be small and the credit not provided to this group of firms may be channelled to other worthy borrowers instead.

5.3 THE EMPIRICAL EVIDENCE

5.3.1 The evidence on credit market imperfections in the existing literature
The intensity of the debate and research on money versus credit shows cycles. Historically, the debate can be traced as far back as the currency versus bullionist controversy (see for example Humphrey, 1988). A next phase of high interest is associated with the writings of Gurley and Shaw (1955, 1960), the 1959 Radcliffe Report on U.K. monetary policy, and the Commission on Money and Credit in the United States. The current phase can be identified with the work of Wojnilowner (1980), Benjamin Friedman (1982, 1983), and Bernanke (1983, 1986). In this review of the evidence in the existing literature I follow recent surveys of the same literature such as Bernanke (1993), Gertler and Gilchrist (1993), Kashyap and Stein (1994), Bernanke and Gertler (1995), Hubbard (1995). However, contrary to these surveys, this review is somewhat more critical of the existing evidence that is presented to suggest a bank lending or credit channel. Many of the empirical results can easily be interpreted in alternative ways.

(i) The time series approach to money and credit
Most of the earlier empirical work on the bank credit channel focused on the correlations between aggregate output, bank assets and liabilities, and indicators of monetary policy. Bernanke and Blinder
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(1992) showed that following a contraction in monetary policy, measured as a change in the federal funds rate, securities held by banks and deposits decline in the first nine months whereas loans change very little. Subsequently, however, security holdings recover while loans fall.\(^3\) The fall in loans coincides with a rise in the unemployment rate. Romer and Romer (1990) obtained similar results although they focus on specific exogenous policy actions, i.e. they examine the behaviour of money and credit following specific episodes of monetary tightening linked to anti-inflation policy.

The true causal relationships between movements in money, credit, and economic activity are very difficult to establish, but several studies have examined whether movements in bank loans or credit systematically precede movements in economic activity (Granger-causality) and/or whether credit aggregates outperform money aggregates in forecasting ability.\(^4\) Campbell (1978), Batavia and Lash (1982), King (1986) and Ramey (1993) found little support for these hypotheses. Generally, these studies show that once the monetary variable is included credit variables no longer contribute to the explanation of movements in output following a change in monetary policy. The results suggest that the bank credit channel can represent only a minor contribution to our understanding of monetary transmission mechanisms. On the other hand, Bernanke (1986), Lown (1988, 1990) found that movements in bank credit precede changes in economic activity. Kahn (1991) examined the relationship between money and bank loans in the U.S. It appears that the evidence for the relationship between money and bank loans is dominated by several large swings in growth rates. Given the banks' balance sheet constraint, such a relationship is hardly surprising. Historically, money growth appears to lead bank loan growth by about 1 year, but Kahn found no statistically significant relationship in the second half of his sample period (1982-1991). Robinson (1993) examined the relationship between money and bank loans in a model also including income and the federal funds rate. The results show that both money and loans are systematically predicted by the federal funds rate. The relationships between shocks to money and loans, however, are not stable with respect to subsamples.

(ii) Direct evidence on nonprice credit rationing

One problem with the time series approach to money and credit is that the balance sheet identity requires that changes in bank assets (loans and securities) equal changes in bank liabilities (deposits and borrowing). Thus, money aggregates and bank credit are two sides of the same balance sheet and cannot be regarded as completely independent variables. Furthermore, evidence that output and bank loans fall after a monetary tightening cannot help identify whether the decline in loan volume reflects a restriction of loan supply (i.e. the bank lending channel), or a decrease in loan demand through traditional mechanisms.

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\(^3\) Cecchetti (1995) shows that the differences between loan and security responses to monetary policy shocks are not significant, and the impulse responses shown in his figure 4 are clearly much less pronounced. Cecchetti's data sample 1959-90 is longer than Bernanke and Blinder's 1959-78 perhaps suggesting that recent changes in the banking and financial markets affect the results.

\(^4\) Several earlier studies examined bank credit measured as the sum of bank loans and investments (see Radecki 1990). If banks are special it is because of the supply of bank loans, not the purchase of marketable securities.
The problem of identifying loan demand and supply effects disappears when independent evidence is available to show that banks apply nonprice credit rationing to their customers. Nonprice credit rationing must be defined as the situation where, at current interest rates, creditworthy borrowers are denied credit even when they are demonstrably able and willing to pay a higher rate of interest. In other words, the situation of nonprice credit rationing is characterized by persistent excess demand for credit and a failure of interest rates to adjust to clear the market. Several studies have examined credit rationing through the role of non-interest terms of loan contracts. This evidence is inconclusive however because collateral, compensating balances, loan maturity, etc. can equally be seen as part of a broader measure of the cost of bank credit. Alternatively, increases in collateral, shorter loan maturities, etc. may also signal responses of banks to changes in perceived riskiness of their customers (compare Baltensperger, 1978).

Another approach to examine credit rationing is to estimate demand and supply schedules for bank loans. King (1986) estimated that loan supply is positively related to the volume of deposits, suggesting that banks are liquidity constrained. He also estimated that the loan market is dominated by periods of excess demand (i.e. estimated demand exceeded actual loans in 63 out of 99 observations). On the other hand, however, the estimated loan supply schedule is also upward sloping with respect to the loan rate. This contradicts the hypothesis of credit rationing. It is also unclear whether perhaps the estimates of excess demand fall within normal standard errors of the estimated equations.

Berger and Udell (1992) examined the evidence for sluggish adjustment of bank loan rates. Details of individual loan contracts show that about half of the sluggish adjustment resulted from prior commitments that set the loan rate. In general, rate stickiness for loans under commitment cannot be associated with credit rationing because commitment contracts preclude rationing. Also note that competitive pressures (e.g. follower-leader problems in game theoretic models), confusion about temporary vs. permanent shocks, etc. can cause sluggish adjustment, particularly in markets characterized more by price setting than auction-based prices.

Lown (1990), Sofianos, Wachtel and Melnik (1990), Morgan (1992) examined the evidence on credit rationing with loan commitment data. Under a loan commitment agreement, a bank promises to issue a borrower a loan up to an agreed amount as long as the borrower satisfies the terms of the contract. Because rationing can only affect firms that do not have such agreements, the percentage of total loans made under commitments should increase in periods of tight credit. Lown (1990) found that the percentage of new loans made under commitment has a significant negative relationship with real output. Hirtle (1990) found that noncommitment loans appear to (weakly) Granger cause output, whereas commitment loans do not. Morgan (1992) confirmed that loans made under commitment track movements in economic activity. Loans not made under loan commitments begin to fall relatively quickly, responding as fast and as sharp as monetary aggregates in response to movements in monetary policy. One aspect that does need an answer is whether the loan commitment evidence is not a reflection of the large firm - small firm effect (see below). Are large firms more likely to have arranged bank loan commitments than small firms? Avery and Berger (1988) and Berger and Udell (1992) argue that commitment loans are usually available to higher quality, less risky borrowers. They find it unlikely that these borrowers would be rationed in the spot loan market or the capital market. Furthermore, contrary to previous results, Berger and Udell (1992) found that the proportion of new loans extended under previous commitments does not rise when credit markets are tight. Their dataset
suggests that the number of all types of commercial loans tends to increase, including noncommitment
loans. Morris and Sellon (1995) point out that loan commitments exhibit an upward trend. Consequently, there is a tendency to find an increase in loan commitments in any period, including
periods of tight monetary policy, at least since the mid-1970s. After eliminating trending behaviour, there is no evidence that loan commitments rise following tight monetary policy.

(iii) Large firms, small firms and access to alternative sources of credit
Kashyap, Stein and Wilcox (1993) approached the loan demand and supply identification problem by
examining the relative movements in bank loans and commercial paper. The intuition is as follows: if
the demand for credit is the underlying cause this would affect all types of finance, while a monetary
shock that operates through a bank credit channel affects only the supply of bank debt. A forced shift
towards commercial paper after a reduction in bank credit supply can also explain why the increase in
the spread between commercial paper rates and Treasury bill rates forecasts economic activity (see
Bernanke, 1990; Friedman and Kuttner, 1993). But Oliner and Rudebusch (1993), Gertler and Gilchrist
(1993) show that the decline in the aggregate bank loan to commercial paper ratio is not conclusive
evidence of a bank credit channel. They find that a monetary contraction causes a shift of all types of
external financing towards large firms. Whereas bank loans to small businesses fall (as well as loans to
consumers and loans for real estate), loans to large firms actually increase so that total bank loans to
businesses do not change after a monetary contraction. One reason why the overall bank share in
external finance declines is that large firms rely less heavily on bank debt than do small firms. Once
firm size is taken into account the mix of financing is left unaffected. With respect to interest rates
Kashyap, Stein and Wilcox (1993) and Romer and Romer (1993) show that the spread between the
prime rate on bank loans and the commercial paper rate increases after a monetary contraction. Thus,
large firms with good credit ratings would have an incentive to replace costly bank finance with
commercial paper. (Note that bank CD rates move very closely with commercial paper rates and both
appear to rise relative to TBill rates during times of tight monetary policy.) In this case the increased
use of commercial paper reflects a demand effect that results from relative price changes rather than
a supply effect through nonprice credit rationing. The alternative interpretation of the increase in the
CP-TBill spread can be a cyclical increase in the risk premium for commercial loans, or a term

5 Freedman (1993, p.124) argues that the dynamic pattern of the prime-CP rate spread
has been misconstrued. After adding the contemporaneous change in the policy variable
(e.g. federal funds rate), the initial response of the prime-CP spread is negative, because
the bank prime rate is sluggish. The initial negative effect on the spread from a rise in
interest rates is then gradually reversed (assumedly by an increase in the prime rate) with
a very small and insignificant steady state result for the spread.

6 A problem with the risk-premium explanation is that default by issuers of prime
commercial paper is rare. Also, other measures of default risk do not provide similar
predictive power for economic activity. In order to exclude the risk premium would be
interesting to examine the spread between commercial paper and bank loan rates. There
exists however a serious data problem because the "true" price of bank loans is imperfectly
observable as a result of the widespread use of non-price terms of the credit (i.e.
covenants, collateral, quantity rationing, etc.).
structure effect\(^7\).

The empirical evidence appears to indicate that a monetary contraction causes a re-shuffling of all credit lines as banks attempt to move liabilities off their balance sheet and bank customers search for the best source of low cost finance. Note that a reduction of bank loans does not eliminate banks as an important participant in the credit markets. Post (1992) documents that commercial paper issues must be supported by a backup source of liquidity; generally a bank line of credit or a standby letter of credit. Indirectly, commercial paper remains a liability for banks, albeit one that does not appear on their balance sheets. Also note that small firms may protect their operations from a decline in bank loans by turning to an increased use of trade credit provided by larger firms (an option suggested by Meltzer, 1960). Calomiris, Himmelberg and Wachtel (1995) present evidence that accounts receivable for CP-issuing firms rise, possibly to finance trade credit to smaller firms. Supporting evidence is found in Gertler and Gilchrist (1994), Eichenbaum (1994) who show that total indebtedness (bank loans, commercial paper, and "other" debt) of small firms initially rises after monetary tightening.

Gertler and Gilchrist (1994) show that after some time small firms reduce both their inventories and their short debt positions in line with a fall in sales. Large firms on the other hand do not. One possible explanation is that large firms do not face the credit constraints that small firms do. Friedman and Kuttner (1993) argue that reduced cash flows from an (expected) economic downturn and inventory accumulation create a financing deficit for firms. This argument requires that it is the optimal response of firms facing adverse economic conditions and declining sales to maintain production at a high level and build inventories. However, the desire to reduce inventory and production as a result of financing costs, uncertainty and risk aversion may very well counterbalance the usual argument of high costs of adjusting production. The alternative hypothesis is then that small firms are perhaps able to respond more flexibly to changes in economic conditions. Through adjustments in production, employment and inventories, small businesses are possibly more able than large firms to reduce their demand for bank credit. A second alternative hypothesis is that the size distribution of firms differs between industries. Small firms could be concentrated in cyclically sensitive industries.

The results on inventory behaviour following monetary policy actions are linked to many studies on the "excessive" sensitivity of business investments to cash flows. Using firm level data, Fazzari, Hubbard and Petersen (1988) found that U.S. firms that do not pay dividends are more sensitive to cash flows and liquidity. Gertler and Hubbard (1988) show that this applies to tight monetary episodes. In support, Kashyap, Lamont and Stein (1994) find that companies without a bond rating exhibit more sensitivity of inventory investment to liquidity positions. Hoshi, Kashyap and Scharfstein (1991) find that Japanese firms not belonging to bank-centered industrial groups exhibit greater sensitivity of investment to cash flows. The usual interpretation of the "excess sensitivity" results is that a portion of firms faces credit constraints. However, Gilchrist and Himmelberg (1993) show that even for high-dividend firms cash flow appears to have explanatory power for investment

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\(^7\) If maturities are not carefully matched, a rise in the spread (typically 6mth CP and 3mth TBill) may also represent a term structure effect (Freedman 1993, p.125). Monetary policy changes are usually implemented in small steps. The longer term rate may rise more because of the expectation of further monetary tightening in the near future.
(beyond its role as a projection of future profitability) although in general high-dividend firms are not assumed to be credit constrained.

(iv) Banks facing capital and credit constraints
Kashyap and Stein (1995) find that following a monetary contraction the total quantity of loans held by small banks falls while that of large banks does not. They interpreted this result as evidence that banks are themselves subject to credit constraints caused by capital market imperfections. However, it is also possible that this phenomenon is a just another demonstration of the large and small firm effect. Ellliehausen and Wolken (1990) show that smaller firms tend to do business with local and therefore generally smaller banks. Angeloni, et al. (1995) show for Italy that there is the tendency for large banks to specialize in large loans/firms and for small banks to lend to small firms. Rondi et al. (1993) already found that also in Italy small firms experience larger drops in sales, inventories, and in bank and trade debt than large firms.

Peek and Rosengren (1995) find that during the 1990-91 recession banks in the U.S. state of New England that were poorly capitalized shrunk more than equivalent institutions with higher net worth. The implication would be that capital market imperfections also apply to banks, because banks cannot (or at least do not) raise the required additional funds, either through increased deposit rates or through more (interbank) borrowing, to avoid balance sheet shrinking. However, there is a different explanation. The behavioural model used by Peek and Rosengren shows that banks shrink when certain risk parameters change. For example, banks' balance sheets shrink when the perceived loss ratio for bank loans increases (reducing the net return to the bank) and when poorly capitalized banks must pay a risk premium for deposits or borrowing. The latter possibilities are normal equilibrium effects and not related to market failure in terms of nonprice credit or capital constraints. (For a more extensive review of these studies see Sharpe, 1995).

5.3.2 Some additional cross-country evidence on monetary policy and bank loans
This section has basically two objectives. First, to examine the transmission of monetary policy shocks through the banking sector balance sheet. Second, to provide some further evidence on the importance of bank loans as a causal factor for economic activity.

