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Keynesian and Monetarist Views on the German Unemployment Problem — Theory and Evidence

by

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Abstract:

Persistently high unemployment rates in Germany have led to a long-running controversy on the causes of the unemployment problem. This paper aims to review the contribution of Keynesian and monetarist theories to this controversy and explores empirically their implications for the explanation of high unemployment in Germany using a structural vector regression approach. In addition, this paper discusses the so-called wage gap which plays an important role in the debate whether the German unemployment problem is a real wage problem. Even though this paper cannot hope to settle the unemployment controversy, it nevertheless shows why a consensus has remained elusive.

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I. Introduction

Persistently high unemployment rates in Germany have led to a long-running controversy on the causes of the unemployment problem and the appropriate policy response. The opposing viewpoints, and in particular the public exchanges on this issues, are often based either on Keynesian or on monetarist theories of business cycle fluctuations which lead to very different conclusions regarding the causes and the cure of the unemployment problem. Since this debate is going on since 30 years and is nowhere near a conclusion, this paper attempts to take stock and offers a review of the arguments exchanged between both sides.

Moreover, this paper presents evidence on the Phillips curve in Germany. This relation is central to the controversy between the two schools of thought because its slope is a key parameter determining whether demand policies can have a lasting impact on real variables like the unemployment rate. Since Keynesians and monetarists disagree sharply on theoretical grounds on this parameter, this paper estimates the Phillips curve using both a Keynesian and a monetarist identification scheme. In addition, the role of demand and supply shocks for fluctuations in unemployment and inflation is investigated using the historical decomposition technique. This serves to explore empirically the explanations offered by the two Phillips curve models regarding the causes of the secular increase in unemployment over the past 30 years.

The empirical analysis provides the background for a detailed discussion of the controversy on the German unemployment problem. In addition to the Phillips curve this paper draws also on the so-called wage gap concept, which measures the distance between the actual real wage and the hypothetical full employment real wage, to analyze the causes of unemployment. To this end an empirical measure of the wage gap is presented and its contribution to the debate is

discussed. Regarding the policy dispute, first the monetarist demand for wage moderation is reviewed, which is followed by a discussion of the Keynesian doubts on the effectiveness of this policy. In conclusion, this paper cannot hope to settle the long-running controversy on this issue, but it shows nevertheless why a consensus has remained elusive and will probably remain so.

The paper is structured as follows. Section II offers a general introduction into the Keynesian and monetarist views on unemployment and inflation. Particular attention is paid to the role of demand management policies in the two paradigms for the stabilization of output, since this is of central importance to the policy debate. This section contains also a discussion of the NAIRU concept, which modifies the traditional Keynesian view in some important aspects. Section III contains the empirical evidence on the Phillips curve in Germany. Before presenting the estimates of the slope of the Keynesian and monetarist Phillips curves, this section shows that at the business cycle frequency a stable Phillips curve relation is present in the data. Next, it provides an introduction into the econometric technique used for testing the slope of the Phillips curve and discusses the identification of the Phillips curve models. Having estimated these models, the results for the Keynesian and monetarist Phillips curves are presented, and the results of the historical decomposition are shown. Against this background section IV provides a detailed review of the controversy in Germany on the unemployment problem and its cure. Section V contains the conclusion.

II. Keynesian and monetarist perspectives on unemployment and inflation

2.1 The Keynesian perspective

2.1.1 The departure from classical economics

The characteristic difference between classical and Keynesian models is that the former assumes that prices (including wages) adjust promptly so as to equate supply and demand quantities on all markets, whereas the latter assumes that nominal wages do not adjust within the relevant period.[1] The assumption of sticky wages makes it is possible in Keynesian models that labor demand does not equal labor supply quantities. In particular, this allows for the existence of involuntary unemployment.[2] This departure from classical economics was prompted by the experience of widespread involuntary unemployment in the depression in the 1930s, which classical economics could not account for. Moreover, the observation that changes in aggregate demand, for example due to changes in government demand for goods, are an important source of short-run fluctuations in economic activity was also hard to reconcile with classical economics.[3] In Keynesian models sluggish wage adjustment accounts for both observations. For example, a fall in demand in product markets will reduce labor demand if wages do not fall sufficiently, thereby leading to involuntary unemployment. If prices also adjust sluggishly, the fall in labor demand reduces product demand further. This leads to a situation where recessions are the result of deficient labor and product demand

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1 See McCallum (1989, pp. 174).

2 Other variants of Keynesian models assume instead of sticky wages that prices are sticky. See Romer (1996, pp. 214), for an extensive discussion.

3 See Romer (1993, p. 5), on these two points.

reinforcing each other.[4] That is, workers are unemployed because firms are not producing enough goods and services, and firms do not increase production because there is not enough demand; and demand is deficient because people are unemployed. Besides accounting for recessions, another implication of sluggish wage adjustment is that the classical dichotomy between real and nominal variables fails, because it is the *nominal* wage which is slow to adjust.[5] Hence, movements in nominal variables like the money supply can have large effects on real variables like output and employment.

2.1.2 The Phillips curve

In the early Keynesian models nominal wages were treated as exogenous which posed a problem for dynamic analysis and for the formulation of policy advice, because nominal wages are likely to be set conditional on the state of the economy.[6] Since in Keynesian models economic policy can affect the state of the economy, it has an influence on the future values of nominal wages even if wages do not respond within the period to the state of the economy. If this effect of policy on future wages is not taken into account, the dynamic analysis misses an important factor and any advice given to policy makers may be flawed. In other words, nominal wages may be treated as predetermined variables, but are unlikely to be exogenous in a complete model of the macroeconomy. Moreover, in Keynesian models prices are determined as a mark up on unit costs at standard rates of output and capacity utilization.[7] Since wage costs are the main determinant of unit costs, treating nominal wages as exogenous precludes analyzing the causes of inflation.

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4 See Snower (1997, p. 20).

5 See Romer (1993, p. 5).

6 See McCallum (1989, pp. 176).

7 See Blanchard (1990, p. 784).

To close the model an equation for nominal wages was needed that explains this variable as a function of conditions prevailing in the past. This link was provided by Phillips (1958) who suggested that the nominal wage rate could be explained by recent values of the unemployment rate.[8] He argued that if the demand for labor was very high relative to the supply of labor, employers would bid up wages very rapidly. As additional workers were hired, the unemployment rate would fall. The larger the discrepancy between labor demand and supply, the larger the upward pressure on nominal wages would become. Excess labor supply would lead, on the other hand, to downward pressure on wages and rising unemployment. Using data from 1861 to 1957 for the United Kingdom he showed empirically that the growth rate of nominal wages was indeed negatively correlated with the rate of unemployment. A hypothetical Phillips curve corresponding to his finding is depicted in Figure 1.[9] The relationship between the wage growth rate and the unemployment rate is non-linear, reflecting the finding of Phillips that the strength of the relationship between the two variables depends on the level of the unemployment level. In particular, tight labor markets cause the employers to bid wages up rapidly, whereas loose labor markets with high rates of unemployment cause workers to bid wages down relatively slowly. This appeared to confirm the assumption of sluggish downward adjustment of wages, which is central for the Keynesian view on the causes of recessions and high unemployment.[10]

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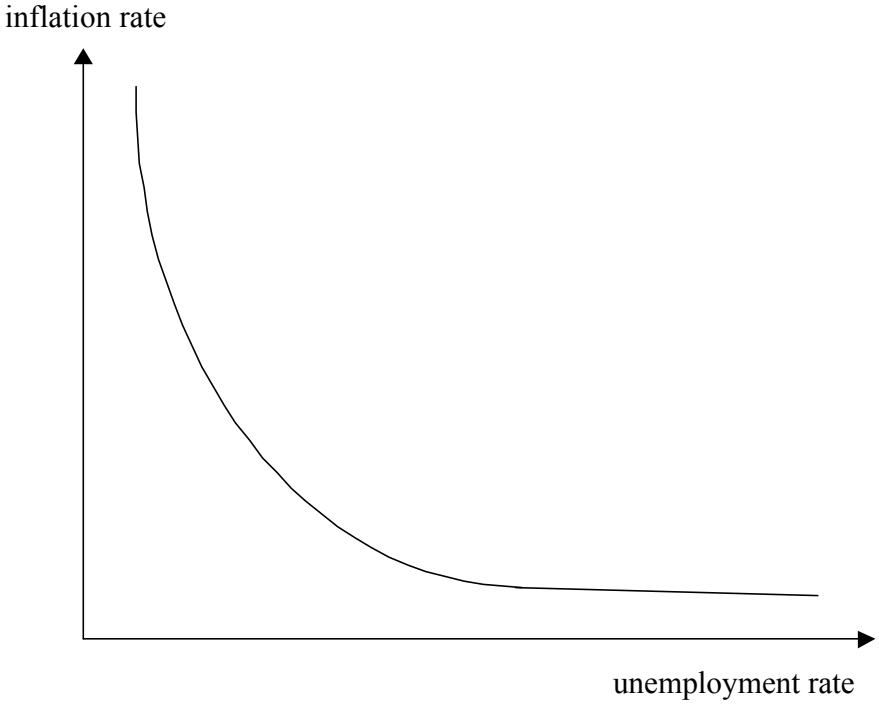
[8] This section draws on the discussion of the Phillips curve in Espinosa-Vega and Russell (1997, pp. 6).

[9] This Figure is reproduced from Espinosa-Vega and Russell (1997, p. 7).

[10] For a more detailed discussion of the Phillips curve, see Espinosa-Vega and Russell (1997, pp. 6).

Figure 1: The Phillips curve



The Phillips curve also establishes the link between monetary policy and inflation. Monetary policy can affect the level of aggregate employment in the economy through its influence on aggregate demand conditions. This implies that monetary policy can exercise control over inflation via the Phillips curve mechanism. Moreover, the Phillips curve suggests that there is a menu of combinations of employment levels and inflation rates the central bank can choose from. In the traditional Keynesian models a demand stimulus through expansionary policy would increase employment without leading to higher inflation because nominal wages and prices were treated as exogenous.[11] With the Phillips curve mechanism providing a link between real and nominal variables, the demand stimulus would still lead to a higher employment level but also to higher inflation. Thus, the Phillips curve suggests that policy makers have to make a trade-off between the unemployment rate and the inflation rate and macroeco-

[11] See also Espinosa-Vega (1998, p. 16).

nomic policy needs to strike the right balance between sustaining robust economic activity and controlling inflation.[12]

The assumption of a stable Phillips curve, which corresponded well to the experience in the United States in the 1950s and 1960s, implies that fiscal and monetary policy are powerful both in the short-run and in the long-run.[13] In particular, this implies that money is not super-neutral in the long-run:[14] If monetary policy increases the rate of growth of the money supply, prices are always one step ahead of nominal wages, because the latter are assumed to adjust only slowly to the rising price level. As a consequence the real wage declines permanently, the employment level increases and unemployment declines.[15] Thus, an increase in the rate of growth of money has long-run effects on real variables.[16]

2.1.3 The case for aggregate demand management policies

Keynesian economics assign economic policy an important role in sustaining robust economic activity. In contrast to the 'natural rate' view which gained

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12 See Espinosa-Vega (1998, p. 19), and Goodfriend and King (1997, p. 236).

13 See Goodfriend and King (1997, p. 236), for a discussion of the empirical evidence on the Phillips curve in the 1950s and 1960s.

14 Fisher and Seater (1993, p. 402), define long-run neutrality (LRN) and long-run super-neutrality (LRSN) of money as follows: "By LRN, we mean the proposition that that permanent, exogenous changes to the *level* of the money supply ultimately leave the *level* of real variables and the nominal interest rate unchanged but ultimately lead to equiproportionate changes in the *level* of prices and other nominal variables; by LRSN, we mean the proposition that permanent, exogenous changes to the *growth rate* of the money supply ultimately lead to equal changes in the nominal interest rate and leave the *level* of real variables unchanged."

15 For a detailed discussion of the permanent output-inflation trade-off see Romer (1996, pp. 222).

16 But monetary policy is neutral in the long-run, if not super-neutral. An increase in the *level* of the money supply leads to an increase in the price level. Eventually nominal wages adjust to this higher price level and the real wage, after falling initially, returns to the value it had before the money supply was increased. Consequently this policy impulse has no long-run effects on the level of employment or output.

predominance later and which we will discuss below, output was not assumed to fluctuate symmetrically around a 'natural' path of growth (potential output) but Keynesians thought that in the absence of vigorous demand management policies the average level of output would be below the potential level of output, and therefore it would be inefficiently low.[17] This view implies that the potential level of output is close to the peaks of the business cycles and not somewhere in the mid range of peak and troughs.[18] Negative demand shocks can push output below its potential level, but positive demand shocks do not push it very much above this level. Tobin (1993) writes: "Excess demand in aggregate is mainly an 'inflationary gap', generating unfilled orders and repressed or open inflation, rather than significant extra output and employment."[19] That is, even though excess demand is an issue in Keynesian models and macroeconomic stabilization therefore requires two-sided counter-cyclical demand management, it is nevertheless maintained that the efficient level of activity is attained only in booms. De Long and Summers note that this positive view of booms is in line with the public perception which sees them generally as representing the 'good times'. They write: "... booms cause few regrets: there are few complaints after cyclical expansions by people who wish they had not been fooled into working."[20] To illustrate the Keynesian view of business cycles, Figure 2 plots for a hypothetical economy the path of potential output as the dotted line and actual output as the solid line.[21]

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[17] This section draws on De Long and Summers (1988, pp. 437). See also Tobin (1996, pp. 4).

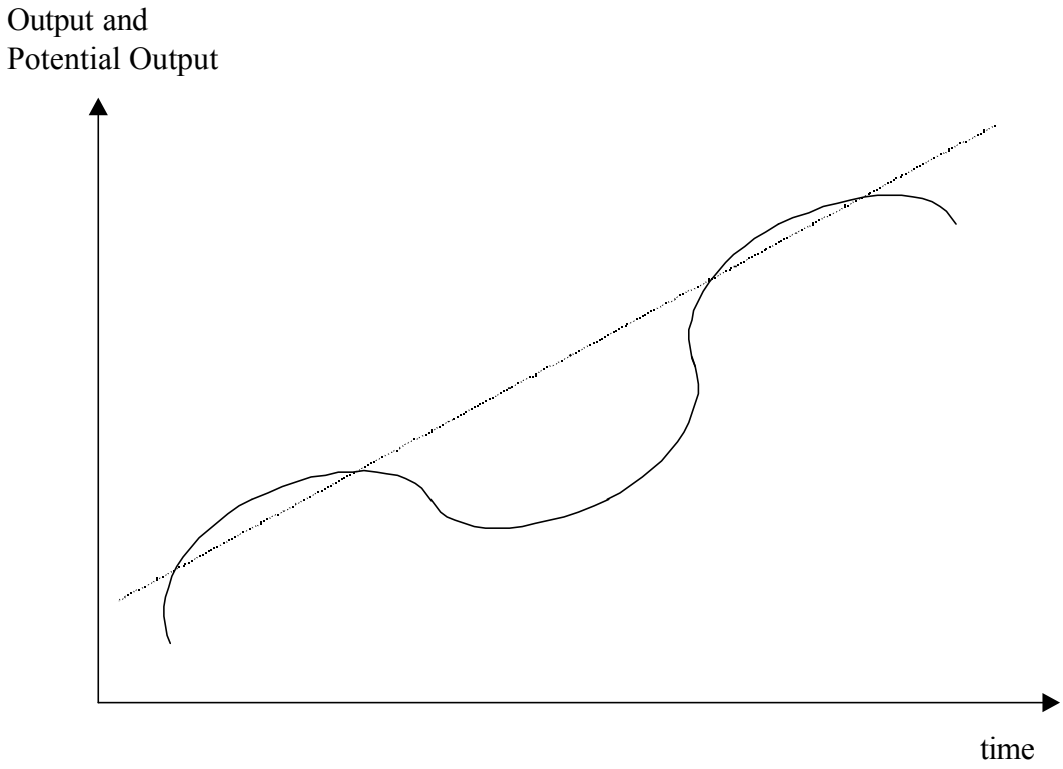
[18] See Tobin (1996, p. 5).

[19] See Tobin (1993, p. 52).

[20] See De Long and Summers (1988), p. 439.

[21] For a Keynesian approach to measuring the output gap see also the peak-to-peak method in De Long and Summers (1988), pp. 457. Figure 2 attempts to present a stylized version of this approach.

Figure 2: Business cycle fluctuations — the Keynesian view



De Long and Summers (1988) summarize the business cycle depicted in Figure 2 as follows: "That the business cycle consists of repeated transient and potentially avoidable lapses from sustainable levels of output is a major piece of the Keynesian view: there is often room for improvement, and good policy aims to fill in troughs without shaving off peaks."[22]

The proposition that output is most of the time below its sustainable level rests on the presumption that monopoly power is widespread because monopoly power leads to higher prices than under perfect competition and therefore to inefficient low real activity.[23] Moreover, the existence of persistent involuntary unemployment is taken as another indicator that there is slack in the economy. It follows that a demand policy that fills in the troughs without shaving off the

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[22] See De Long and Summers (1988, p. 438).

[23] See De Long and Summers (1988, p. 437).

peaks would be welfare enhancing, because this policy would raise the average level of output, which would bring the economy closer to its efficient level of real activity.[24]

2.1.4 The Keynesian policy assignment

According to the Keynesian perspective on business cycle fluctuations an activist aggregate demand management policy has the potential to be welfare enhancing. With fiscal and monetary policy economic policy makers have two tools at their disposal to achieve this objective. Even though Keynesian models suggest that monetary policy has powerful effects, in the 1950s and 1960s the role of monetary policy in practice was to support fiscal policy which had to carry the main burden of stabilization policy.[25] It was thought that monetary policy worked primarily by affecting the availability of financial intermediary credit, which is particular important for small businesses and individuals. "Accordingly," Goodfriend and King write, "there was a reluctance to let the burden of stabilization policy fall on monetary policy, since it worked by a distortion of sorts."[26]

The task of demand policy to strike the right balance between sustaining a high employment level and keeping inflation under control is complicated by the possibility that wage-price spirals lead to high rates of inflation without stimulating real activity. A wage-price spiral may emerge when trade unions and employers make incompatible claims on national income and each side attempts to increase its income share by increasing wages or prices respectively, which is answered by the other side in kind. In terms of Figure 1 the resulting wage-price

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[24] See De Long and Summers (1988, p. 437).

[25] See Goodfriend and King (1997, p. 237).

[26] See Goodfriend and King (1997, p. 237).

spiral leads to an upward shift of the Phillips curve. Economic policy has to respond to this increase in inflation by tightening demand conditions, thereby reducing inflation but incurring higher unemployment. The threat of tight demand conditions represents, of course, a major incentive to the partners in the wage bargaining process to settle their disputes without taking recourse to wage-price spirals. Consequently trade unions and employers have in the Keynesian policy assignment the task to preserve price stability, whereas economic policy has to ensure the maintenance of full employment by using its instruments of demand policy to this effect, but only if wages and prices are set in accordance with the price stability goal. Thus, sustaining full employment and keeping inflation low requires a large degree of coordination between all three parties.

The task for economic policy makers in the Keynesian assignment is particularly challenging because they have to make sure that economic activity meets the expectations of trade unions and employers, which requires considerable fine tuning. For instance, an economic boom due to an unexpected surge in foreign demand is likely to favor firms, because these can raise the prices for their products and thereby increase their share in national income, whereas nominal wages have been fixed in advance and cannot respond to booming demand and rising prices. The perceived injustice by trade unions may trigger high wage demands in the next wage round, leading to a wage-price spiral. To prevent this, economic policy has to respond to the surge in foreign demand by tightening domestic demand in order to cool the economy down and to limit the scope for price increases of firms. Since economic policy affects the real economy only with lags, this is a highly challenging task.[27]

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[27] An interesting discussion of the difficulties of demand management policies in reconciling the expectations of firms and trade unions is found in Sachverständigenrat (1975, p. 6).

2.2 The monetarist challenge

2.2.1 The expectations-augmented Phillips curve

The monetarist challenge to the Keynesian consensus, which prevailed until the early 1970s, was based both on theoretical and empirical arguments.[28] They showed that on theoretical grounds the traditional Phillips curve is miss-specified and proposed instead the expectations-augmented Phillips curve. Empirically, the monetarist position was substantiated by the experience of stagflation in the 1970s when the expectations-augmented Phillips curve empirically fared much better than its traditional counterpart.

Beginning with the theoretical objections to the traditional Phillips curve, Milton Friedman, the 'father' of monetarism, pointed out that unemployment is the difference between labor supply and demand and, according to standard economic theory, households and firms base their decisions on labor supply and demand on *real* wages and not on *nominal* wages.[29] It follows that instead of the nominal wage it should be the real wage which rises when there is excess demand for labor and falls when there is excess supply.[30] That is, the Phillips curve should be formulated in terms of real wages. If instead a relationship between the change in nominal wages and the unemployment rate is postulated, as the traditional Phillips curve does, this implicitly assumes that changes in current nominal wages are equivalent to changes in expected future real wages, taking into account the forward looking nature of wage contracts.[31] Furthermore, Friedman notes that this assumption really encompasses two assumptions: First, price

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[28] See Blanchard (1990, pp. 785), and Mankiw (1990, p. 5).

[29] See Espinosa-Vega and Russell (1997, pp. 8), and McCallum (1989, pp. 181).

[30] See McCallum (1989, p. 182).

[31] The following line of argument draws on Espinosa-Vega and Russell (1997, pp. 8).

expectations need to be rigid in the sense that people do not expect the price level to change and, hence, a change in nominal wages corresponds to a change in real wages. Second, only if workers do not resist a reduction in their real wages through higher inflation is it possible to obtain a Phillips curve that is stable enough to offer policy makers a usable menu of options. Both assumptions are hard to justify because the first assumption exposes that Keynesian models have not paid very much attention to the process of expectations formation and the second assumption appears odd if one recalls that downward rigidity of nominal wages, which is a central element of Keynesian economics, rests on the assumption that workers resist reductions in their real wages and it is not obvious why they would be less opposed to a wage cut if it occurs through an increase in inflation.[32]

Modifying the Keynesian Phillips curve to account for agents forming expectations about future prices changes the short- and long-run relationship between inflation and unemployment considerably.[33] The expectations-augmented Phillips curve is given by the following equation:

(1) $\Delta w_t = f(u_{t-1}) + \Delta p_t^e$.[34]

The change in current nominal wages, Δw_t, is still a function of recent rates of unemployment, $f(u_{t-1})$, as postulated in the traditional Phillips curve, but in addition the change in nominal wages depends now on expected inflation, Δp_t^e. The sign of the short-run relationship between inflation and unemployment is

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[32] However, Tobin (1993) points out that this behavior would be rational if workers did not care so much about their absolute wage but more about their wage relative to their co-workers. Thus, a worker might be unwilling to accept a nominal wage cut since he does not know for sure if his co-workers will do the same. An increase in inflation, in contrast, ensures that the real wages of all workers are affected in essentially the same way.

[33] The following section draws on McCallum (1989, pp. 181).

[34] Small letters denote logarithms throughout the paper.

the same as before, but the transmission mechanism differs: An increase in aggregate demand allows firms to increase their prices, which leads to a higher inflation rate. Friedman assumes that expectations are formed adaptively ($\Delta p_t^e = \Delta p_{t-1}$), meaning that the increase in current inflation is not expected by workers since they expected inflation to be equal to the inflation rate in the last period.[35] The unexpected increase in inflation reduces the real wage received by workers, which increases labor demand by firms, employment rises and the unemployment rate falls. Consequently there is a negative short-run relationship between inflation and unemployment, just as predicted by the traditional Phillips curve, but in the monetarist model the transmission runs from aggregate demand via unexpected inflation to the unemployment rate, while in Keynesian models the transmission runs from aggregate demand via the unemployment rate to nominal wages and inflation. That is, compared to its traditional counterpart the expectations-augmented Phillips curve postulates exactly the opposite direction of causality.

There is also a striking difference in the long-run properties of the traditional Phillips curve and the expectations-augmented Phillips curve: Whereas the former implies that there is a long-run trade-off between the rate of inflation and the unemployment rate, there is no such trade-off in the latter. This follows from the observation that in the long-run, when the economy is in steady state, the rate of growth of the nominal wage is equal to $\Delta w_t = \Delta p_t + l$ where l depends on productivity growth in steady state.[36] Inserting this condition into (1) yields the following steady state relation between inflation and unemployment:

(2) $$\Delta p + l = f(u) + \Delta p^e .$$

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[35] See Taylor (2001, p. 125), for Friedman's position on expectation formation.

[36] This section draws on McCallum (1989, pp. 182).

In steady state expected inflation is equal to actual inflation ($\Delta p^e = \Delta p$) and the two terms drop out of (2), leaving us with

(3) $\quad l = f(u)$.

This expression shows that once the Phillips curve is augmented to account for expectations the steady state unemployment rate is *not* related to the steady state inflation rate, in contrast to the predictions of the traditional Phillips curve. Thus, in the long-run there is no trade-off between inflation and unemployment anymore. Technically, this means that superneutrality holds in monetarist models. This has far reaching policy implications, which we will discuss in more detail below.

The disappearance of the long-run trade-off is also called the accelerationist hypothesis.[37] To illustrate this hypothesis we denote the steady state unemployment rate as $\bar{u}$ and specify $f(u_{t-1})$ as u_{t-1}. Moreover, we formulate the expectations-augmented Phillips curve as a relation governing the inflation process and introduce a supply side shock $e_{s,t}$ which proved important for modeling the inflation process in the 1970s when major oil price shocks hit the world economy. This yields

(4a) $\quad \Delta p_t = \Delta p_t^e - a(u_{t-1} - \bar{u}) + e_{s,t}$, $\qquad$ with $a > 0$.

Assuming again adaptive expectations we obtain the following version of the expectations-augmented Phillips curve:[38]

(4b) $\quad \Delta p_t = \Delta p_{t-1} - a(u_{t-1} - \bar{u}) + e_{s,t}$.

With this formulation of the Phillips curve there is a trade-off between the *change* in inflation and the unemployment rate, but no permanent trade-off be-

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[37] See Espinosa-Vega (1998, p. 18).

[38] See also Romer (1996, p. 412).

tween the *level* of inflation and unemployment.[39] To hold inflation steady at a given level, unemployment must be at its steady state level. At this level, any rate of inflation is sustainable. But if policy makers try to keep unemployment permanently below its steady state level, this leads to *accelerating* inflation.

The vertical long-run Phillips curve has also implications for the observed relationship between inflation and unemployment. According to the traditional Phillips curve, there is a stable relationship between the two. As noted above, the traditional Phillips curve provides a good description of inflation and unemployment in the 1950s and 1960s which confirms this claim. However, the expectations-augmented Phillips curve suggests that this relationship will break down if economic policy makers attempt to exploit the apparent trade-off between inflation and unemployment. Such an attempt will yield permanently higher inflation rates but will only have a transitory effect on the unemployment rate. The stagflation experience in the 1970s seemed to confirm this prediction.[40] Thus, in contrast to the traditional Phillips curve the expectations-augmented Phillips curve was able to account both for the stable relationship between inflation and the unemployment rate in the 1950s and 1960s, when movements in inflation tended to be short-lived and inflation expectations did not change much, and for the more turbulent 1970s when this relationship disappeared.[41]

2.2.2 The natural rate of unemployment

The preceding discussion has shown that the expectations-augmented Phillips curve implies that there is a steady state unemployment rate which is independent of the steady state inflation rate. This steady state unemployment rate is

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[39] See Romer (1996, p. 229).

[40] See Mankiw (1990, p. 5).

[41] See Romer (1996, p. 231).

also called the 'natural rate of unemployment'.[42] The defining characteristic of the natural rate is that it is determined by real rather than nominal forces. Even though it is possible for policy makers to drive the level of actual unemployment below the natural rate by creating a spell of unexpected inflation, they cannot keep unemployment indefinitely below the natural rate, meaning that money is super-neutral.[43]

If unemployment is at its natural level, the structure of real wage rates is in equilibrium and the corresponding rate of growth of real wages can be indefinitely maintained so long as capital formation, productivity increases etc. remain on their long-run trends.[44] If unemployment is below the natural rate, there is excess demand for labor and real wages tend to rise whereas an unemployment rate above the natural rate indicates excess labor supply and real wages tend to fall. The similarity to the traditional Phillips curve is not coincidental, as Friedman points out. By reformulating the Phillips curve in terms of real wages he intends to overcome the basic defect of the traditional Phillips curve of not distinguishing between nominal and real wage rates.[45] Regarding the determination of the natural rate of unemployment, he writes: "The 'natural rate of unemployment', in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of

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42 See Friedman (1968, p. 8).

43 For a discussion of the natural rate hypothesis see also Romer (1996, pp. 225). Regarding the role of superneutrality for the monetarist framework, see Espinosa-Vega (1998, p. 16).