Although the time series approach is well-known to be very limited, it is frequently useful to provide a cross-country perspective on the empirical results. Here the results are for four countries: Germany, the Netherlands, United Kingdom, and United States. Most monthly and quarterly data on bank deposits, bank loans, bank securities, economic activity and prices are for the period 1957-1993. The data appendix provides more specific information on data definitions and sources. In addition to the cross-country perspective, sensitivity to sample periods is examined in a subsample which covers the period since 1977. Choosing the sample splitting date is always somewhat arbitrary and the subsample results should be viewed foremost as a robustness check. However, the recent sample contains most of the experience in the present more deregulated financial systems.

Tables 2 and 3 provide evidence on the empirical relationship between monetary policy, bank lending and money growth. The individual equations were estimated using quarterly data. Following Bernanke and Blinder (1992) and others, the short-term interest rate (call money or TBill) is taken to be the indicator of monetary policy. Money is defined alternatively as M1 and M2/M3. Nominal
income is included to capture changes in demand.

Probably the first most important result to be examined is the response of money growth and bank lending to changes in monetary policy stance. Tables 2 and 3 show that bank loans are significantly related to the interest rate (note here that significance is determined by the inclusion in the equation based on the FPE criterion, not by the statistics on significance of the long-run effect), except in the post-1977 sample for the U.K. The interest rate is significant in explaining M1 growth in all countries (table 2), both in the full sample and the post-1977 subsample. The interest rate does not always significantly explain movements in the broader M2/M3 aggregates (table 3): in the United Kingdom not at all, in Germany not in the most recent period, and in the Netherlands not in the pre-1977 data. The sum of the lagged coefficients provides evidence on the likely long-run effects of a permanent change in the interest rate.\(^8\) A pattern in the results for M1, and to a minor extent for M2/M3, is that the (long-run) interest rate effect is larger and more significant in the post-1977 samples.\(^9\) Note that, in contrast, the interest rate effect on loans is generally smaller in the post-1977 samples.

\(^8\) It is important to note that for a given growth rate of nominal income, a hypothetical permanent change in the nominal rate can be seen as a change in the real interest rate. This depends on the assumption that the growth rate of nominal income acts as a sufficient proxy for expected inflation.

\(^9\) A problematic result is the significantly positive long-run response of U.S. M2 to a permanent change in the interest rate in the post-1977 sample. This may merely represent a small sample bias. It is related to findings by other researchers of a "price puzzle" (the observation that restrictive monetary policy is followed by a rise in the price level). The consensus view of this "puzzle" today is that the central bank probably responds to information about future prices, etc., but succeeds in only partially offsetting undesirable developments.
**Table 2**  Relationships between monetary policy, bank loans and M1

A search procedure using the final prediction error criterion was used to determine whether or not and with how many lags to include a variable in the estimated equation. For each explanatory variable the table presents the sum of the lagged coefficients and its t-statistic, the number of lags is in square brackets. The FPE values (not shown) are taken as the measure of significance. OLS estimates of individual equations.

<table>
<thead>
<tr>
<th>independent variable</th>
<th>dependent variable</th>
<th>M1</th>
<th>LOANS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>sum coeff.</td>
<td>lags</td>
</tr>
<tr>
<td>Germany 1962-1989</td>
<td>M1</td>
<td>0.016 (0.17)</td>
<td>[1]</td>
</tr>
<tr>
<td></td>
<td>LOANS</td>
<td>--</td>
<td>0.908 (12.9)</td>
</tr>
<tr>
<td></td>
<td>INCOME</td>
<td>0.180 (2.10)</td>
<td>[1]</td>
</tr>
<tr>
<td></td>
<td>IST</td>
<td>-0.296 (1.43)</td>
<td>[2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.102</td>
<td>[1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.73)</td>
<td>[6]</td>
</tr>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>-1.263</td>
<td>[2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.89)</td>
<td>[4]</td>
</tr>
<tr>
<td>Netherlands 1959-1993</td>
<td>M1</td>
<td>-0.220</td>
<td>[8]</td>
</tr>
<tr>
<td></td>
<td>LOANS</td>
<td>(0.78)</td>
<td>0.770 (10.9)</td>
</tr>
<tr>
<td></td>
<td>INCOME</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>IST</td>
<td>0.707 (3.55)</td>
<td>[3]</td>
</tr>
<tr>
<td></td>
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<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.164)</td>
<td>(0.60)</td>
</tr>
<tr>
<td>United Kingdom 1959-1993</td>
<td>M1</td>
<td>0.833 (11.3)</td>
<td>[6]</td>
</tr>
<tr>
<td></td>
<td>LOANS</td>
<td>--</td>
<td>0.709 (6.25)</td>
</tr>
<tr>
<td></td>
<td>INCOME</td>
<td>0.193 (2.71)</td>
<td>[2]</td>
</tr>
<tr>
<td></td>
<td>IST</td>
<td>-0.032 (0.26)</td>
<td>[6]</td>
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</tr>
<tr>
<td>United States 1959-1993</td>
<td>M1</td>
<td>0.810 (9.64)</td>
<td>[7]</td>
</tr>
<tr>
<td></td>
<td>LOANS</td>
<td>--</td>
<td>0.729 (12.5)</td>
</tr>
<tr>
<td></td>
<td>INCOME</td>
<td>0.102 (0.84)</td>
<td>[7]</td>
</tr>
<tr>
<td></td>
<td>IST</td>
<td>-0.035 (0.44)</td>
<td>[2]</td>
</tr>
<tr>
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</tbody>
</table>

**Notes:** All variables except interest rates are quarterly log growth rates. Variables M1, LOANS, INCOME, and IST denote M1 money aggregate, bank loans to the private sector, nominal GNP/GDP, and money-market interest rate. The German sample is truncated at the end of 1989 to avoid distortion from unification.
A search procedure using the final prediction error criterion was used to determine whether or not and with how many lags to include a variable in the estimated equation. For each explanatory variable the table presents the sum of the lagged coefficients and its t-statistic, the number of lags is in square brackets. The FPE values (not shown) are taken as the measure of significance.

<table>
<thead>
<tr>
<th>dependent variable</th>
<th>M2/M3</th>
<th>LOANS</th>
<th>M2/M3</th>
<th>LOANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>independent variable</td>
<td>sum coeff. (t-value)</td>
<td>lags</td>
<td>sum coeff. (t-value)</td>
<td>lags</td>
</tr>
<tr>
<td></td>
<td>LOANS</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>INCOME</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>BT</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Netherlands 1959-1993</td>
<td>M3</td>
<td>0.502 (3.71)</td>
<td>[8]</td>
<td>0.294 (1.90)</td>
</tr>
<tr>
<td></td>
<td>LOANS</td>
<td>--</td>
<td>0.675 (7.86)</td>
<td>[8]</td>
</tr>
<tr>
<td></td>
<td>INCOME</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>BT</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>United Kingdom 1959-1993</td>
<td>M3</td>
<td>0.818 (7.18)</td>
<td>[8]</td>
<td>0.648 (2.93)</td>
</tr>
<tr>
<td></td>
<td>LOANS</td>
<td>--</td>
<td>0.427 (3.21)</td>
<td>[4]</td>
</tr>
<tr>
<td></td>
<td>INCOME</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>BT</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>United States 1959-1993</td>
<td>M2</td>
<td>0.808 (8.94)</td>
<td>[5]</td>
<td>0.550 (4.84)</td>
</tr>
<tr>
<td></td>
<td>LOANS</td>
<td>--</td>
<td>0.655 (11.2)</td>
<td>[1]</td>
</tr>
<tr>
<td></td>
<td>INCOME</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>BT</td>
<td>--</td>
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</tr>
</tbody>
</table>

Notes: see table 2.

An interesting question is also whether money and bank loans are related when the monetary policy impulse variable is held constant. One strand in the literature argues that bank loans represent the more crucial financial variable, and that money growth is merely a derivative of credit growth. The results are, however, mixed and difficult to interpret. Loans directly affect particular money aggregates in Germany and the U.K. (M1 in the post-1977 sample, M3 before 1977), but not in the U.S. and the
Netherlands. In all countries money was clearly a significant influence on bank loans before 1977. But only broad money M2/M3 in the U.K. and the U.S. still affects bank loans after 1977.\footnote{It is difficult to say to what extent these results are affected by changes in the link between the supply of reserves and deposits and deposits and loans, or by changes in financial markets that have removed some constraints on funding loan growth from nondeposit sources.}

Figures 1 and 2 show in more detail the dynamic effects of monetary policy on bank balance sheets. These graphs are in the spirit of Bernanke and Blinder (1992) and show the 48-month impulse responses to a shock in the interest rate. The impulse responses are calculated from six-variable VARs that include log industrial production, the 12-month log change in the consumer price index, a short-term interest rate as the indicator of monetary policy, log real bank loans to the private sector, log real non-currency component of the broad money aggregates M2/M3, and log real securities held by banks. The three bank balance-sheet variables were deflated by the CPI.

Deposits and/or securities are evidently the first portfolio components that react to a tightening of monetary policy. Bank loans to the private sector are temporarily protected from falling but do fall eventually (note however that significance levels of the responses are missing). The time period associated with loan adjustment differs notably between the U.S. and Germany on the one hand and the Netherlands and the U.K. on the other hand. Banks in the U.K. and the Netherlands protect their loan portfolio for approximately 14 and 20 months, against 4-8 months for the U.S. and Germany.

Figure 2 provides some evidence on the adjustment of bank balance sheets in the more recent period, when banks operated in a more deregulated and more sophisticated financial market environment. There are a few noteworthy changes in responses. First, in the U.S. banks’ responses to interest rate shocks are generally somewhat smaller in the most recent period. In Germany much more of the shock is transferred to banks’ securities. In the Netherlands, loans decline much earlier and banks show more eagerness to rebuild their securities portfolios on short notice. Finally, in the U.K. banks apparently succeed in fully shielding loans to the private sector from tight monetary policy.

Figure 3 provides the impulse response functions of economic activity with respect to tighter monetary policy. The interesting experiment here is to examine whether across countries differences in bank balance sheet adjustments are reflected in corresponding differences in the response of the real economy. Note that in the U.S. bank loans and economic activity tend to follow similar time paths. It has been suggested that this signals a strong link between bank loans and the economy, albeit without clear cut proof of the direction of causality. Note also however, that in the Netherlands and the U.K. the fact that banks are able to protect their loans from falling does not prevent a very quick decline in industrial production after a rise in interest rates. Apparently the link between economic activity and bank loans is not very strong in a cross-country perspective. Similar examples are found in the post-1977 data.
Figure 1  Banks' balance sheet adjustments after an interest rate shock

Notes: The impulse responses are calculated from six-variable VARs that include log industrial production, the 12-month log change in the consumer price index, a short-term interest rate as the indicator of monetary policy, log real bank loans to the private sector, log real non-currency component of the broad money aggregates M2/M3, and log real securities held by banks. The three bank balance-sheet variables were deflated by the CPI. A final prediction error search procedure was used to determine whether or not to include a variable, with a maximum of 12 lags.
Figure 2  Banks' balance sheet adjustments after an interest rate shock, post-1977 subsample

Notes: See figure 1.
Figure 3  Response of industrial production to interest rate shocks

(a) full sample

(b) post-1977 subsample

Notes: See figure 1.
The final piece of evidence from the estimated VARs is whether bank loans are likely sources of independent effects in business cycles. Starting point is the assumption that the supply of bank loans may be rationed and economic activity is constrained by a lack of credit. If bank loans are in fact rationed, positive loan shocks increase supply and should lead to an increase in economic activity. Figure 4 shows the responses of industrial production to a positive bank loan shock. These results do not appear to provide very much support for the loan rationing hypothesis. Only the U.K. sample shows a strong positive response. The German and U.S. data are more consistent with a positive demand shock in anticipation of worsening economic conditions. In the Netherlands, there is no significant response at all.

**Figure 4** Response of industrial production to loan shock

Notes: See figure 1.

5.4 THE SPECIALNESS OF BANK CREDIT (II): WILL WE EVER KNOW, AND HOW MUCH DOES IT MATTER?

The recent increase in research on a credit channel for monetary policy can be attributed to four main motives. The first motive follows from the desire to develop additional instruments of monetary policy, to be used in addition to the traditional instruments of money supply or interest rates. A bank credit channel might allow central bank actions to affect the real spending of borrowers directly. The
objective would be to improve the trade-off between inflation and output objectives, or exchange rate and domestic economic objectives. Of course, this concept of direct credit controls is reminiscent of some old ideas widely used in many countries until the late 1970s. The experiments with direct credit controls have been abandoned because they distort competition between financial institutions and are generally very difficult to enforce.

The second motive results from the observation that financial deregulation and innovations have reduced the share of bank credit in the total amount of funds available to the private sector (for the U.S. see for example Edwards, 1993; Gorton and Pennacchi, 1993). If the economic effect of monetary policy depends on the leverage that the central bank has on the lending behaviour of commercial banks, monetary policy may be in danger of losing its effectiveness (Thornton, 1994; Cecchetti, 1995). At the same time, some authors have argued that financial deregulation, innovations and global integration of financial markets tend to reduce the influence of central banks on market interest rates. Thus, there exists a fear that while a decreasing factor in funding the private sector, central banks may increasingly have to rely on the bank credit channel to affect the economy.

The third motive for examining the credit channel is to develop a (more) reliable information variable for monetary policy. The experience in many countries is, that the short-run relationship between money aggregates and the economy tends to break down from time to time. If the credit channel is important, (bank) credit aggregates may be more reliable indicators of monetary policy effects than money aggregates (for example, Friedman 1983). Changes in the way banks create deposit money (their portfolio mix of securities and loans) may provide useful complementary information on the relationship between money and the economy.

The fourth use of evidence on a credit channel is to strengthen the case for the proposition that monetary policy affects the real economy. Despite a large body of statistical evidence in favour of (short-term) real effects of monetary policy, the transmission mechanisms remain unclear. It has remained a somewhat troublesome proposition that relatively small changes in (real) interest rates cause such pronounced effects on investment, consumer expenditure, etc. (Bernanke and Gertler, 1995). Bernanke and Blinder (1988), Greenwald and Stiglitz (1990) show how interaction with bank credit increases the real effect of monetary policy, while at the same time mitigating the effect on market interest rates. Gertler and Hubbard (1988) and Bernanke, Gertler and Gilchrist (1994) argue the case for a general "financial accelerator".

Of the four motives to examine the bank credit channel, both the first and the second require that (bank) credit rationing exists. But the direct and indirect evidence on credit rationing by banks appears to be negative. The micro evidence that does suggest credit rationing exists for some

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11 Alternative evidence provided by Kashyap and Stein (1994, table 7.1) show that there is no declining role of bank credit for manufacturing firms. Bank debt as a percentage of total debt of manufacturing firms was 34.4 percent in 1973 and 33.0 percent in 1991. There have been changes in the composition of bank debt: shifts between short-term and long-term debt, and between large, medium and small firms.

12 Examples of the possible usefulness of information on credit market problems are the failures of banks and savings and loan associations in the U.S. during the 1980s, the so-called credit and capital crunch around 1990, and the recent behaviour of Japanese banks facing large losses from bad loans.
borrowers is insufficient evidence that rationing also exists on a macro level and has large effects. It must be proved that resources denied to one section of borrowers (e.g., small firms) is not channelled to alternative borrowers (e.g., large firms). Furthermore, it must be shown that funds unavailable from one category of credit suppliers (e.g., banks) are not provided by alternative suppliers (e.g., finance companies). The third motive requires a stable relationship between changes in (bank) credit and the economy. But the empirical evidence (for example, Friedman, 1988) is that credit and money aggregates share similar breaks and volatility in their relationships with the economy.

Elimination of motives one, two, and three leaves us with just the motive to increase our general understanding of the transmission of monetary policy effects. At this stage, it is useful to distinguish between two versions of the credit view (see Gertler and Gilchrist, 1993). According to the pure credit view, monetary policy works by and large because it directly regulates the flow of bank credit (monetary aggregates are assumed to be largely unimportant variables, see for example Stiglitz, 1989). The pure credit view is thus very pessimistic about the short-term real effects of monetary policy when financial deregulation and innovation diminish the role of bank credit in the economy. A related but different interpretation of the credit view of monetary policy is that credit market frictions are part of a more general financial propagation mechanism. A reduction in bank credit as a response to a tight monetary policy enhances the overall impact of the shock. Credit market imperfections act as a "financial accelerator" because investment and aggregate demand fall by more than through only the effects of conventional channels (Gertler, 1988; Gertler and Hubbard, 1988; Bernanke and Gertler, 1989; Bernanke, Gertler and Gilchrist, 1994). In this view monetary policy need not become impotent when the bank credit channel is limited or even absent.

(i) the identification of demand and supply

The most sophisticated empirical studies, using micro panel data, and the simple fact that credit intermediaries exist, appear to suggest that there are credit market imperfections. These studies also suggest that the effects are particularly apparent during periods of tight monetary policy. However, whether the bank credit channel is an important part of the aggregate monetary transmission remains questionable. We are simply unable to trace the effects of a credit supply shock. In the absence of effective credit rationing it is very problematic to separate shifts in loan demand and in loan supply. It may be that a decline in economic activity that follows a contraction in monetary policy leads to an erosion of the value of (small) firms' collateral. In a world of information and/or agency problems, such a "collateral shock" will make it harder for these firms to raise external financing of any sort. At the same time, it is also possible to argue that firms may wish themselves to avoid external finance.

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13 It does not automatically follow that redistribution effects have large macroeconomic consequences.

14 It does not automatically follow that the higher costs of funds due to less efficient intermediation are excessively prohibitive.

15 Note that this line of argument is complicated. Wealth effects from changes in interest rates are usually considered a component of the traditional analysis! The credit market imperfections approach depends on unfavourable developments in the composition of balance sheets, but for a given level of net wealth.
Risk averse agents who face substantial costs of default or bankruptcy reduce their use of bonds and loans when uncertainty increases and/or when their balance sheets comprise very few liquid and relatively many illiquid assets. In general, the appearance of increased liquidity constraints may not reflect an inward shift of just bank loan supply (the bank lending channel), but a more general deterioration of creditworthiness.

(ii) the identification of money and bank credit

Research on the bank credit channel is also complicated by the fact that money and credit are two sides of one banking sector balance sheet. To examine the issue of a bank credit channel for monetary policy, the crucial question is how to distinguish between money and bank credit effects on economic activity. First, note that bank credit, as the main source of the expansion of deposit money in modern fractional-reserve banking systems, consists of bank holdings of tradable securities, loans to the government and loans to the private sector. The money view of the transmission of monetary policy posits that, as a first approximation, the composition of bank credit is not important but only its total volume which is correlated with deposit money. The credit view of the transmission of monetary policy argues that bank loans to the private sector are special.

Consider the following two hypothetical experiments to distinguish the money and credit views. First, assume that commercial banks do not exist and all money is in fact currency (allowing the public to maintain deposits with the central bank does not change the example). The central bank can increase the money supply by purchasing securities and assets from the public. For initial levels of transactions, prices, and interest rates, part of the public will eventually end up with currency holdings in excess of normal demand. To reduce the excess, spending on goods and interest-bearing securities will be increased. Temporarily, economic activity may increase and interest rates may fall, until a new equilibrium is established at a higher price level. This is of course the normal textbook example of monetary policy. Key element in the transmission of monetary policy is the fact that the newly created money represents immediate additional purchasing power for private agents.

Consider now the possibility of a pure bank credit channel when commercial banks increase their loans without changing the quantity of money. If we assume a 100 percent reserve requirement on bank deposits banks are no longer money-creating institutions, but pure credit intermediaries. (For simplicity we also discard the currency leak and assume that all money is deposit money.) For a given level of reserves, banks can increase their loan portfolio if they succeed in inducing the private sector to convert some of their deposits into bank borrowing (e.g. bonds or shares). These borrowings can then be used to increase loans. Alternatively, in a nonmonetary barter economy, banks could borrow real assets from private sector agents with positive savings and lend these real assets to other agents with a current use on the promise to return at some future date an equal amount of the real asset plus the required (real) interest rate. How, in this hypothetical economy, is economic activity affected by

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16 In the world of the ISLM model, bank balance sheets are reduced to reserves, bonds, and bank deposits. Neither do bank loans exist, nor do we distinguish between bank borrowing and securities held by banks. All credit is extended through transactions in marketable securities (government and corporate). Except for the liquidity services there is no special role for banks: in short, banks act as mutual investment funds (compare Fama 1980).
the increase in bank loans? First, banks must access idle resources because otherwise the banks’ access to these resources would detract from the availability of deposits for other transactions or the availability of real assets for other uses. Alternatively, banks could be more efficient credit intermediaries, improving the risk-return trade-off for savers and/or reducing the cost of credit to borrowers.

The discussion above suggests that in the role of bank credit two different elements should be distinguished. First, there is a money-creation element where in a system of fractional reserve banking banks increase the amount of economy-wide purchasing power through an expansion of credit. This channel is independent of the special role of bank loans vis-à-vis expansion of deposits through purchasing securities. This channel is also independent of the actual volume of intermediation through the banking sector. What is important is that banks, on initiative from the central bank, can act as marginal suppliers of money and credit. Second, bank credit can be special because banks are highly efficient credit intermediaries. When an increase in money is accomplished more through bank loans than through open market transactions there could be a reduction in the average, overall cost of credit in the economy. Arguably the effects of monetary policy on the increase of purchasing power is generally the first-order effect. The specialness of bank loans is probably the second-order effect. Unfortunately, it appears that the importance of the bank loan channel will never be precisely established, because major changes in money and bank loans are normally closely related. Both are constrained by the same balance sheet, and the major movements caused by changes in monetary policy exhibit strong systematic patterns caused by the mechanisms of optimal portfolio behaviour. At the same time, because of the systematic patterns and because the bank credit channel is of second-order nothing substantial is gained or lost in our usual view of monetary policy.

(iii) A graphical illustration of the role of bank credit
Bernanke and Blinder (1988) provide an appealing illustration of the effect of bank credit in a macroeconomic model. In their extended ISLM model the additional market for bank credit causes both the LM and the IS curve to shift to the left (right) in response to a monetary contraction (expansion). The bank channel magnifies the decline in output as a result of a monetary contraction,

17 One of the few estimates of the additional effect of bank loans is provided by Ramey (1993). Her estimates suggest a very small contribution of the bank loan channel. However, because the empirical evidence on the relative quantitative effects is scarce, the term second-order refers mainly to the fact that it merely accompanies and adds to the first-order effect.

18 In practice two qualifications to this statement appear important. First, the usual analysis of monetary policy focuses on market interest rates, but the importance of credit intermediaries suggests the much broader concept of “average cost of credit”. Second, credit market shocks (creditworthiness, etc.) suggest an additional source of long and variable lags in the transmission of monetary policy. These elements were already part of earlier discussions between keynesian and monetarist economists.

19 Note that a bank credit channel is only one possible cause. In monetarist models the direct effect of excess money balances on spending, other than through the interest rate channel, causes similar effects.
while the effect on market interest rates is limited.

To sharpen the focus on the assumption that bank credit is special, a different graphical illustration may be useful (compare also Thornton, 1994). Figure 5 part (a) shows the market for total credit in the macroeconomy. Note that the vertical axis shows the average cost of credit, which includes the cost of obtaining loans from different types of credit intermediaries and not just the open market interest rate (compare the diagram in Bernanke and Blinder, 1988). When there are no banks, the downward sloping demand (D) and upward sloping supply of credit (S_{nb}) correspond to the demand for investment and the supply of savings from households. The existence of a nonbank financial sector to intermediate between savers and investors is one of the determinants of the position of the credit supply curve. Efficient financial intermediation reduces the overall cost of credit, or, equivalently, increases the effective supply of credit derived from a given level of saved resources. Also note that, as in the model of Stiglitz and Weiss (1981), problems of asymmetric information may cause equilibrium credit rationing. As a result additional credit supply is not forthcoming beyond a certain level of interest rates and the supply curve of credit is usually assumed to be backwards sloping at higher interest rates.

Introducing a banking sector has the following two implications. First, banks are not merely intermediaries with the sole purpose of transforming savings into equivalent amounts of effective credit. The central position of banks in the payments system and fractional reserve requirements means that banks can operate a money and credit multiplier. In other words, banks are money and credit creating institutions and the banking system increases the available amount of credit and means of payment. The availability of additional resources from banks shifts the economy-wide supply curve to the right. This occurs even when bank credit is not special, for example, because banks only buy marketable government and/or private sector securities. Additional efficiency of financial intermediation through the banking system, the introduction of bank loans, shifts the credit supply curve down. Equilibrium credit rationing may also apply to bank credit, although comparative advantages of banks in monitoring their loan customers may mean that the threshold for the interest rate is now at a higher level. Assume that the total supply of nonbank and bank credit is given by S.

Note that what matters is the amount of real money and real credit. For simplicity, the effects of continuous money and credit expansion on the rate of inflation are ignored.
Notes: Total credit supply represents a) the simple intermediation of private savings, plus b) the volume of (real) credit generated through the money/credit multiplier mechanism of a fractional banking system. Asymmetric information problems (moral hazard, adverse selection) can effectively end the supply of credit beyond a certain level of interest rates. Theoretically the supply curve becomes backward sloping.
Much of the macroeconomic debate about a bank credit channel for monetary policy can now be described in terms of supply shifts in the model represented by figure 5. There are three cases: (1) monetary policy affects the amount of total available real (credit) resources, (2) monetary policy affects the efficiency of total credit intermediation, (3) monetary policy affects the amount of credit rationing.

As a result of the loss of reserves following restrictive monetary policy actions, banks must reduce the amount of credit linked to their money/credit multiplier. In figure 5(b) available real (credit) resources fall as the supply curve of total credit shifts leftwards. Of course, banks can always attempt to maintain their own initial level of intermediation by borrowing new funds, but this is primarily a change in market share between bank and nonbank credit intermediaries. In figure 5(c) bank loans are special, in the sense that banks achieve economies of scale, scope and specialization. A loss of bank credit may change the slope of the credit supply curve and/or shift the supply curve upwards. The main difference with the previous case is that the change in the average cost of obtaining credit is larger as is the fall in total credit volume. It is clear that distinguishing special and nonspecial bank credit effects will be extremely difficult, because the direction of the changes is the same and only the size of the effect is different. In any case, it is not very apparent what additional analytical insights are gained from this distinction. Figure 5(d) illustrates the case of effective credit rationing. Credit demand for basically sound and creditworthy investment projects is larger than the supply of credit because credit suppliers in general are unable to separate good and bad borrowers. The theory of equilibrium credit rationing shows that monetary policy actions affect the effective supply of credit, but will not in general change the equilibrium interest rate.

From our illustration it appears that, except in the case of credit rationing, the question of a special role for bank credit in monetary policy can be reduced to a debate about the relative size of the shift in total credit supply and the effect on the overall cost of credit intermediation. Restrictions on the intermediation by banks can cause a rise in costs of external finance because borrowers are forced to turn to other lenders with less comparative advantage in extending credit. The debate on the lending channel of monetary policy is then how much the cost of external funds rises when banks are restricted in their supply of credit. This, however, is a gliding scale from zero to infinity depending on the "specialness" of bank credit vis-à-vis credit through other financial intermediaries. Only the phenomenon of credit rationing can be a fundamentally new insight. Otherwise nothing fundamental is changed compared to traditional analyses of monetary policy.

5.5 CONCLUDING REMARKS

The "credit view" emphasizes the impact of monetary policy on the amount and conditions of credit supplied by the banking sector as a main channel of transmission. Banks are credit institutions that specialize in project screening and develop long-term relationships with individual clients to overcome informational failures in financial markets. As a result, banks can provide financing to worthy borrowers who perhaps would not otherwise have had access to external finance.

That banks are in some sense special is widely accepted. However, whether the bank credit channel is an important part of the aggregate monetary transmission remains questionable. Evidence
on nonprice credit rationing by banks appears to be negative. Most attempts to establish that changes in bank credit are special fail to provide conclusive evidence. In general, the appearance of increased liquidity constraints may not reflect an inward shift of just bank loan supply (the bank lending channel), but a more general deterioration of small firms’ creditworthiness and a reduced desire to borrow.

The empirical results in this paper confirm the link between monetary policy shocks captured by interest rates and movements in bank loans and money (although to lesser extent for broad money aggregates such as M2/M3). Holding interest rates constant, evidence on the direct relationships between money and loans are mixed and difficult to interpret. There is no strong evidence that bank loan growth is the primary determinant of money aggregates, whereas there used to be (because less so in the post-1977 data) a strong relationship between money growth and bank loans. The cross-country evidence on loans and real output does not suggest the presence of macroeconomic credit constraints, because in 3 of the 4 countries an increase in bank loans is related to a fall in output negative.

Finally, I argued that much of the macroeconomic debate on a bank credit channel of monetary policy appears to deal with second-order effects. In the role of bank credit two elements should be distinguished. First, there is a money-creation element where in a system of fractional reserve banking banks increase the amount of economy-wide purchasing power. Second, bank loans to the private sector may be special because banks are highly efficient credit intermediaries. When an increase in money is accomplished more through bank loans than through open market transactions, there could be a reduction in the average overall cost of credit in the economy. Unfortunately, money, bank credit and bank loans appear on two sides of one banking sector balance sheet and the portfolio adjustment of banks after policy shocks exhibits strong systematic patterns. Consequently, we will probably never be able to estimate with any degree of confidence the effect associated with the special role of bank loans on a macroeconomic level. At the same time, because of the systematic patterns and because the bank credit channel is of second-order nothing is gained or lost in our usual view of monetary policy.
APPENDIX 5 DATA

Bank deposits, securities, and loans to the private sector. Bank deposits are calculated as the noncurrency component of the available money aggregate.