44 See Friedman (1968, p. 8).

45 See Friedman (1968, p. 8).

mobility, and so on."[46] Friedman emphasizes that the term 'natural' does not mean to suggest that the natural rate of unemployment cannot be changed. He points out that many of the market characteristics that determine it are man-made and policy-made. These factors include minimum wages, the strength of trade unions etc.[47]

2.2.3 The monetary transmission mechanism

We have noted in the discussion of the expectations-augmented Phillips curve that unexpected inflation has a central role in the transmission mechanism. This raises the question what the link between monetary policy and inflation in a monetarist model is. We have seen that in a Keynesian model this link is fairly indirect and runs from aggregate demand to unemployment and via the traditional Phillips curve to inflation. In the monetarist framework the quantity theory is used to postulate a direct link between money supply and prices, and hence between the rate of growth of the money supply and inflation. According to the quantity theory, nominal income ($y_t + p_t$) is the result of the stock of money (m_t) and its velocity (v_t):[48]

(5) $$y_t + p_t = m_t + v_t .$$

The quantity theory makes assumptions about the determination of money, velocity and real output. Without these assumptions equation (5), which is also called the 'quantity equation', is nothing but an accounting identity.[49] Monetarists transform the quantity equation into a theory by assuming that the central bank controls the money supply and, hence, the variable m_t in (5). Moreover,

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46 See Friedman (1968, p. 8).

47 See Friedman (1968, p. 9).

48 See Goodfriend and King (1997, p. 238).

49 See also the discussion in Espinosa-Vega (1998, p. 16).

they assume that there is a stable demand for real money balances ($m_t - p_t$), which are thought to be a function of economic fundamentals such as real income (y_t), the interest rate and the nature of the technology for conducting transactions.[50] From this follows that there is a stable function describing the path of velocity.[51] The assumption that the demand for real money balances depends on economic fundamentals implies that a change in the money supply engineered by the central bank has no long-run impact on real money balances or, more importantly, on velocity.[52] In other words, the assumptions regarding the determinants of money demand and the stability of this relation have the effect to tie down velocity in equation (5). The quantity equation shows that with these assumptions any change in the money supply leads to an equiproportional change in nominal income. Since monetarists assume that real variables like unemployment or real output cannot be affected in the long-run by nominal variables (natural rate hypothesis), this implies that in the long-run there is a one-to-one relationship between the money supply and prices, and between the rate of growth of the money supply and the rate of inflation.

Due to the direct link between money and prices, money balances have a much more important role in the monetarist than in the Keynesian transmission mechanism, since the latter emphasize the role of monetary policy for credit

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50 See Espinosa-Vega (1998, p. 16).

51 Velocity is defined as $v_t \equiv y_t - (m_t - p_t)$. If there is a stable relationship for real money balances of the form $m_t - p_t = b_1 y_t + b_2 x_t + e_{md,t}$, where x_t denotes variables capturing the influence of interest rates and transaction technologies on money demand and $e_{md,t}$ denotes a stochastic money demand shock, then there is also a stable relationship for velocity of the form $y_t - (m_t - p_t) = (1 - b_1) y_t - b_2 x_t - e_{md,t}$.

52 This does not hold exactly: Monetarists stress that nominal interest rates reflect to a large extent inflation premia. Since nominal interest rates affect money demand, inflation does so too. Noting that inflation is a monetary phenomena in the monetarist framework, it follows that a change in the rate of growth of money supply has a long-run effect on the demand for real money balances and on velocity. However, monetarists assume that this effect is quantitatively small.

availability and for long-term interest rates and deem these variables to be more important than money balances for consumption and investment decisions.[53] Since credit availability is only an issue when financial markets are imperfect and monetarists in general are skeptical of claims of market failure, they do not assign much importance to this transmission channel. Regarding the role of long-term interest rates, monetarists regard most of the variations in long-term interest rates as reflecting inflation premia and consequently are skeptical of the role of interest rates in the transmission mechanism.[54] Moreover, since it was a major part of the monetarist research program to demonstrate the power of monetary policy to influence real activity in the short-run, fiscal policy is superseded by monetary policy as the most potent device available to policy makers.[55]

Since monetarists argue that inflation is determined by the growth rate of money supply, this suggests that the expectations-augmented Phillips curve given by equation (4a) is somewhat misleading with respect to the monetarist view on the sources of inflation, because it models inflation as a function of labor market conditions. The relation given by (4a) is much more compatible with the Keynesian view of the Phillips curve as the link between aggregate demand conditions and inflation than it is with the quantity theory. To account for the fact that in the monetarist framework causality runs from unexpected inflation to the labor market and not into the other direction as in Keynesian models, it is useful to rewrite the expectations-augmented Phillips curve as follows:[56]

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[53] See Goodfriend and King (1997, p. 238).

[54] See Goodfriend and King (1997, pp. 238).

[55] The seminal work demonstrating the power of monetary policy is Friedman and Schwartz (1963). Regarding the importance of monetary policy relative to fiscal policy in the monetarist framework see Goodfriend and King (1997, p. 239), and De Long (2000, p. 91).

[56] See also the discussion of the classical and the Keynesian Phillips curve in Sargent and Söderström (2000, p. 41), and the discussion in King and Watson (1994, pp. 10).

(6) $u_t = \bar{u} - f\left(\Delta p_t - \Delta p_t^e\right) + e_{s,t}$, with $f > 0$,

where the parameter f denotes the sensitivity of unemployment to unexpected inflation ($\Delta p_t - \Delta p_t^e$). We will see below that the expectations-augmented Phillips curve given by (4a) represents a typical modern Keynesian formulation of aggregate supply, while the expectations-augmented Phillips curve given by (6) represents the monetarist view on the relationship between inflation and unemployment.[57]

2.2.4 The case against aggregate demand management policies

In the monetarist framework there are essentially two objections against an activist policy of aggregate demand management. First, in contrast to the Keynesian framework the gains of such a policy are small, because it is not desirable in the first place to attempt to increase the average level of output, which is the objective of Keynesian demand management. Second, even if this were desirable, monetarists argue that demand policy could not achieve this objective.

The first objection follows from the natural rate hypothesis of unemployment which implies that there is also a natural rate of output. In contrast to the Keynesian view of business cycles, output is assumed to fluctuate in a *symmetric* fashion around the natural rate of output. This is illustrated in Figure 3.

A comparison of Figure 3 with Figure 2 shows that monetarists take a fundamentally different position on business cycle fluctuations than Keynesian economists. Whereas the latter consider economic booms to be welfare enhancing because they help to bring real activity closer to its efficient level, monetarists see booms and recessions as equally welfare reducing. In other words, the

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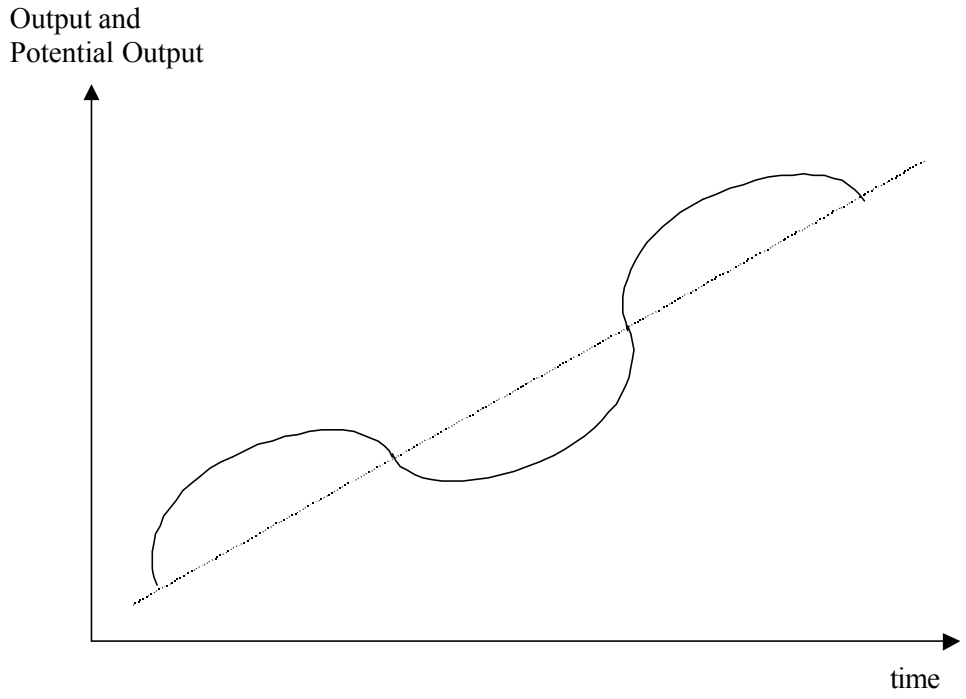
[57] For a discussion of the role of the expectations-augmented Phillips curve in New Keynesian models see Roberts (1995).

monetarist view implies that the average level of output over a full business cycle is also the efficient level of output, while Keynesians believe that without activist demand management policies the average level of output will be inefficiently low.

Figure 3: Business cycle fluctuations — the monetarist view



These fundamental differences regarding the efficiency of the average level of output are a reflection of different assumptions regarding the flexibility of prices, the prevalence of monopoly power and the causes of involuntary unemployment. Beginning with the controversy about the flexibility of prices, we have noted in section 2.1.1 that Keynesians are distrustful of the ability of wages and prices to adjust sufficiently to clear labor and product markets. Monetarists, in contrast, belief that prices are flexible enough to ensure that markets clear rapidly.[58] These differences are also apparent in the monetary transmission mechanism, since nominal wage and/or price rigidities play a central role in the

[58] See Burda and Wyplosz (1997, p. 412).

Keynesian transmission mechanism of nominal impulses, but not in the monetarist transmission mechanism where expectations errors are central. The downward rigidity of nominal wages is a particular important assumption in Keynesian models. This assumption is disputed by monetarists. Even though the latter are prepared to concede that institutional aspects like minimum wages may account for some nominal wage rigidity, situations like these are thought to represent the exception rather than the rule.[59] Since most workers earn more than the minimum wage, monetarists argue that nothing prevents them from accepting a pay cut to avoid layoffs. And even though unions may be willing to delay a pay cut because this would benefit unemployed workers at union members' expense, Friedman finds it doubtful whether unions are strong enough or perverse enough to keep wages from adjusting to full employment in the long-run.[60] In sum, in contrast to Keynesians the monetarists believe that any deficiency of demand can persist only for short periods of time, because in such a situation firms reduce their prices, thereby increasing the real value of money balances and building up demand for their products.[61]

Another argument put forward by Keynesians to justify their presumption that the average level of output is inefficiently low is the alleged pervasiveness of monopoly power. Monetarists disagree and prefer the assumption of perfect competition which was also common in classical economics.

As regards the argument that persistent involuntary unemployment indicates that there is slack in the economy, monetarists concede that there is involuntary unemployment, but they argue that this is the result of institutional characteris-

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[59] See Espinosa-Vega and Russell (1997, p. 8).

[60] See Espinosa-Vega and Russell (1997, p. 8).

[61] For a discussion of the role of the real balance effect in neoclassical theories see Jarchow (1998, pp. 180). For a discussion of the Keynesian skepticism of the real balance effect see Tobin (1993, pp. 59). This issue is also discussed in detail in section IV.

tics of the labor market like minimum wage regulations. In other words, persistent involuntary unemployment is the result of a high natural rate. Since monetary policy cannot reduce unemployment below the natural rate permanently, it is an unsuitable tool to remedy the situation.

The limits of demand management policies in monetarist models are vividly illustrated by De Long and Summers (1987). Their starting point is the observation that the essence of the natural rate view is contained in the stylized Phillips curve given by the following equation:[62]

$$\Delta p_t = \Delta p_{t-1} - a(y_{t-1} - \bar{y}). \tag{7}$$

De Long and Summers proceed by summing the relation (7) over time and rearranging, thereby obtaining[63]

$$\frac{\sum_{t=1}^{T}(y_t - \bar{y})}{T} = \frac{\Delta p_T - \Delta p_0}{aT}. \tag{8}$$

It is apparent from equation (8) that a macroeconomic policy that does not change the rate of inflation over time ($\Delta p_T = \Delta p_0$) cannot affect the average level of output over that period ($\sum_{t=1}^{T}(y_t - \bar{y}) = 0$), which shows that the average level of output is pinned down by its natural level, $\bar{y}$, if inflation is kept constant over time. In other words, if macroeconomic policy causes a boom in period t it has to cause a recession of similar proportions in the next period to return inflation to its desired level. Otherwise inflation stays indefinitely above this level. De Long and Summers conclude that the natural rate view implies that macroeco-

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62 See De Long and Summers (1987), p. 438. Note that the relation given by (7) is closely related to the expectations-augmented Phillips curve given by (4b). The only differences are that in (7) the supply shock is omitted and the deviation of unemployment from the natural rate is replaced with the deviation of output from its natural level ($y_t - \bar{y}$).

nomic policies can do no first-order net good or harm on the output side without permanently raising or lowering the inflation rate. They write: "Why, then, should anyone care about cyclical unemployment? Excess unemployment incurred today because of policy 'mistakes' allows a larger boom tomorrow. The business cycle produces welfare losses *only* because consumption is not efficiently smoothed across years."[64] This implication of the natural rate view stands in stark contrast to the Keynesian view of business cycle where demand management policies can have first-order effects on output without permanently affecting the inflation rate, because in Keynesian models inflation is pinned down by labor market conditions. Put another way, in both the monetarist and the Keynesian framework a boom in economic activity goes along with falling unemployment and increasing inflation. In Keynesian models inflation declines again when unemployment rate returns to its equilibrium level after the boom has passed, because the looser labor market conditions exert downward pressure on the inflation rate, while in monetarist models inflation remains high in spite of the increase in unemployment. In the latter type of model it takes a recession which pushes unemployment above its natural level to reduce inflation again.

2.2.5 The monetarist policy assignment

In the monetarist framework the best monetary policy can hope to accomplish is to reduce volatility of output fluctuations. But monetarists fear that any attempt at fine-tuning the economy carries also the risk of destabilizing the economy, since the uncertain strength and lags of policy instruments prevent policy makers from knowing exactly what the effects of a given monetary policy action are

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[63] See De Long and Summers (1987, p. 439).

[64] See De Long and Summers (1987, p. 440).

going to be.[65] Friedman writes in this regard: "As a result, we cannot predict at all accurately just what effect a particular monetary action will have on the price level and, equally important, just when it will have this effect."[66] Monetarists attribute the variability in the effects of monetary policy actions to differences in the degree to which policy actions are expected, because expectations determine the degree to which people adjust prices and wages to neutralize the real effects of an injection of money.[67]

Since monetarists believe that the risks of an activist monetary policy outweigh the benefits of reducing the volatility of output fluctuations they recommend that policy should not try to offset minor disturbances to the economy.[68] Instead monetary policy should try to prevent money from becoming itself a source of economic disturbances and aim to provide a stable background for the economy by acting in a predictable way, thereby ensuring that the average level of prices will behave in a known way in the future.[69] In other words, monetarists argue that reducing uncertainty regarding the future price level should be the overriding objective of the central bank. The best way to achieve this is to avoid discretionary policy and to conduct monetary policy on the basis of fixed policy rules. The most famous rule in this regard the k%-rule suggested by Friedman in which the quantity of money grows at a constant rate sufficient to accommodate trend productivity growth.[70]

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65 See De Long (2000, p. 88).

66 See Friedman (1968, p. 15).

67 See Goodfriend and King (1997, p. 239).

68 See Friedman (1968, p. 14).

69 See Friedman (1968, p. 13).

70 See Friedman (1968, p. 16).

In contrast to the Keynesian policy assignment, where demand policy management policies have a central role in sustaining full employment, monetary policy has no such task in the monetarist policy assignment. If a persistent increase in the unemployment rate occurs, monetarists attribute this to an increase in the natural rate of unemployment. For a discussion of the monetarist view of the causes of unemployment it is useful to decompose the natural rate of unemployment into two components: The first component consists of the minimum level of frictional and of structural unemployment which cannot be avoided in a dynamic economy. The second component is comprised of the amount of involuntary unemployment which is attributable to the failure of real wages to clear the labor market.

The unavoidable frictional unemployment is related to the process of job creation and destruction which occurs in any dynamic economy.[71] The resulting search process of firms and workers takes some time because of imperfect information on the part of firms seeking workers and of workers who are seeking jobs. The extent of frictional unemployment is closely related to the institutions of the labor market which determine the efficiency of the matching process and the number of job separations and vacancies. The unavoidable structural unemployment is related to structural change in the economy, which leads to the disappearance of jobs in some sectors and to new jobs in others. Structural unemployment exists because displaced workers often do not have the skills required in the newly available jobs. This means displaced workers will either have to accept a wage cut to maintain their previous job or they will have to invest into new skills. This adjustment process is likely to take some time so that a minimum of structural unemployment cannot be avoided in an economy that is constantly changing.

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[71] See Burda and Wyplosz (1997, pp. 153).

More problematic from the viewpoint of economic policy is the amount of involuntary unemployment which exists because real wages are too high to equate labor supply and demand. The failure of real wages to adjust sufficiently to clear the labor market may be the result of the monopolistic behavior of trade unions, high minimum wages, generous unemployment benefits or other distortions in the labor market. For the 1970s monetarists often cite excessive wage aspirations of trade unions in the early 1970s, the demand of unions to be compensated for high oil prices following the two oil price shocks and their failure to adjust to the productivity slowdown which began in the middle of the decade as reasons why real wages became too high and led to an increase in the natural rate of unemployment in Germany in the 1970s and early 1980s.[72] Consequently they conclude that the obvious remedy to high unemployment is a slow-down in the growth rate of real wages. That is, since monetarists see the German unemployment problem as being foremost a natural rate problem, they argue that a reduction in the natural rate is a task that trade unions have to accomplish and not monetary policy makers.

2.3 The Keynesian response to the monetarist revolution: The NAIRU

The stagflation period following the first oil price shock represented a major problem for the traditional Phillips curve. The simultaneous increase in inflation and unemployment during most of the 1970s led to a distinctively positive correlation between inflation and unemployment which contradicted the prediction of the traditional Phillips curve of a negative long-run correlation between the

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[72] See the discussion of different approaches towards a supply-side explanation of the increase in unemployment in Europe in Bean (1994, pp. 587). A concise theoretical analysis of the role of these supply side factors for high unemployment in Europe is also contained in Sachs (1986).

two variables.[73] The experience of the 1970s led Lucas and Sargent (1978) to their famous quip that the traditional Phillips curve was an "econometric failure on a grand scale." One source of the breakdown of the traditional Phillips curve was its failure to account for the effects of aggregate supply shocks on inflation and unemployment.[74] Since an adverse supply shock like an increase in oil prices leads even in Keynesian models to a positive correlation between inflation and unemployment, the oil price shocks in 1973 and 1979 are liable to account for some of the failings of the Phillips curve. But there was also a more fundamental problem: The secular rise in inflation coincided with the attempt of policy makers to stem the increase in unemployment with expansionary demand management policies.[75] The warnings of monetarists that the Phillips curve will break down when policy makers try to exploit the alleged trade-off between inflation and unemployment were proved correct by the acceleration in inflation occurring during the 70s. The dismal results of the attempt to 'ride the Phillips curve' strengthened the credibility of the monetarist position greatly. In Lucas (1981) words, "We got the high-inflation decade, and with it as clear-cut an experimental discrimination as macroeconomics is ever likely to see, and Friedman and Phelps were right."[76]

To rescue the Keynesian position the traditional Phillips curve had to be adapted. This led to the NAIRU concept which extended the Keynesian view of the inflation process and equilibrium unemployment in several ways. First, the NAIRU concepts augments the traditional downward sloping Phillips curve with a vertical Phillips curve, thereby accounting for the role of inflation expectations

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[73] See Gordon (1997, p. 13).

[74] See also the discussion in Romer (1996, p. 226).

[75] See also Espinosa-Vega and Russell (1997, p. 11).

[76] See Lucas (1981, p. 560).

in the inflation process. Second, the NAIRU is often estimated using the so-called triangle model of inflation where inflation is determined by inertia and demand and supply conditions. Third, the NAIRU concept allows for changes over time in the equilibrium rate of unemployment.

2.3.1 Augmenting Keynesian inflation models with a vertical Phillips curve

The NAIRU, standing for *N*on-*A*ccelerating *I*nflation *R*ate of *U*nemployment, is defined as the unemployment rate consistent with an unchanging inflation rate. When the unemployment rate is below the NAIRU, there is pressure for the inflation rate to increase; contrarily, when the unemployment rate is above the NAIRU, there is pressure for the inflation rate to fall.[77] In other words, the NAIRU is the unemployment rate at which the Keynesians' downward-sloping Phillips curve intersects the monetarists' vertical Phillips curve. Since the position of the vertical Phillips curve determines in the monetarist framework the natural rate of unemployment it follows that numerically the NAIRU is identical with the natural rate. This is shown in Figure 4.[78]

Adding a vertical Phillips curve to the traditional downward sloping curve meant that Keynesians accepted the monetarist argument that the Phillips curve needs to be augmented with a term capturing the process of expectation formation. Thus, Keynesians adopted the expectations-augmented Phillips curve given by (4a) as their inflation model. This implies in particular that Keynesians accepted the monetarist acceleration hypothesis that any attempt to push the unemployment rate below the NAIRU / natural rate will lead to accelerating inflation.

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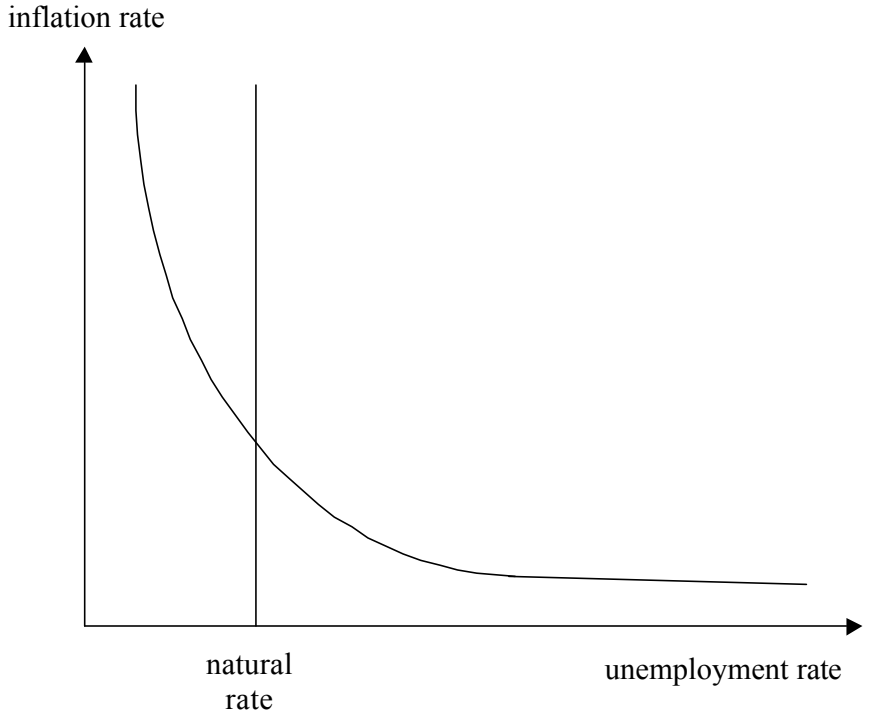
[77] See Stiglitz (1997, p. 3).

[78] Figure 4 is reproduced from Espinosa-Vega and Russell (1997, p. 12), Chart 3.

Figure 4: The NAIRU



It is tempting to use the terms NAIRU and the natural rate interchangeably because they are numerically identical, but this risks blurring the substantial differences between the two concepts that remain.[79] Both concepts differ in particular with respect to their implications for stabilization policy. Monetarists intended to demonstrate with the expectations-augmented Phillips the ineffectiveness of aggregate demand management policies. However, even though Keynesians integrated the expectations-augmented Phillips curve into their framework, they did not buy this part of the monetarist argument. In fact, the monetarist position regarding the futileness of demand management policies is based on a number of assumptions; besides the acceleration hypothesis it is in particular the assumption that prices are flexible enough to clear labor and goods markets which matters in this regard. Keynesians continued to disagree with the latter assumption and maintained their position that nominal rigidities matter and

[79] Stiglitz (1997), for example, uses the term natural rate as synonym for NAIRU. See Stiglitz (1997, p. 3).

that consequently involuntary unemployment can persist for considerable lengths of time. Thus, acceptance of the expectations-augmented Phillips curve did not invalidate the Keynesian rationale for stabilization policy. Modigliani and Papdemos, who in 1975 originally proposed the NAIRU concept, interpret the NAIRU as a constraint of policymakers to exploit a trade-off that remained both available and helpful in the short-run.[80] In terms of Figure 4 this means that Modigliani and Papdemos assert that the economy spends most of the time in a range of unemployment rates well to the right of the NAIRU. Since the Phillips curve is fairly flat in this range there is a considerable trade-off between inflation and unemployment. Only if policy makers try to push the unemployment rate below the NAIRU would the problem of accelerating inflation arise, because the short-run Phillips curve is fairly steep in this range. Thus, seen from this standpoint of view the adoption of the natural rate in form of the NAIRU by Keynesian economists did not represent much of a concession to the monetarist position.

However, even though the NAIRU continues to be an important part of New Keynesian models, which summarizes the Keynesian research program of the 1980s and 1990s, it should be noted that this modern brand of Keynesian economics is considerably more skeptical about the benefits of stabilization policy than Modigliani and Papdemos were when they proposed the NAIRU concept. The traditional Keynesian endorsement of demand management policies is based on the assumptions that the short-run Phillips curve has a convex shape and that nominal rigidities are strong enough to prevent a clearing of goods and labor markets for long periods of time. In New Keynesian models, on the other hand, the Phillips curve is often assumed to be linear. Moreover, even though nominal rigidities have an important role in New Keynesian models, these do

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[80] See the discussion in Espinosa-Vega and Russell (1997, pp. 11).

not give rise to such a strong degree of persistence in real variables as to imply that the economy is most of the time somewhere to the right of the NAIRU. Instead the unemployment rate is typically assumed to fluctuate in a symmetric fashion around the NAIRU. Since this means that New Keynesian models have adopted a key element of monetarist models, it follows that regarding the benefits of stabilization policy these models are closer to the monetarist position than to the traditional Keynesian position.

2.3.2 The triangle model of inflation

The NAIRU model is like its predecessor, the traditional Phillips curve, in the first place an inflation model. Since modeling inflation means modeling the price-setting behavior of firms, it represents also the Keynesian view on the determination of aggregate supply. The events of the 1970s showed that the traditional Phillips curve was inadequate as an inflation model. It has been replaced in Keynesian economics by the triangle model of inflation which has been developed by Gordon in the second half of the 1970s and continues up to the present to be widely used for the modeling of inflation and the estimation of the NAIRU.[81] The label 'triangle' is meant to summarize the dependence of inflation on three basic determinants: inertia, demand and supply.[82] The most general specification of the triangle model is[83]

$$\Delta p_t = a(L)\Delta p_{t-1} + b(L)D_t + c(L)z_t + e_t, \tag{9}$$

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[81] This section draws on Gordon (1997). For a review of the 'history' of the triangle model, see Gordon (1997, pp. 18). This model has been recently employed, for example, by the OECD to estimate the NAIRU for several OECD countries. See OECD (2000, pp. 155).

[82] See Gordon (1997, p. 14).

[83] See Gordon (1997, p. 14). The lag polynomial $a(L)$, for example, denotes $a(L) = a_0 + a_1 L + a_2 L^2 + ... + a_n L^n$.

where the term $a(L)\Delta p_{t-1}$ models the inertia in inflation, D_t is an index of excess demand (normalized so that $D_t = 0$ indicates the absence of excess demand), z_t is a vector of supply shock variables ($z_t = 0$ indicates the absence of supply shocks) and e_t is a serially uncorrelated error term. The sum of the coefficients in the lag polynomial $a(L)$ is typically constrained to one, because only in this case is there a 'natural' rate of the demand variable D_t consistent with a constant rate of inflation. The intuition behind this constraint can be clarified by considering the simple case of only one lag of inflation, $a_0\Delta p_{t-1}$, and by modeling D_t as the deviation of the actual unemployment rate from its natural rate, $(u_t - \bar{u})$. Restricting a_0 to one and omitting the supply shocks yields in this case $\Delta p_t = \Delta p_{t-1} + b_0(u_t - \bar{u}) + e_t$, with $b_0 < 0$. Thus, this constraint yield the expectations-augmented Phillips curve given by (4b). In particular, it ensures that the inflation model conforms to the acceleration hypothesis. Another noteworthy aspect of (9) is that it does not include a nominal wage variable.[84] This formulation is not meant to deny that wage costs play an important in the price setting decision behavior of firms, but is an reflection of an empirical finding by Gordon that a specification like the one given in (9), which treats wages only implicitly, performs better than models with separate wage growth and price mark up equations.[85]

The role of the lag polynomial $a(L)$ is to model the inertia in inflation. This inertia can be due to nominal rigidity, arising for example through multi-period nominal contracts, or to lags in the expectation formation. The triangle model is compatible with adaptive expectations or with rational expectations, which are

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[84] For a model with a wage variable as an additional determining variable see Franz (2000, pp. 3).

[85] See Gordon (1997, p. 17).

often employed in New Keynesian models.[86] Gordon interprets the lag polynomial $a(L)$ as capturing the influences of both the speed of price adjustment and the speed of expectation formation on the dynamics of inflation without separating between the two.[87]

Another approach to modeling inflation inertia has been proposed by Gerlach and Svensson (2000) who argue that inflation dynamics are comprised of a backward-looking and a forward-looking part. The former can be modeled in a straightforward manner by including lags of the inflation variable in the model. Regarding the latter, Gerlach and Svensson propose to model the forward-looking part as a function of the inflation objective of the central bank, which yields the following formulation for the expectation formation process:

$$(10) \qquad \Delta p_t^e = \hat{p}_t + l\left(\Delta p_{t-1} - p_{t-1}\right),$$

where $\hat{p}_t$ denotes the inflation objective of the central bank, which may be time varying. The parameter l is interpreted as measuring the credibility of the inflation objective; if $l = 0$ the inflation objective is fully credible and determines the expected inflation rate for the period t, whereas $l = 1$ indicates that the central bank has no credibility and inflation expectations are formed adaptively. This parameter is not constrained in their inflation model and therefore can take any value between zero and one. This approach demonstrates that in Keynesian inflation models inflation expectations are often assumed to be anchored by variables like the inflation objective of the central bank or, alternatively, by the underlying trend of inflation.[88] The drawback of this approach is that it assumes

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[86] The New Keynesian model is reviewed in detail below.

[87] See the discussion in Gordon (1997, pp. 16).

[88] Romer (1996) proposes to use for the term Δp_t^e in the expectations-augmented Phillips curve the core inflation rate as a proxy for the underlying trend of inflation. See Romer (1996, pp. 229).

that the inflation anchor is determined outside the model.[89] However, since the acceleration hypothesis implies that the expectations-augmented Phillips curve models the *change* in inflation, it lies in the very nature of this model that it is silent on the determinants of the *level* of inflation.[90]

The variable D_t in (9), which models the inflationary pressures arising from excess demand in the economy, usually includes the output gap, $(y_t - \bar{y})$, the unemployment gap, $(u_t - \bar{u})$, or the capacity utilization rate. The causation in the triangle model runs from the unemployment gap and the other demand variables to inflation, and not into the other direction as in the monetarist framework. This means that this model is resolutely Keynesian, as Gordon emphasizes.[91]

The ultimate source of excess demand is 'excess nominal GDP growth', which Gordon defines at the extent to which growth of nominal GDP exceeds the growth of potential output.[92] This implies that growth in the money supply is not a unique cause of inflation. Gordon writes in this context: "In a literal sense, the triangle model predicts inflation without using information on the money stock. In an economic sense, this implies that any long-term effect of money growth on inflation operates through channels that are captured by the real excess demand variables."[93] Put another way, the quantity *equation* given by (5) of course also holds in the Keynesian framework because it is an accounting identity. But the quantity *theory* does not need to hold. In terms of equation (5) this

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89 See Romer (1996, p. 230).

90 This is formally shown in Fabiani and Mestre (2000, pp. 44). This can also be seen by rewriting the expectations-augmented Phillips curve given by (4b) as $\Delta^2 p_t = -a(u_{t-1} - \bar{u}) + e_{s,t}$ which shows that the *level* of the inflation rate does not enter this equation, only the *change* in inflation is determined.

91 See Gordon (1997, p. 18).

92 See Gordon (1997, p. 15).

93 See Gordon (1997, p. 18).

implies that in the Keynesian framework a change in the money stock (or velocity) affects first real output and then prices.[94]

The supply shocks in equation (9) are included because these shocks can cause a positive correlation between inflation and unemployment. Their inclusion ensures that the triangle model is consistent with the positive correlation between the two variables in the 1970s, due to the explicit treatment of supply shocks such as the rise and eventual fall of oil prices.[95]

2.3.3 Estimating a time-varying NAIRU for Germany and the USA

A model like (9) can be used to estimate the NAIRU. To this end we rewrite (9) as[96]

(11) $\Delta p_t = a(L)\Delta p_{t-1} + b(L)(u_t - \bar{u}) + c(L)z_t + e_t$,

where $\bar{u}$ represents the natural rate of unemployment. First, we derive from (11) the so-called no-shock NAIRU. That is, we are assuming that there are no supply shocks, i.e. $z_t = 0$, and no stochastic disturbance, i.e. $e_t = 0$. With this assumption we can rearrange (11) to obtain

(12a) $\Delta p_t = a(L)\Delta p_{t-1} + b(L)u_t + b_0\bar{u} + b_1\bar{u} + ... + b_k\bar{u}$, or

(12b) $\Delta p_t = d + a(L)\Delta p_{t-1} + b(L)u_t$,

with $d = b(1)\bar{u}$.[97] The NAIRU is defined as the unemployment rate consistent with a stable inflation rate, that is, $\Delta p_t = \Delta p_{t-1} = ... = \Delta p_{t-n}$. Inserting this condition

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[94] In the monetarist framework, in contrast, velocity is assumed to be constant so that changes in the money supply are the only source of changes in the price level. Moreover, a monetary impulse affects directly the price level, and any real effects are the consequence of unexpected changes in the price level.

[95] See Gordon (1997, p. 17).

[96] The following discussion draws on Franz (2000, pp. 5).

[97] The term $b(1)$ denotes the sum of the parameters in the lag polynomial $b(L)$.

into (12b) and solving for the unemployment rate which is consistent with this scenario yields the no-shock NAIRU estimate:[98]

(13) $u^{NS} = d / b(1)$.

Since $d = b(1)\bar{u}$ it follows from (13) that the no-shock NAIRU u^{NS} is identical with the natural rate $\bar{u}$.

If there are supply shocks, however, the NAIRU and the natural rate do not coincide anymore. With $z_t \neq 0$ we obtain instead the NAIRU estimate

(14) $u^{NAIRU} = (d + c(L)z_t) / b(1)$.

This shows that if policy makers wish to keep the inflation rate constant when an adverse supply shock like an oil price shock occurs they have to tighten demand conditions in order to increase the unemployment rate, because the NAIRU has increased in this scenario too. That is, the NAIRU estimated in this way is a short-run concept, indicating which unemployment rate in a given year and based on the actual history of unemployment would be associated with a constant rate of inflation.[99] It follows that in the discussion of the NAIRU it is often useful to distinguish between the NAIRU that is obtained after the effects of supply shocks have passed through the economy (the no-shock NAIRU) and the NAIRU which is consistent with stabilizing the inflation rate at its current level in the next period (the short-run NAIRU).[100]

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[98] Recall that the sum of the lag polynomial $a(L)$ has been constrained to one.

[99] See Elmeskov (1998, p. 31).

[100] See also the discussion of these NAIRU concepts in the OECD (2000 report, p. 157). The OECD calls the no-shock NAIRU the long-term equilibrium unemployment rate and the NAIRU which is consistent with stabilizing inflation at its current level the short-term NAIRU.

Up to now we have assumed that the NAIRU is constant in time. However, the unemployment experience in the past 30 years in Germany suggests that the NAIRU has moved upwards over time. To identify the time-varying NAIRU we need to specify the stochastic process for this variable.[101] In the following estimation of the NAIRU for Germany and the USA we employ the Elmeskov method which is based on the identifying assumption that the NAIRU is constant between two consecutive periods.[102] The starting point of the Elmeskov method is a slightly modified version of the expectations-augmented Phillips curve given by (4b):

$$(15) \qquad \Delta^2 p_t = -a_t\left(u_{t-1} - u_t^{NAIRU}\right).$$

This model does not control for the effects of supply shocks on inflation and unemployment, which implies that the resulting NAIRU corresponds to the unemployment rate consistent with stabilizing inflation at its current level, regardless of its cause. For example, if inflation is high due to an adverse supply shock hitting the economy, we estimate the unemployment rate that is consistent with stabilizing inflation at this high level. That is, we estimate the short-run NAIRU. It is noteworthy that the parameter a_t can change in time which means that the Elmeskov method is not based on the a priori assumption of a stable systematic relationship between inflation and the unemployment gap. If the parameter a_t were known the NAIRU could be constructed based on observed data for the rate of inflation and the unemployment rate. We can obtain an estimate of a_t by assuming that the NAIRU does not change between two consecutive periods. Differencing (15) and using this assumption yields

$$(16) \qquad a_t = -\Delta^3 p_t / \Delta u_t \,.$$

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[101] See Franz (2000, pp. 6), for an extensive discussion of this issue.

[102] See Elmeskov (1993, p. 94), Elmeskov and MacFarlan (1993, p. 85), and the discussion of his method in Fabiani and Mestre (2000, pp. 14).

Substituting this result into (15), an estimate of the NAIRU in any time period can be calculated as

$$(17) \qquad \hat{u}_t^{NAIRU} = u_t - \left(\Delta u / \Delta^3 p_t\right)\Delta^2 p_t .$$

Since the parameter a_t is computed as a fraction where the denominator might be close to zero, the resulting estimate can be highly volatile, leading also to a considerable volatility in the NAIRU estimate itself.[103] To overcome this problem, we follow Elmeskov suggestion and use a Hodrick-Prescott filter with a smoothing factor of 25 to filter the raw data.

The Elmeskov method can be applied to a model like (15) with consumer prices as the price variable, yielding the NAIRU, or with a nominal wage variable instead of prices, yielding the *N*on-*A*ccelerating *W*age *R*ate of *U*nemployment (NAWRU).[104] Alternatively the capacity utilization rate can be used instead of price or wage inflation.[105] Elmeskov denotes the resulting estimate of the unemployment rate consistent with a stable capacity utilization rate as the Okun curve indicator. The resulting estimates for these three measures for West Germany and the USA are displayed in Figures 5 and 6.[106]

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[103] See also the discussion in Fabiani and Mestre (2000, p. 15).

[104] See Elmeskov and MacFarlan (1993, p. 85).

[105] See Elmeskov (1993, pp. 95).

[106] The consumer price series and the unemployment rate for Germany have been obtained from the Bundesbank. The respective Datastream codes are BDUU01FAA and WGUS0106Q. The wage series has been constructed using data from the 'Sachverständigenrat' on wage income and the labour force. The time series on capacity utilization is based on the regular 'ifo survey' on capacity utilization in the manufacturing sector (Datastream code: BDIFOCAPE). The U.S. unemployment rate has been obtained from the U.S. Department of Labour (Datastream code: USUNRATEE). The consumer price series (Datastream code: USCP….F) and the wage series (compensation per hour in the business sector; FRED database) have been published by the U.S. Bureau of Labour Statistics. The capacity utilization series is available from the Federal Reserve Bank (Datastream code: USOPERATE).

Figure 5: Indicators of trend unemployment in West Germany

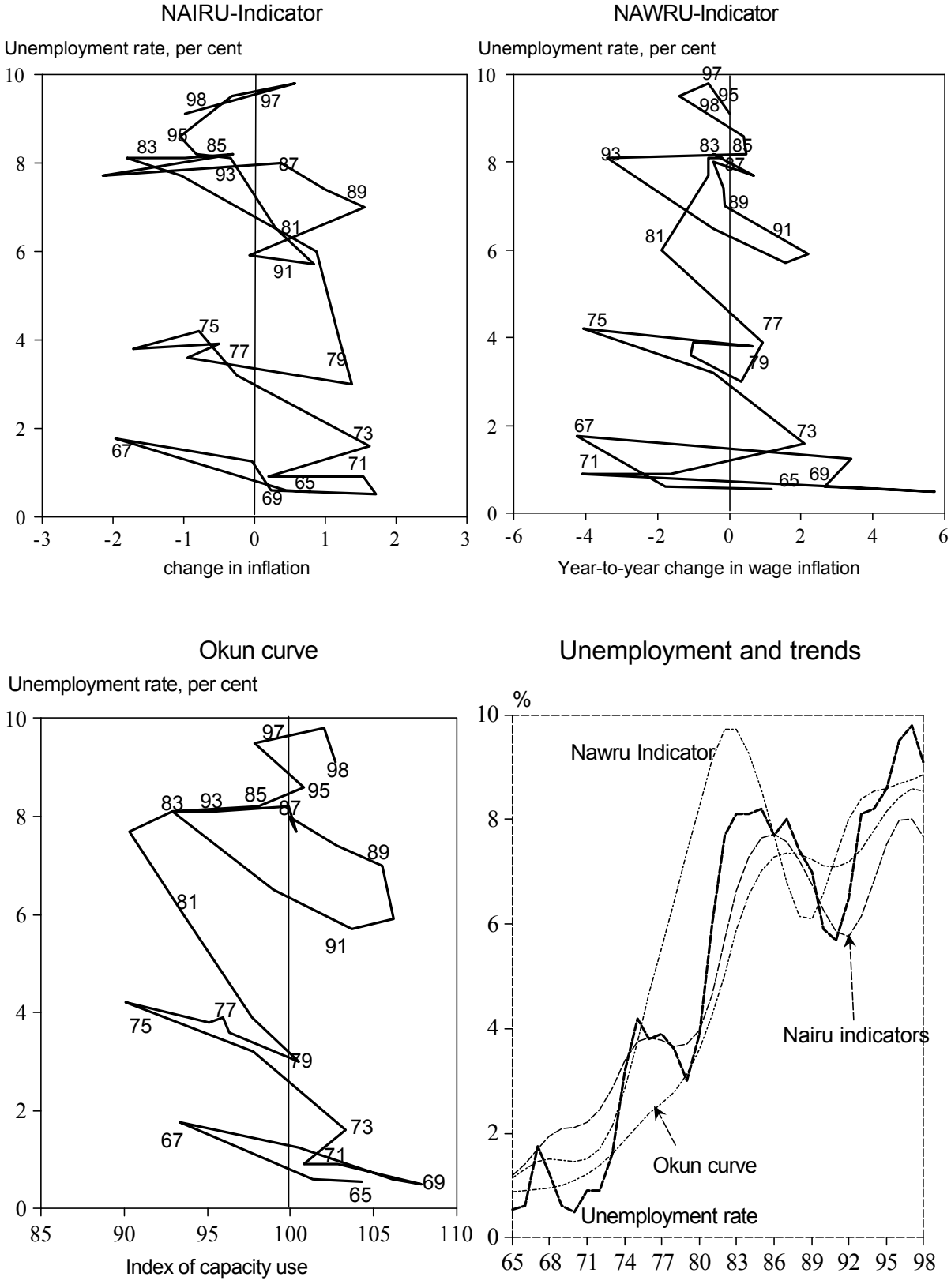
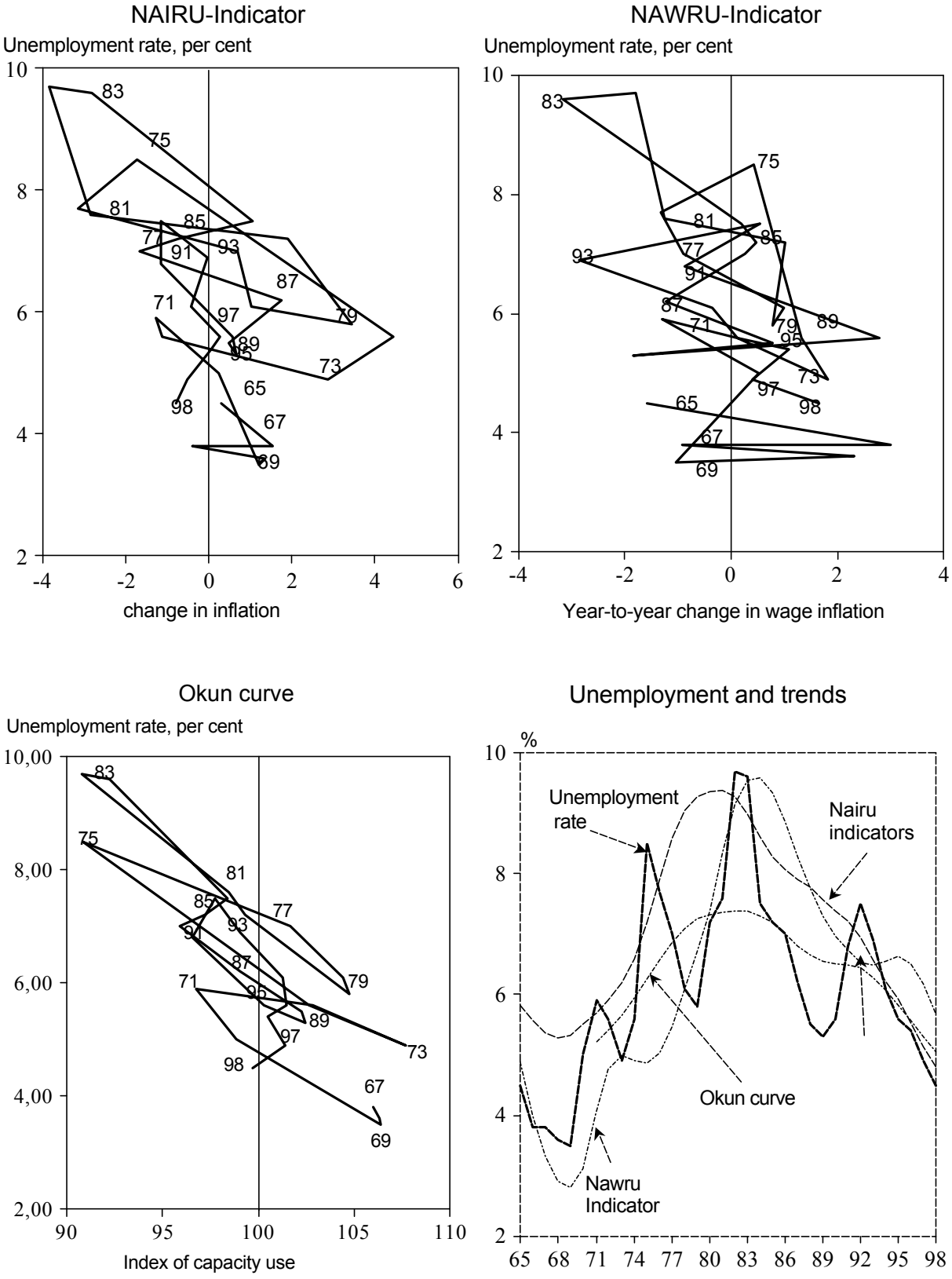


Figure 6: Indicators of trend unemployment in the USA



Even though the indicators differ somewhat, they agree in both countries on the underlying trend of the NAIRU. The NAIRU increased considerably in both West Germany and the USA throughout the 1970s and reached its peak in the early 1980s. Since the middle of the 1980s the divergence in the labor market performance in the two countries is striking: In West Germany the NAIRU declined in the following fifteen years only marginally from its peak in the early eighties, whereas in the United States the NAIRU returned in this time period to the low levels it had in the 1960s. The explanation of the superior performance of the American labor market plays an important role for the controversy on the German unemployment problem, since both Keynesians and monetarists cite the United States as an example of what their policies could achieve. The former argue that the reduction in unemployment in the United States is due to a commitment of the Federal Reserve Bank to maintain full employment, while monetarists attribute this success to the flexibility of the American labor market. We review this controversy in detail in section 4.

2.3.4 The NAIRU in practice

The NAIRU concept is very popular in applied business cycle research. This is borne out by the observation that it pervades current policy discussions, particular so in the U.S., and that economists in institutions like the OECD and the ECB regularly concern themselves with the estimation of the NAIRU.[107] A major factor in this regard is the empirical success of NAIRU models to account for inflation dynamics.[108] Stock and Watson (1999), for example, investigate the forecasting power of various leading indicator for U.S. inflation and find that excess demand variables perform well in this regard. They conclude: "The con-

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[107] See for example OECD (2000) and Fabiani and Mestre (2000).

[108] For a recent application of the NAIRU concept to German data see Franz (2000).

ventionally specified Phillips curve, based on the unemployment rate, was found to perform reasonably well. Its forecasts are better than univariate forecasting models (both autoregressions and random walks), which in many situations have proven to be surprisingly strong benchmarks. Moreover, with few exceptions, incorporating other variables does not significantly improve upon its short run forecasts. Specifically, there are no gains from including money supply measures (consistent with results in Estrella and Mishkin (1997)), interest rates and spreads (consistent with the 'short-end of the term structure' results reported in Mishkin (1990)), or commodity prices (in contrast to the 'price puzzle' rationale for including commodity prices in VARs first suggested in Sims (1992)). The few forecasts that do consistently improve upon unemployment rate Phillips curve forecasts are in fact from alternative Phillips curves, specified using other measures of aggregate activity instead of the unemployment rate."[109] Altimari (2000) investigates leading indicators for inflation in the euro area and finds that money based indicators usually work best, particularly so for long forecast horizons, but Phillips curve models perform well, too. She writes: "When evaluated over the 1995-2000 period, the simple Phillips curve's performance is very close to the best money-based models. Over the most recent 1998-2000 period this model produces the smallest forecast errors of all models."[110]

However, the finding that excess demand variables like the unemployment gap are reasonable good leading indicators for inflation does not mean that the NAIRU automatically should be assigned an important role in the policy making process, because the deviation of unemployment from the NAIRU accounts only for some part of the inflation variability. Stiglitz writes in this regard: "... our analysis indicates that at least 20 percent of the variation in the inflation rate can

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[109] See Stock and Watson (1999, p. 23).

[110] Altimari (2001, p. 22).

be explained by unemployment alone. This figure serves as a reminder that the actual inflation process — and the policy decisions that must be based on it — is much more complicated than the simple link between the NAIRU and inflation."[111] Moreover, NAIRU estimates usually are very imprecise, which limits the usefulness of this variable to guide policy decisions.[112] Nevertheless, the empirical success of the NAIRU concept and the fact that this concept is "resolutely Keynesian" mean that Keynesian economics have made a remarkable comeback from near obliteration.

III. The long-run Phillips curve and the source of business cycle fluctuations in Germany

This section uses empirical evidence on the Phillips curve in West Germany to investigate the superneutrality proposition and to illustrate the differences between the Keynesian and the monetarist positions regarding the source of business cycle fluctuations. To this end we show first that the negative correlation between inflation and unemployment postulated by Keynesian models never disappeared at the business cycle frequency. Thus, despite the criticism of the Phillips curve as an "econometric failure on a grand scale"[113] the relation between inflation and unemployment remained even in the 1970s a useful tool to investigate business cycles. Second, to estimate the Phillips curve this section employs a technique introduced by King and Watson (1994) who show that theoretical Keynesian and monetarist macroeconomic models yield identifying restrictions which can be used to estimate empirical models of the Phillips curve reflecting the respective theoretical viewpoints of Keynesian and monetarist

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[111] Stiglitz (1997, p. 5).

[112] The seminal paper in this regard is Staiger et al. (1996).

[113] Lucas and Sargent (1978).

models. The empirical analysis proceeds within the framework of structural vector autoregression (SVAR) models.[114] In a first step we identify a demand and a supply shock and trace out the dynamics of the Phillips curve model in response to these shocks. This allows us to quantify the trade off between inflation and unemployment implied by Keynesian and monetarist Phillips curve models. The superneutrality proposition, which is central to the controversy between Keynesians and monetarists, is investigated by testing the significance of the long-run trade-off between the two variables. Next, using the historical decomposition technique we attribute the fluctuations in West German unemployment and inflation rates in the past thirty years to demand and supply shocks buffeting the economy.

3.1 The unemployment-inflation relationship in West Germany

The evolution of the unemployment rate and the inflation rate in West Germany is shown in Figure 7.[115] To help visual inspection the shaded areas mark periods of recessions.[116] For the raw data it is difficult to discern a clear relationship be-

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[114] A detailed introduction into the structural vector autoregression methodology is given by Gottschalk (2001).

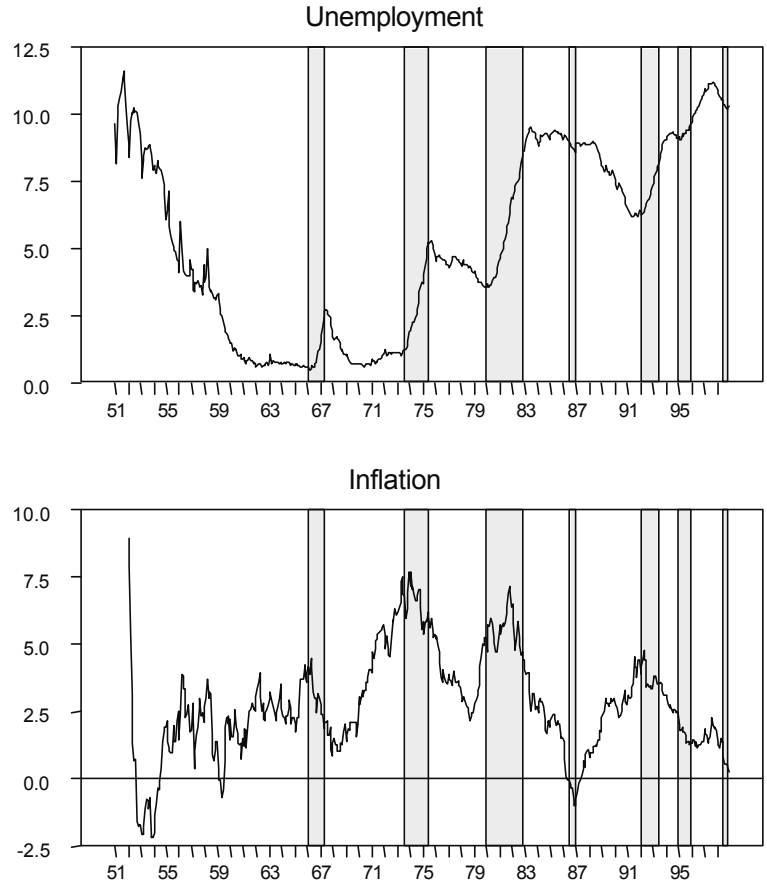
[115] The unemployment rate in Figure 7 is the share of unemployed persons relative to dependent labour. The inflation rate is computed as $100[\ln(P_t / P_{t-12})]$, where P_t is the consumer price index. The unemployment rate and the consumer price index have been seasonally adjusted using Census X11 (multiplicative). Both time series are available from Datastream (WGTOTUN%F and WGCP....F). Since in 1999:1 the calculation method of the unemployment rate has changed, the sample period ends in the remainder of this paper in 1998: 12.

[116] The recession dates are taken from Artis et al. (1997) who developed a procedure to determine peaks and troughs in the business cycle similar to the NBER classification procedure for the United States. They propose classical business cycle turning points for the G7 and a number of European countries based on time series of industrial production for the respective countries. A recession is defined as the time period between a peak and the following trough. For Germany, the authors determine the business cycle turning points for the time period beginning in 1961 and ending in 1993. Döpke (1999) uses their procedure to determine the turning points in Germany for the time period from 1994 until 1999. I am grateful to Jörg Döpke for making his results available to me.

tween the two variables. The inflation rate appears to fluctuate around a rate of approximately 2.5 percent, while the unemployment displays in the 1950s a strong downward drift and since the early 1980s an upward drift. However, in recessions the unemployment rate rises strongly while the inflation rate falls, so that in these periods the negative correlation between the two variables predicted by the Phillips curve is visible.

In Figure 8 we employ the band-pass filter introduced by Baxter and King (1995) to extract the business cycle component from the two time series.[117] To

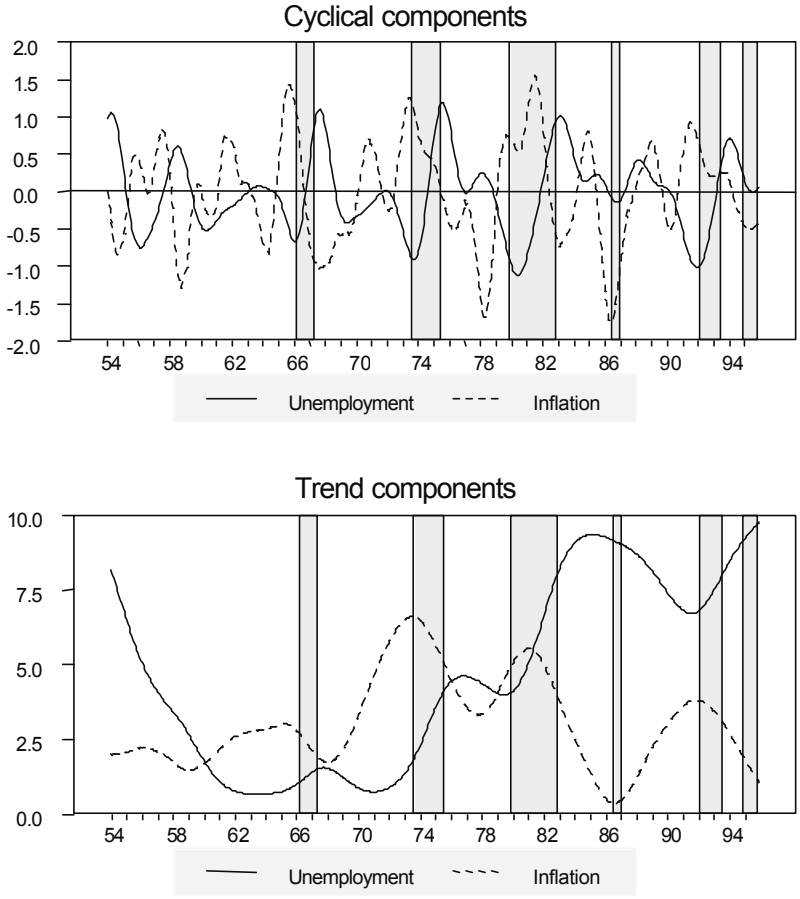
Figure 7: Unemployment and inflation in West Germany 1951-1998



[117] Here we apply the band-pass filter to the monthly annualised rate of change of the consumer price index defined as $\Delta p_t = 1200 \ln(P_t / P_{t-1})$. For a similar investigation for the USA see King et al. (1995). To account for the start-point and end-point problems of these filter methods, we drop the first three and the three last years of the sample period. See also the discussion in Baxter and King (1995, p. 9), of this issue.

this end, we use the 'Burns and Mitchell' band-pass filter which admits frequency components between 6 and 32 quarters. Baxter and King recommend this particular filter because it removes low-frequency trend variation and smoothes high-frequency irregular variation while retaining the major features of business cycles.[118] The cyclical components of the unemployment and the inflation rate are shown in the upper panel of Figure 8 while the lower panel shows the trend components. The latter have been estimated using the Hodrick-Prescott filter.[119]

Figure 8: Cyclical and trend components of unemployment and inflation in Germany



[118] See Baxter and King (1995), p. 22.