Germany
Bank loans: advances and loans to domestic enterprises and individuals (short term, medium term, long term), plus lending to domestic public authorities (excl. T-bills/Sec/Equ).
Bank securities: banks' holdings of securities (excl. bank bonds).
M1: currency in circulation and domestic nonbanks' sight deposits.
M3: M1, plus domestic nonbanks' time deposits (less than 4 yrs) and savings deposits (3 mth notice).
Sources: Bundesbank database and Monthly Reports.

Netherlands
Bank loans: loans to the private sector, plus loans to local authorities.
Bank securities: securities total, plus loans to central government.
M1: currency in circulation and domestic nonbanks' sight deposits.
M3: M1, plus domestic nonbanks' time deposits (less than 2yrs), foreign exchange deposits (less than 2yrs), and savings deposits (total).
Sources: DNB worksheets and Quarterly Report.

United Kingdom
Bank loans: advances to UK residents total, loans to local authorities, banks acceptances total.
Bank securities: call money and loans discount market, Sterling bills, Sterling investments.
M1: currency in circulation and U.K. nonbank private Sterling sight deposits.
M3: M1 plus U.K. nonbank private Sterling time deposits, plus UK nonbank public Sterling sight and time deposits, plus UK nonbank private and public nonSterling deposits.

United States

Other data.
CPI: Basic source is IFS series f64 consumer price index, linked to historical data from OECD Main Economic Indicators Historical Statistics and national source data to avoid rounding errors in index data.
IP: Basic source is IFS series f66c industrial production (sadj), linked to historical data from OECD Main Economic Indicators Historical Statistics and national source data to avoid rounding errors in index data.
Interest rates: Germany IFS f60b, call money rate; Netherlands IFS f60b, call money rate; United Kingdom IFS f60c, 3-mth T-bill rate; United States IFS f60b, federal funds rate.
GNP/GDP: Germany IFS f99ac and f99ar; Netherlands IFS f99bc and f99br, before 1977 national source data; United Kingdom IFS f99bc and f99br; United States IFS f99bc and f99br.
CHAPTER 6

The household balance sheet and durable consumer expenditures

6.1 INTRODUCTION

A number of observers have pointed to the negative effects of balance sheet restructuring as an explanation for the slow recovery by some OECD countries from the recent 1990s recession (for example, IMF 1992a, 1992b; OECD 1993). Others have repeatedly cautioned against the general increase in financial fragility in several countries (see for example Friedman 1986; Kaufman 1986; Biemans and Boonstra 1993). According to this view governments, households and firms had built excessive debt burdens during the prosperous 1980s. Faced with unexpected adverse economic conditions, high debt and declining asset values, firms and households restrained their spending plans to restructure their balance sheets. Governments were unable to provide extra economic stimulus because this conflicted with their plans to reduce fiscal debts and deficits.

The usual explanations for the developments in private and public sector debt and asset values during the 1980s and 1990s emphasize financial deregulation and accommodative monetary policy. Deregulation of financial markets in the 1980s resulted in heightened competition between old and new financial institutions, both offering a broader range of financial services and instruments. Many financial institutions developed an increased tendency to enter more profitable but also riskier lines of business and they increased the volume of leveraged transactions, leveraged buyouts, off-balance sheet derivative products, etc. At the same time, monetary policy accommodated large increases in asset market values, especially concentrated in real estate markets. The change to a more restrictive monetary policy caused a rise in real interest rates and a fall in asset market values. Higher interest rates, unemployment, a deflation in real asset prices, and a decline in net worth led to a cutting back on current expenditures by nonfinancial firms and households to rebuild net worth and make interest payments and amortization payments. In addition, especially in the United States, Japan and the Nordic countries (Finland, Norway, Sweden) the financial sector was hit hard by the volume of bad loans and appeared to be restraining new lending to the private sector -- causing a credit crunch.
This paper examines the relationship between household balance sheets and consumer expenditures. In particular, the objective is to evaluate the claims for an important role of balance sheet restructuring in the economic downturn of the early 1990s. An important reason to examine the relationship between consumer expenditures and financial factors is also to improve our understanding of the transmission mechanisms of monetary policy.¹ In the mainstream literature on consumer expenditure, the impact of monetary policy operates through interest rate or liquid asset (real balance) effects. The empirical evidence for these effects is mixed. Nevertheless, in many countries central banks significantly relaxed monetary conditions after the stock market crash in 1987, because they feared that the collapse of asset prices would cause a financial crisis and that adverse wealth effects would depress consumer spending. This illustrates that knowledge about a balance sheet effect on consumer spending may be important.

¹ There exists a large literature on the relationship between financial factors and business investment (see for example, Gertler 1988; Fazzari, Hubbard and Petersen 1988; Kashyap, Lamont and Stein 1994). There exists, however, remarkably little research into the effects of the household balance sheet on consumer expenditures (among the few studies are Mishkin 1976, 1977, 1978; McCarty 1993).
The main results of this paper can be summarized as follows. Theoretically and empirically, the emphasis placed in some analyses on an "excess" increase of debt-income ratios appears unfounded. As a first illustration, figure 1 shows the development in household debt ratios in the United States, United Kingdom, Japan and Germany. Clearly, rising debt-income ratios are not a recent phenomenon. Debt ratios have been on the increase throughout the postwar period. Also note that households have not responded to previous recessions with a marked reduction in debt ratios, which questions the validity of the current notion of excess debt ratios. Theory and empirical results emphasize net worth and income as prime determinants of consumer spending. Debt is merely one component of the household balance sheet, and, when taken alone, provides no information on consumer behaviour. The empirical results do provide some minor evidence for a role of household liquidity (i.e. the ratio of liquid financial assets to debt) as suggested by Mishkin (1976).

The structure of the remainder of this paper is as follows. Section 2 presents a short introduction to consumption theory and empirical evidence. The objective is to derive an equation for consumer expenditure that is consistent with modern theory. This equation will be the basis for the empirical tests of the balance sheet effects. Section 3 provides an impression of the data used in this study. Because there exist no official time series for household balance sheet data in the Netherlands, the general methodology used to construct the data series is described here. Section 4 presents the statistical tests of a household balance sheet effect on consumer expenditures. The final section contains concluding remarks.

6.2 CONSUMER EXPENDITURE AND THE HOUSEHOLD BALANCE SHEET

The life-cycle theory of consumption developed by Modigliani, Ando and Brumberg (Modigliani and Brumberg 1954; Ando and Modigliani 1963) and the permanent-income theory of Friedman (1957) show that to maximize utility a representative agent consumes from wealth and expected income rather than from current disposable income alone. The trade-off between consuming today and consuming tomorrow results in the Euler equation

\[
E_t \left[ \frac{U'(C_{t+1})}{U'(C_t)} \right] \frac{(1+r_{t+1})}{(1+\gamma)} = 1
\]

where \(E_t\) = expectation conditional on information available at time t; \(\gamma\) = the rate of subjective time preference; \(r\) = the real rate of interest at which the consumer can borrow and lend; \(U\) = one-period utility from consumption, and \(U'\) the marginal utility from consumption; \(C\) = consumption

Assuming a quadratic one-period utility function and a real interest rate equal to the rate of subjective time preference, it can be shown that the expected time path of consumption is horizontal, i.e. \(E_t C_{t+1} = C_t\). Current consumption is proportional to the consumer's wealth or permanent income and consumption changes only to the extent that changes in income are unexpected and/or because of
new information about future income.\footnote{See Hall (1978) for the stochastic implications for consumption behaviour. Recent reviews of the literature are Deaton (1992) and Speight (1990).}

Empirical studies usually find that consumption is approximately a random walk (with drift).\footnote{In this paper no distinction will be made between random walk and martingale properties of a single time series.} Many studies also find that the restrictions imposed by the rational expectations hypothesis appear to be too strong. Some lagged information variables predict changes in consumption (at least in ex post evaluations) and consumption appears to exhibit excess sensitivity to unexpected changes in income (at least for some models of expected income). To explain why standard LCPIH models fail some empirical tests, the literature usually points to liquidity constraints and non-rational consumers. However, liquidity constraints and "rule-of-thumb" consumer spending are not the only possible explanations why standard LCPIH models fail some empirical tests. A number of modifications to the assumptions of the basic model have been suggested. For example, Attanasio (1995) and Attanasio and Weber (1995) show how precautionary savings and demographic factors can result in a close correspondence between consumption and income, fully consistent with the LCPIH model. Another modification is to allow time-varying real interest rates. It is possible that during business cycle fluctuations, the correlations between consumption and income proxy for the relationship between consumption and real interest rates (Mankiw 1981). The presence of durable consumer goods results in intertemporal dependence of expenditures, income and consumption (Mankiw 1982). The usual tests of the LCPIH model with aggregate consumption and income data tend to suffer from an aggregation bias (Attanasio and Weber 1993; Deaton 1992).

The remainder of this paper proceeds on the basis that, the intricate details of aggregation problems notwithstanding, the representative LCPIH consumer model provides a sufficiently good approximation of aggregate consumption behaviour.

\subsection*{6.2.1 Durable consumer goods}

It is well known that durability of consumer goods affects the intertemporal behaviour of consumer expenditure. No longer is the stochastic implication that consumer expenditure follows a random walk, but durability of consumer goods introduces negative serial correlation in consumer expenditures (see Mankiw 1982).

Another perspective on durable consumer goods is their role as real assets on the balance sheet of households. An important aspect of consumer durables as an asset is their illiquidity. Contrary to financial assets, most of which are traded on well-developed markets, consumer durables cannot be easily sold to generate cash. Imperfect information causes high search costs or long waiting periods in finding an interested buyer. Furthermore, asymmetric information with respect to the quality of the good can cause a large spread between actual value and sale price, especially in case of a distress sale. Mishkin (1976) has argued that households may be reluctant to buy additional durable goods when they perceive an unfavourable balance between liquid assets, illiquid assets, debt and uncertain income. A consumer who risks financial distress when he cannot readily pay his bills would prefer to hold highly liquid financial assets rather than illiquid tangible assets.
McCarty (1993) provides additional reasons why consumer durables spending is affected by balance sheet effects.

1) Durable goods are bought on credit. Lenders use balance sheets to examine creditworthiness and this affects the amount of credit available to purchase durable goods. To some extent this is not a robust explanation, because consumers can also buy durable goods from savings. A positive value for time preference does suggest however that consumers may be unwilling to wait long periods. Furthermore, purchasing durable goods on credit matches payments with the service streams from the durable goods.

2) Durable goods expenditures are easily postponed. Many durable goods are replaced with new models when they are still functional. Consumers usually have the option to continue using the old good or maybe to repair the old good at lower cost.

Mishkin (1976, 1977, 1978) is one of the few who have studied the relationship between durable goods expenditures and the household balance sheet (McCarty 1993). Mishkin’s so-called liquidity model starts from some general idea about the LCPIH consumption function. The desired stock of consumer durables, from which a flow of consumption services is derived, is a function of permanent income and the user rental cost of capital. In addition the liquidity hypothesis states that the desired stock of durables also depends on the value of the consumer's debt and financial assets. Using a stock adjustment model and the relationship between stocks and expenditures, Mishkin’s final equation for durables expenditures is

\[ \text{EXP}_D^P = a^* + (b^* + c^* \text{CAPC}^i) Y_i^p + d^* \text{DEBT}_{i,t-1} + e^* \text{FIN}_{i,t-1} + \Phi Y_i^T + \mu K_{i,t-1} + \epsilon_i \]

where \( \text{EXP}_D^P \) = real per capita expenditures on consumer durables; \( Y_i^p \) = real per capita permanent or expected average income and \( Y_i^T \) = transitory income; \( \text{CAPC} \) = user rental cost of consumer durables; \( \text{DEBT} \) = real per capita debt holdings of households; \( \text{FIN} \) = real per capita gross financial asset holdings. Mishkin (1976) estimated for the U.S. 1954-1972 that debt and financial assets have different effects on consumer expenditures. In particular, in absolute terms, the negative coefficient for \( \text{DEBT} \) is larger than the positive coefficient for \( \text{FIN} \). This implies that an equal increase in both \( \text{DEBT} \) and \( \text{FIN} \), leaving net wealth the unchanged, lowers expenditures on durable goods.

### 6.2.2 More on modelling durable consumer expenditures

From a theoretical perspective there are two approaches to testing alternative hypotheses about consumption behaviour. First the consumption-function approach and second the Euler-equation approach. In principle there is no specific reason to argue that one approach is better than the other. Note that in the intertemporal optimizing theory of consumer behaviour the consumption function and Euler equation are not independent models, but closely linked.\(^4\) However, whereas the use of Euler equations in many empirical studies is a clear reference to a specific consumer optimization model, the

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\(^4\) The definition of the consumption function is the relationship between the level of consumption (expenditures) and current and expected levels of income, wealth and relative prices. The Euler-equation approach does not allow determination of the level of consumption, but describes the growth rate of consumption that corresponds to the optimal time path under intertemporal optimization.
use of general functions for consumer expenditure and income variables allows a number of alternative interpretations. Frequently, the Euler-equation approach is preferred because closed-form solutions for the consumption function are only available for certain classes of utility functions -- limiting the analysis to certain classes of risk aversion behaviour. Consumption functions are also more demanding in the requirement to develop explicit models of expected future income and wealth. The following two subsections describe how to derive the descriptions of consumption behaviour that will return in the empirical work.

(i) The consumption function approach

A consensus in the recent literature on consumption functions is that the preferred specification for empirical work is the model developed by Davidson, Hendry, Srba and Yeo (DHSY, 1978) and Hendry and Von Ungern-Sternberg (HUS, 1981). A general formula for the quarterly DHSY model is

\[
\Delta t c_t = \alpha(L) \Delta t y_t + \beta(L) Z_t - \gamma (c - y)_t, 4
\]

DHSY (1978, p.684) provide the following interpretation. Consumers plan to spend in each quarter of a year the same as they spent in that quarter of the previous year \(c_t = c_{t-4}\), modified by a proportion of the change in income \(\Delta y_t\) as well as by other short-run influences \(Z_t\) including wealth revaluation effects, etc. Most importantly, the dynamic DHSY specification is characterized by a feedback or error correction mechanism \((c - y)_{t-4}\), ensuring coherence with a long-run relationship between consumption and income levels \(c_t = y_t\).5

In modern terminology, the DHSY model builds on the assumption of a bivariate cointegration relationship between consumption and income. However, a more general long-run relationship implied by LCPIH models of consumption is between consumption, (expected lifetime or permanent) income, net worth of household assets \(W_t\), and real interest rates \(r_t\).6 A simple log-linear representation would be

\[
c_t = \alpha_0 + \alpha_1 y_t + \alpha_2 w_t + \alpha_3 r_t
\]

which is consistent with a model of expected income described as \(E(y_{t+1}) = f(y_t)\). For example, a random-walk-with-drift model for log income is \(E(\Delta y_t) = g + e_{t+1}\).7 8

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5 The condition \(c_t = y_t\) applies because DHSY (1978) prefer to eliminate the constant term of the regressions. See the critique that followed from HUS (1981) and Patterson (1985).