[119] The Hodrick-Prescott filter is the 'industry standard' in applied business cycle research for the estimation of trend components of time series. We have set the smoothing parameter Lambda to 14400, which is the suggested value for monthly data.

Figure 8 shows that the cyclical components of unemployment and inflation are negatively correlated. In particular, it is a salient feature of the German business cycle that inflation almost always reaches its cyclical peak and unemployment its lowest cyclical level just before or shortly after a recession sets in.[120] Once the recession is under way unemployment increases strongly while inflation falls. To investigate the stability of the relationship of the cyclical components of unemployment and inflation we divide the sample period into two subperiods, ranging from 1954 until 1979 and from 1980 until 1995. The first sample period covers the Bretton Wood regime of fixed exchange rates and the first years of flexible exchange rates. It also includes the two oil crisis in the 1970s. The second period is characterized by the European Monetary System (EMS) establishing fairly stable exchange rates in Europe and by a firm commitment of the Bundesbank to maintain low inflation rates and its refusal to continue with activist demand management policies. Table 1 shows that the cyclical components are negatively correlated with a remarkable stable correlation coefficient ranging between approximately -0.50 and -0.60 over all sample periods.[121] The lead of unemployment of three to seven months with respect to inflation is also fairly constant. If one considers the raw data or the trend component, there is no stable relationship between the unemployment rate and the inflation rate, which shows that the Phillips curve is a business cycle phenomena and not universally valid. In this context it should also be noted that business cycle variations in the unemployment rate account for only a relatively small part of its overall varia-

[120] This holds in particular for the large recessions in 1966, 1974, 1980–1982 and 1992–1993.

[121] This result is robust with respect to the choice of the sample periods.

tion, since Figure 8 shows that most changes in the German unemployment rate are of a permanent nature.[122]

Table 1: Sample correlation of unemployment and inflation

Sample Period	Raw data	Cyclical components	Trend components
1954–1995	–0.20 (k = -10)	–0.57 (k = -4)	–0.41 (k = -12)
1954–1979	–0.13 (k = -10)	–0.62 (k = -3)	–0.24 (k = -12)
1980–1995	–0.53 (k = -10)	–0.51 (k = -7)	–0.89 (k = -3)

Notes: The raw data correspond to the unemployment rate and the monthly inflation rate. The cyclical and trend components have been estimated using the band-pass and the Hodrick-Prescott filter respectively. The cross correlations between unemployment and inflation have been computed for twelve lags and leads. The parameter k in brackets indicates the lag/lead where the correlation is at its maximum. A value $k < 0$ indicates that unemployment leads inflation.

3.2 Estimating Keynesian and monetarist Phillips curves for Germany

3.2.1 Time Series Properties

Before we estimate the Phillips curve models for Germany, we need to determine the stationarity properties of the unemployment rate and the inflation rate. For this purpose we employ a number of unit root tests. The tests proposed by Perron (1997) and Elliott et al. (1996) are variants of the familiar augmented Dickey Fuller (ADF) tests with the null hypothesis of non-stationarity. The Perron (1997) test considers as alternative hypothesis stationary fluctuations around a deterministic trend function and makes allowances for possible

[122] Regarding the second sample period, it is a striking finding that the trend components of the unemployment rate and the inflation rate are extremely highly correlated. Moreover, the negative coefficient is in accordance with the predictions of the traditional Phillips curve. This finding differs markedly from results for the United States: King et al. (1995) have applied the same technique to U.S. data and find no correlation between the trend components in the time period from 1974 until 1992, while the corresponding correlation coefficient for Germany for this time period is –0.83. For the correlation of the cyclical components King et al. report a correlation coefficient of approximately –0.60 over all sample periods, which is very similar to our results for Germany, indicating that Germany and the United States differ mainly in their long-run response to demand shocks.

changes in its intercept or its slope. The modification of the Dickey-Fuller test (DFGLS) statistic suggested by Elliott et al. is intended to improve the power of the conventional ADF test. The third test is a unit root test with the null of stationarity, which has been proposed by Kwiatkowski et al. (1992). The results are reported in Table 2.

Table 2: Unit root tests

Variable	Perron (1997)	DFGLS	ADF	KPSS	Order of Integration
u	–5.48	–1.17 (c,t)	–3.40 (c,t)	0.73** (τ)	I(1)
Δu	–26.68**	–8.46** (c)	–15.92** (c)	0.67* (μ)	I(0)
P	–3.87	–1.42 (c,t)	–3.55* (c,t)	0.92** (τ)	I(2)
Δp	–4.71	–0.84 (c)	–3.30* (c)	0.33 (μ)	I(1)
$\Delta^2 p$	–16.16**	–10.43**	–10.43**	0.35 (μ)	I(0)

Notes: Asterisks denote: * = significant at 5% level; ** = significant at 1% level. Δ is the difference operator. Perron (1997) denotes the unit root test statistic proposed by Perron (1997) allowing for a shift in the slope of the time trend and a shift of the intercept at an unknown date (in case of the differenced series only the latter is allowed for). The null hypothesis is non-stationarity. The timing of the break is determined by selecting the date which minimizes the t-value of the lagged endogenous variable in the regression. The lag length is chosen on the basis of a LM test for serial correlation. DFGLS denotes the modified Dickey-Fuller t test statistic proposed by Elliot et al. (1996). The terms in the bracket indicate the inclusion of a constant and a trend respectively. The null is again non-stationarity. The ADF statistic denotes the result of a conventional ADF test. KPSS denotes the test statistic proposed by Kwiatkowski et al. (1992), which tests the null of stationarity around a level (μ) or trend-stationarity (τ). A lag truncation parameter of 12 is used. The sample period for all unit root tests is 1951: 1 until 1998: 12.

Table 2 displays strong evidence that the West German unemployment rate (u) is a non-stationary variable: All three versions of the ADF test cannot reject the null of non-stationarity at conventional significance levels, while the KPSS test rejects the null of stationarity at the 1% significance level. The tests for the differenced unemployment variable (Δu) indicate that this variable is stationary, implying that the unemployment rate is integrated of order one. The consumer price level (P) is found to be a non-stationary variable. The case for the inflation rate (Δp) is less clear cut, because the conventional ADF test rejects the null

of non-stationarity at the 5% significance level and the KPSS test does not reject the null of stationarity at conventional significance levels, but both the Perron and the DFGLS test fail to reject the null of non-stationarity. Since the latter two tests are likely to be more powerful than the ADF test, on balance the evidence suggests that the inflation rate is non-stationary. The differenced inflation series ($\Delta^2 p$) is stationary, from which follows that the inflation rate is integrated of order one and the price level is integrated of order two.

3.2.2 Testing the superneutrality proposition

3.2.2.1 The role of integration and cointegration for superneutrality tests

The order of integration of the time series in our Phillips curve models has important implications for the testing of the significance of the long-run trade-off between inflation and unemployment. Since the existence of such a trade-off violates the superneutrality proposition, testing the significance of the long-run trade-off is equivalent to a superneutrality test.[123] Before we consider the role of the stationarity properties of our time series for this test in more detail, it is useful to recall that long-run neutrality refers to a one-time, permanent, unexpected change in the *level* of the money stock. If long-run neutrality holds, ultimately this change in the money stock leaves the level of real variables unchanged.[124] A second hypothetical experiment that more closely resembles actual monetary policy says that the central bank maintains a certain growth rate for the money stock for a long period of time and then unexpectedly changes the growth rate to a new level. If this change in the *growth rate* for the money stock has no long-run effect on the level of real variables, this is referred to as long-run superneu-

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[123] See also the discussion in section 2.1.2. and 2.2.1.

[124] The following discussion is based on Bullard (1999, pp. 57), and on Fisher and Seater (1993, p. 402).

trality. In this hypothetical experiment it is important that the new growth rate for the money stock be maintained for a long-period of time, to allow the transition effects to vanish. Theoretically, the change in the growth rate has to be permanent. Also, it is important that the change in policy be unexpected, because an anticipated change in policy in the near future may induce the economy's participants to change their present behavior. For example, they might stockpile on goods before the faster expansion of the money supply begins to push up prices; consequently, inflation might begin to rise in advance of the change in money growth. Since this complicates the story, we will focus below on unexpected permanent shocks to the money supply to investigate the superneutrality proposition.[125]

Fisher and Seater (1993) have shown that neutrality and superneutrality tests depend crucially on the order of integration of the variables involved. For example, considering the money stock as a monetary policy variable and output as the real variable of interest, their results imply that testing the neutrality proposition requires both the money stock and the output variable to be integrated of order one. If the money stock is integrated of order zero, there are no permanent stochastic changes in the money stock, meaning that shocks to the money stock do not change the money stock permanently and so long-run neutrality is not addressable. If the money stock is integrated of order one and output is integrated of order zero, long-run neutrality holds by definition and does not need to be tested, because permanent changes in the money stock cannot be associated with permanent changes in output since the latter do not exist. Thus, testing neutrality is possible only when both the money stock and output are integrated of order one, since in this case there are permanent changes in both the level of

[125] See also Bullard (1999, p. 58).

the money stock and output.[126] Testing long-run superneutrality requires the monetary policy variable to be integrated of order two and the output variable to be integrated of order one. If the money stock is integrated of order one there are no permanent stochastic changes in the money growth rate and the superneutrality proposition is not testable. If output is integrated of order zero, it is again evident that permanent changes in the growth rate of money cannot be associated with nonexistent permanent changes in output.

When we test superneutrality within the Phillips curve framework, we treat the price level as the monetary policy variable and unemployment as the real activity variable of interest. Since we find prices to be integrated of order two and unemployment to be integrated of order one, we can test for superneutrality.[127] Note that treating the consumer price variable as a monetary policy variable does not mean that monetary policy is assumed to have full control over the price level in every period. Rather, we only assume that monetary policy shocks are the source of non-stationarity in prices.

Fisher and Seater point out that, in general, cointegration plays no role in testing long-run neutrality and superneutrality because both concepts are based on how *changes* in money or its growth rate are ultimately related to *changes* in other variables.[128] Nevertheless, they also note that cointegration of the money stock and the real activity variable is sufficient to reject long-run neutrality and, similarly, cointegration of the change in the growth rate of the money stock and the real activity variable is sufficient to reject superneutrality.[129] Thus, if we find a cointegration relationship between the rate of inflation and unemployment this

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[126] For a more detailed discussion see Fisher and Seater (1993, pp. 405).

[127] Fisher and Seater (1993) show that the relative order of integration in our case implies that long-run neutrality holds by definition.

[128] See Fisher and Seater (1993, p. 414).

[129] Fisher and Seater (1993, p. 414).

would constitute strong evidence against the superneutrality proposition. To investigate this issue, we test the cointegration rank of a system comprised of inflation and unemployment using the maximum likelihood procedure proposed by Johansen (1988).[130] We begin by setting up a vector autoregressive system comprised of these two variables and use information criteria to determine the appropriate lag length.[131] The Schwarz-criterion suggests the inclusion of two lags, the Hannan-Quinn criterion suggests twelve lags and the Akaike-criterion 37 lags. However, even with 37 lags severe problems with autocorrelation remain. This indicates that the bivariate system is too small to model all movements in inflation and unemployment in the period from 1951 until 1998 successfully. If we proceed nevertheless with the cointegration rank test, using the bivariate autoregressive system with 37 lags to minimize the autocorrelation problem, the rank test yields evidence in favor of one cointegration vector.[132] The results are shown in Table 3, which reports the values of the l-trace statistic testing the null hypothesis of no cointegration relationship ($r = 0$) and the null that the rank of the system is at most one ($r = 1$). It is apparent from Table 3 that the null of no cointegration is rejected at the 5% significance level, whereas the null of at most one cointegration vector is not rejected at conventional significance levels.

Imposing a rank of one on the system and normalizing the cointegration vector on the inflation rate yields the following cointegration vector:

(18) $\Delta p + 0.11u = 0$.

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[130] The cointegration analysis has been done using MALCOLM.

[131] The data set is the same we have used for the unit root tests.

[132] There are also indications of non-normality in the residuals, but the trace-statistic used below to test the cointegration rank is known to be robust to non-normality so that is less of a problem.

Table 3: Trace test for the cointegration rank

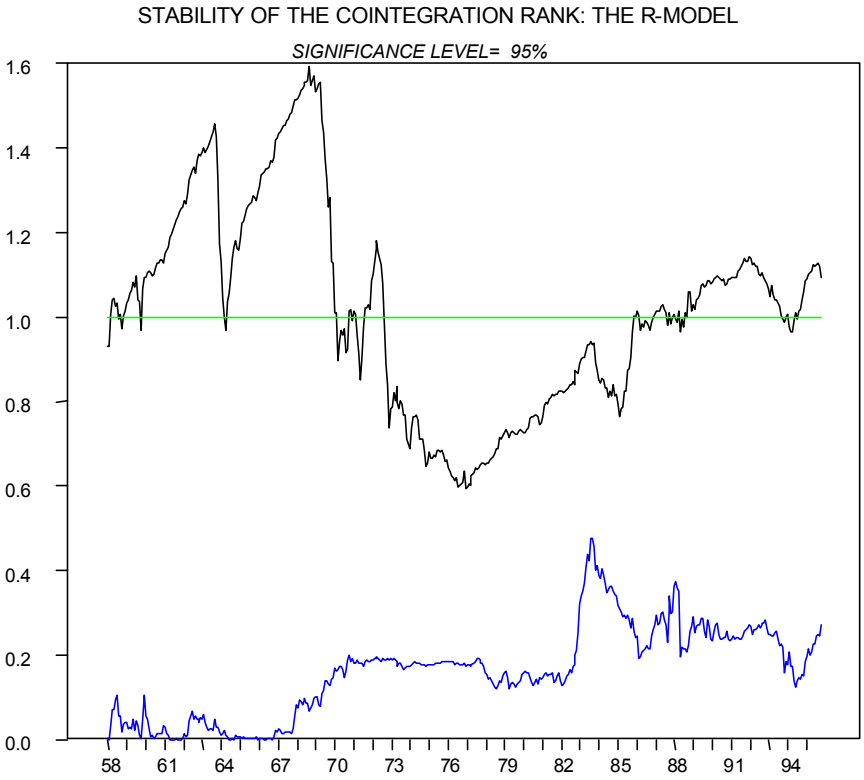
Rank	l -trace statistic	95% critical values
$r = 0$	16.88*	15.41
$r = 1$	1.01	3.76

Notes: Asterisks denote: * = significant at 5% level; ** = significant at 1% level. An unrestricted constant but no trend is allowed for in the system.

According to this estimate increasing the inflation rate by one percentage point lowers the unemployment rate in the long-run by 0.11 percentage points. That is, in the long-run inflation and unemployment are negatively correlated as predicted by the traditional Phillips curve. However, economically the trade-off between inflation and unemployment is negligible. Moreover, testing the stability of the cointegration rank using recursive estimation reveals severe instability (Figure 9).[133] This is not surprising since the computation of the correlation coefficients of the trend components of inflation and unemployment over different sample periods already revealed signs of instability. Figure 9 shows that the cointegration relationship breaks down in the 1970s when large supply shocks hit the economy, just as predicted by Milton Friedman. In sum, even though there is evidence for a negative correlation between inflation and unemployment in the long-run, the instability of the cointegration vector indicates that this long-run relation does not hold over the entire sample period and, therefore, the significance of the trace statistic in Table 3 in itself does not constitute strong evidence against the superneutrality proposition.

[133] A similar result is obtained when using the Z-model. The difference between the two models is that the R-model controls for changes in the short-run dynamics of the model. Also, when testing the stability of the cointegration space after the rank restriction has been imposed reveals again severe signs of instability. Note that the unit line in Figure 9 marks the 95% significance level.

Figure 9: Recursive estimation of the trace test for the cointegration rank



3.2.2.2 The Lucas-Sargent Critique

Testing superneutrality by estimating the long-run trade-off between inflation and unemployment has been common in the early 1970s but fell in disrepute after fundamental criticism of this approach by Lucas (1972) and Sargent (1971). However, King and Watson (1994) show that if inflation is integrated of order one this approach to testing superneutrality remains feasible.[134] Since this issue is of central importance to this paper, this section provides a short review of the controversy.

Early empirical researchers like Gordon (1970) and Solow (1970) investigated long-run superneutrality by taking the Keynesian version of the expectations-augmented Phillips curves as a starting point,

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[134] See also King and Watson (1992) and King and Watson (1997).

(19) $$\Delta p_t = a u_t + b \Delta p_t^e + e_t ,$$

where e_t denotes the residual in the price equation and all other symbols as before.[135] Equation (19) is closely related to the expectations-augmented Phillips curve given by (4a), the only difference being that in contrast to (4a) the coefficient on expected inflation in (19) is not restricted to unity on a priori grounds but is estimated freely.[136] Expected inflation is modeled as a distributed lag function of actual inflation,

(20) $$\Delta p_t^e = v(L)\Delta p_t = \sum_{i=0}^{m} v_i \Delta p_{t-1-i} ,$$

with the restriction $\sum_{i=0}^{m} v_i = 1$ imposed to ensure that if there were a permanent increase in inflation, inflation expectations would ultimately capture it ($\partial \Delta p^e / \partial \Delta p = 1$), i.e. permanent inflation expectations errors are ruled out. The short-run slope of the Phillips curve is given by $\partial \Delta p_t / \partial u_t = a$. More interestingly, the long-run slope of the Phillips curve is given by $\partial \Delta p / \partial u = a/[1 - bv(1)] = a/[1-b]$. Thus, if the coefficient b is found to be equal to unity, there is no long-run trade-off between inflation and unemployment since the attempt to lower the unemployment permanently leads to an infinite inflation rate, confirming the monetarist acceleration hypothesis. If, on the other hand, b is found to be smaller than unity there is a long-run trade-off, confirming the Keynesian standpoint. Solow (1970) finds the long-run Phillips curve slope to be approximately $\partial \Delta p / \partial u = 1$, indicating a substantial long-run trade-off between inflation and unemployment.

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[135] This section is based on King and Watson (1994, pp. 13).

[136] The natural rate of unemployment is modelled as a constant in (19), which is not explicitly shown to simplify notation. Also, the sign of a in (19) is not pinned down on a priori grounds as it is in (4a).

This result was challenged by Sargent (1971) and Lucas (1972). They take the monetarist version of the expectations-augmented Phillips curve as the starting point of their argument,

(21) $u_t = f\Delta p_t - f^e \Delta p_t^e + e_t$,

with $f, f^e < 0$ and where e_t denotes now the residual in the unemployment equation. According to the natural rate hypothesis, the coefficients on actual inflation and expected inflation are identical ($f = f^e$).[137] Inflation is assumed to be generated by an autoregressive process,

(22) $\Delta p_t = r_1 \Delta p_{t-1} + r_2 \Delta p_{t-2} + ... + r_n \Delta p_{t-n} + m_t$,

where m_t is a shock to the inflation process. Moreover, Sargent and Lucas assume that agents have rational expectations, implying that expected inflation is given by,

(23) $\Delta p_t^e = E_{t-1}\Delta p_t = r_1 \Delta p_{t-1} + r_2 \Delta p_{t-2} + ... + r_n \Delta p_{t-n}$.

According to this model the reduced form relationship between unemployment and inflation is given by

(24) $u_t = f\Delta p_t - f^e \sum_{i=1}^{n} r_i \Delta p_{t-i} + e_t$.

The reduced form summarizes the information in the data on the relationship between inflation and unemployment. Lucas and Sargent point out that if equations (21) to (23) represent the true model of the economy it is possible to observe a statistical relationship between inflation and unemployment in the data in spite of the fact that the Phillips curve is vertical, i.e. the natural rate hypothesis holds. In other words, equation (24) shows that an empirical researcher investigating the slope of the long-run Phillips curve would find that

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[137] The only difference between equation (21) and (6) is that the former treats the natural rate of unemployment as a constant which is not shown to keep notation simple.

$\partial u / \partial \Delta p = \left(f - f^e \sum_{i=1}^{n} r_i \right)$. If $\sum_{i=1}^{n} r_i < 1$ the researcher would conclude that there is a long-run trade off between inflation and unemployment even though none is implied by the structural model ($f = f^e$). From this follows that the approach by Gordon and Solow to estimate the long-run trade-off would fail if agents have rational expectations since in this case their estimate of the slope of the long-run Phillips curve really represents a mixture of the slope coefficient and the inflation process. However, King and Watson (1994) argue that if inflation is integrated of order one, the approach by Gordon and Solow yields valid results because a unit root in the inflation process means that $\sum_{i=1}^{n} r_i = 1$.[138] Put another way, the Lucas-Sargent critique is an early example of the point stressed by Fisher and Seater (1993):[139] If inflation is stationary ($\sum_{i=1}^{n} r_i < 1$), the relevant superneutrality experiment — permanent stochastic changes in the inflation rate — are absent from the inflation data and the slope of the long-run Phillips curve cannot be estimated. But with inflation being integrated of order one (and, hence, prices being integrated of order two), the relevant experiments are present in the data and the long-run slope can be determined.

3.2.2.3 The identification problem

In the preceding discussion we have assumed that the money supply process is exogenous to the model.[140] Since monetary policy is likely to respond endogenously to developments in the real and nominal spheres, this assumption is very

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[138] King and Watson (1994, pp. 15), show that this result carries over to richer models than the one considered here.

[139] See King and Watson (1994, pp. 15), for a detailed discussion.

[140] Regarding the Phillips curve, the corresponding assumption is that exogenous monetary policy shocks are responsible for the non-stationary behaviour of prices and inflation.

restrictive. Allowing for an endogenous money supply, however, raises the issue of the identification of exogenous monetary policy shocks. This section provides a brief introduction into the identification issue using a simple macroeconomic model with the money stock as the monetary policy instrument and output as the real variable of interest.[141] In the model presented here, only neutrality can be investigated but the identification principle is the same as in Phillips curve models where superneutrality is the issue. Having introduced the identification principle in this section, we discuss the identification of exogenous monetary policy shocks in Keynesian and monetarist Phillips curve models in the following two sections.

In this section we consider the linear dynamic model given by[142]

$$g_y(L)y_t = \theta p_t + f_m(F)E_t m_t + f_h(F)E_t h_t \tag{25}$$

$$g_p(L)p_t = -\delta y_t + \gamma_m(F)E_t m_t + \gamma_h(F)E_t h_t \tag{26}$$

$$\Delta m_t = \lambda_{my}\Delta y_t + a_{my}(L)\Delta y_{t-1} + a_{mm}(L)\Delta m_{t-1} + \varepsilon_t^m \tag{27}$$

$$\Delta h_t = \lambda(L)\varepsilon_t^h . \tag{28}$$

L is the lag operator, $E_t m_s$ is the conditional expectation of m_s formed at date t, F is the forward operator defined as $F^j[E_t m_t] = E_t m_{t+j}$, ε_t^h is an exogenous real shock and ε_t^m is an exogenous monetary policy shock.[143] Equations (25) and (26) determine output and prices respectively. The model allows for gradual output and price adjustment via the lag operator terms $g_y(L)$ and $g_p(L)$. Moreover, it allows for forward looking behavior via the forward operator terms. Equation (27) gives the reaction function of the central bank. The coefficient λ_{my}

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[141] This section is based on King and Watson (1992, pp. 7).

[142] See King and Watson (1992, pp. 5).

[143] The lag polynomial $a(L)$ takes the general form $a(L) = a_0 + a_1(L) + a_2 L^2 + \ldots + a_n L^n$.

shows the contemporaneous effect of output on the money supply. In addition, the central bank is assumed to respond to past output and money growth. Discretionary monetary policy actions are represented by the monetary policy shock term e_t^m. Equation (28) specifies the process of the second stochastic disturbance in the model, the real disturbance h_t.

With this model, the final form equation for output becomes[144]

(29) $$\Delta y_t = l_{ym}\Delta m_t + \sum_{j=1}^{p} a_{yy}^j \Delta y_{t-j} + \sum_{j=1}^{p} a_{ym}^j \Delta m_{t-j} + e_t^h ,$$

where the coefficient l_{ym} gives the contemporaneous response of output to changes in the money supply. Since we are interested only in the dynamic relationship between the money supply and output, we consider in the remainder of this section the bivariate dynamic simultaneous equations model comprised of the final form output equation and the money supply equation (27):

(30a) $$\Delta y_t = l_{ym}\Delta m_t + \sum_{j=1}^{p} a_{yy}^j \Delta y_{t-j} + \sum_{j=1}^{p} a_{ym}^j \Delta m_{t-j} + e_t^h$$

(30b) $$\Delta m_t = l_{my}\Delta y_t + \sum_{j=1}^{p} a_{my}^j \Delta y_{t-j} + \sum_{j=1}^{p} a_{mm}^j \Delta m_{t-j} + e_t^m ,$$

or, equivalently, these equations can be written as

(30c) $$a_{yy}(L)\Delta y_t = a_{ym}(L)\Delta m_t + e_t^h$$

(30d) $$a_{mm}(L)\Delta m_t = a_{my}(L)\Delta y_t + e_t^m ,$$

with $a_{mm}(L) = 1 - \sum_{j=1}^{p} a_{mm}^j L^j$, $a_{my}(L) = l_{my} + \sum_{j=1}^{p} a_{my}^j L^j$, $a_{yy}(L) = 1 - \sum_{j=1}^{p} a_{yy}^j L^j$, $a_{ym}(L) = l_{ym} + \sum_{j=1}^{p} a_{ym}^j L^j$.
The variance-covariance matrix of the model is given by $\Sigma_e = E(e_t e_t')$. Finally, in stacked form, the model becomes:

(31) $$a(L)X_t = e_t ,$$

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[144] See King and Watson (1992, p. 8).

where $a(L)=\sum_{j=0}^{p} a_j L^j$, and $X_t=\begin{bmatrix}\Delta y_t\\ \Delta m_t\end{bmatrix}$, $e_t=\begin{bmatrix}e_t^h\\ e_t^m\end{bmatrix}$, $a_0=\begin{bmatrix}1 & -l_{ym}\\ -l_{my} & 1\end{bmatrix}$, and $a_j=-\begin{bmatrix}a_{yy}^j & a_{ym}^j\\ a_{my}^j & a_{mm}^j\end{bmatrix}$, $j=1,...,p$.

In the context of structural vector autoregression analysis it is common to consider the moving-average form of a model, expressing all variables as a function of the structural shocks in the model. Introducing this alternative notation will prove useful when we estimate the monetarist Phillips curve model below. The moving-average form of our model is obtained by inverting the AR-form, yielding[145]

(32a) $\Delta y_t = q_{yh}(L)e_t^h + q_{ym}(L)e_t^m$

(32b) $\Delta m_t = q_{mh}(L)e_t^h + q_{mm}(L)e_t^m$.

In stacked form, this model becomes:

(33) $X_t = q(L)e_t$,

where $q(L)=\begin{bmatrix}q_{yh}(L) & q_{ym}(L)\\ q_{mh}(L) & q_{mm}(L)\end{bmatrix}$ which is related to $a(L)$ by $q(L)=a(L)^{-1}$, that is,

$$q_0=\begin{bmatrix}\frac{1}{1-l_{my}l_{ym}} & \frac{l_{ym}}{1-l_{my}l_{ym}}\\ \frac{l_{my}}{1-l_{my}l_{ym}} & \frac{1}{1-l_{my}l_{ym}}\end{bmatrix}, \text{ and } q_j=\begin{bmatrix}\frac{-a_{mm}^j}{a_{mm}^j a_{yy}^j - a_{my}^j a_{ym}^j} & \frac{a_{ym}^j}{a_{mm}^j a_{yy}^j - a_{my}^j a_{ym}^j}\\ \frac{a_{my}^j}{a_{mm}^j a_{yy}^j - a_{my}^j a_{ym}^j} & \frac{-a_{yy}^j}{a_{mm}^j a_{yy}^j - a_{my}^j a_{ym}^j}\end{bmatrix}.$$

The long-run multiplier giving the long-run response of output to a one unit permanent increase in the money stock is $g_{ym}=a_{ym}(1)/a_{yy}(1)$.[146] The long-run neu-

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[145] See King and Watson (1997), p. 73. For the conditions which need to hold for the model to be invertible, see King and Watson (1997, pp. 75).

[146] The term $a(1)$ refers, in general, to the lag polynomial $a(L)$ evaluated at $L=1$. That is, $a(1)$ refers to the sum of the coefficients in $a(L)$, i.e. $a(1)=a_0+a_1+a_2+...+a_n$. Note that, for example, in $\Delta y_t = a(1)\Delta m_t$ the coefficient $a(1)$ gives the long-run response of the *level* of output to a permanent unit change in the money stock.

trality restriction is $g_{ym} = 0$.[147] In the moving-average representation the equivalent restriction is $g_{ym} = q_{ym}(1)/q_{mm}(1)$ where $q_{ym}(1)$ denotes the long-run response of the level of output to a monetary policy shock and $q_{mm}(1)$ denotes the corresponding response of the money stock.[148] Using long-run restrictions like $q_{yn}(1) = 0$ in SVAR analysis has been popularized by Blanchard and Quah (1989) and we will use such restrictions below when estimating the monetarist Phillips curve model.

Testing long-run neutrality is complicated by the fact that the model given by (30) is not identified. That is, without further restrictions imposed on the model its parameters cannot be estimated. To see this, consider the reduced form of model (31):[149]

(34) $$X_t = \sum_{i=1}^{p} f_i X_{t-1} + e_t ,$$

where $f_i = a_0^{-1} a_i$ and $e_t = a_0^{-1} e_t$. The reduced form summarizes all information in the data on the relationship between the variables in the vector X_t. To obtain estimates of the structural parameters in (30) we need first to estimate the reduced form parameters f_i, $i = 1,...,p$, and then we have to retrieve the structural parameters of interest from the reduced form model, using the following set of equations:[150]

(35) $$a_0^{-1} a_i = -f_i , \; i = 1,...,p ,$$

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147 Note that long-run superneutrality cannot be tested within this model because the money stock is, according to equation (27), integrated of order one and not of order two, as is required for superneutrality tests. For a modification of this model allowing for superneutrality tests see King and Watson (1992, p. 10).

148 See King and Watson (1997, p. 74).

149 See King and Watson (1992, p. 9).

150 See King and Watson (1992, p. 9).

(36) $a_0^{-1}\Sigma_e a_0^{-1\prime} = \Sigma_e$,

where Σ_e denotes the variance-covariance matrix of the reduced form model. It is obvious from (35) and (36) that there are more unknown structural parameters on the left hand side than there are estimated reduced form parameters on the right hand side. Considering equation (36), the reduced form equation yields three unique parameters in Σ_e, whereas on the left hand side we have five unknown parameters: l_{ym} and l_{my} in a_0, and s_{eh}, s_{em}, and $s_{eh,em}$ in Σ_e. Thus, without further restrictions it is not possible to obtain unique estimates of the structural parameters from the reduced form parameters. In SVAR models it is typically assumed that the structural disturbances e_h and e_m are uncorrelated, yielding the restriction $s_{eh,em} = 0$. Our bivariate model requires one additional restriction to identify the model. To this end one could assume, for example, that the model is recursive, so that either $l_{my} = 0$ or $l_{ym} = 0$.[151] With $l_{my} = 0$, the central bank is assumed not to respond contemporaneously to changes in output growth, i.e. Δm_t is predetermined, whereas $l_{ym} = 0$ means that output would not respond to a change in the money supply within the period which could be an appropriate assumption if there are lags in the monetary transmission mechanism and the measurement period was relatively short.[152] One could also identify the model by imposing the long-run neutrality restriction ($g_{ym} = 0$) on the model.[153] Another alternative is to assume that the central bank sets the money supply in the long-run independent of output, which implies the restriction $g_{my} = 0$. According to

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[151] For a survey on identifying restrictions used in the literature, see King and Watson (1997, pp. 76).

[152] See Fisher and Seater (1993, p. 407).

[153] The seminal paper in this regard is Blanchard and Quah (1989). For a survey on bivariate SVAR models using long-run neutrality restrictions, see Gottschalk and Van Zandweghe (2001).

Fisher and Seater (1993), this restriction can be interpreted as asserting the 'long-run exogeneity' of the money stock, in the sense that a permanent change in output has no effect on the money stock in the long-run.[154] Yet another approach is chosen by King and Watson (1992, 1997) and Weber (1994), the latter applying the King and Watson approach to data from G7 countries: Instead of reporting results for a single identifying restriction, these authors summarize the results for a wide range of identifying assumptions in graphs, thereby allowing the reader to specify a value for any one of the parameters l_{ym}, l_{my}, g_{ym} or g_{my} and find the implied estimates for the other three parameters.

In this paper we take another approach and follow King and Watson (1994), Roberts (1993), Bullard and Keating (1995) and Dolado et al. (1997) who derive from Keynesian and monetarist Phillips curve models identifying restrictions for models comprised of unemployment and inflation. It needs to be emphasized that all the resulting models are just-identified, because we are imposing only two just-identifying and no over-identifying restrictions on the models, and, hence, these models are all observationally equivalent, meaning that their reduced forms fit the data equally well.[155] From this follows that we cannot test the validity of the individual models formally. Notwithstanding, these models have different implications regarding the long-run trade-off between inflation and unemployment and regarding the sources of business cycle fluctuations. The latter means that the models yield different interpretations of particular historical episodes. For example, they are likely to disagree on the sources of recessions. This offers an informal way to assess the plausibility of these models, but before doing so, we need to identify the Keynesian and monetarist Phillips curves.

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[154] See Fisher and Seater (1993), p. 408. King and Watson (1997, p. 77), propose the alternative restriction $g_{my} = 1$ which would be consistent with a policy aiming at price stability under the assumption of stable velocity.

[155] See also the discussion in Dolado et al. (1997, p. 12).

3.2.3 The Keynesian Phillips curve

3.2.3.1 Identifying the Keynesian Phillips curve

The essence of traditional Keynesian models is contained in the following two equations, where for expositional convenience we focus on the contemporaneous interaction between inflation and unemployment and leave (for the moment) dynamics aside:[156]

(37) $\Delta p_t = au_t + s_t$

(38) $u_t = h\Delta p_t + d_t$.

The first equation is a price equation, representing the wage-price block in Keynesian models. In the spirit of the traditional Phillips curve inflation is assumed here to be a function of the unemployment rate, which is an indicator of aggregate demand conditions. Moreover, inflation is influenced by supply shocks, s_t. The second equation represents the IS/LM block and determines unemployment as a function of demand shocks, d_t. In addition, inflation may have an effect on demand. But, as King and Watson (1994) write, "the conventional Keynesian macroeconometric view was that the short-run dependence on real variables on the price level was minor, suggesting small values h in equation (2) [38], and that demand variations were dominated by exogenous shocks (d_t)."[157] Recall that this assumption sets the Keynesian model apart from monetarist models, where (unexpected) inflation plays a major role in determining demand conditions.

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[156] This section is based on King and Watson (1994, pp. 11).

[157] King and Watson (1994, p. 11).

The following model represents a Phillips curve model with more elaborate dynamics:[158]

$$\text{(39a)} \quad \Delta u_t = l_{u\Delta p}\Delta^2 p_t + \sum_{i=1}^{p} f_{u\Delta p,i}\Delta^2 p_{t-i} + \sum_{i=1}^{p} f_{uu,i}\Delta u_{t-i} + e_{s,t}$$

$$\text{(39b)} \quad \Delta^2 p_t = l_{\Delta pu}\Delta u_t + \sum_{i=1}^{p} f_{\Delta p\Delta p,i}\Delta^2 p_{t-i} + \sum_{i=1}^{p} f_{\Delta pu,i}\Delta u_{t-1} + e_{d,t} \,,$$

where $e_{s,t}$ is a supply and $e_{d,t}$ is a demand shock. We will interpret equation (39a) in the remainder of this paper as representing the Phillips curve. While this equation provides a natural setting for the monetarist version of the Phillips curve, we need to rearrange the Keynesian Phillips curve given by (37) so that it determines the unemployment rate. Doing so means that the parameter $l_{u\Delta p}$ in equation (39a) corresponds to $1/a$ in (37), and $e_{s,t}$ is proportional to s_t.[159] The model is specified in differences, to account for our earlier finding that both inflation and unemployment are integrated of order one and that there is no stable cointegration relationship between the two variables in levels. Since differencing is a (crude) way to remove the trend components, our empirical Phillips curve model is based on the business cycle components in the two time series.[160] The objective is to estimate the slope of the long-run Phillips curve. However, rather

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[158] Dolado et al. (1997, pp. 8), show that equation (39a), which is interpreted here as representing the Phillips curve, can be derived from a wage and price setting model, assuming imperfect competition and a hysteretic mechanism. Furthermore, they show that equation (39b) can be interpreted as an aggregate demand equation.

[159] For the interpretation of equation (39a) as a monetarist Phillips curve, recall the discussion in section 2.2.3. See in particular equation (6).

[160] Removing the trend components from the data, of course, does not mean that we cannot investigate the long-response of the two variables to shocks. Even though in our small bivariate model there is no stable relationship between the trend components of inflation and unemployment, a demand shock, for example, can still have long-run effects on both inflation and unemployment. Note that even if demand shocks are an important factor for both variables in the long-run, we would not find a stable long-run relationship between the two variables if there are other sources of shocks not included in our small model which are important for one and/or the other variable in the long-run.

than computing $\partial\Delta p/\partial\Delta u$, as Gordon (1970) and Solow (1970) did, we will determine the slope of the Phillips curve as $g_{u\Delta p} = \lim_{k\to\infty}\{[\partial u_{t+k}/\partial e_{d,t}]/[\partial\Delta p_{t+k}/\partial e_{d,t}]\} = f_{u\Delta p}(1)/f_{uu}(1)$.[161] That is, we will be concerned with the relative effects of demand shocks on unemployment and inflation.[162] With the reduced form of model (39) given by

(40a) $\Delta u_t = c(L)\Delta u_{t-1} + d(L)\Delta^2 p_{t-1} + e_{u,t}$

(40b) $\Delta^2 p_t = f(L)\Delta u_{t-1} + g(L)\Delta^2 p_{t-1} + e_{\Delta p,t}$,

it can be shown

(41) $g_{u\Delta p} = |((1-g(1))l_{u\Delta p} + d(1)|/|(1-c(1)) + l_{u\Delta p}f(1)|$,

meaning that the long-run Phillips curve slope is a function of the short-run slope $l_{u\Delta p}$ and the long-run relationships between inflation and unemployment in the reduced form model.[163] Thus, to estimate the long-run slope we need to identify the short-run Phillips curve slope.

Identification of the Keynesian Phillips curve model requires two restrictions. The assumption that the demand and supply shocks are mutually uncorrelated provides one of the two identifying restriction. For the other identifying restriction we follow King and Watson (1994) who argue that the econometric implementations of the traditional Keynesian model (37)-(38) allowed for little contemporaneous feedback between the wage-price block (summarized by (37)) and

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[161] The latter coefficients are defined as $f_{u\Delta p}(1) = l_{u\Delta p} + \sum_{i=1}^{p} f_{u\Delta p,j}$ and as $f_{uu}(1) = 1 - \sum_{i=1}^{p} f_{uu,j}$.

[162] Since in the Keynesian version of the Phillips curve, which was the starting point of the investigation of Gordon (1970) and Solow (1970), unemployment is an indicator of aggregate demand, both approaches to estimating the long-run slope of the Phillips curve are closely related, but in our model we are more explicit about the identification of the demand shock. Furthermore, we consider the reciprocal of the Phillips curve slope coefficient estimated by Solow (1970).

[163] See Dolado et al. (1997, p. 13).

the IS-LM block (summarized by equation (38)).[164] In particular, they note that early researchers like Gordon (1970) and Solow (1970) used ordinary least square estimators to estimate wage-price equations like (37). That is, in early work the unemployment rate was treated as an exogenous variable in the wage-price block.[165] From this follows that that they assumed for equation (38) that $h = 0$, which yields the other identifying restriction we have been looking for.[166] This restriction implies that u_t and $e_{s,t}$ are uncorrelated and, hence, we can estimate the Phillips curve (39a) by using the contemporaneous value of u_t as an instrument for the contemporaneous price variable, $\Delta^2 p_t$.[167] This approach defines a value for $l_{u\Delta p}$ which we will use in the estimation of long-run Keynesian Phillips curve trade-off. It should be noted that the restriction we use here to identify the Keynesian Phillips curve does not impose a long-run vertical Phillips curve on the model. Even though NAIRU models are often specified to include a vertical Phillips curve in the long-run, we do not impose any long-run restrictions on our Phillips curve model in order to be able to test empirically the slope of the long-run Keynesian Phillips curve.

3.2.3.2 The long-run trade-off in the Keynesian Phillips curve model

In a first step we estimate the reduced form of model (39).[168] We determine the appropriate lag length using information criteria. With the effective sample period beginning in 1954:1 and ending in 1998:12 we find, however, that there are

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[164] King and Watson (1994, p. 17).

[165] King and Watson (1994, p. 18).

[166] See also the discussion in King and Watson (1997, p. 93).

[167] See King and Watson (1994, p. 18). These authors also note that, following the 'price equation' estimation strategy used by Gordon (1970) and other researchers in the Keynesian tradition, equation (39a) can equivalently be estimated by OLS using the reverse regression of $\Delta^2 p_t$ onto Δu_t and relevant lags.

[168] For the unemployment rate and the price level we use the same time series as before. We compute the inflation rate, Δp_t, as the monthly annualised rate of change of the consumer price index, i.e. $\Delta p_t = 1200 \ln(P_t / P_{t-1})$.

severe problems with autocorrelation in the system even if we specify the system on the basis of the Akaike information criterion which tends to over-parameterize the system.[169] Nevertheless, the system does not display any signs of instability when we investigate its stability using recursive Chow breakpoint tests. Thus, like in the cointegration analysis the problem appears to be that the bivariate system is too small to model all movements of our unemployment and inflation variables over the past 50 years. Considering shorter sample periods helps alleviating this problem. With the effective sample period beginning in 1970:1, there are no more signs of autocorrelation or heteroscedasticity in the residuals at the system level, but problems with non-normality remain.[170] Single equation misspecification tests show that the unemployment equation, which represents the Phillips curve in our model, is well specified, but the null hypotheses of no autocorrelation and normally distributed residuals are clearly rejected in the price equation. The time series for $\Delta^2 p$ is depicted in the lower panel of Figure 1A in the appendix and it is apparent that this series displays a lot of high frequency noise. It is likely that our Phillips curve model does not adequately model this component in the price variable since it is a business cycle model, which would account for the residuals in the price equation not being white noise. Since the high frequency noise in the price variable is not of major interest to us, we will continue using this model in spite of the problems with the normality assumption at the system level. In Figure 2A we show the results for 1-step-ahead Chow forecast tests (first row), n-step-ahead Chow forecast tests (second row) and Chow breakpoint tests (third row). These tests show no signs of instability in the single equations (first and second column) or in the system (third column).[171] This confirms our earlier finding that the Phillips curve relation is stable at the business cycle frequency.

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[169] Recall that we experienced the same problem when testing for cointegration.

[170] Detailed results are shown in Table 1A in the appendix.

[171] We use one quarter of the sample period (seven years of data) to obtain an initial estimate of our Phillips curve system before proceeding with recursive estimation of the system.

Having specified the reduced form Phillips curve model, we estimate the parameter $l_{u\Delta p}$ using the approach outlined above.[172] This yields a value of 0.6006 for $l_{u\Delta p}$. Surprisingly, our estimate of $l_{u\Delta p}$, which is equivalent to $1/a$ in equation (37), has a positive sign instead of the negative sign we would expect from the Phillips curve relation. Nevertheless, Figure 10a shows the response of unemployment and inflation to a demand shock, also called impulse response functions, and it is apparent that our identification strategy yields a plausible estimate of the Keynesian Phillips curve. The demand shock has been scaled so that the inflation rate is eventually reduced by one percentage point. In the long-run this leads to an increase in the unemployment rate by 1.61 percentage points. That is, the Keynesian Phillips curve suggests that there is a substantial long-run trade-off between inflation and unemployment.[173] As we argued in section 2.1, this long-run trade-off is an essential part of the traditional Keynesian paradigm, so this finding supports our assertion that our identification strategy yields indeed a Keynesian Phillips curve.

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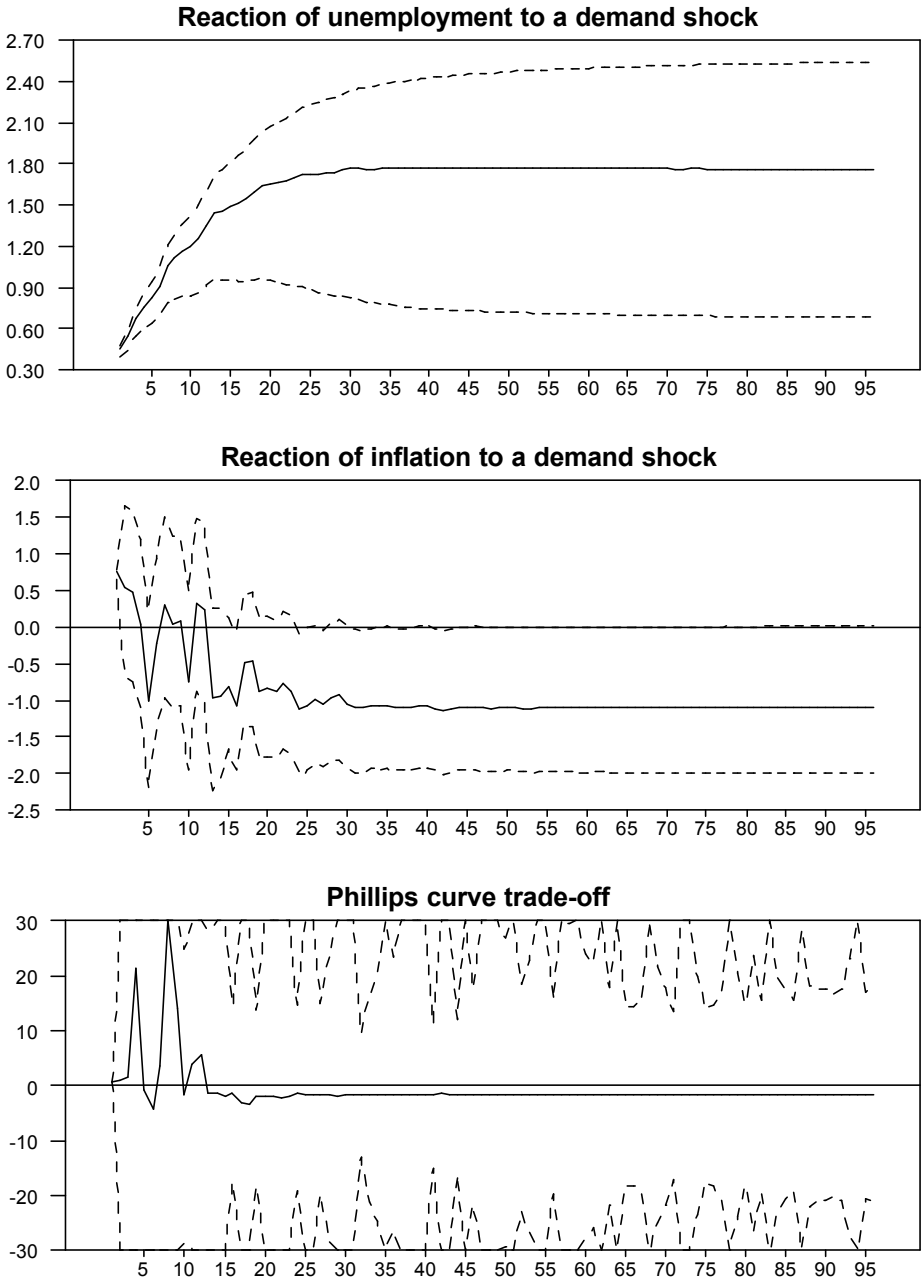
[172] I am grateful Mark W. Watson for making available his RATS programs used in the King and Watson (1994) paper. These programs are available from his homepage.

[173] This estimate of the long-run trade-off is considerable larger than the comparable estimate by King and Watson (1994) for the United States of –0.71 for the full sample period from 1954 until 1992. For the sample period from 1954 until 1969 they report a value of –1.30. The Keynesian Phillips curve model for Germany implies for this sample period a value of –1.82. Considering the large uncertainty in estimating the inflation and unemployment response to a demand shock, these values are relatively close to each other. For the time period from 1970 until 1992 King and Watson report a value of the long-run trade-off of only –0.57. This decrease in the long-run trade-off goes along with an increase in the median inflation rate from 1.67% in the earlier period to 4.82% in the latter period. In the period of higher trend inflation King and Watson find that shocks to inflation have become more persistent, meaning that the sum of coefficients in the inflation process became larger (see equation (22)), a finding which would account for the long-run trade-off becoming smaller (see the discussion in section 3.2.2.2). A comparable increase in the median inflation rate did not occur in Germany (the median inflation rate in the earlier period is 2.29% and 3.23% in the latter period). If in contrast to the United States the inflation process did not become more persistent over time this would explain why the long-run trade-off in Germany remained relatively high in the 70s and 80s.

Figure 10a: The trade-off between inflation and unemployment in the Keynesian Phillips curve



To investigate the significance of the long-run response of unemployment and inflation to the demand shock we employ a bootstrapping procedure to generate a two standard error confidence band. This is shown in Figure 10a as the dotted lines.[174] The unemployment response is clearly significant, but the inflation re-

[174] The bootstrapping procedure is based on 1000 draws.

sponse is very imprecisely estimated and not significantly different from zero. With the inflation response forming the denominator of our estimate of the long-run Phillips curve slope it is no surprise that the Phillips curve trade-off is not significantly different from zero either. In fact, since the Phillips curve trade-off is computed as a fraction where the denominator might be close to zero, it follows that the resulting estimate is bound to be highly volatile. This is shown in the third panel of Figure 10a. The insignificance of the long-run trade-off means that, contrary to our expectations, the Keynesian Phillips curve model does not reject the superneutrality proposition. However, since this reflects largely the insignificant response of inflation to a demand shock and we have seen above that the reduced form of our price equation is not well specified this should not be seen as constituting strong evidence against the Keynesian position.[175] Nevertheless, the imprecise estimate of the inflation response and the resulting large uncertainty about the slope of the long-run Phillips curve implied by the Keynesian model raises some doubts whether this model presents an adequate description of the inflation and unemployment dynamics in Germany, in particular so because we will see below that the monetarist Phillips curve model does not suffer to the same extent from these problems.

Regarding the short-run responses, Figure 10a shows that it takes approximately two years until the unemployment and the inflation rates reach their new steady state values. The unemployment rate increases on impact and continues to increase gradually over the next two years. Since in Keynesian models the unemployment rate is an indicator of aggregate demand conditions, this suggests

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[175] To obtain a better estimate of the long-run trade-off it would appear promising to augment the Phillips curve models with other (exogenous) variables to control for shocks to the inflation variable which are not related to the Phillips curve model. For such an extension, see Dolado et al. (1997) or King and Watson (1994, pp. 27). Moreover, Weber (1994, p. 20), finds strong evidence against a vertical Phillips curve in a Keynesian Phillips curve model. His results are discussed in more detail below.

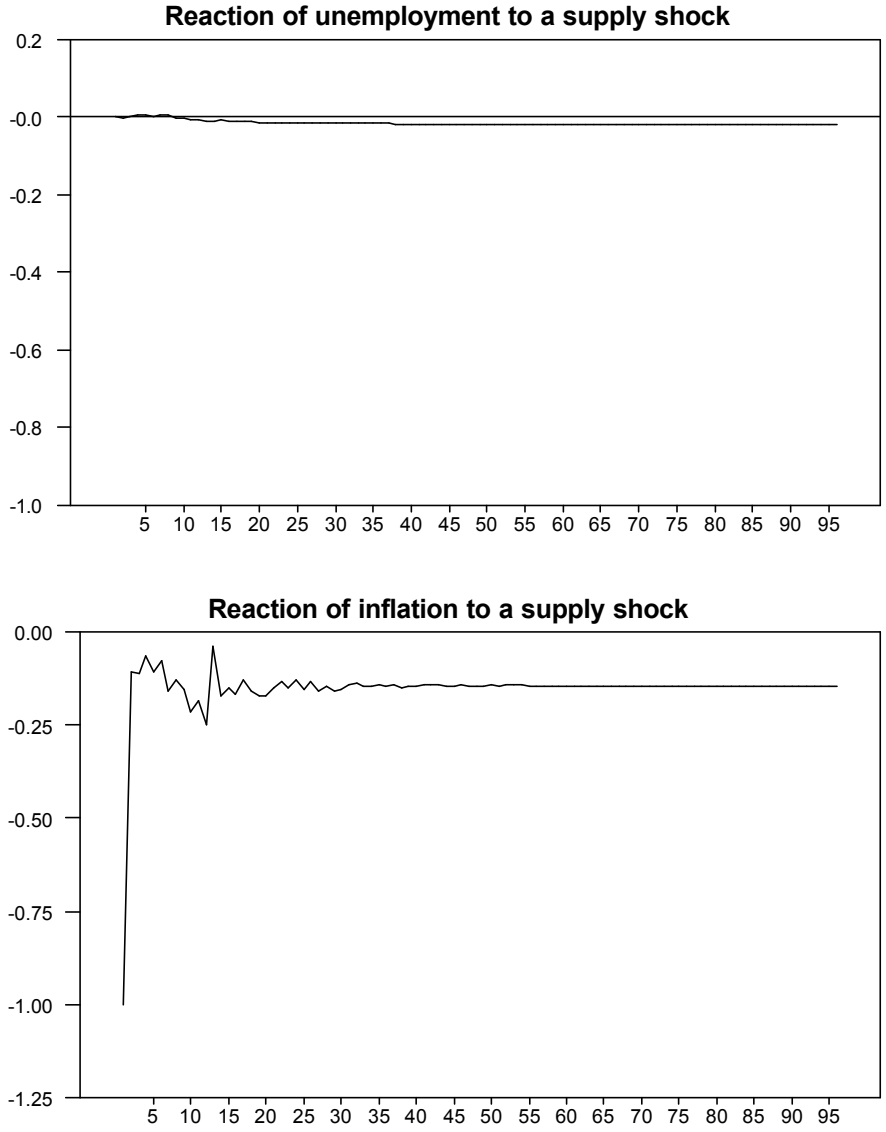
that, following an adverse demand shock, aggregate demand conditions do not deteriorate immediately but do so gradually. With respect to inflation, Figure 10a shows that in the first three months there is a positive response, consistent with our positive estimate of $l_{u\Delta p}$. Since in Keynesian models a negative demand shock might be the result of a tax increase or higher interest rates charged in the financial sector, an initial positive price response is not implausible if firms try to pass higher costs on to customers via higher prices. One year after the demand shock has occurred inflation begins to fall permanently. This delayed inflation response is consistent with the Keynesian view of sticky prices. Given the large increase in unemployment, the inflation response seems to be small. However, such a small response is consistent with the observation by Blanchard (1990) that in the early 1970s there was a wide consensus that prices did not seem to respond much to demand conditions.[176] All in all, our Keynesian Phillips curve model appears to yield a plausible estimate of the short-run Keynesian Phillips curve.

In Figure 10b we consider the response of unemployment and inflation to a supply shock which has been scaled so that it reduces the inflation rate on impact by one percentage point. Such a shock could correspond, for example, to a technological innovation which increases productivity, or to a reduction in oil prices. In general, we expect a supply shock to push unemployment and inflation into the same direction. In Figure 10b we observe that in the first year following the shock unemployment remains virtually unchanged but then begins to fall slightly. Inflation, on the other hand, responds strongly to the supply shock, falling on impact by one percentage point. This fall in inflation is quickly reversed,

[176] Blanchard (1990, p. 784).

but inflation remains permanently below the base line.[177] This suggests that in response to a supply shock it is the unemployment rate which is sticky while prices are flexible. That is, firms pass lower oil prices, for example, quickly on to customers while keeping employment unchanged. It should be noted that this follows directly from our identifying restriction: By assuming $h = 0$ in equation

Figure 10b: The effects of supply shocks in the Keynesian Phillips curve model



[177] The base line represents the value a variable would have taken in the absence of the disturbance considered in the experiment underlying the impulse response analysis and is given here by the zero line.

(38) we specify that prices can respond on impact to all shocks while unemployment is restricted to respond instantaneously only to demand shocks. King and Watson (1997) write that "for today's 'new Keynesians' this may appear to be a very unreasonable identifying restriction (and so must any evidence about the Phillips curve that follows from it). However, the identifying restriction is consistent with the traditional Keynesian model of the late 1960s."[178]

3.2.4 The monetarist Phillips curve

Roberts (1993) argues that the monetarist paradigm suggests two long-run restrictions which can be used to identify our Phillips curve model. From the natural rate hypothesis follows that a demand shock, and, in particular, a monetary policy shock cannot have a long-run effect on the level of a real variable like unemployment. That is, we can impose the superneutrality restriction $g_{u\Delta p} = 0$ to identify the monetarist Phillips curve. Moreover, the monetarist assertion that ‚inflation is always and everywhere a monetary phenomenon' yields another identifying long-run restriction: Roberts points out that this means that even though non-monetary shocks like oil price shocks may have a temporary effect on inflation, inflation is ultimately under control of the central bank and, hence, only central bank actions can have a permanent effect on inflation.[179] Roberts (1993) writes: "By this argument, if there is any non-stationary element to inflation, it must be the result of changes in the rate of inflation that the central bank chooses to tolerate. These changes in the target inflation rate can be thought of as shocks to the preferences for inflation, either of society or simply of the central bank. … The preceding analysis suggests a natural set of restrictions on a vector autoregression, since a central bank need not change its inflation objec-

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[178] King and Watson (1997, p. 93).

[179] Roberts (1993, pp. 923).

tives in response to other exogenous shocks, and so these shocks can be constrained to have no effect on inflation in the long run."[180]

To see how the Phillips curve model is identified using long-run restrictions we consider the moving-average representation of model (39),

(42a) $\Delta u_t = q_{us}(L)e_{s,t} + q_{ud}(L)e_{d,t}$

(42b) $\Delta^2 p_t = q_{\Delta ps}(L)e_{s,t} + q_{\Delta pd}(L)e_{d,t}$.