6 In a similar context HUS (1981) argue that the DHSY model provides no “integral control” mechanism. The steady-state condition is \(c = y\), but there is no correction for the accumulated change in wealth during the adjustment period when \(c \neq y\).

7 A problem is that this model can not distinguish between the role of income as a general proxy for expected future income and the alternative of a traditional Keynesian “rule-of-thumb” model with fixed propensity to consume from current disposable income.

8 More general distributed lag models of (expected) income are possible, albeit that under rational
To derive a model for durable goods expenditures assume as in Mishkin (1976), that consumption flows from durable goods are a proportion of the existing stock of durable goods (K).

\[ k_i^* = \alpha_0 + \alpha_1 y_i + \alpha_2 w_{t-1} + \alpha_3 r_i \]

(5)

\[ (k_i - k_{i-1}) = \lambda (k_i^* - k_{i-1}) \]

(6)

\[ \exp_D^p = \delta_0 + \delta_1 k_i + (1 - \delta_1) k_{i-1} \]

(7)

Combining the desired stock of durable goods (K*) with partial adjustment (equation 6) and the relationship between expenditures (EXP^p), depreciation and stocks (equation 7)\(^9\), results in the following equation for durable goods expenditures

\[ \exp_D^p = \alpha_0^* + \alpha_1^* y_i + \alpha_2^* w_{t-1} + \alpha_3^* r_i + (1 - \delta_1) \lambda k_{i-1} \]

(8)

Modern research tends to replace the partial adjustment hypothesis by a more general error correction model (ECM). The long-run or cointegrating relationship in the first stage of the two-step Engle-Granger ECM method corresponds to setting \(\lambda = 1\) in eqn. 8. The second step consists of estimating a general dynamic model for the short-run behaviour of consumption which includes the residuals from the long-run equation as an explanatory variable.

(ii) The Euler-equation approach

Since Hall's (1978) paper on the stochastic implications of consumption models, the Euler-equation approach has frequently been used as an alternative to model consumption behaviour. Basically, the Euler equation establishes a relationship between expected changes in consumption and the real rate of interest.

To incorporate durables in the consumer model it is common to assume separability of utility. Subject to the budget constraint, the representative consumer maximizes the utility function:\(^10\)

\[ E_1 \sum_{t=1}^{\infty} \left(1 + \gamma \right)^t \left[U\left(C_{t+1}\right) + V\left(K_{t+1}\right)\right] \]

(9)

expectations certain restrictions apply.

\(^9\) Using log expenditures requires a Taylor-approximation from the actual relationship \(\exp_D^p = K_i - (1-d)K_{i-1}\) with \(d\) the rate of depreciation. Coefficients \(d_0\) and \(d_1\) are log(\(d\)) and the first-derivative around point log(\(d\)) respectively.

\(^10\) The basic assumption in this model is that the flow of consumption services is a constant proportion of the stock of durables and that utility from consumption flows must be maximized (Mankiw 1982). Bernanke (1984) assumed that households purchase durable goods at a rate given by a partial adjustment process. Bernanke (1985) developed a model with explicit adjustment costs. Bar-Ilan and Blinder (1988) developed a model that takes explicit account of the lumpiness of durables. In this model purchases and sales of durables occur when the stock falls outside an optimal range.
where, in addition to the definitions given above, \( C \) = consumption (expenditures) on nondurable goods and services; \( V \) = one-period utility from (consumption services of) the durables stock \( K \) with \( V' \) the marginal utility; and the relationship between durables expenditures \( \text{EXP}_D \) and stocks \( K \) defined by \( K_t = (1-d) K_{t-1} + \text{EXP}_D^t \).

One can take as a starting point the Euler equation described by Mankiw (1982). Additional restrictions on the intertemporal optimization problem can be modeled as influences on the Euler equation. Zeldes (1989) proposes a general formulation of the type

\[
E_t \left[ \frac{V(K_{t+1})}{V(K_t)} \right] (I + r_{t+1}) (I + \mu_t) = I
\]

where \( \mu_t \) refers to the multiplier or shadow price associated with the additional constraint. If at time \( t \) the additional constraint is non-binding, then \( \mu_t = 0 \). Because \( \mu_t \) is not observable, proxy variables for the additional constraint can be included in the equation for durable expenditures.

Mankiw (1982) derives that with quadratic utility and perfect markets durables expenditures must follow an ARMA(1,1) process. This model appears to be rejected by the data. If the simple quadratic utility function used by Mankiw is replaced by a constant relative risk aversion (CRRA) utility function such as \( V(K) = \beta (1-\beta)^{-1} K(1-\beta) \), it can be shown that durable consumer expenditures follow

\[
\Delta_t \left( \frac{\text{EXP}_D^t}{K_t} \right) = \beta^{-1} \Delta \log(I + r_{t+1}) + v_{t+1} - v_t
\]

Perhaps earlier rejections of the ARMA(1,1) model were caused by inappropriate scaling of expenditures and the neglect of the effects of real interest rate changes.

The theoretical considerations here are completed with the observation that proxies for additional constraints, including the effects of Mishkin’s (1976) liquidity hypothesis, can be used as additional explanatory variables and their significance can be tested.

### 6.2.3 Interlude: What about the household debt ratio?

The LCPIIH model of consumer behaviour has no a priori optimal debt ratio. Desired borrowing by households depends on the amount of intertemporal substitution in relation to current and expected future income. Furthermore, if borrowing is used to acquire tangible or intangible assets there is no net change in wealth and no necessarily adverse effect on consumption. At this stage, compare the debate on household debt ratios for the aggregate or representative consumer to a similar debate on government debt ratios. The discussions related to the entry requirements for European countries for a future economic and monetary union have made it clear that a single target for the government debt ratio has no economic justification. An important alternative requirement is the non-explosive or sustainable time path of debt ratios. But analyses show that any debt ratio can be sustainable, provided there is an appropriate combination of the fiscal surplus/deficit, interest rate and economic growth.

More important than sustainable debt ratios is the following. The adverse economic effects
that feature in popular discussions of "excessive" debt ratios result from the supposed perverse effects of increased saving (both government and private saving) on economic activity. However, this effect is important only in old-fashioned Keynesian income-expenditure multiplier models. In natural-rate models of the economy it cannot be true that changes in public or private savings affect economic activity (at least not in any substantial direct way as in the Keynesian multiplier model).\footnote{It is true that changes in saving may affect the accumulation of capital and therefore the natural rate or long-run potential output. However, these effects are normally excluded from standard business cycle analysis.} Saving primarily affects the composition of aggregate expenditures, but not its level.

Faced with uncertainty, some households may overestimate their earnings potential and, as a result, must confront the necessity to reduce spending and increase savings. It is important to note that the debt with banks, pension funds, etc. of some households is normally the holdings of deposits with banks, pension claims, etc. of other households. As a first approximation, household debt ratios featuring in popular discussions are clearly uninformative about macroeconomic behaviour because these debt ratios fail to take into account the proper consolidation of the aggregate household balance sheet. From a macroeconomic point of view, the major disappointment is the unrealized growth of wealth. Otherwise the adjustment of savings and spending by a portion of households signals only a redistribution of income or wealth between borrowers and lenders.

\section*{6.3 EMPIRICAL RESULTS}

\subsection*{6.3.1 An impression of the data}

There exist no official time series for the balance sheet of Dutch households. Until recently almost all financial and nonfinancial data published were for the aggregate private sector. Swank et al. (1989) provided an important first step to assemble the necessary disaggregated data, but that study is limited to annual data for the period 1982-1987.

The following quarterly time series data for household balance sheet variables were constructed: twelve financial balance sheet variables (currency, demand deposits, short and long term deposits, savings deposits, foreign currency deposits, savings certificates, bonds, shares, short-term debt, long-term debt (loans), mortgage debt), two real assets (owner occupied housing stock, consumer durables stock) and an estimate of assets held with institutional savings institutions (pension funds, (life-) insurance companies). The dataset consists of quarterly data for the period 1972-93. Because the data set is new an impression of the time series characteristics is provided first (details on the construction of the data are in a separate data appendix.) First, table 1 provides an impression of the composition of the Dutch household balance sheet at selected dates. In particular, end-1982 and end-1987 observations are provided to facilitate comparison with Swank et al. (1989). Next, figure 2 presents a graphical illustration of the composition of the financial balance sheet.
Table 1 shows the large role of financial institutions in managing the household balance sheet. About 45 percent of total assets is held with banks and in pension fund and (life-) insurance assets. Another 40-45 percent of total assets consists of household fixed investments (housing and durable goods). The proportion of assets in bonds and shares has increased in recent years but is currently just exceeding the range of 10-12 percent of total assets.

Figure 3 shows that Dutch households are no exception to the general pattern of increasing debt ratios in the OECD countries. Household debt as a percentage of household disposable income increased from just over 30 percent in 1972 to almost 70 percent in 1993. Half of this increase occurred in only 3 years, 1976-1978. During the 1980s the household debt ratio rose with another 10 percentage points. Figure 3 also shows that the rise in household debt corresponds with a fall in the ratio of household liquid financial asset to debt. This variable is prominent in Mishkin's (1976) liquidity hypothesis.

Debt is only one side of the balance sheet. The increase in household debt provides no evidence on the net worth of households. Figure 4 shows that real net worth per household increased during the 1980s. This is equally true for alternative measures of real net worth, defined to include the housing stock (RNW1), plus the stock of durable goods (RNW2), plus institutional savings (RNW3). The general movement of real net worth is almost entirely due to the housing stock. The time series display a strong emphasis on housing wealth with a substantial increase during the second half of the 1970s and an almost equal decline in the early 1980s. Note that a number of recent studies by Carruth and Henley (1990), Bomhoff (1994), Meltzer (1995) have found changes in housing prices and wealth to be important determinants of aggregate economic activity.
Notes: Bank deposits are demand deposits, term and savings deposits (incl. short-term savings certificates) and foreign currency deposits. Bonds include long-term and exchange traded savings certificates.

Figure 3 Dutch household debt as share of disposable income, financial assets as share of debt
Figure 4 Real net worth per household (logarithms)

Notes: Real net worth definitions are in order of increasing coverage, real net financial worth (RNFW), plus housing stock (RNW1), plus consumer durables stock (RNW2), plus institutional savings with pension funds and (life-) insurance companies (RNW3).

Figure 5 Real consumer durables expenditure and real disposable income, per household
Table 2  Estimated equations for log real durable consumer spending  $\exp^D_t$

<table>
<thead>
<tr>
<th>wealth definition</th>
<th>constant</th>
<th>$y_t$</th>
<th>$w_{t-1}$</th>
<th>$rr_t$</th>
<th>$relpr_t$</th>
<th>stock$_{t-1}$</th>
<th>E-G coint.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $w_1$</td>
<td>-3.577</td>
<td>0.897</td>
<td>0.379</td>
<td>-0.010</td>
<td>-0.002</td>
<td>-0.127</td>
<td>-3.59</td>
</tr>
<tr>
<td></td>
<td>(2.70)</td>
<td>(6.00)</td>
<td>(10.70)</td>
<td>(7.19)</td>
<td>(1.09)</td>
<td>(1.26)</td>
<td></td>
</tr>
<tr>
<td>(2) $w_1$</td>
<td>-4.172</td>
<td>0.921</td>
<td>0.370</td>
<td>-0.010</td>
<td>-0.085</td>
<td>-0.127</td>
<td>-3.63</td>
</tr>
<tr>
<td></td>
<td>(3.46)</td>
<td>(6.21)</td>
<td>(10.72)</td>
<td>(7.37)</td>
<td>(0.91)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) $w_1$</td>
<td>-0.891</td>
<td>0.548</td>
<td>0.438</td>
<td>-0.010</td>
<td>-0.086</td>
<td>-0.038</td>
<td>-2.48</td>
</tr>
<tr>
<td></td>
<td>(0.62)</td>
<td>(3.07)</td>
<td>(10.26)</td>
<td>(7.28)</td>
<td>(0.72)</td>
<td></td>
<td></td>
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<tr>
<td>(4) $w_1$</td>
<td>-5.748</td>
<td>1.335</td>
<td>0.491</td>
<td>-0.010</td>
<td>0.038</td>
<td>-0.222</td>
<td>-3.61</td>
</tr>
<tr>
<td></td>
<td>(2.83)</td>
<td>(5.54)</td>
<td>(10.66)</td>
<td>(7.32)</td>
<td>(0.22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) $w_2$</td>
<td>-4.435</td>
<td>0.935</td>
<td>0.491</td>
<td>-0.010</td>
<td>-0.222</td>
<td>-0.066</td>
<td>-2.79</td>
</tr>
<tr>
<td></td>
<td>(3.69)</td>
<td>(6.31)</td>
<td>(10.66)</td>
<td>(7.32)</td>
<td>(0.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6) $w_3$</td>
<td>-8.986</td>
<td>1.303</td>
<td>0.275</td>
<td>-0.018</td>
<td>0.066</td>
<td>-0.222</td>
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<td></td>
<td>(5.75)</td>
<td>(6.38)</td>
<td>(10.66)</td>
<td>(8.60)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: $\exp^D_t$ is log real durable consumer spending per household; $rr$ is the real interest rate; relative price ($relpr$) is log ratio of the deflator of consumer durable goods and the deflator of all consumer goods; stock is log stock of durable consumer goods per household; $y$ is log real disposable income per household; $w$ is log real net wealth per household defined as net financial wealth plus housing stock ($w_1$), plus stock of durable consumer goods ($w_2$), plus pension reserves ($w_3$). The final column shows the Engle-Granger test on cointegration using 1 lag (McKinnon 10% critical values for rows 1-4 are -4.581, -4.259, -3.910, -3.526). Note that with nonstationary variables the t-statistics (in parentheses) are unreliable.

Finally, figure 5 displays the two other main variables used in this study: real consumer durables expenditures per household and real disposable income per household. It is clear that patterns in these variables are dominated by the slump in economic activity starting 1980-1981. Also observe the tendency of income and consumer durables expenditure to flatten in the early 1990s after a period of substantial growth from 1985.

6.3.2 Regression results for durables expenditures

The next two subsections provide estimates of the relationship between durables expenditures and the household balance sheet. The main question to be answered is the role of consumer debt ratios in determining consumer expenditures. Following the discussion above, the discussions of the empirical results are divided according to the two approaches to modelling consumer expenditures.

(i) The consumption function approach

Table 2 presents estimates of equation (8), describing the long-run equilibrium relationship between levels of consumer expenditure, income, wealth and interest rates. The rows in table 2 refer to
estimates using three alternative wealth variables, and several additions/deletions of other variables. In row 1 one notable modification of equation (8) is the inclusion of the change in the relative price of consumer durables. The motivation for this addition is that the standard real interest rate is based on a correction of nominal interest rates for the change in overall consumer prices, whereas in this case a measure of the user cost of durable goods may be more appropriate. Note that with nonstationary variables (and, except for the stock of durable goods, none of these variables passed the usual ADF-test for unit roots and nonstationarity) the usual tests of significance of variables are unreliable. Nevertheless, the overall results suggested that there is no substantial evidence for an important contribution of relative price changes in the long-run equation. The last column of table 2 presents the Engle-Granger tests of cointegration between the variables in each row. Unfortunately, none of the cointegration statistics reaches acceptable significance levels (although the estimate in row 2 comes close to reaching significance at 10-percent). These results fail to support formally the hypothesis of a long-run cointegration relationship between durables expenditures, income, wealth and real interest rates. Proceeding in the framework of Engle-Granger error-correction models is now admittedly ad hoc. On the other hand, theoretical and practical considerations to continue with the widely used DHSY(-extended) model are quite strong. Furthermore, failure of the cointegration tests may be caused by the limited size of the data sample, or, more generally, by the low power of the unit-root tests. This issue is recommended for more research. Although cointegration remains yet an unproven proposition, one long-run equation is selected with which to continue. The empirical evidence provides very little guidance on this issue, but the equation in row 2 with income, wealth variable w1 and the real interest rate was selected (the empirical results showed little sensitivity to changes in the choice of a long-run equation).

Table 3 presents the estimates of the short-run, dynamic model of durable consumer spending. After some experiments with different variables and different lags, the equation in column 1 emerged as the basic equation. The growth rate of real durable consumer spending depends negatively on the increase of durables prices relative to total consumer prices and positively on the increase in income and wealth. The lagged error-correction term EC from equation 2 in table 2 is significant and negative (providing some alternative support for the long-run cointegration relationship). The preliminary estimates showed strong serial correlation of the residuals, possibly because of the use of overlapping observations. But a correction for first-order serial correlation removed this problem, indicated by the fact that the LM(S,4) test statistics (4 lags) are now insignificant (p-values exceeding 0.1). The LM(E,4) tests for ARCH-type heteroscedasticity are also insignificant. Note that a substantial part of the explanatory power of the equations is derived from the three dummy variables included in the estimations. These dummy variables capture shifts in the timing of durable goods expenditures usually associated with (VAT) tax changes and are defined as +1/-1 in quarters 1973:4/1974:1, 1975:4/1976:1, 1992:4/1993:1 and zero otherwise (estimates using these dummies actually include them as 4-quarter changes).

12 Note that in table 3 the estimates of the ECM coefficients in the dynamic short-run equations provide alternative information on cointegration. See Kremers, Ericsson and Dolado (1992).

13 Alternatively, consistent estimates of the standard errors could be obtained using the Newey-West correction.
Table 3  Estimated equations for growth rate of real durable consumer spending

<table>
<thead>
<tr>
<th></th>
<th>dependent variable is $\dot{w}_t \exp \frac{D_t}{P_t}$</th>
<th>wealth definition is $w_1$</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>constant</td>
<td>-0.414</td>
<td>-0.574</td>
<td>-6.225</td>
<td>-18.223</td>
<td>-18.590</td>
</tr>
<tr>
<td></td>
<td>(0.51)</td>
<td>(0.09)</td>
<td>(0.82)</td>
<td>(1.33)</td>
<td>(1.38)</td>
</tr>
<tr>
<td>$\dot{W}_1 (P_t^D/P_t)$</td>
<td>-0.484</td>
<td>-0.474</td>
<td>-0.443</td>
<td>-0.473</td>
<td>-0.476</td>
</tr>
<tr>
<td></td>
<td>(3.21)</td>
<td>(3.16)</td>
<td>(2.93)</td>
<td>(3.20)</td>
<td>(3.21)</td>
</tr>
<tr>
<td>$\dot{y}_t$</td>
<td>0.424</td>
<td>0.414</td>
<td>0.377</td>
<td>0.408</td>
<td>0.406</td>
</tr>
<tr>
<td></td>
<td>(4.01)</td>
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<td>(3.93)</td>
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<tr>
<td>$\dot{w}_{t-1}$</td>
<td>0.281</td>
<td>0.207</td>
<td>0.205</td>
<td>0.268</td>
<td>0.268</td>
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<tr>
<td></td>
<td>(4.46)</td>
<td>(2.46)</td>
<td>(2.61)</td>
<td>(2.63)</td>
<td>(2.67)</td>
</tr>
<tr>
<td>$\text{fin}_{t-1}$</td>
<td>0.000</td>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.27)</td>
<td>(3.63)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\text{debt}_{t-1}$</td>
<td>-0.000</td>
<td>-0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.75)</td>
<td>(3.35)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIN/DEBT$_{t-1}$</td>
<td></td>
<td></td>
<td>0.076</td>
<td>0.077</td>
<td>0.077</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.69)</td>
<td>(1.73)</td>
<td>(1.77)</td>
</tr>
<tr>
<td>DEBT/Y$_{t-1}$</td>
<td></td>
<td></td>
<td>0.054</td>
<td>0.058</td>
<td>0.061</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.48)</td>
<td>(0.52)</td>
<td>(0.55)</td>
</tr>
<tr>
<td>EC$_{t-4}$</td>
<td>-0.455</td>
<td>-0.445</td>
<td>-0.428</td>
<td>-0.436</td>
<td>-0.440</td>
</tr>
<tr>
<td></td>
<td>(5.61)</td>
<td>(5.52)</td>
<td>(5.26)</td>
<td>(5.40)</td>
<td>(5.43)</td>
</tr>
<tr>
<td>$\gamma(1)$</td>
<td>0.710</td>
<td>0.706</td>
<td>0.759</td>
<td>0.716</td>
<td>0.717</td>
</tr>
<tr>
<td>adjR2</td>
<td>0.798</td>
<td>0.804</td>
<td>0.790</td>
<td>0.805</td>
<td>0.806</td>
</tr>
<tr>
<td>DW</td>
<td>2.14</td>
<td>2.22</td>
<td>2.30</td>
<td>2.24</td>
<td>2.25</td>
</tr>
<tr>
<td>LM(S,4)</td>
<td>0.645</td>
<td>0.530</td>
<td>0.158</td>
<td>0.419</td>
<td>0.411</td>
</tr>
<tr>
<td>LM(E,4)</td>
<td>0.788</td>
<td>0.680</td>
<td>0.270</td>
<td>0.634</td>
<td>0.619</td>
</tr>
<tr>
<td>LM(D)</td>
<td>-</td>
<td>0.097</td>
<td>0.001</td>
<td>0.069</td>
<td>0.071</td>
</tr>
</tbody>
</table>

Notes: Equations also include dummy variables representing shifts in expenditures to 73:4 (+1) from 74:1 (-1), 75:4(+1)/76:1(-1), 92:4(+1)/93:1(-1). Variable (fin) FIN is (log) real financial assets per household, (debt) DEBT is (log) real debt per household; $\gamma(1)$ is the 1st-order serial correlation coefficient of the residuals. EC is $10^{-2}$ the residual from equation 2 in table 2. LM(S,4), LM(E,4), LM(D) denote the probability values of the LM test statistics for serial correlation (4 lags), ARCH heteroscedasticity (4 lags), and excluding the fin, debt, or FIN/DEBT, DEBT/Y variables.
Table 4  Euler equations for real durable consumer spending (% durable consumer stock),

\[
\text{dependent variable is } \frac{\text{EXP}^D_{t+1}}{\text{STOCK}_t}
\]

<table>
<thead>
<tr>
<th></th>
<th>const</th>
<th>(?rr_{t+1})</th>
<th>(?relpr_{t+1})</th>
<th>(?1)</th>
<th>(?4)</th>
<th>adjR2</th>
<th>LM (S,4)</th>
<th>LM (E,4)</th>
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</thead>
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<tr>
<td>(1)</td>
<td>0.016</td>
<td>0.075</td>
<td>0.024</td>
<td>-0.289</td>
<td>0.515</td>
<td>0.486</td>
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<td></td>
<td>(0.13)</td>
<td>(1.13)</td>
<td>(0.68)</td>
<td>0.467</td>
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<tr>
<td>(2)</td>
<td>-0.017</td>
<td>0.072</td>
<td>-0.278</td>
<td>0.519</td>
<td>0.516</td>
<td>0.030</td>
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<td>(0.15)</td>
<td>(1.09)</td>
<td></td>
<td>0.479</td>
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<tr>
<td>(3)</td>
<td>-0.013</td>
<td>-0.290</td>
<td>0.518</td>
<td>0.580</td>
<td>0.024</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
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<td></td>
<td>0.461</td>
<td></td>
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</table>

instrument list: lagged variables added to equation (3)

<table>
<thead>
<tr>
<th></th>
<th>LM (D)</th>
<th>adjR2</th>
<th>LM (S,4)</th>
<th>LM (E,4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4)</td>
<td>0.274</td>
<td>0.524</td>
<td>0.595</td>
<td>0.058</td>
</tr>
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<td>(5)</td>
<td>0.442</td>
<td>0.518</td>
<td>0.491</td>
<td>0.005</td>
</tr>
<tr>
<td>(6)</td>
<td>0.133</td>
<td>0.535</td>
<td>0.332</td>
<td>0.358</td>
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</tbody>
</table>

Notes: Equations also include three dummy variables for specific shifts in expenditures between quarters. LM(D) is the probability value of the LM test statistic for excluding the instrument list.

Columns 2, 3, and 4 of table 3 present the crucial results for the objective of this paper. In these columns the evidence for the relative importance of household liquid financial assets and debt ratios can be examined. In LCPIH models, household portfolios are viewed as homogeneous aggregates where only net worth matters. On the other hand, Mishkin's hypothesis on liquidity effects emphasizes the importance of the composition of the household balance sheet, in particular the share of liquid assets in household portfolios. In addition, in recent debates on depressed consumer spending commentators have focused on the adverse affects resulting from high debt-income ratios.

The empirical results provide very little support for the disaggregation of household wealth. Columns 2 and 3 in table 3 show that financial assets and debt are significant explanatory variables for durables expenditure only when aggregate wealth effects are not included. Column 4 shows that the hypothesis that high debt/income ratios depress consumer spending receives no support. The estimates suggest that a definitive judgement on Mishkin's liquidity hypothesis should perhaps be postponed. There is no evidence that the coefficients for financial assets and debt are different. Column 4, however, shows that the ratio of liquid financial assets to household debt is potentially a significant variable. Further research with a larger sample period is recommended.
(ii) The Euler-equation approach

Table 4 presents the results for the alternative approach to modelling consumer spending based on the Euler-equation. Note that following the algebraic derivation of this model, the dependent variable is now defined as durables spending as a proportion of the existing durables stock. Most characteristic for the Euler-equations is that income and wealth variables are not included as explanatory variables in the basic equation. Part 1 of table 4, consisting of rows 1, 2, and 3 displays various estimates of the basic equation. Row 1 and 2 show that although they enter with the correct signs, the real interest rate and relative price variables are not significant in explaining movements in durables spending. Essentially, quarterly durables spending has a unit root, with negative first-order serial correlation of the disturbances. In the estimated equations a fourth-order serial correlation component was also included. Although there is no strong theoretical justification to do this, it is consistent with the possibility of an inadequate seasonal adjustment of the consumption data (for example, because the seasonal factors have changed through time).

Part 2 of table 4, presents tests of the so-called overidentifying restrictions. The effects of liquidity constraints and deviations from the rational expectations hypothesis can be identified by testing the explanatory power of lagged variables. For these tests several sets of variables were examined, but the test statistics showed that values of income, wealth, and balance sheet components provide no significant additional explanatory power for future durables expenditures. The stochastic behaviour of durables expenditures is found to be consistent with a model of intertemporal utility maximization and no financial constraints. Closer examination of the individual estimated coefficients of the instrument variables (not shown) confirmed the results in table 3, in the sense that the variable FIN/DEBT appeared as the most significant variable, generally approaching, but not exceeding, the 10 percent significance level.

6.4 CONCLUDING REMARKS

This paper examined the relationship between the household balance sheet and consumer durables expenditures. A number of observers have pointed to the negative effect of balance sheet restructuring as an explanation for the slow recovery by some OECD countries from the recent recession. The household balance sheet may also provide a channel of transmission of monetary policy.

The empirical results confirm that household wealth is an important determinant of consumer (durables) expenditures. As such this result is not very surprising. However, the data on the household balance sheet show that a substantial part of changes in household wealth must be attributed to housing wealth. Several authors (e.g. Bomhof 1994; Meltzer 1995) have suggested that monetary policy has significant effects on household wealth, and identify this effect as an important channel of transmission.

No evidence was found for the claim that "excessive" household debt ratios are directly responsible for slowing down consumer durables expenditure. The empirical results do provide some minor evidence for an extended life cycle - permanent income model, which includes the liquidity hypothesis developed by Mishkin (1976). The financial position of households affects their desire to
commit part of their wealth to illiquid durable consumer goods. Higher (lower) liquidity as represented by a larger (lower) proportion of liquid financial assets in net worth or relative to debt should increase (decrease) spending on durable consumer goods. The estimates show that there is only marginal influence of liquidity in the form of financial assets relative to debt when the net effects on wealth have been taken into account. The recent emphasis in the literature on developments in debt/income ratios remains unsupported by this evidence. More international evidence is certainly needed. One preliminary conclusion, however, is that the recent emphasis on debt ratios is perhaps merely an illustration of a common failure to consolidate balance sheets on an appropriate level when discussing macroeconomic issues.
APPENDIX 6A  DERIVATION OF AN EULER EQUATION MODEL FOR DURABLE GOODS EXPENDITURES

The first-order conditions of maximizing expected utility from

\[ E_t \sum_{s=0}^{\infty} (1 + \gamma)^s [U(C_{t+s}) + V(K_{t+s})] \]

result in

\[ E_t [V'(K_{t+1}) - V'(K_t)] \frac{(1 + r_{t+1})}{(1 + \gamma)} = I \]

With one-period utility \( V(K) = \gamma (1-\beta)^{-1} K \) and rational expectations hypothesis \( E[x_t] = 1 + \epsilon_t \), we obtain

\[ \frac{\theta K_t^{\beta}}{\theta K_t^{\beta}} \left( \frac{1 + r_{t+1}}{1 + \rho} \right) = I + \epsilon_{t+1} \]

Log transformation using the approximation \( \log(1+x_t) = \epsilon_t - (\epsilon_t)^2/2 \) results in

\[-\beta \log(K_{t+1}) = -(e_{t+1})^2/2 + \log(1+\gamma) - \log(1+r_{t+1}) + \epsilon_{t+1} \]

Now note that the stock-expenditure relationship \( K_{t+1} = (1-d) K_t + \exp_{t+1} \) can be rewritten as \( (K_{t+1} - K_t)/K_t = d + \exp_{t+1}/K_t \). Because \( \log(K_{t+1}) \) is approximately \( (K_{t+1} - K_t)/K_t \) we find

\[ \frac{\exp_{t+1}}{K_t} = \delta + \beta^{-1} \left[ \frac{(e_{t+1})^2}{2} \right] \log(1+\rho) + \beta^{-1} \log(1+r_{t+1}) - \beta^{-1} \epsilon_{t+1} \]