The natural rate hypothesis implies that $q_{ud}(1) = 0$ and the 'inflation is a monetary phenomenon' restriction implies $q_{\Delta ps}(1) = 0$. Together with the assumption that the demand and supply shocks are uncorrelated we have three identifying restrictions, yielding one over-identifying restriction which can be tested. Blanchard and Quah (1989) have shown how to impose these long-run restrictions on vector autoregression models. However, when we impose these restrictions on the reduced form Phillips curve model we used above to estimate the Keynesian Phillips curve, it becomes apparent that even though the resulting impulse response functions appear plausible the overidentifying restriction is nevertheless clearly rejected by the data.[181] That is, the monetarist model does not entirely fit the German data. Since we do not know which of the two monetarist identifying restrictions are rejected by the data, we proceed by considering two just-identified monetarist models, one representing the natural rate hypothesis and the other the 'inflation as a monetary phenomenon' restriction. In the next section, where we investigate the sources of business cycle fluctuations implied by the two models, we hope to shed some more light on the plausibility of these models.

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[180] Roberts (1993, p. 924).

[181] The model has been estimated using Malcolm. The significance level of the test statistic for the over-identifying restriction is 2.04e-21.

3.2.4.1 The long-run trade-off in the 'natural rate' Phillips curve model

When we consider monetarist Phillips curve models, we assume that in the Phillips curve equation (39a) the direction of causality runs from (unexpected) inflation to the unemployment rate and not into the other direction as in the Keynesian Phillips curve. Also, inflation is now the indicator of demand conditions while the unemployment rate indicates the supply response. Since in monetarist models inflation is assumed to be determined largely by monetary policy shocks, the demand shock in the aggregate demand equation (39b) is interpreted here as representing for the most part monetary policy shocks.[182]

Imposing the 'natural rate' restriction $q_{ud}(1) = 0$ on the Phillips curve model implies a value of –0.0044 for $l_{u\Delta p}$. This means that in the 'natural rate' model there is practically no short-run response of the unemployment rate to a demand shock. Thus, this model has very different unemployment-inflation dynamics than the Keynesian model where we observe a large contemporaneous response of the unemployment rate to a demand shock ($l_{u\Delta p} = 0.6006$). Moreover, Figure 11a shows that in the 'natural rate' model the unemployment rate barely changes at any horizon in response to a demand shock. In this context it is interesting to notice that our 'natural rate' identification happens to be very close to the $l_{u\Delta p} = 0$ restriction used by King and Watson (1994) and Dolado et al. (1997) to identify a Real Business Cycle (RBC) model. This type of model postulates that real activity variables like unemployment are determined only by real shocks like technological innovations and not by nominal shocks like monetary policy shocks. Moreover, prices are assumed to be flexible. Our 'natural rate' model appears to have RBC characteristics, since the demand shock leads on impact to a very strong inflation response which practically neutralizes the effect of this

[182] In Keynesian models, on the other hand, this shock is assumed to represent largely fiscal policy shocks and other *real* demand shocks.

shock on the real sphere.[183] Given these characteristics, there is, of course, no Phillips curve trade-off neither in the short-run nor in the long-run.

Figure 11a: The trade-off between inflation and unemployment in the monetarist Phillips curve — 'Natural rate' identification

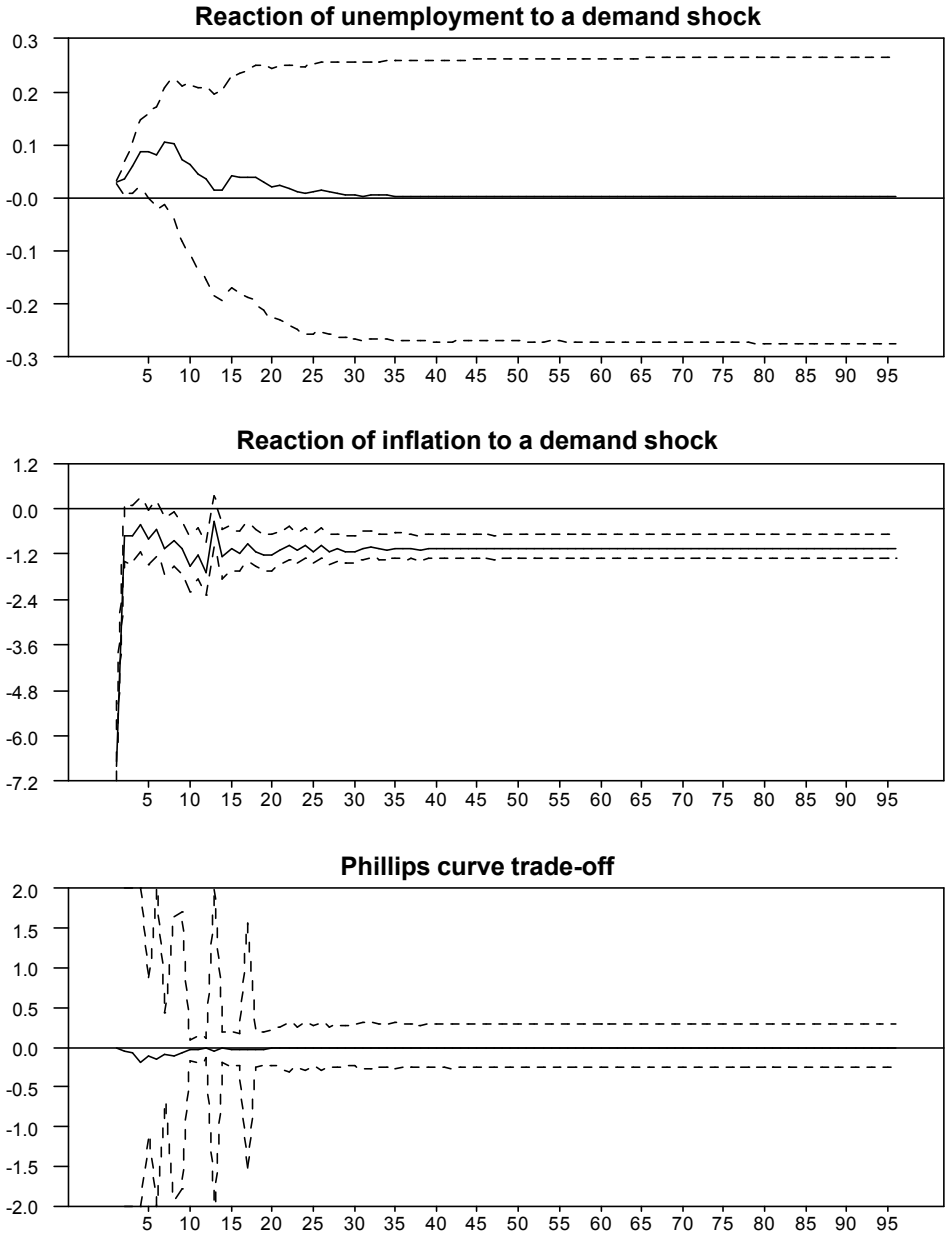
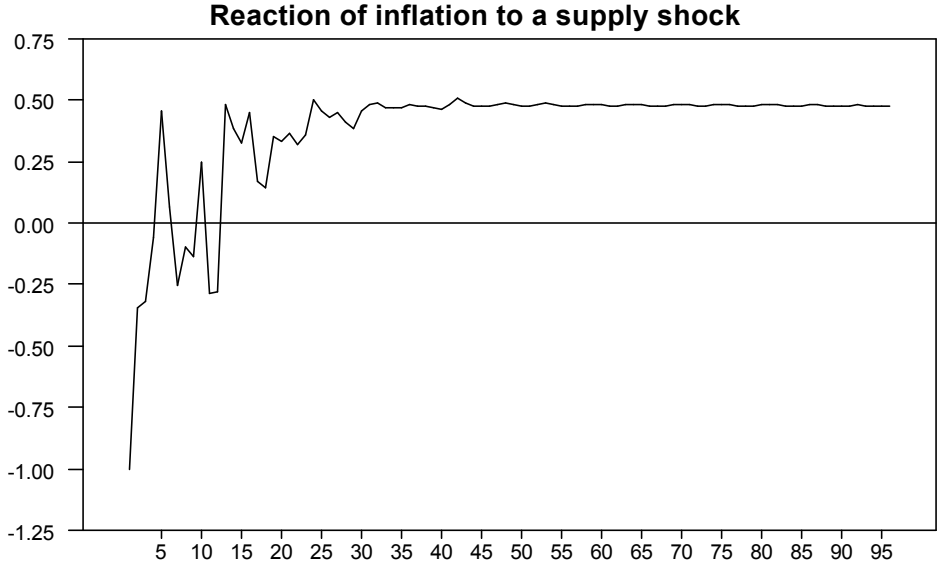


Figure 11b shows the response of unemployment and inflation to a supply shock, which again has been scaled so that it reduces inflation on impact by one

[183] Note that the inflation rate in Figure 11a is expressed as an annualised rate.

percentage point. In contrast to the Keynesian identification there is a very strong unemployment response. This is consistent with the RBC view that real shocks are behind most movements in unemployment. Inflation falls initially below the base line, consistent with our requirement that a supply shock pushes inflation and unemployment into the same direction, and then rises slightly above it as the real economy approaches its new steady state level.

Figure 11b: The effects of supply shocks in the monetarist Phillips curve model — 'Natural rate' identification



3.2.4.2 The long-run trade-off in the 'inflation as a monetary phenomenon' Phillips curve model

In this section we assume that inflation is a monetary phenomenon. According to the quantity theory this means that the permanent component of inflation is determined by permanent changes in the growth rate of money.[184] To identify this model we impose the restriction $q_{\Delta ps}(1) = 0$ on the Phillips curve model.[185] This yields a value of –0.0295 for $l_{u\Delta p}$. Thus, the short-run response of the unemployment rate to a demand shock is larger (in absolute terms) than under the natural rate restriction but still considerably smaller than under the Keynesian identification. Figure 12a shows the resulting impulse response functions. It appears this monetarist models is an intermediate case between the Keynesian model and the 'natural rate' model. There is a strong contemporaneous response of inflation to the demand shock which helps to insulate the real economy from this disturbance, but in contrast to the natural rate restriction the inflation response is not strong enough to fully neutralize its effect on the unemployment rate. Following the demand shock the unemployment rate gradually increases and reaches its new long-run level after about two years when it has increased by 0.44 percentage points. The unemployment response is significant, so is the slope of the long-run Phillips curve.

It is a surprising finding that the monetarist model of the Phillips curve entails a significant long-run trade-off between inflation and unemployment. Formally, this means that the superneutrality proposition is rejected, contradicting a central tenet of the monetarist view. Nevertheless, the long-run trade-off is fairly small, indicating a very steep long-run Phillips curve. King and Watson (1994) also re-

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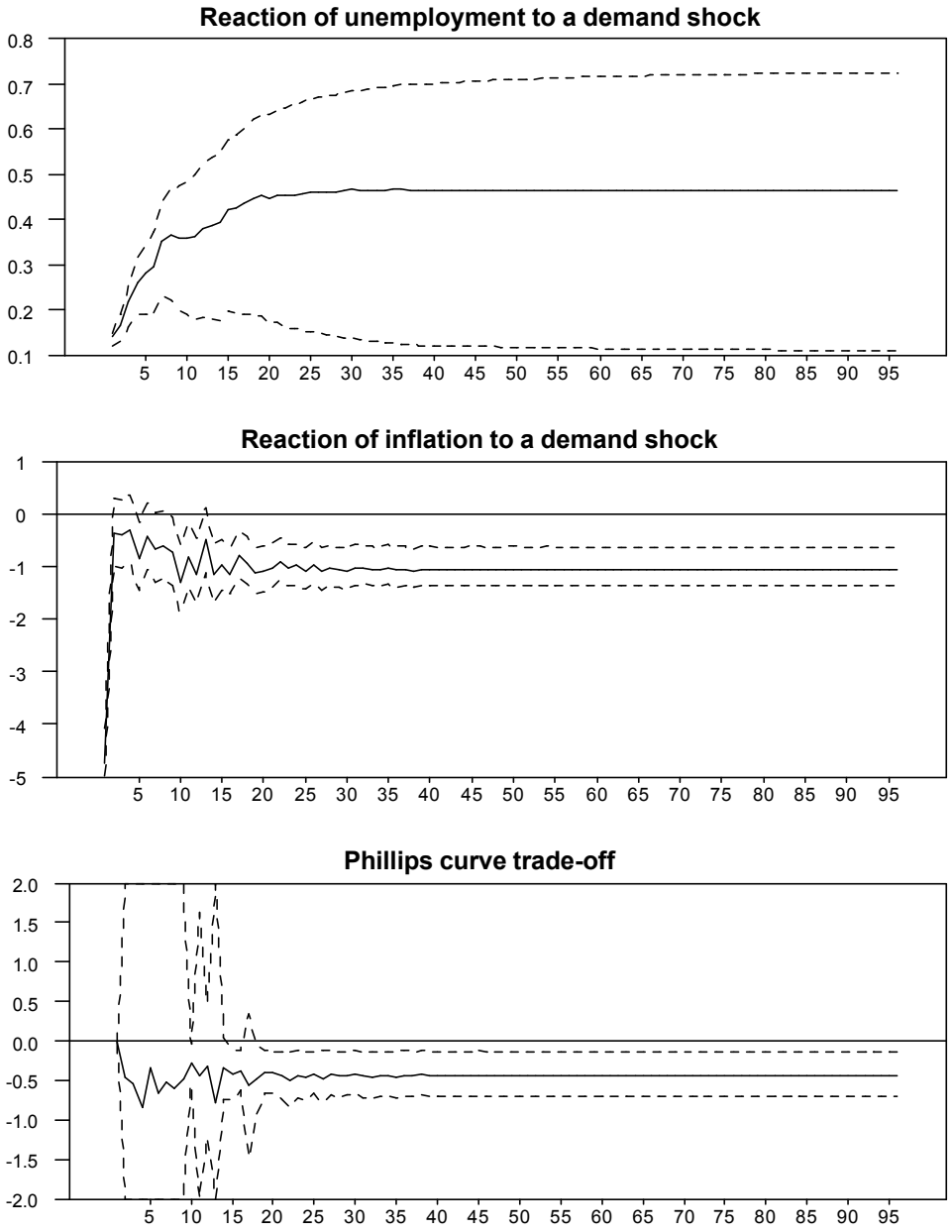
[184] See also the discussion in Bullard and Keating (1995, p. 478).

[185] A similar approach to identify the monetarist Phillips curve has been used by Bullard and Keating (1995) and Dolado et al. (1997).

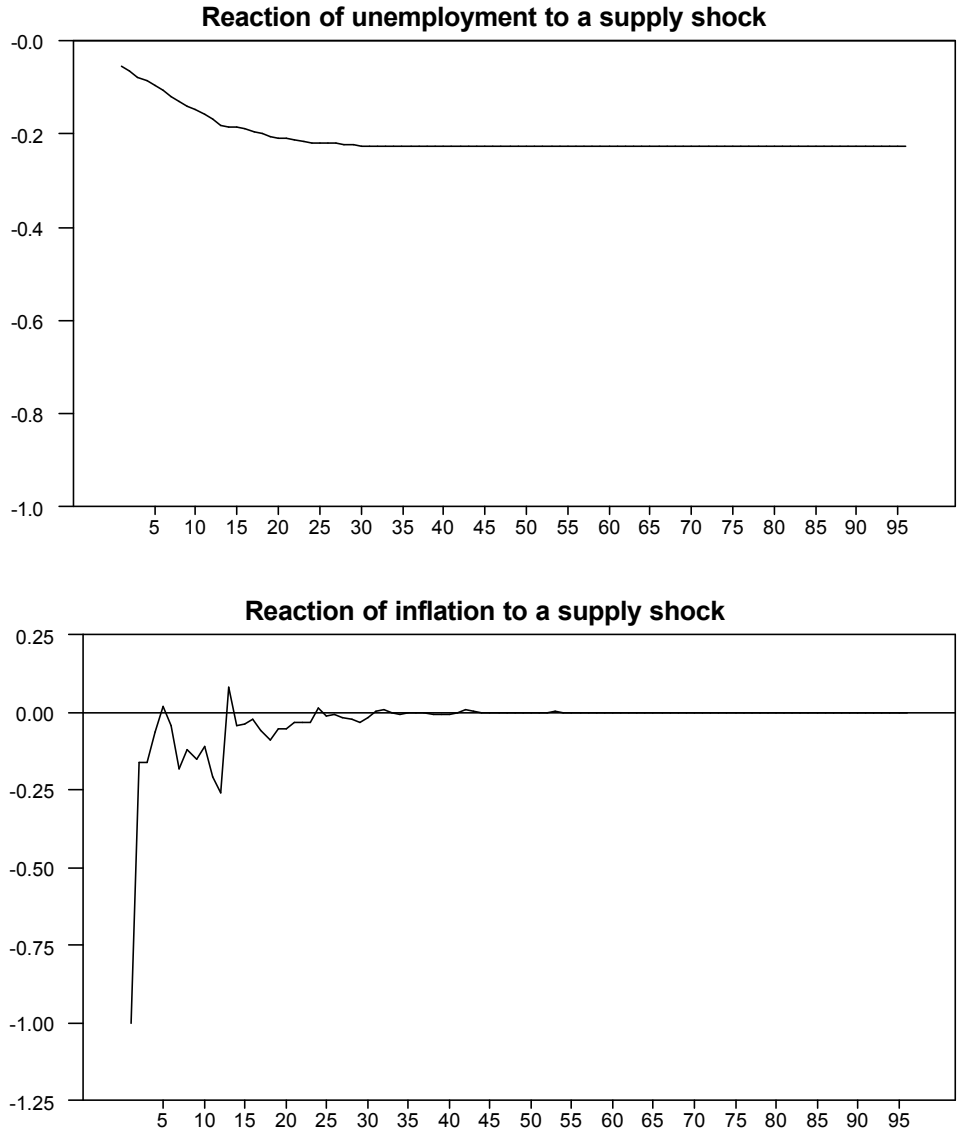
Figure 12a: The trade-off between inflation and unemployment in the monetarist Phillips curve — 'Inflation as a monetary phenomenon' identification



port for the monetarist Phillips curve model they estimate for the United States a significant but steep long-run Phillips curve.[186] Moreover, Bullard and Keating (1995) investigate a similar model using the same identifying restriction and find

[186] For the sample period from 1954 until 1992 they report a long-run trade-off of –0.29. See also King and Watson (1997, p. 95).

Figure 12b: The effects of supply shocks in the monetarist Phillips curve model — 'Inflation as a monetary phenomenon' identification



for German data too that a permanent increase in inflation is associated with a positive, permanent, and statistically significant increase in the level of output. In addition, they find for a number of low inflation countries that superneutrality does not hold and write: "We note, more generally, that our estimated long-run response [of output] tends to be positive for low inflation countries and lower or negative for countries with higher average inflation rates over the sample period. These results are consistent with theories which predict Mundell Tobin effects at low steady state inflation rates, but where the effect dissipates at higher steady

state inflation rates."[187] This is confirmed by Bullard (1999) who finds in a recent survey on superneutrality tests that for low inflation countries the available evidence suggests that permanently higher money growth or inflation is associated with permanently higher output and permanently lower real interest rates.[188] Finally, for German data Weber (1994) also concludes that evidence against the superneutrality of money is relatively easy to detect.[189] Thus, even though our finding of a significant long-run trade-off is likely to be controversial, it is nevertheless well established in the literature.

Figure 12b shows the response of unemployment and inflation to a supply shock. The inflation response is relatively short-lived and after approximately 18

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[187] Bullard and Keating (1995, p. 478).

[188] Bullard (1999, p. 74).

[189] He tests the superneutrality of money in a bivariate system comprised of the change in the growth rate of money and the growth rate of output and concludes for German data that "it is fairly easy to find evidence against the superneutrality of money in German data." (Weber (1994), p. 19). Regarding the long-run Phillips curve he finds that "except for very extreme values of l_{pu} (>6.37) [in our notation this is $l_{\Delta pu}$] and l_{up} (<-0.06) [$l_{u\Delta p}$], the hypothesis of a long-run vertical Phillips curve ($g_{up}=0$ [$g_{u\Delta p}=0$]) cannot be rejected at the five-percent level. … In the case with reverse causation, …, it is easy to find evidence against the long-run neutrality hypothesis $g_{pu}=0$ [$g_{\Delta pu}=0$] … ." (Weber (1994), p. 20). Since our 'inflation as a monetary phenomenon' implies a value of –0.0295 for $l_{u\Delta p}$ and we do find for this value a significant long-run trade-off this means we cannot replicate exactly the results found by Weber, which is probably due to differences in the sample period and the data set. More generally, it should be noted that a value of –0.07 for $l_{u\Delta p}$, for example, hardly seems 'very extreme' since it implies only a very small contemporaneous response of the unemployment rate to a nominal shock and also happens to be the value used by King and Watson (1994) to identify their monetarist Phillips curve model. Moreover, it should be noted that what Weber calls the 'reverse causation' case is shown by King and Watson (1997, pp. 92) to correspond to the traditional Keynesian perspective of the Phillips curve. Hence, his rejection of the long-run neutrality restriction $g_{\Delta pu}=0$ means that in a Keynesian Phillips curve model the long-run Phillips curve is not vertical. While we could not reject the hypothesis of a vertical Phillips curve in our Keynesian Phillips curve model, Weber apparently finds strong evidence against this hypothesis, which is encouraging from a traditional Keynesian viewpoint. Finally, even if one leaves aside the Keynesian interpretation, a finding that a change in the unemployment rate has a permanent effect on inflation is at odds with the monetarist proposition that 'inflation is always and everywhere a monetary phenomenon'.

months inflation is back at its base line. Note that the supply shock has been restricted not to have a permanent effect on inflation. But this shock reduces the unemployment rate permanently by a sizeable amount, even though by less than is the case in the 'natural rate' model.

3.2.5 The source of business cycle fluctuations

3.2.5.1 The historical decomposition technique

In this section we attribute the fluctuations in unemployment and inflation to demand and supply shocks buffeting the economy using the historical decomposition technique. The idea of this technique is best understood by considering the moving average representation of a structural model.[190] In particular, consider the general model

$$X_t = C_D(L)D_t + C(L)e_t, \tag{43}$$

where the vector X represents the endogenous variables. The vector D contains the deterministic part of the model, with the term $C_D(L)$ representing a polynomial matrix giving the effects of D on the variables in X. The vector e contains the structural shocks. In the case of our Phillips curve model these are the demand and supply shocks. Finally, the matrix $C(L)$ contains the estimated impulse response functions, showing how the endogenous variables respond to the structural shocks. Equation (43) states that the dynamics of the endogenous variables can be expressed as the sum of the deterministic and the stochastic component of the model. The latter is of particular interest. For expositional convenience, the deterministic part of the model is omitted in the following presentation of the historical decomposition technique. With this convention, for a particular period $t + j$, equation (43) can be rewritten as

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[190] See e.g. Fackler and McMillin (1998) for a detailed description of the historical decomposition technique.

$$(44) \qquad X_{t+j} = \sum_{s=0}^{j-1} C_s \boldsymbol{e}_{t+j-s} + \sum_{s=j}^{\infty} C_s \boldsymbol{e}_{t+j-s}$$

with C denoting the impulse responses to a structural innovation.

Equation (44) represents the historical decomposition of the variables in the vector X. It is apparent from (44) that the variable X_{t+j} is composed of two types of terms. The term on the far right contains the information that is available at time t. Based on this information the expected X_{t+j} can be computed. This is the so-called 'base projection' of X_{t+j}, which contains also the effects of the deterministic part of the model. However, the base projection is unlikely to coincide with X_{t+j}, because in the time period from $t+1$ to $t+j$ 'new' structural innovations hit the system. By their very nature these shocks are unexpected; hence, the first term on the right-hand side can be interpreted as the forecast error of X_{t+j}. This is the most interesting part of the historical decomposition because it allows one to attribute the unexpected variation in X_{t+j} to individual structural innovations buffeting the economy which is useful for exploring the sources of fluctuations.

Using the historical decomposition technique given by (44), there are essentially two ways to compute a time series of the forecast errors of X_{t+j}. The first approach we use is to keep the forecast horizon fixed while the time index t moves from the beginning of the sample period to the end. The historical decomposition presented below is computed with the forecast horizon set to $j = 24$. We choose a forecast horizon of two years (24 months) because this horizon corresponds to a typical business cycle frequency. To illustrate the procedure, t is first set to 1970:1, the beginning of the effective sample period, and the forecast error of $X_{1970:1+24} = X_{1972:1}$ is computed on the basis of the demand and supply shocks hitting the economy in the time period from 1970:2 until 1972:1. Next, t is

set to 1970: 2 and the forecast error of $X_{1972:2}$ is computed. This procedure is repeated until X_{t+24} reaches the end of the sample period. Thus, the historical decomposition computed this way plots the variables in X_t as a function of the demand and supply shocks occurring in the time period from t to $t-23$, thereby showing how these two structural shocks have led to the unexpected variation in the unemployment and inflation variables at the two year horizon.

The alternative approach to compute the forecast error is to set t to the beginning of the sample period and to increase the forecast horizon j until the end of the sample period is reached. This approach has the disadvantage that the decomposition may not be very reliable for the early part of the sample period because only a limited number of shocks have been identified, meaning that the decomposition proceeds on a rather small basis.[191] Still, this is not a major drawback as this period is presumably not of very much interest, while more recent developments are. To control for this shortcoming, we plot the historical decomposition of the unemployment and inflation variable below beginning in 1972: 1. The strength of this approach is that it allows us to isolate the demand and the supply components in the time series. Consider, for example, the unemployment rate: by computing u_t as a function of all supply shocks occurring in the time period from 1970:1 until t we obtain the supply component of the unemployment rate in time t. Put another way, with this approach we can compute the unemployment rate that would have been obtained if there were no demand shocks, and vice versa. Also, defining the natural rate of unemployment as being determined by the deterministic component in the unemployment rate and

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[191] To illustrate this problem, it is useful to consider the decomposition of unemployment in 1970:1, which is the first period for which estimates of the structural shocks are available. The change in unemployment in this month is attributed in full to the demand and supply shocks occurring in this month even though it is very likely that earlier shocks have had an influence as well. But the effects of these shocks cannot be identified here, because they lie outside the effective sample period.

its supply component, we can estimate the natural rate of unemployment implied by our three Phillips curve models. This way we can determine whether the secular increase in the German unemployment rate since the early 1970s is due to the natural rate increasing over time or whether it reflects progressively worsening demand conditions.

The third measure we employ to investigate the source of business cycle fluctuations is the forecast error variance decomposition of our two variables. As the name suggests, this measure decomposes the variance of the forecast error. In contrast to the historical decomposition, which gives a decomposition of the forecast error in time, it is the second moment of the forecast error which is of interest here. The intuition of the variance decomposition can be understood by revisiting the impulse response functions for the unemployment variable which we computed in the previous section. The first panels in Figures 10a and 10b, for example, depict the changes in the unemployment rate induced by the demand and supply shocks in the Keynesian Phillips curve model. For a given forecast horizon and a given shock the corresponding impulse response function can be used to compute the variance in unemployment due to this specific shock. Once one has computed the total variance of unemployment due to both shocks for a given horizon, the variance decomposition for this horizon is obtained by calculating the contribution of the individual shocks to the total variance. Below, we will present the variance decompositions of our unemployment and inflation variables implied by our three Phillips curve models.

3.2.5.2 The source of business cycle business fluctuations in the Keynesian Phillips curve model

Figures 13 and 14 display the historical decomposition of the unemployment rate and the inflation rate for the Keynesian Phillips curve model. The inflation rate is computed here as the annual change in the price level ($100[\ln(P_t / P_{t-12})]$)

and not as the monthly annualized inflation rate which we have used in the estimation of the Phillips curve models, because the latter series displays too much noise which makes its interpretation difficult. The solid lines show the contribution of the supply shock (first panel) and the demand shock (second panel) to the fluctuations in unemployment and inflation at the business cycle frequency, while the dashed lines give the combined effect of the demand and the supply shock. It is apparent from the first panel that supply shocks practically play no role for the unemployment rate at the business cycle frequency, meaning that virtually all fluctuations in this variable are accounted for by demand shocks. On the one hand, this is very much in line with the traditional Keynesian perception that the unemployment rate is an indicator of aggregate demand conditions. On the other hand, this means also that *all* recessions, which are indicated by the shaded areas in Figures 13 and 14, have been caused by adverse demand shocks.[192] However, it is widely believed that at least the large recessions in 1974/75 and 1980/81 were caused to some extent by the large oil price shocks preceding these recessions. Thus, the Keynesian identification seems to yield an interpretation of fluctuations in the unemployment rate which puts an extreme emphasis on demand shocks. The fluctuations in inflation, on the other hand, are dominated by supply shocks. Even though the large demand-induced recessions are effective in reducing the inflation rate, their role is relatively small compared to those of the supply shocks.