The variance of expectational errors captured in \( (e_{t+1})^2/2 \) is taken as constant and finally we define \( v_i = -\beta^{-1} \epsilon_i \). Thus,

\[ \Delta(\frac{\exp_{t+1}}{K_t}) = \beta^{-1} \Delta \log(1+r_{t+1}) + v_{t+1} \cdot v_t \]

APPENDIX 6B  LOG LINEAR APPROXIMATION OF THE DURABLES STOCK-EXPENDITURE RELATIONSHIP

Durables expenditures (\( \exp^D \)) and stocks (\( K \)) are related as

\[ \exp^D_t = K_t + (1 - \delta) K_{t-1} \]

with \( d \) the rate of depreciation. After rewriting and taking logarithms we obtain

\[ \exp^D_t - k_{t-1} = \log \left( \frac{\exp^D_t}{K_{t-1}} \right) = \log \left( \frac{K_t}{K_{t-1}} \right) - I + \delta + \epsilon_t \]

Assuming that \( (K_t / K_{t-1}) \) is close to one \( \log (\exp^D_t / K_{t-1}) \) is close to \( \log(d) \). A Taylor-approximation results in
\[
\exp_D = \alpha_0 + \alpha_1 k t + (I - \alpha_1) k_{t-1}
\]

with \(\alpha_0 = \log(d)\) and \(\alpha_1 = 1/d\)

### APPENDIX 6C PRELIMINARY TESTING FOR NONSTATIONARITY

<table>
<thead>
<tr>
<th></th>
<th>Augmented Dickey-Fuller tests</th>
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<tr>
<td></td>
<td>constant term and trend</td>
</tr>
<tr>
<td></td>
<td>levels</td>
</tr>
<tr>
<td></td>
<td>lags</td>
</tr>
<tr>
<td>(\exp^D)</td>
<td>6</td>
</tr>
<tr>
<td>(y)</td>
<td>4</td>
</tr>
<tr>
<td>(mv1)</td>
<td>8</td>
</tr>
<tr>
<td>(mv2)</td>
<td>8</td>
</tr>
<tr>
<td>(mv3)</td>
<td>4</td>
</tr>
<tr>
<td>(r)</td>
<td>1</td>
</tr>
<tr>
<td>(k)</td>
<td>5</td>
</tr>
</tbody>
</table>

| | constant term only |
| | levels | differences \(t_1\) | differences \(t_4\) |
| | lags | ADF t \(\mu\) | lags | ADF t \(\mu\) | lags | ADF t \(\mu\) |
| \(\exp^D\) | 6 | -2.487 | 4 | -2.804* | 1 | -2.786* |
| \(y\) | 4 | -2.155 | 3 | -4.546*** | 3 | -4.539*** |
| \(mv1\) | 8 | -2.504 | 1 | -3.332** | 2 | -2.942** |
| \(mv2\) | 8 | -2.537 | 1 | -3.266** | 2 | -2.849* |
| \(mv3\) | 4 | -0.931 | 1 | -3.383** | 2 | -2.936** |
| \(r\) | 1 | -2.269 | 1 | -6.719*** | 3 | -6.286*** |
| \(k\) | 5 | -3.623*** | 4 | -1.620 |

Notes: *, **, *** denote significance at 10, 5, 1 percent levels. ADF lags are determined by removing longer lags until last lag is significant.

Variables definitions: \(\exp^D\) is log real durables expenditure per household, \(y\) is log real disposable income per household, \(mv1, mv2, mv3\) are log real net worth per household for alternative wealth definitions, \(r\) is real interest rate, \(k\) is log real stock of durable goods per household.
APPENDIX 6D  DATA

There exist no official time series for the balance sheet of Dutch households. Until recently almost all financial and nonfinancial data published were for the aggregate private sector. Swank et al. (1989) provided an important first step to assemble the necessary disaggregated data, but the study is limited to annual data for the period 1982-1987. Researchers of the Dutch central bank have constructed a dataset for their macroeconomic model MORKMON (see Fase, Kramer and Boeschoten 1990. Bikker and Van Els (1993) employed these data to estimate a financial portfolio model for the Dutch household sector.) The data were never published and are not available. However, general discussions about the method of construction were beneficial. The CCSO research group from the Universities of Groningen and Twente operate the large-scale IBS-CCSO quarterly econometric model of the Netherlands. This model has a substantial monetary submodel (see Jacobs et al. 1993). The detailed data description proved useful.

Several quarterly time series for variables of the household balance sheet were constructed: twelve financial balance sheet variables, plus institutional savings with pension funds and (life-) insurance companies, and two real asset variables: housing stock and durable consumer stock. Breaks in the data series were removed using a ratio splice.

**Currency:** 1972.1-1982.4 total currency from MFJK(table 2.1.a) desaggregation factor for 1982.4-1993.4 = 0.95; 1982.4-1993.4 based on method in Swank et al (1989, pp. 111-112), using Financial statistics of large companies (SFGO, CBS);

**Bank deposits:** consisting of
- (i) demand deposits. 1972.1-1983.4 MFJK(table 3a(1b) + 3a(1c)) desaggregation factor for 1982.4-1983.2 = 0.57 applied to total; 1982.4-1993.4 demand deposits of personal sector DNBKB(table 2.1.3 (17))
- (ii) short term-deposits. 1972.1-1983.4 MFJK(table 3a(2c1)) desaggregation factor for 1982.4-1983.4 = 0.06 applied to total; 1982.4-1993.4 DNBKB(table 2.1.3(18)).
- (iii) foreign currency deposits. 1972.1-1983.4 MFJK(table 3a(2c2)) desaggregation factor for 1982.4-1983.4 = 0.06 applied to total; 1982.4-1993.4 DNBKB(table 2.1.3(19+20)).
- (iv) savings deposits. Savings deposits with domestic banks are all held by households. 1970.1-1983.4 MFJK(table 3a(10)); 1982.4-1993.4 DNBKB(table 3.2).

**Savings certificates:** Savings certificates with maturities longer than 2 years, incl. those listed on the Amsterdam Exchange (maturities up to 2 years are counted as short term deposits). 1972.1-1983.4 MFJK(table 3a(9)); 1982.4-1987.4 DNBKB(table 2.1.3(32)); 1988.1-1990.4 not exchange-listed savings certificates DNBKB(table 2.1.3(32)), and market value of exchange listed savings certificates (AEX); 1991.1-1993.4 only data for market value of exchange listed savings certificates available, ratio spliced to earlier data.

**Shares:** Market value of shares.

\[
SHARES(h) = (1-factor1)*BWA(g+b) + (1-factor2)*BWABU(g+b), \text{ factor1 and factor2 are used to exclude the portion of shares held by businesses, leaving households and mutual funds.}
\]

\[
BWA(g+b) = BWA - BWA(bu) - BWA(f) - BWA(gi)
\]

BWA is market value of common stocks listed on Amsterdam exchange (AEX). 1972.1-1993.4 CBSMF.

BWA(bu) is market value of Dutch shares held by foreigners. Starting point is the value end-1990 from Sparling (1993, p.53). Backward and forward calculations using price index and net purchases of shares by foreigners from DNBKB(table 6.5.2(10)). Calculation \(BWA(bu)(t) = KIS(t)/KIS(t+1) \times [BWA(bu)(t+1) - \text{net purchases (t+1)}].\) Price index for shares KIS is CBS general index.

BWA(f) is value of Dutch shares held by nonbank financial institutions. 1972.1-1983.4 MFJK(table 2.2e(3b); 1982.4-1987.4 DNBKB(table 2.2(10)). From 1986.4 a new presentation in DNBKB
Chapter 6

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aggregates shares and participations, desaggregation factor 0.934 using 1986.4-1987.4.
BWA(gi) is value of Dutch shares held by banking sector. 1972.1-1983.4 MFJK(table 2.1a(4b), 2.2a(3b)); 1982.4-1993.4 DNBKB(table 2.1(13)).

BWABU(g+b) = BWABU - BWABU(f) - BWABU(gi)
BWABU is market value of foreign stocks held by Dutch residents. Starting point is the value end-1990 from Sparling (1993, p.50). Backward and forward calculations using price index, exchange index and net purchases by Dutch residents from DNBKB(table 6.5.1(10)). Weighted average of price index and exchange index using regional distribution of foreign share holdings end-1990 from Sparling (1993): US 29.3%, UK 18.5%, Japan 16.7%, Germany 9.3%, France 5.6% and Australia 1.9%.
BWABU(f) is value of foreign shares held by nonbank financial institutions. 1972.1-1983.4 MFJK(table 2.2(4b)); 1982.4-1987.4 DNBKB(table 2.2(10,11,12,13) From 1986.4 a new presentation in DNBKB aggregates shares and participations, desaggregation factor 0.946 using 1986.4-1987.4.
BWABU(gi) is value of foreign shares held by banking sector. 1972.1-1983.4 MFJK(table 2.1a(5b), 2.2a(4b); 1982.4-1993.4 DNBKB(table 2.1(17)).

Bonds: Market value of bonds, excluding exchange-listed savings certificates.
BONDS(h) = (1-factor)*[BWO(g+b) + BWOBU(g+b)], factor is used to exclude the share of bonds held by businesses, leaving households and mutual funds.
BWO(g+b) = WO - WO(bu) - WO(f) - WO(gi)
BWO is market value of Dutch bonds traded on Amsterdam exchange. 1987.4-1993.4 VEH (except 93.1) and annual data for 1985-1987. Backward calculations using formula BWO(t) = KIB(t)/KIB(t+1)[BWO(t+1) - net demand(t+1)]. 1972.1-1987.3 quarterly data on net demand (= emissions - amortization/conversions) from MFJK(table 7b(6b)) and DNBKB(table 7.1(14.2)). Data from 1986 include net demand of domestic sector in other countries. Price index KIB is CBS price index for bonds, partly calculated from interest rate data. Correction applied for exchange-listed savings certificates: 1988.1-1993.4 (AEX); 1972.1-1987.4 interpolated from total savings certificates using constant desaggregation factor for 1987.4.
BWO(bu) is market value of Dutch bonds held by foreigners. Starting point is the value end-1990 from Sparling (1993, p.53). Backward and forward calculations using price index and net purchases by foreigners from DNBKB(table 6.5.2(10)).
BWO(f) is value of Dutch bonds held by nonbank financial institutions. 1972.1-1983.4 MFJK(table 2.2(4a), 2.2f(4a)); 1982.4-1987.4 DNBKB(table 2.2(8,9,10)).
BWO(gi) is value of Dutch bonds held by banking sector. 1972.1-1983.4 MFJK(table 2.1a(4a), 2.2a(4a)); 1982.4-1993.4 DNBKB(table 2.1(15)).

BWOBU(g+b) = BWOBU - BWOBU(f) - BWOBU(gi)
BWOBU is market value of foreign bonds held by Dutch residents. Starting point is the value end-1990 from Sparling (1993, p.50) excl. DNB holdings of long-term foreign assets. Backward and forward calculations using price index, exchange index and net purchases by Dutch residents from DNB (table 6.5.1(10)). Weighted average of price index and exchange index using regional distribution of foreign bond holdings end-1990 from Sparling (1993): Germany 36.7%, US 13.8%, Japan 7.9%, France 6.3%, Australia 4.2% and UK 2.1%.
BWOBU(f) is foreign bonds held by nonbank financial institutions. 1972.1-1983.4 MFJK(table 2.2(4a), 2.2f(4a)); 1982.4-1987.4 DNBKB(table 2.2(12))
BWOBU(gi) is foreign bonds held by banking sector. 1972.1-1983.4 MFJK(table 2.1a(5a), 2.2a(4a)); 1982.4-1993.4 DNBKB(table 2.1(15))

Short-term debt: Short term debt of households with banks, incl. consumer credit by finance companies which are owned by banks. Excluded is consumer credit from other finance companies and mail order companies, as well as short-term debt to businesses and the government.
1972.1-1983.4 short-term debt with banks of private sector MFJK(table 2.1d, 2.1e, 2.2a*factor=1.110)
The household balance sheet

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desaggregation factor for 1982.4-1983.4 = 0.149; 1982.4-1993.4 short-term debt of personal sector with banks DNBKB(table 2.1.3)

**Long-term debt:**

(i) banks: 1972.1-1983.4 loans to private sector MFJK(table2.1d(6c), 2.1e(6c), 2.2a(5c)) desaggregation factor for 1982.4-1983.4 = 0.213; 1982.4-1993.4 loans to personal sector DNBKB(table 2.1.3)

(ii) life-insurance companies, pensionfunds: 1972.1-1988.1 loans to private sector MIFJK(table 2.2e(5c)) and DNBKB, desaggregation factor for 1986.4-1988.1 = 0.033; 1986.4-1993.4 loans to personal sector DNBKB(table 2.2)

(iii) social security institutions: no series could be constructed, but amount is small

**Mortgage debt:**

(i) with banks: 1972.1-1983.4, mortgage debt private sector MFJK(table 2.1a(7), 2.2a(6)) desaggregation factor for 1982.4-1983.4 = 0.70; 1982.4-1993.4 mortgage debt personal sector DNBKB(table 2.1.3(9 and 10))

(ii) with life-insurance companies, pensionfunds: 1972.1-1988.1 mortgage debt private sector MFJK(table 2.2e(6)) and DNBKB, desaggregation factor for 1986.4-1988.1 = 0.884; 1986.4-1993.4 mortgage debt personal sector DNBKB(table 2.2.1)


(iv) social security institutions: 1972.1-1983.4 MFJK(table 2.2f(6)) and 1984.1-1993.4 DNBKB(table 2.2(27)).


**Durable consumer stock:** Real stock of durables calculated as \( V_t = \sum_{i=0}^{n} \left[ (1-d)^{i+0.5} \exp^{D}_{t-i} \right] \) (compare Owen, 1986, p.122) where \( d = 1 - 0.05 \) \( \frac{1}{(n-0.5)} \) the depreciation rate for which after \( n \) years only 5 percent of the original purchase remains. Koyck transformation can be used to rewrite the stock of durables as \( V_t = (1-d) V_{t-1} + (1-d)^{0.5} \exp^{D}_{t-1} - (1-d)^{n+1.5} \exp^{D}_{t-n-1} \)

Starting value 1971.4 for \( V \) based on data starting 1958.4.

**Institutional savings:** 1972.1-1983.4 MFJK(table 2.2e(10)); 1984.1-1993.4 DNBKB(table 2.2(27)).

**Real interest rate:** Defined as average of long and short interest rate less previous quarter value of year-on-year consumer price inflation.


**Consumer durables expenditure:** Value and volume indexes of expenditures on consumer durable goods CBSM. Rebased to 1990 value of consumer durable expenditure CBSNR.