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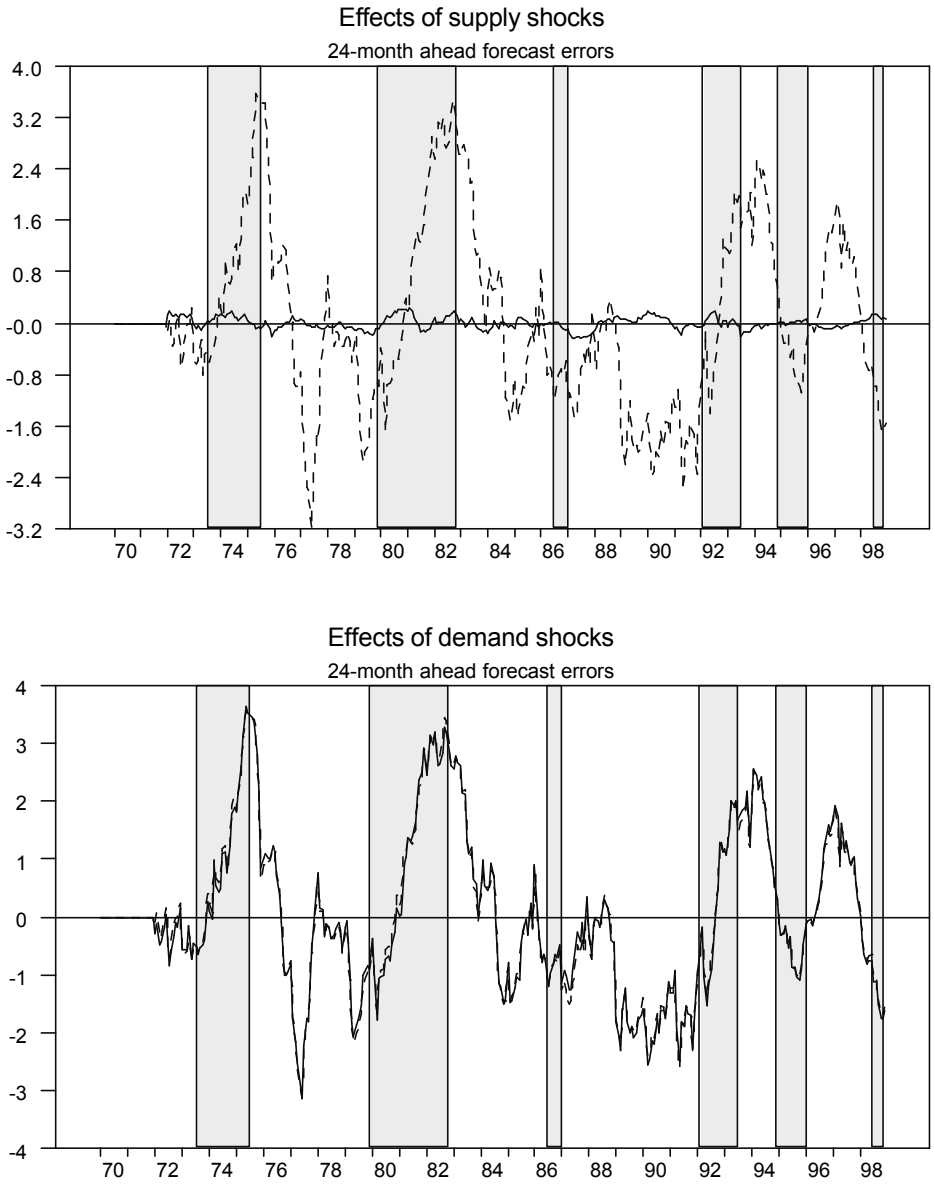
[192] The recession dates are the same as those used in Figures 7 and 8. These have been computed for industrial production, which may explain why there is some discrepancy between the recession dates and the cyclical fluctuations in unemployment. In particular, it appears the recession in 1995 had an effect on unemployment only in 1996 and the minor recessions in 1987 and 1998 were probably too small to have a noticeable effect on unemployment.

Figure 13: Business cycle fluctuations in the unemployment rate — Keynesian Phillips curve model



In Figure 15 we present the estimate of the natural rate of unemployment implied by the Keynesian Phillips curve model (dashed line) together with the actual unemployment rate (solid line). It becomes apparent that even in the Keynesian model the secular increase in the German unemployment rate reflects an increase in the natural rate. Technically, this is due to the deterministic trend in the unemployment rate which we estimate in the reduced form model of the Phillips curve. Since a deterministic time trend is not very informative on the causes of unemployment, we are facing here the limitations of the Phillips curve

model which, as a business cycle model, has not much to say about the trend component of unemployment. Nevertheless, this finding shows that even a Keynesian model of the business cycle does not give rise to the claim that the unemployment problem in Germany is entirely a demand problem. Still, the second panel in Figure 15 shows that, according to the Keynesian view, Germany experienced very high rates of cyclical unemployment in the past 30 years, particular so in the 1980s. This is in line with the assertion by many Keynesian economists that fiscal and monetary policies in Germany have been way too tight since the monetarist revolution in the 1970s.

Figure 14: Business cycle fluctuations in the inflation variable — Keynesian Phillips curve model

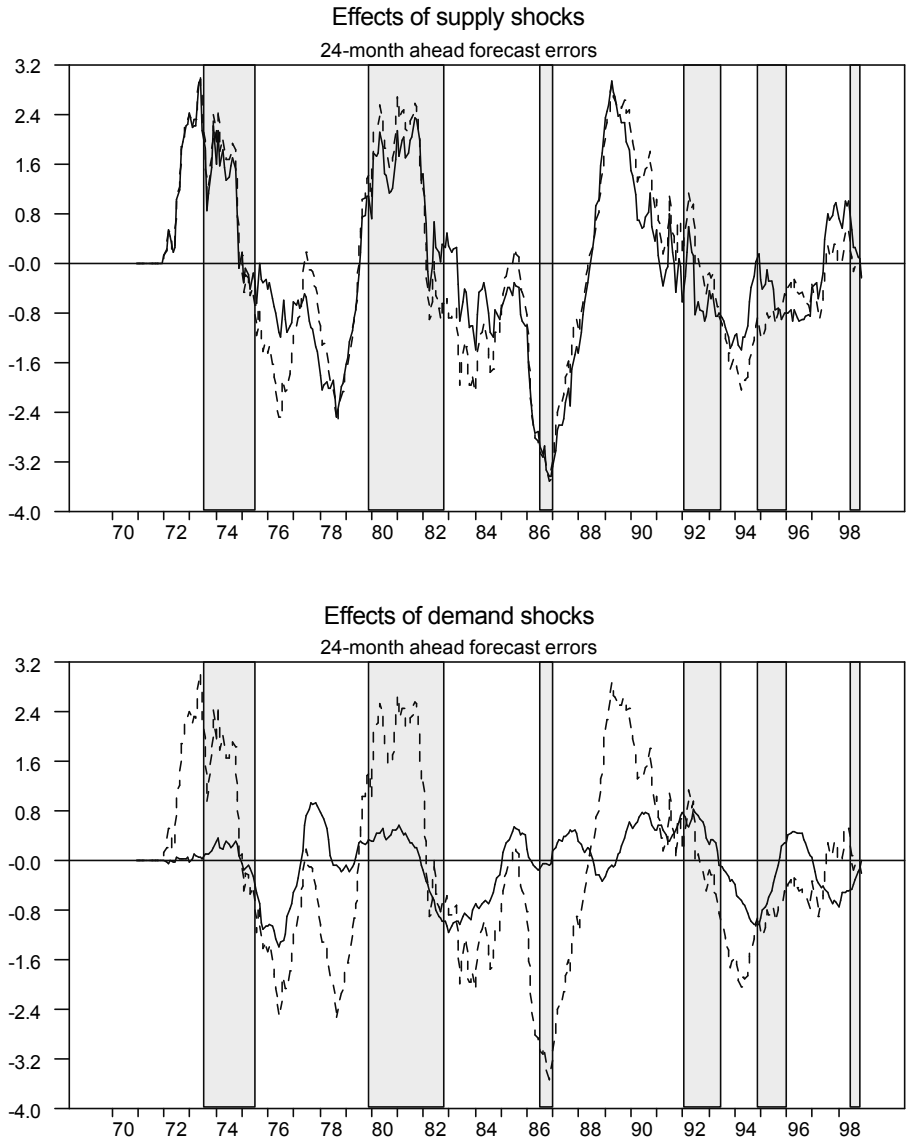


Figure 15: Historical decomposition of the unemployment rate — Keynesian Phillips curve model

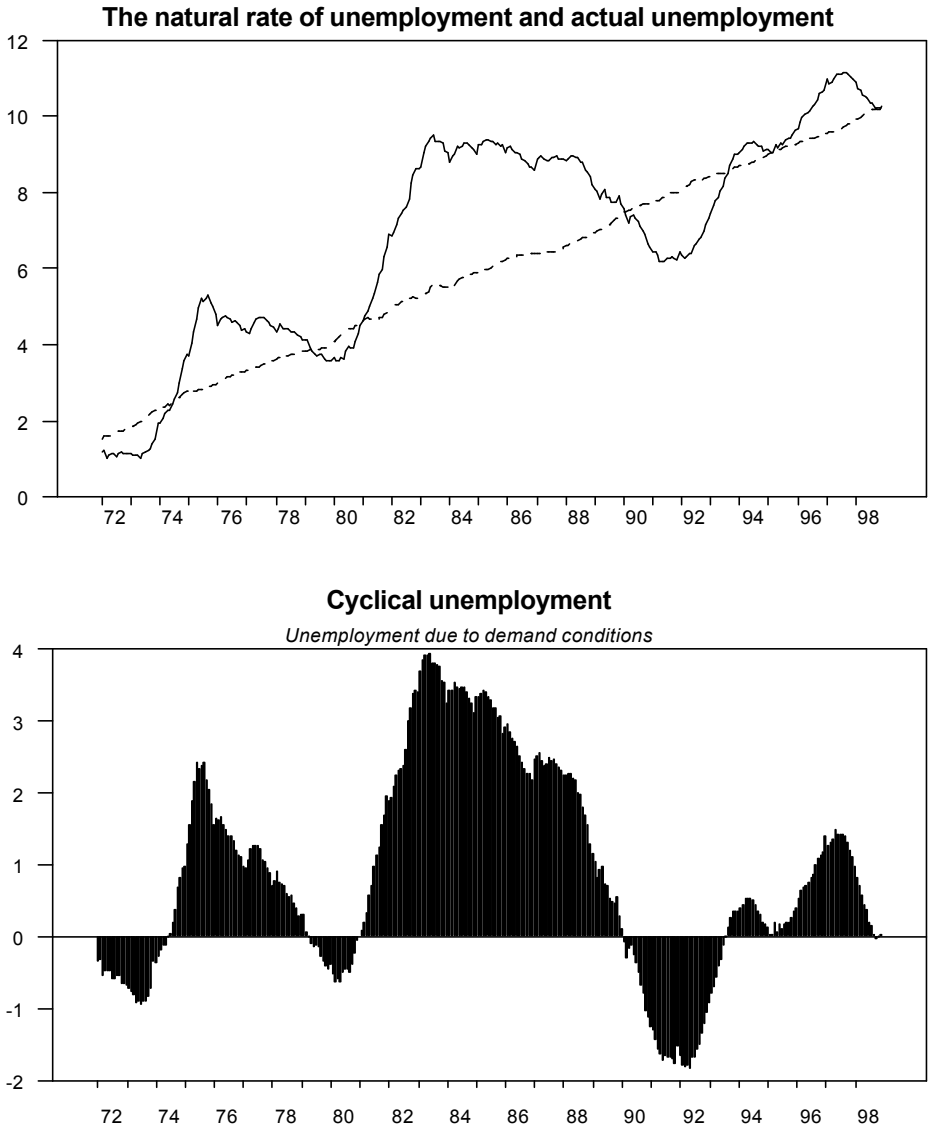
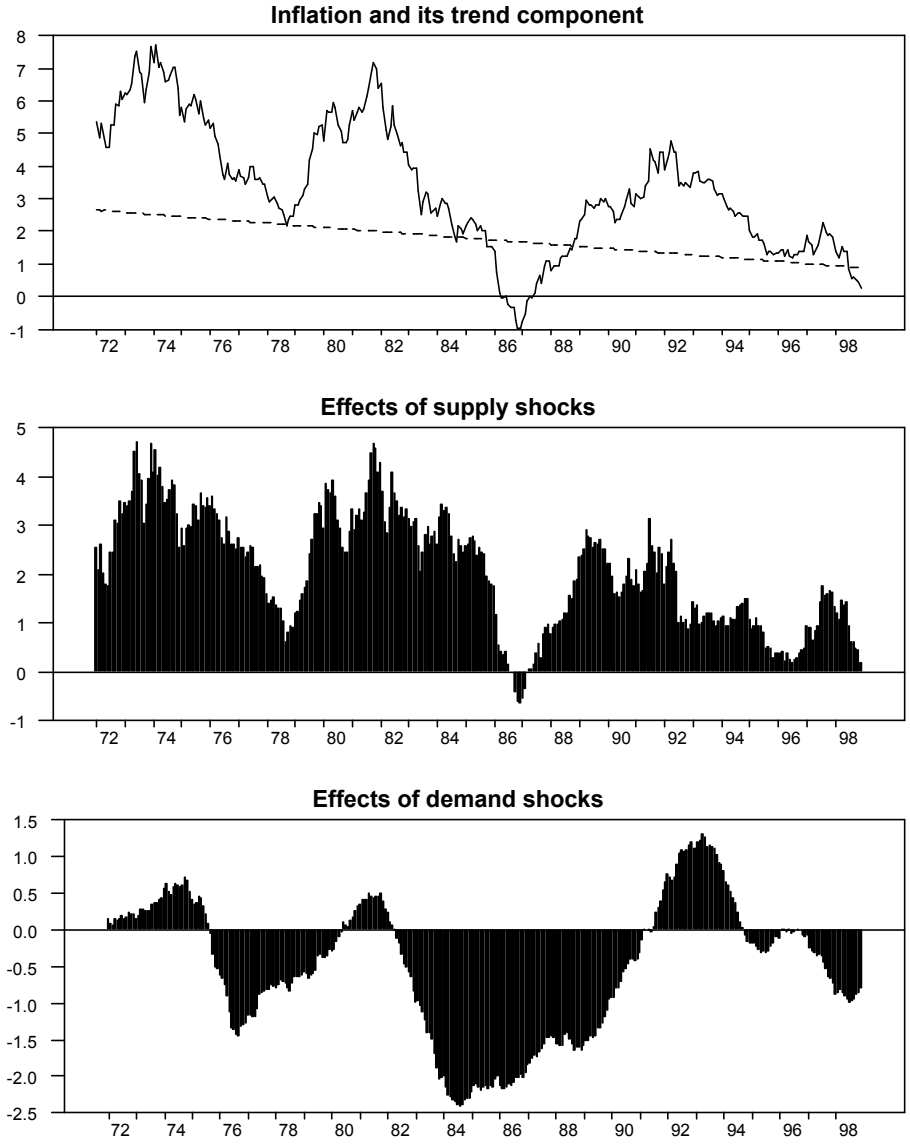


Figure 16 shows the historical decomposition of the inflation rate. The first panel shows that our reduced form model implies a deterministic downward trend in the inflation rate. This deterministic disinflation process reduces the inflation rate from approximately 3% in the early 1970s to about 1% in 1998. The fluctuations in the inflation rate around this deterministic trend are attributed to supply shocks (second panel) and demand shocks (third panel). The Keynesian view implies that the high inflation rates throughout the 1970s and the first half of the 1980s were attributable to adverse supply shocks. In light of the large oil

price shocks in this period this is not implausible. Apparently a policy of tight demand throughout the 1980s tried to offset the inflationary pressures arising from these shocks, a policy which came with very high costs in terms of unemployment, as we have seen above. The increase in inflation in the early 1990s during the unification boom is attributable in equal measure to demand and supply shocks.

Figure 16: Historical decomposition of the inflation rate — Keynesian Phillips curve model



In Table 4 we compute the forecast error variance decomposition of the unemployment rate and the inflation rate. In particular, table 4 shows the contribution of demand shocks to the variance in these two variables. The results confirm our earlier finding that demand shocks are responsible for virtually all fluctuations in the unemployment rate at all horizons. For inflation, demand shocks are unimportant at short horizons. At the business cycle frequency they account for a small amount of the variance in inflation which increases as the forecast horizon becomes longer.

Table 4: Forecast error variance decomposition in the Keynesian Phillips curve model — Contribution of demand shocks:

Period	unemployment	inflation
0	100	0.46
1	100	0.81
6	99.74	0.71
12	99.69	0.31
18	99.58	1.78
24	99.41	5.62
36	99.21	13.50
48	99.11	18.66
96	98.99	25.86

3.2.5.3 The source of business cycle business fluctuations in the 'natural rate' Phillips curve model

Figures 17 and 18 show the source of business cycle fluctuations in the unemployment and inflation rate implied by the monetarist 'natural rate' model. This identification seems to yield exactly the opposite implications as the Keynesian model. This may also help to explain the sharp clash between the two schools of thought which continues to persist in the public debate up to the present time. While the Keynesian view attributes all fluctuations in the unemployment rate at the business cycle frequency to demand shocks, the 'natural rate' model attributes all of these fluctuations to supply shocks. In fact, Figure 17 reveals again

the RBC characteristics of our 'natural rate' identification, since it is a central tenet of RBC models that real variables like unemployment are a function only of real shocks. Monetarist models, on the other hand, do allow for nominal shocks to have temporary effects on real variables. In particular, monetarists argue that recessions in many instances are due to monetary policy actions. That is, they view discretionary monetary policy as an important source of business cycle fluctuations. Consequently even monetarists are likely to disagree with Figure 17 where every recession is entirely due to supply shocks. Since we found earlier that the monetarist model is rejected by the data when the 'natural rate' restriction is imposed together with the 'money as a monetary phenomenon' restriction, the extreme implications of the 'natural rate' restriction visible in Figure 17 suggest that it is this restriction which is at odds with the data. Regarding Figure 18, business cycle fluctuations in the inflation rate are attributed almost entirely to demand shocks. While this is in line with monetarist thinking, it is somewhat implausible that the two large oil price shocks in the 1970s did not have a noticeable effect on inflation.

Figure 19 shows the natural rate of unemployment implied by the 'natural rate' restriction. It is apparent that practically all changes in the unemployment rate reflect changes in the natural rate while the role of demand shocks is negligible. Figure 20 shows the historical decomposition of the inflation rate. A comparison with Figure 16 is striking: the fluctuations in inflation which the Keynesian model attributes to supply shocks are attributed by the 'natural rate' model to demand shocks, and vice versa. In the 'natural rate' interpretation of inflation fluctuations, the high inflation rates observed in the 1970s and 1980s were the consequence of expansionary demand policies, reflecting presumably an inflationary bias of policy makers. Supply shocks had a dampening effect on inflation. Since under the 'natural rate' restriction the impulse response function for the inflation variable shows that an adverse supply shock tends to lower in-

flation in the long-run (Figure 11b), the dampening effect of supply shocks on inflation visible in Figure 20 is due to adverse supply shocks, which is hard to reconcile with the implications of standard models about the effects of such shocks.

Figure 17: Business cycle fluctuations in the unemployment rate — 'Natural rate' identification

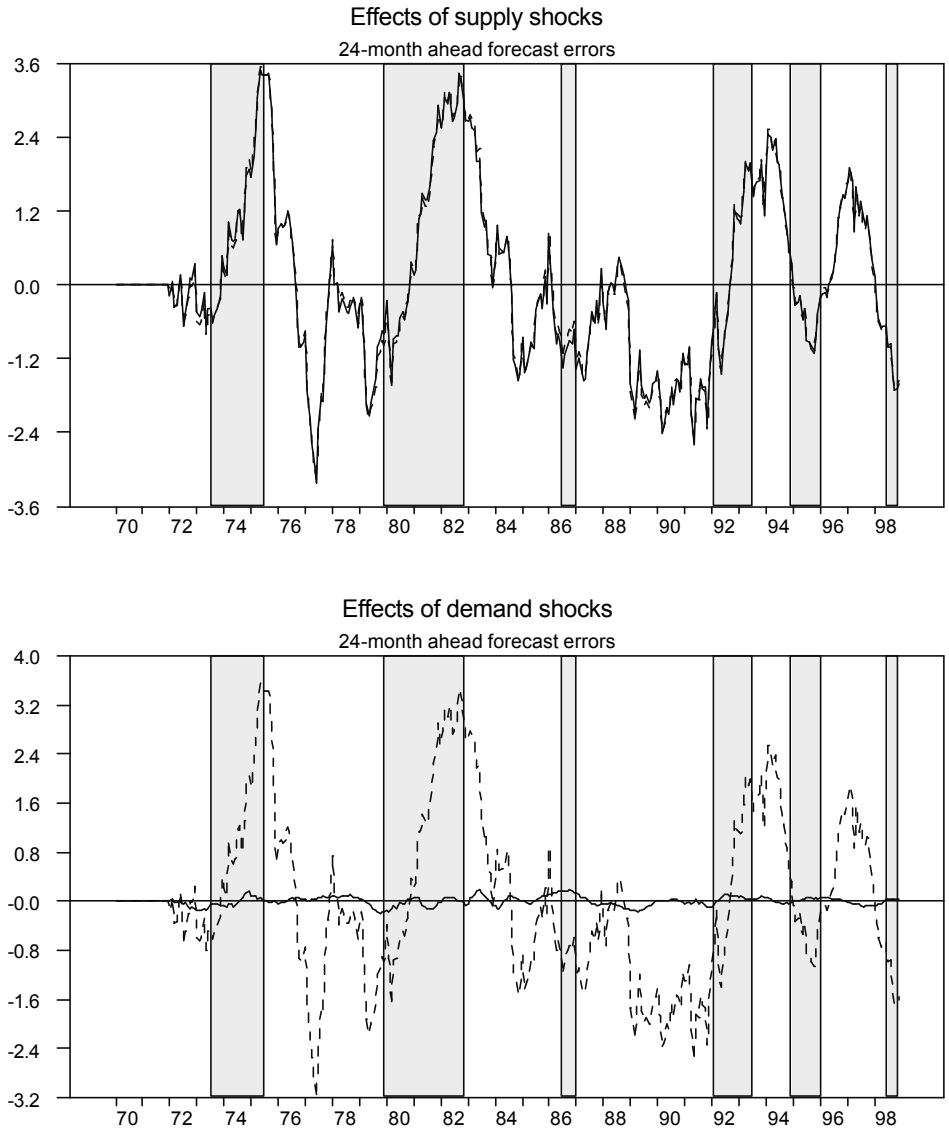
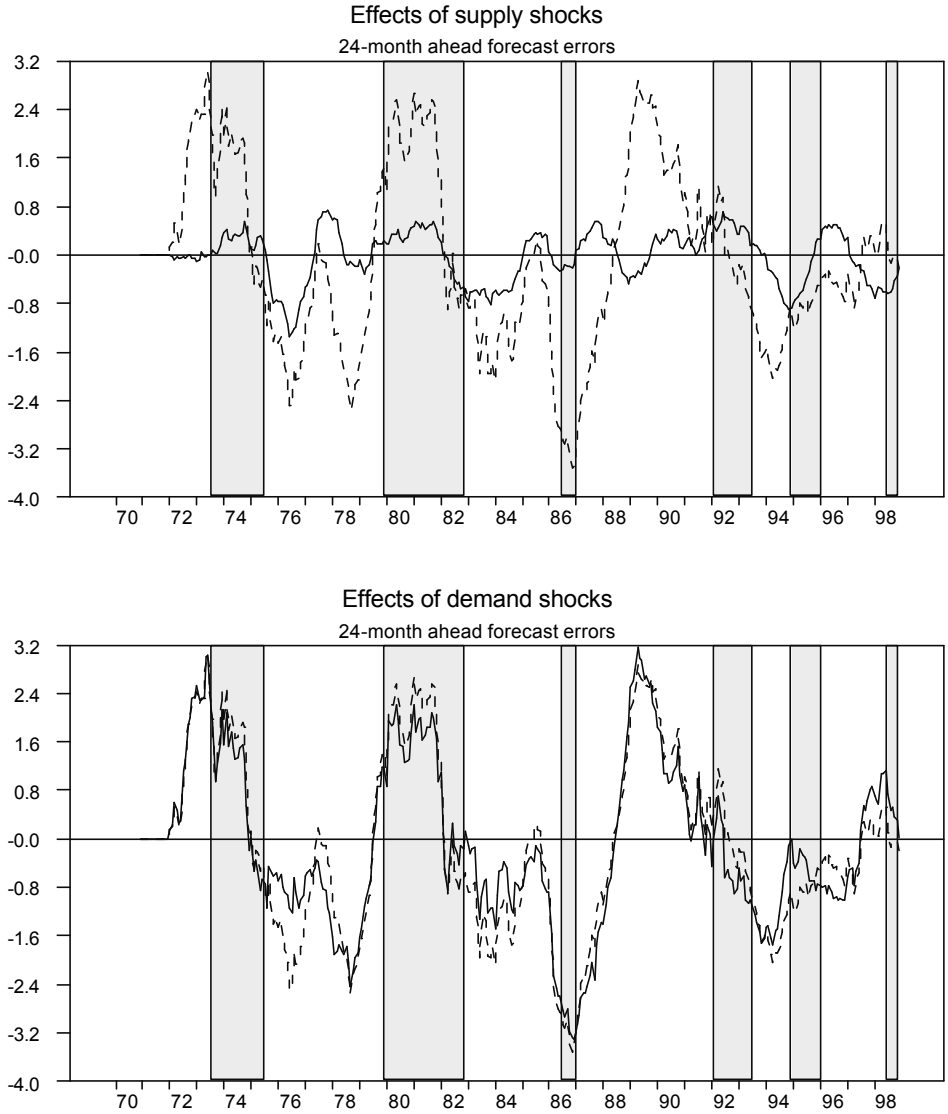


Figure 18: Business cycle fluctuations in the inflation rate — 'Natural rate' identification



Regarding the forecast error variance decomposition, Table 5 shows that demand shocks do not matter in the 'natural rate' model for the unemployment rate at any forecast horizon. But demand shocks account for all fluctuations in inflation at short horizons and at the business cycle frequency. At longer forecast horizons supply shocks gain in importance. This shows that in this model supply shocks can have long-run effects on inflation, contradicting the monetarist proposition that 'inflation is always and everywhere a monetary phenomenon'.