**ABBREVIATIONS FOR SOURCES:**

<table>
<thead>
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>CBSM</td>
<td>Central Bureau of Statistics, CBS Maandschrift</td>
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<tr>
<td>CBSMB</td>
<td>Central Bureau of Statistics, CBS Maandstatistiek Bouwnijverheid</td>
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<tr>
<td>CBSMF</td>
<td>Central Bureau of Statistics, CBS Maandstatistiek Financiewezen</td>
</tr>
<tr>
<td>CBSNR</td>
<td>Central Bureau of Statistics, CBS Nationale Rekeningen</td>
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<tr>
<td>DNBKB</td>
<td>Dutch central bank, DNB Kwartaalbericht</td>
</tr>
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</table>
MFJK Dutch central bank, DNB Monetaire en Financiele Jaar- en Kwartaalreeksen 1957-1983
VEH Association for Securities Exchange, Amsterdam exchange (AEX)
VROM Dutch government, Eigen woningbezit in cijfers 1993

References

Data points for comparison
The data in this study generally concur with Swank et al (1989). There are however a number of differences in classification (e.g. bonds and bank saving certificates) and factors applied to separate holdings of households and businesses.

<table>
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<tr>
<th></th>
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<th>Swank et al (1989)</th>
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<tr>
<td></td>
<td>1982</td>
<td>1987</td>
</tr>
<tr>
<td>Assets</td>
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<tr>
<td>Currency</td>
<td>22.7</td>
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<td>Bank deposits</td>
<td>169.8</td>
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<td>Bonds</td>
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<td>Shares</td>
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<td>Liabilities</td>
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21.1 30.7
177.7 205.7
44.1 66.6
25.1 52.5
14.6 19.5
14.6 13.2
123.0 159.7
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SAMENVATTING

(Summary in Dutch)

 Dit proefschrift bestaat uit een aantal artikelen over onderwerpen uit de monetaire economie. Monetaire economie gaat over "geld en economie" en beslaat als gevolg een zeer groot terrein van de economie. Wat heeft er in onze economie tenslotte niet met geld te maken? De artikelen c.q. hoofdstukken in dit proefschrift hebben ook op het eerste gezicht gevarieerde onderwerpen. De gemeenschappelijke noemer is echter steeds weer de relatie richting monetair beleid.

De introductie in hoofdstuk 1 geeft aan dat het in de economische wetenschap moeilijk is om "de" waarheid en de enige goede economische analyse (incl. bijbehorende beleidsaanbevelingen) aan te wijzen. Economie blijft toch steeds een voortdurende discussie tussen economen, over alternatieve modellen en hypotheses, en op basis van een stelsel wetenschappelijke normen en waarden. In de volgende hoofdstukken is ook vooral die discussie over modellen en analyses op basis van argument en tegenargument steeds terug te vinden.

Hoofdstuk 2 behandelt de samenhang tussen prijzen, inflatie en reele economische activiteit. Kydland en Prescott (1990) presenteerden in termen van gemiddelden, varianties en covarianties een beschrijving van de macro-economische data van de Verenigde Staten. Hun bedoeling was om te komen tot een set van gestyleerde feiten, waarmee een criterium zou ontstaan waaraan concurrerende macro-economische theorieen getoetst konden worden. Een van de resultaten van Kydland en Prescott is een ogenschijnlijke revolutie in de visie op het cyclische gedrag van prijsspiegels en inflatie (hun relatie tot de cyclus in reele economische activiteit). In tegenstelling tot de bestaande consensus in de macro-economie concluderen Kydland en Prescott dat de relatie van prijzen met economische activiteit niet procyclisch (een positieve correlatie met economische activiteit) is, maar in ieder geval tijdsvariabel en eerder contracyclisch (een negatieve correlatie met economische activiteit). De implicatie daarvan zou zijn dat er iets fundamenteel mis is met de meest gangbare macro-economische theorieen, omdat die vooral gericht zijn op de verklaring van procyclische prijzen. Volgens Kydland en Prescott is de negatieve correlatie tussen prijzen en economische activiteit een sterke indicatie dat de moderne "real business cycle" theorie beter correspondeert met de werkelijkheid. Hoofdstuk 2 bevat een uitwerking van wat de standaard theorie zegt over het cyclische gedrag van prijsspiegel, economische activiteit, en inflatie. Tevens worden de resultaten van Kydland en Prescott nader geanalyseerd. De belangrijkste conclusies zijn als volgt. (1) Wanneer we de Kydland-Prescott correlaties nemen zoals ze zijn, is een van de bijbehorende conclusies dat de macro-economische dynamiek van na de Tweede Wereldoorlog veroorzaakt zou zijn door tijdelijke aanbod- en vraagschokken. Dit strookt niet met de tegelijkertijd waargenomen persistentie in inflatie en suggereert er is niet klopt met de gebruikte methodologie. (2) Een door vraagschokken veroorzaakte conjunctuurcyclus kan heel goed resulteren in
tijdsvariabele en negatieve correlaties. Correlaties alleen onderscheiden dus niet tussen reele en nominale oorzaken van de conjunctuur. (3) De negatieve correlatie tussen prijzen en economische activiteit die Kydland en Prescott en anderen vinden, blijkt het gevolg van een specifieke wijze waarop de "trend" uit de prijzedata wordt verwijderd. Aangetoond kan worden dat het verwijderen van de "trend" in prijzen direct verband houdt met veronderstellingen over de vorming van verwachtingen ten aanzien van prijsschokken en inflatie. Daarmee verandert de kwestie van pro- of contracyclische prijzen van een discussie over nominale of reelle conjunctuurschokken in een discussie over het juiste model van inflatieverwachtingen.

Sinds de jaren tachtig is de doelstelling van prijstabiliteit of lage inflatie een steeds belangrijker thema in het macro-economische beleid van geindustrialiseerde landen. Daarmee heeft ook de discussie over de fundamentele determinanten van inflatie aan belang gewonnen. De consensus waarmee bijna elke student economie wordt grootgebracht is dat inflatie -- correct gedefinieerd als de lange termijn opwaartse beweging in het algemeen prijsschok -- primair een monetair fenomeen is. In hoofdstuk 3 wordt stelling genomen tegen de vanzelfsprekendheid waarmee toch in populaire behandelingen gesproken wordt over lonen, energieprijzen, huren, belastingen, etc. als determinanten van inflatie. Het steeds terzijde schuiven van de monetaire aspecten wordt gerelateerd aan drie mogelijke verklaringen: (1) verschil van inzicht ten aanzien van de definitie van inflatie; (2) fundamenteel verschil van mening over de correcte macro-economische theorie en empirie; (3) andere monetaire relaties in een kleine open economie met een vaste wisselkoers. De praktische uitwerking van het vraagstuk vindt plaats in de vorm van een vergelijking van twee inflatiemodels. De specifieke vraag die onderzocht wordt is of het onlangs ontwikkelde P-ster model -- dat representatief zou kunnen zijn voor de standaard theorie over geld en prijzen -- verworpen moet worden ten gunste van het populaire socio-politieke model, dat vooral kostenfactoren benadrukt als drijvende kracht achter inflatie. De uitkomst is dat noch theoretisch, noch empirisch voldoende reden aanwezig is om het monetaire model te verwerpen. Dat het P-ster model empirisch goede resultaten geeft staat enigszins in contrast met vroegere studies waarin het verband tussen geld en inflatie in ieder geval op kortere termijn niet zo sterk leek. Daarmee worden de argumenten dat lonen en kosten eigenlijk vooral monetaire transmissiemechanismen weergeven (i.p.v. fundamentele schokken) of in ieder geval niet aan de macro-economische geldhoeveelheidsrestrictie kunnen ontkomen (MV=PY) weer op de voorgrond gehaald. Maar zolang empirisch niet overduidelijk onderscheid te maken is tussen de verschillende modellen, terwijl toch de beleidsimplicaties sterk kunnen verschillen, moet aan de hand van ander bewijsmateriaal een keuze tussen de modellen gemaakt worden. Verwijzend naar de bestaande literatuur is de conclusie dat we het monetaire model zouden moeten blijven prefereren. Het hoofdstuk besluit met enige beschouwingen over de politieke aspecten van het inflatie debat. De economische en dus ook politieke kosten van anti-inflatie beleid zijn zeer afhankelijk van de ontwikkelingen in lonen, energieprijzen, huren, belastingen, etc. Vanuit die optiek is de aandacht die vaak uitgaat naar deze zgn. kostenfactoren wel begrijpelijk. Maar die gerechtvaardigde aandacht betekent natuurlijk niet dat daarmee de eindverantwoordelijkheid van de monetaire autoriteiten voor inflatie ontlopen kan worden, of dat we door de nadruk die het kostendebat krijgt de monetaire oorzaken c.q. randvoorwaarden van inflatie als minder belangrijk moeten gaan beschouwen.

Hoofdstuk 4 gaat over endogeniteit van de geldhoeveelheid en de betekenis daarvan voor het vraagstuk van de causaliteit tussen geld en economie. Tegen het midden van de jaren zeventig was de
significante relatie tussen de geldhoeveelheid en economische activiteit in brede kring aanvaard als een maatstaf voor de effectiviteit van monetair beleid. In recente jaren staat de causaliteit van geld en monetair beleid richting economie weer ter discussie. In de "real business cycle" theorie wordt aan geld volstrekt geen rol toebedacht ter verklaring van de reële conjunctuur. De positieve correlatie tussen geld en economische activiteit wordt verklaard als een omgekeerde causaliteit. In de real business cycle theorie beïnvloeden veranderingen in economische activiteit de behoefte aan geld als transactiemiddel en staat het bankwezen als financiële intermediair bereid om volledig passief aan deze veranderende behoefte te voldoen. Een iets specifiekere uitwerking van de hypotheses over endogeniteit of exogeniteit van de geldhoeveelheid staat bekend als de "multiplier approach". Monetaire autoriteiten beheersen de hoeveelheid basisgeld (bankbiljetten, munten, reserves van het bankwezen). Daarentegen is de totale geldhoeveelheid een veelvoud van de basisgeldhoeveelheid, met daartussen de geldmultiplikator die een functie is van beslissingen van het commerciële bankwezen en de private sector. De hypothese van de real business cycle theorie is nu dat acties van monetaire autoriteiten die de basisgeldhoeveelheid betreffen geen effect hebben op economische activiteit en dat de correlatie tussen totale geldhoeveelheid en economische activiteit voortkomt uit veranderingen van de geldmultiplikator. De empirie wijst uit dat veranderingen in de basisgeldhoeveelheid wel effecten hebben op economische activiteit (in termen van Granger causaliteit). Bovendien is het zo dat de geldmultiplikator niet alleen maar het resultaat is van beslissingen van banken en private sector in reactie op andere reële determinanten, maar dat monetair beleid ook invloed heeft op de multiplikator. Daarmee lijkt de splitsing van de correlatie tussen geld en economie in een (exogeen nominaal) monetair deel en een (endogeen) reeel deel niet langer zinvol. De multiplier-approach is niet geschikt om een definitieve uitspraak te verkrijgen over het belang van reële en nominal conjunctuurschokken.

Hoofdstuk 5 behandelt de "credit view" van monetair beleid. The credit view benadrukt het effect van monetair beleid op de hoeveelheid en condities van het kreditaanbod door banken als een essentieel onderdeel van de transmissie van monetair beleid. De bestaande literatuur geeft aan dat het idee dat banken als financiële intermediairs een speciale rol vervullen algemeen aanvaard is. Echter, het is nog maar de vraag of daarmee ook is aangetoond dat de kredietverlening door banken essentieel is voor monetaire transmissie. Het is heel goed mogelijk dat de recente discussie over bankkrediet slechts een aspekt van tweede-orde belangrijkheid betreft. Commerciele banken zijn om twee redenen speciaal. (1) In bankaire systemen met geen of slechts fractionele reserveverplichtingen zijn banken niet alleen kredietintermediairs, maar kreeren banken nieuw geld en krediet. (2) Banken zijn in staat door specialisatie, etc. als kredietintermediairs in algemene zin de kosten van krediet te verlagen. Een theoretische beschouwing geeft aan dat deze twee aspecten waarschijnlijk niet los van elkaar staan. Veranderingen in het aanbod van geld en krediet bepalen ook de prijs van geld en krediet -- de rente. Een speciale rol van banken als kredietintermediairs voegt daar een dimensie aan toe maar verandert de analyse niet wezenlijk. De nadruk die in de recente literatuur is komen te liggen op aspekt (2) is dan waarschijnlijk ook overdreven, omdat zelfs wanneer banken geen speciale rol vervullen als kredietintermediairs, monetair beleid toch effectief blijft. Nieuwe inzichten uit de credit view volgen alleen als er sprake zou zijn van (niet-prijs) kredietransactsoenering door banken. Voor deze specifieke hypothese lijkt echter in de empirie geen bewijsmateriaal te bestaan.

Hoofdstuk 6 behandelt de relatie tussen consumentenbestedingen aan duurzame goederen en de vermogenspositie van gezinnen. Als reactie op het langzame economische herstel uit de recessie aan
het begin van de jaren negentig heeft destijds een groot aantal commentatoren gewezen op het mogelijk negatieve effect van de slechte staat van de financiële balans van banken, private sector en overheid. De gangbare redenering was dat gedurende de jaren tachtig overheden, huishoudens en bedrijven een overmaat aan geld geleend hadden. Toen ze eenmaal geconfronteerd werden met onverwachte economische tegenvallers was het resultaat dat men uitgaven ging uitstellen om versneld schulden af te lossen. Maar schuld is slechts een onderdeel van de totale vermogenspositie van huishoudingen. En economische theorie over consumptiegelddrag geeft aan dat alleen de totale vermogenspositie relevant zou moeten zijn voor consumptieve bestedingen. Het mag duidelijk zijn dat als leningen gebruikt worden om duurzame activa te kopen er niet perse een negatief effect op vermogensposities plaats heeft. Een extra specifieke hypothese over consumentengedrag is de liquiditeitshypothese van Mishkin (1976). Mishkin onderzocht en vond voor de Verenigde Staten dat de samenstelling van de vermogensbalans van gezinnen, en met name de verhouding tussen vaste schuld en liquide activa, van belang zou zijn voor consumentenbestedingen aan duurzame goederen. Om voor Nederland deze hypothesen empirisch te kunnen onderzoeken zijn er tijdsreeksen samengesteld voor de vermogensbalans van Nederlandse gezinnen. We vinden geen empirische ondersteuning voor het idee dat de omvang van consumentenschuld (als ratio van beschikbaar inkomen) iets betekent voor consumentenbestedingen. Consumenten reageren op inkomen en netto vermogen zoals de theorie aangeeft, en schuld zegt in principe niets over netto vermogen omdat daar bezittingen tegenover kunnen staan (bijvoorbeeld: hypotheken en huizen). Wel is er een matige indicatie dat de verhouding tussen liquide activa en schuld een negatief effect uitoefent op bestedingen.
CURRICULUM VITAE