Figure 19: Historical decomposition of the unemployment rate — 'Natural rate' identification

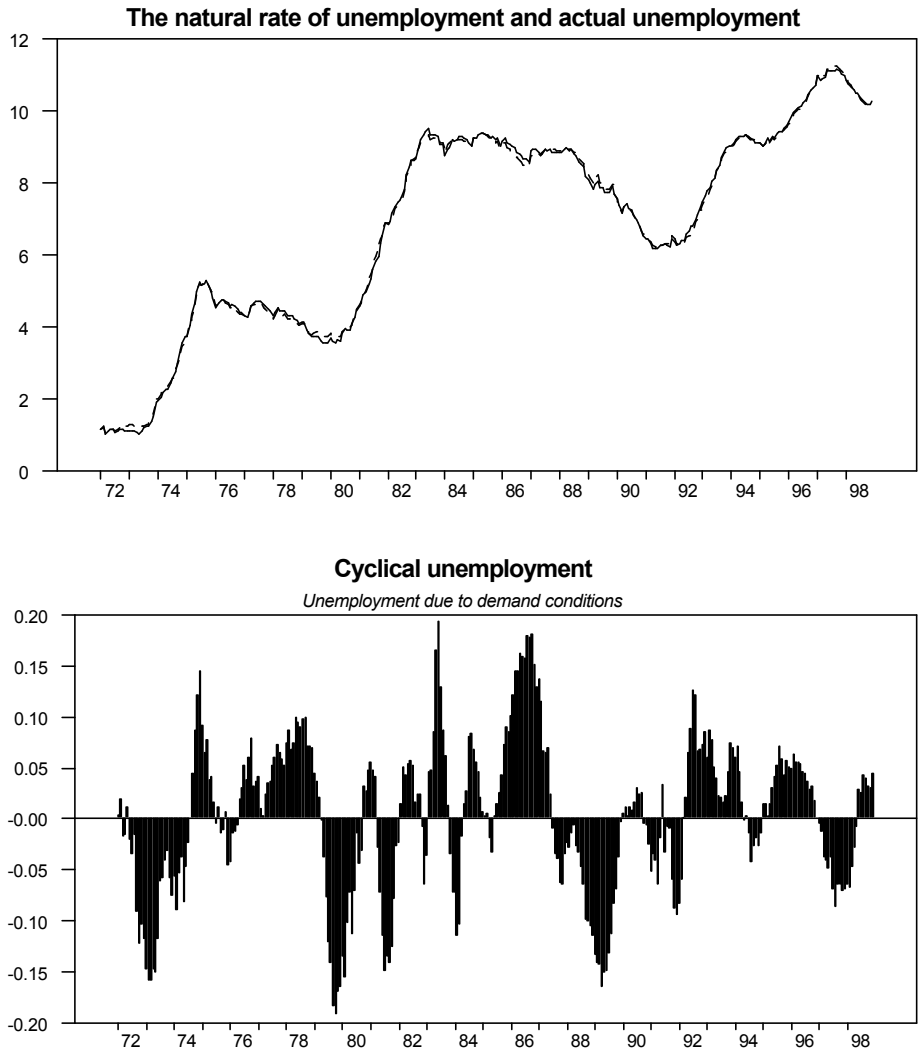
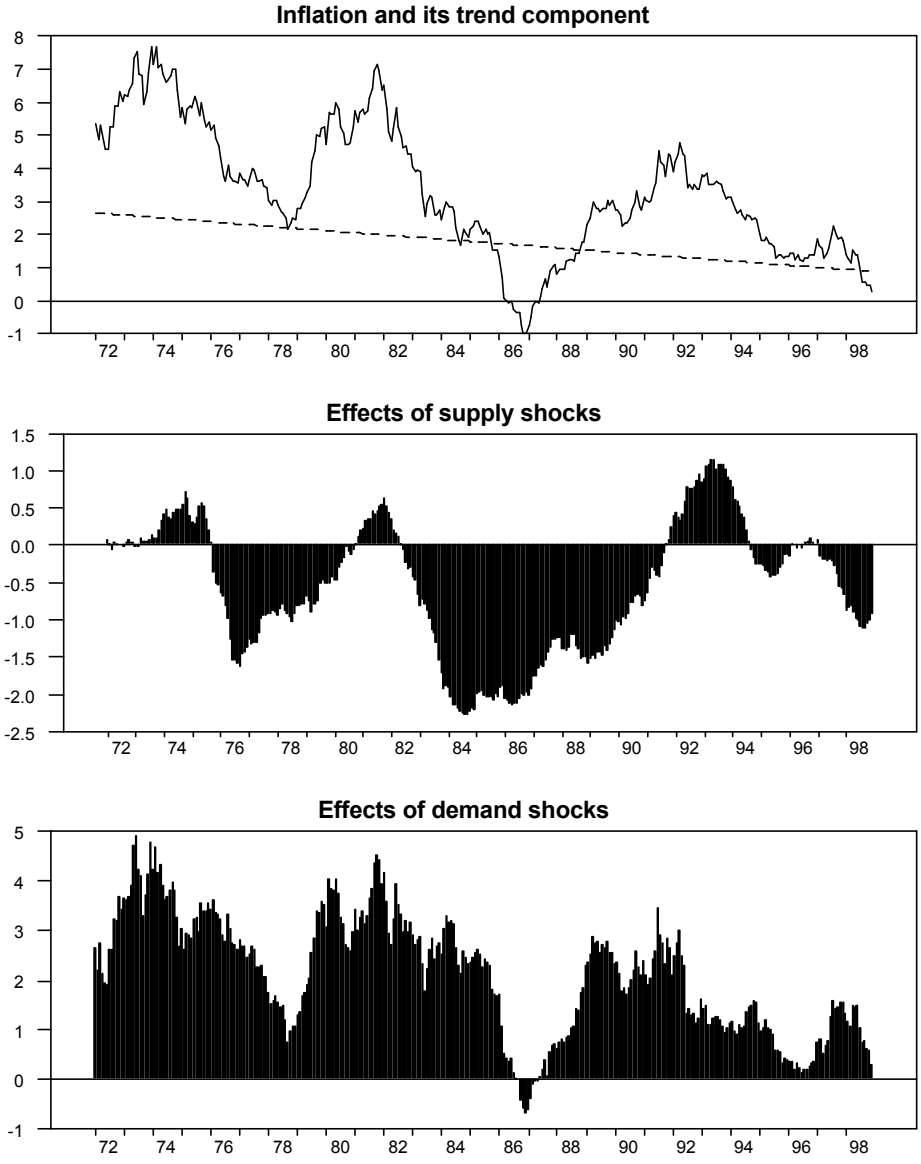


Table 5: Forecast error variance decomposition in the 'natural rate' Phillips curve model — Contribution of demand shocks:

Period	unemployment	inflation
0	1.14	96.98
1	1.08	96.20
6	2.36	96.57
12	1.15	97.71
18	0.63	98.08
24	0.40	96.23
36	0.22	90.99
48	0.16	87.24
96	0.07	81.94

Figure 20: Historical decomposition of the inflation rate — 'Natural rate' identification

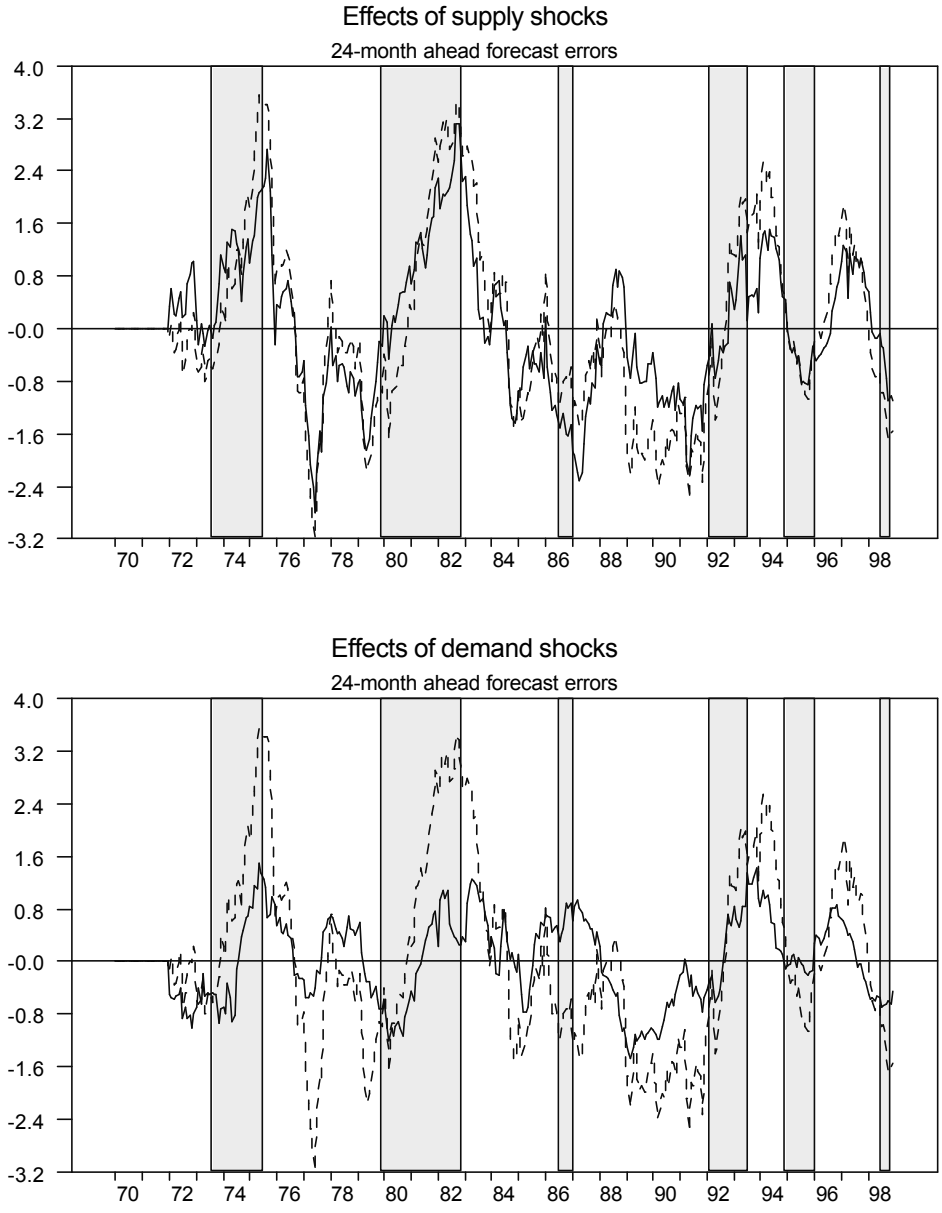


3.2.5.4 The source of business cycle business fluctuations in the 'inflation as a monetary phenomenon' Phillips curve model

The 'inflation as a monetary phenomenon' identification provides a more balanced view of the source of business cycle fluctuations. Figure 21 shows that most fluctuations in the unemployment rate at the business cycle are due to supply shocks, but demand shocks also play a noticeable role. According to this view, the recessions following the two oil price shocks are largely, but not en-

tirely, due to adverse supply shocks, while the recession following the unification boom in 1992/93 is largely the consequence of adverse demand shocks. Since the latter recession followed a tight policy by the Bundesbank to cool the Germany economy down, this appears to be a plausible characterization of this episode. In general, demand shocks lead to fluctuations in the unemployment rate of about one percentage point in either direction. Regarding inflation, Figure 22 shows that fluctuations in the inflation rate are dominated by demand

Figure 21: Business cycle fluctuations in the unemployment rate — 'Inflation as a monetary phenomenon' identification



shocks. But supply shocks also play a noticeable role. In particular, the two oil price shocks are clearly visible in the decomposition of the inflation series. Nevertheless, the high inflation rates in the 1970s are, in general, the product of demand shocks. All in all, this seems to be a characterization of business cycle fluctuations that many economists in Germany would find plausible.

Figure 22: Business cycle fluctuations in the inflation rate — 'Inflation as a monetary phenomenon' identification

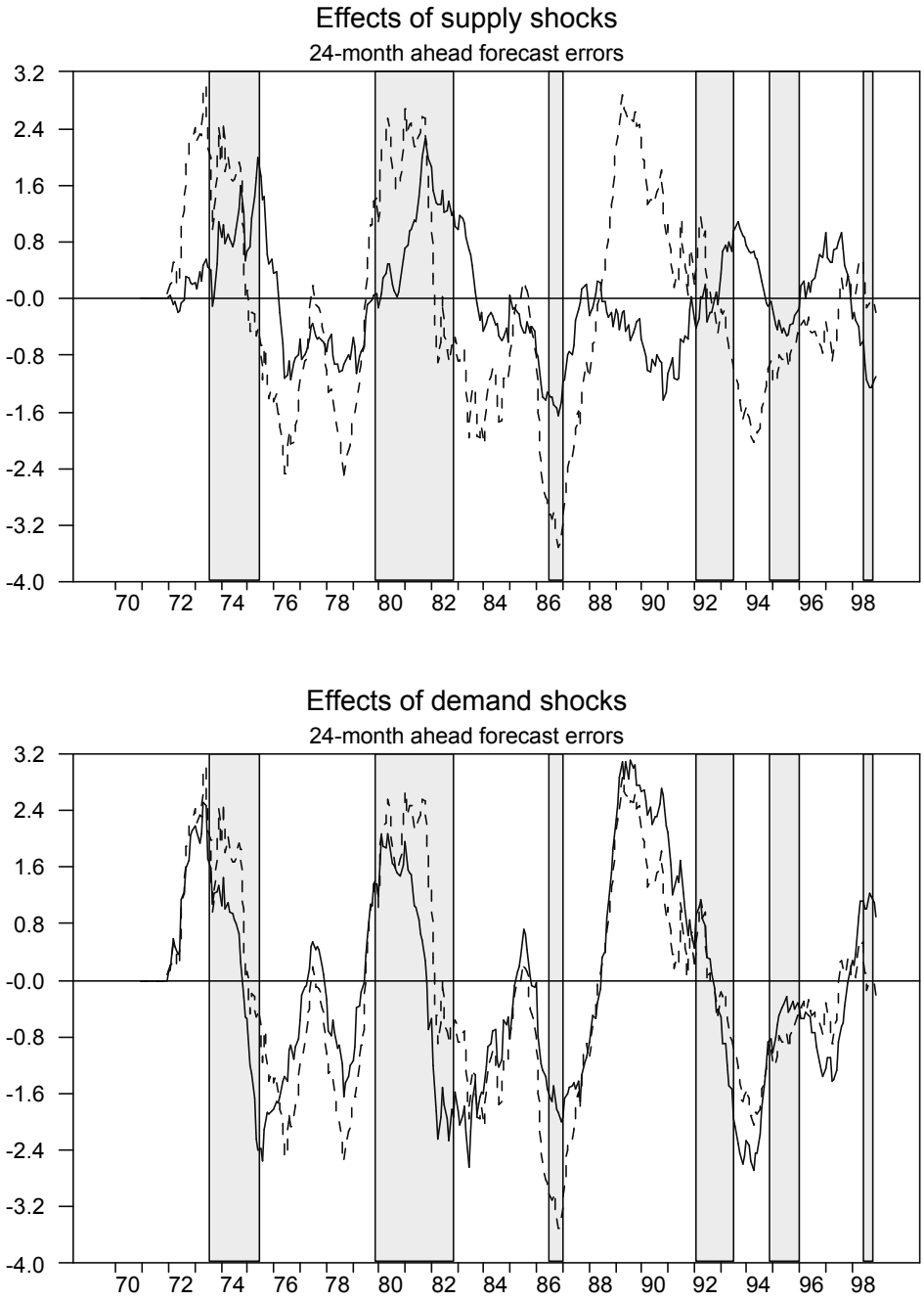
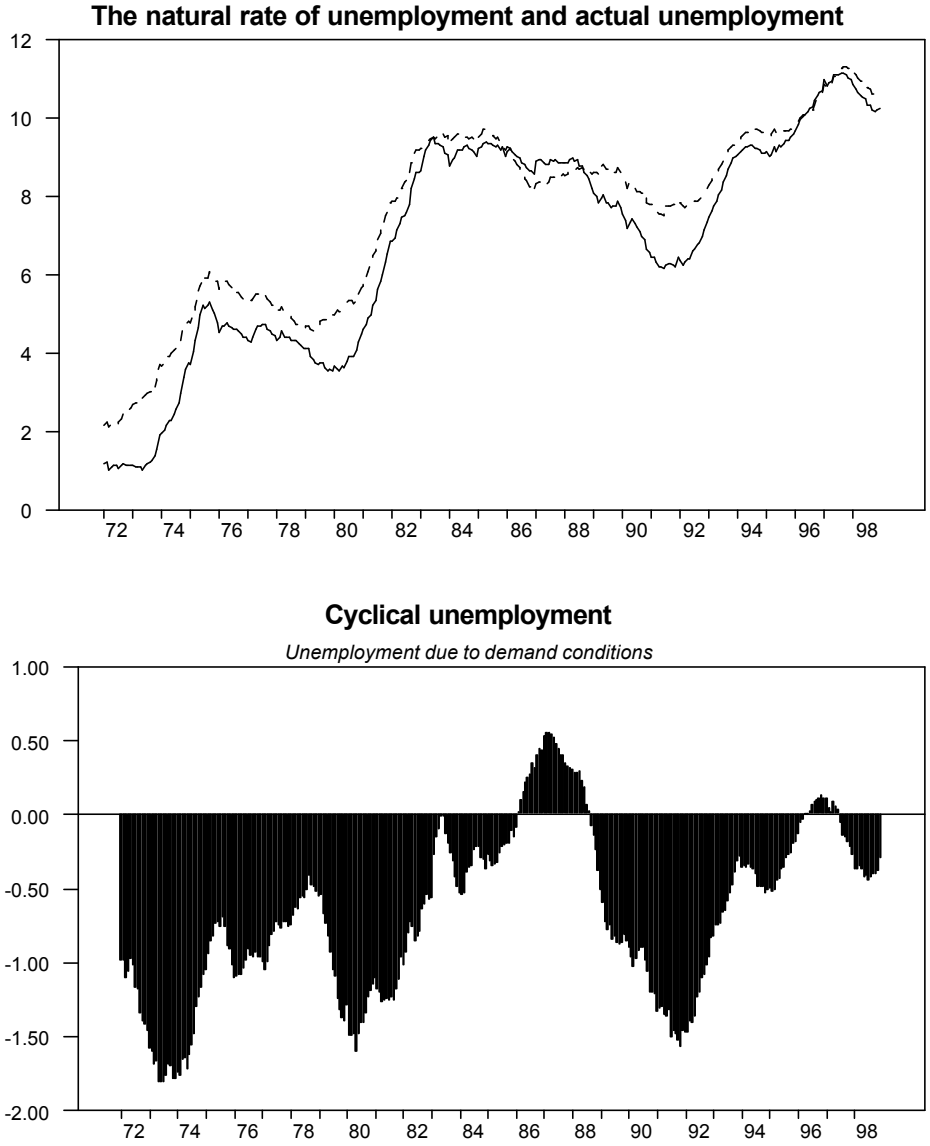


Figure 23 shows the natural rate of unemployment implied by this model. It is apparent that over most of the sample period the natural rate of unemployment was higher than the actual unemployment rate, which is consistent with the perception of many monetarists that policy makers constantly try to push unemployment below the natural rate. This holds in particular for the 1970s and early 1980s, when the cyclical component in the unemployment rate is strongly negative. The other episode where demand shocks push the unemployment rate by a considerable amount below the natural rate is the period in the late 1980s and

Figure 23: Historical decomposition of the unemployment rate — 'Inflation as a monetary phenomenon' identification



early 1990s, following unification. More generally, comparing Figure 23 with Figure 15 shows that monetarists have a completely different view of demand conditions in Germany than Keynesian economists. While the latter think that in the past 30 years demand conditions in Germany were almost always depressed, the former believe that Germany suffered over most of this time from excess demand.

Figure 24 shows that in the monetarist model demand shocks account for most of the inflationary episodes. In this context it is important to recall that in the 'inflation is always and everywhere a monetary phenomenon' model demand shocks are interpreted as monetary policy shocks. From this follows that the episodes of high inflation reflect a tendency by monetary policy makers to increase the inflation rate, presumably in order to push the unemployment rate below the natural rate. In this sense Figure 24 reveals the inflationary bias of monetary policy makers which so often is deplored by monetarist economists in Germany, confirming that this identification captures an important aspect of monetarist thinking. Besides demand shocks, supply shocks also play a role for inflation dynamics in this Phillips curve model, even though they cannot have a permanent effect on inflation. Important supply shocks include the two oil price shocks in the 1970s and the sharp decline in oil prices in 1985. Interestingly, the unification boom in 1990 also had a noticeable positive supply component.

Table 6 shows the forecast error variance decomposition for this monetarist Phillips curve model. It is apparent that demand shocks account for about one third of the variance in unemployment at short horizons. With the forecast horizon becoming longer the role of demand shocks becomes smaller, but at the business cycle frequency they still account for approximately one quarter of the variance in unemployment and in the long-run they have a share of 20%. For inflation, the picture is reversed. Initially, demand shocks are behind 60% of the

variance in inflation, with the share becoming larger as the forecast horizon is extended. The identifying restriction imposed on this model ensures that for an infinite forecast horizon demand shocks account for 100% of the variance in inflation.

Figure 24: Historical decomposition of the inflation rate — 'Inflation as a monetary phenomenon' identification

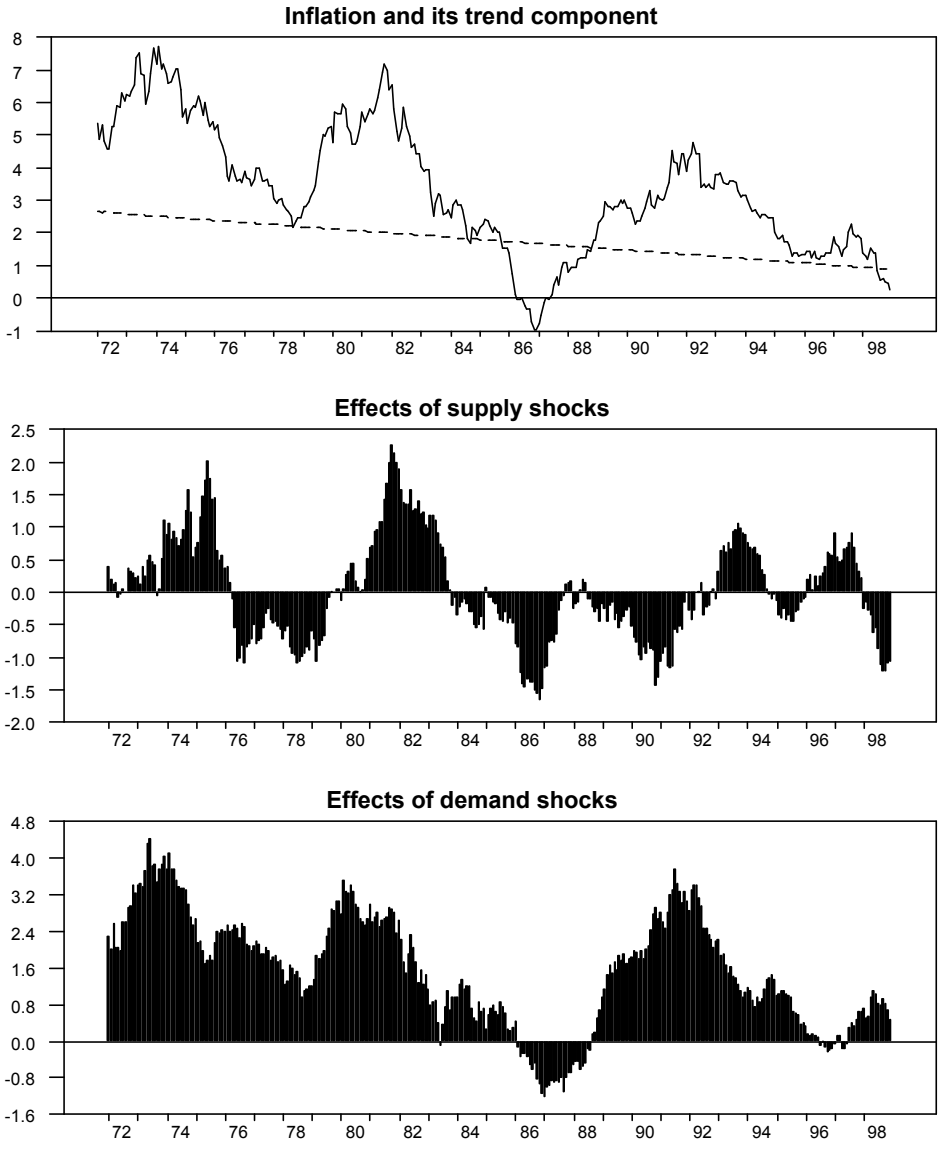


Table 6: Forecast error variance decomposition in the 'money as a monetary phenomenon' Phillips curve model — Contribution of demand shocks:

Period	unemployment	Inflation
0	32.30	61.23
1	32.05	59.19
6	36.67	60.38
12	31.14	63.86
18	28.41	71.30
24	26.72	78.32
36	25.14	86.38
48	24.43	90.25
96	23.58	95.38

IV. The debate on the causes of unemployment in Germany

4.1 The wage gap — a monetarist view

Having reviewed the Keynesian and monetarist perspectives on the need for stabilization policies and having explored the implications of their Phillips curve models, we discuss now in more detail the controversy between these two schools on thought on the German unemployment problem. We have seen that in monetarist models the increase in unemployment over the past thirty years reflects almost entirely an increase in the natural rate of unemployment. This reflects to some extent an increase in frictional and structural unemployment, but mostly a failure of real wages to clear the labor market, leading to high rates of involuntary unemployment. An important argument of monetarists in this regard is the evolution of the so-called wage gap over time. Paqué (1999) defines this concept as follows: "A major strand of neoclassical theory holds that any non-cyclical unemployment going beyond a certain frictional or structural minimum is due to a level of real wages which is too high relative to the marginal (physical) productivity of

labor at full employment. Conversely, a state of non-cyclical over-employment is due to a level of real wages below the full-employment marginal productivity of labor. Any percentage deviation of the actual real wage from the hypothetical real wage at full employment is called a wage gap (WG), i.e.

$$WG \equiv (w/p_v)/(w/p_v)^f - 1 = (w/p_v)/v_L^f - 1,$$

with w defined as the nominal wage, p_v as the value-added deflator, v_L as the marginal productivity of labor in terms of value added v $(v_L = \partial v/\partial L)$ and the superscript 'f' denoting variables measured at full employment."[193] A positive real wage gap may arise through a wage shock pushing nominal wages over their full employment level, or a productivity slowdown which is not reflected in a comparable slowdown in wage growth, or a deceleration in inflation which again is not reflected in wages. That is, monetarists identify either unrealistic wage aspirations of trade unions or their failure to adjust to a new environment as the main source of the German unemployment problem.[194] This, of course, presumes that real wages are set by trade unions and can be treated as an exogenous variable.

An operational concept of the wage gap usually involves fixing a benchmark year when full employment prevailed at a normal utilization of the capital stock, defining the wage gap as zero for this year, and then calculating the variation of the wage gap in the following years as the difference between the actual real wage and the hypothetical real wage at full employment.[195] In practice, measuring the wage gap is complicated by the fact that for calculating the hypothetical full employment real wage one needs to know the marginal productivity of labor at full employment, which cannot be directly observed. This actually poses two

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[193] Paqué (1999, pp. 12).

[194] See Siebert (1998, pp. 31), for a discussion of the relationship between wages, productivity growth and employment.

[195] Paqué (1999, p. 14).

problems, since there are no statistics on the marginal productivity of labor either.[196] Paqué (1999) shows that both problems can be overcome if one assumes a Cobb-Douglas technology for the production process.[197] In particular, he assumes

(45) $V = \left(e^{gt} L\right)^{f} K^{1-f}$,

with V defined as value added at constant prices, L as labor input (employment), K as the capital stock at constant prices, t as a trend variable, and g and f as constant parameters ($g \geq 0$, $0 \leq f \leq 1$). With this assumption it can be shown that marginal and average labor productivity change at the same rate. Since the latter variable is observable, this property makes it possible to obtain a measure of the change in marginal labor productivity. Moreover, defining the marginal labor productivity as V_L it can be shown that the change in this variable can be expressed as[198]

(46) $dV_L / V_L = -(1-f)(dL / L)$.

Next, Paqué defines a level of full employment L^f that differs from actual employment by $\left(L^f - L\right) \neq 0$. When employment changes from L to L^f, equation (46) shows how this affects marginal labor productivity, with dV_L defined as $\left(V_L^f - V_L\right)$, i.e. the difference between full-employment and actual marginal labor productivity. Substituting $\left(L^f - L\right)$ for dL, $\left(V_L^f - V_L\right)$ for dV_L, and $f(V/L)$ for V_L and solving equation (46) for V_L^f, one obtains

(47) $V_L^f = f\left[1 - (1-f)\left(L^f - L\right)/L\right](V/L)$.

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[196] For a detailed discussion of this issue and several approaches to overcome these problems, see Paqué (1999, pp. 14).

[197] Paqué (1999, pp. 16).

[198] Note that $V_L = f(V/L)$.

Since L and (V/L) are observable, Paqué calculates with the help of equation (47) an estimate of the marginal labor productivity at full employment for any point in time. All that is required as further input is a sensible measure for f (the partial elasticity of production with respect to labor input) and L^f (full employment). Inserting the resulting estimate of V_L^f into the equation defining the wage gap yields

(48) $$WG = z^{-1}\left[(w/p_v)/f(V/L)\right] - 1,$$

with $z = \left[1-(1-f)\left(L^f - L\right)/L\right]$. Paqué writes that equation (48) can be regarded as a general formula for a wage gap in a 'Cobb-Douglas world' with constant returns to scale.[199] In a final step, he normalizes all wage gaps to the level of a base year with approximately full employment., choosing the year 1960 for this purpose.[200] This defines an index of full-employment labor cost (FELC) as

(49) $$FELC = \left[(1+WG)_t/(1+WG)_{60}\right]\cdot 100.$$

In Figure 25, the resulting index for Germany is shown.[201] Due to lack of data, this index can be computed for West Germany ($FELC$ WG) only up to 1992.[202] The series $FELC$ G shows the corresponding series for the united Germany, but this series represents at best a first approximation of the full-employment labor

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[199] Paqué (1999, p. 17).

[200] Paqué (1999, p. 17).

[201] The nominal wage variable is defined as the average gross annual compensation of a dependent-status employee, which is available from national accounts. The level of full employment is approximated with the actual labour force. The corresponding series has been taken from the statistical annex to the annual report of the council of economic experts (Sachverstaendigenrat). This source also contains the series on actual employment (L). The variable p_v is defined as the value-added deflator, and V is net value added at constant value added prices. Both series are again available from the Sachverstaendigenrat report. Following Paqué, f is set to 0.7.

[202] This series reproduces the estimate by Paqué (1999), p. 22, Figure 3. Paqué computes also wage gaps for selected sectors in West Germany and finds that the wage gap was basically a matter of industry, while there is no wage gap in the service sectors. See Paqué (1999, pp. 23).

costs, since the underlying assumption that the wage gap of the year 1960, which we use to normalize the series, is relevant for the united Germany should be considered as a rather strong assumption.

Figure 25 shows that real wages have risen in the 1970s and early 1980s by considerable more than the hypothetical real wage at full employment, leading to a large wage gap. This supports the monetarist view that excessive real wage growth is the source of the German unemployment problem. It is argued that one factor behind the surge in wages is the attempt by unions in the early 1970s to increase their share in national income, which can be interpreted as a genuine wage push shock. The failure of unions to adjust their wage aspirations to the secular productivity slowdown, which set in the middle of the 1970s, is identified as another factor. In addition, the insistence of unions to have their members compensated for the loss of purchasing power due to the increase in oil prices in this decade is seen as yet another factor behind the wage gap.[203] Also, the reform of the German social security system in the 1960s and 1970s which made it more generous is thought to have contributed to the rising wage aspirations by increasing the effective minimum wage.[204] In the second half of the eighties a period of wage moderation began, which almost closed the wage gap by the early nineties.[205] Monetarists credit this wage moderation with facilitating the strong build-up in employment in the 1980s.[206] Following unification, monetarists argue that another wage push shock occurred when unions tried to increase wages in East Germany to West German levels even though productivity

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[203] See Franz (1997, p. 191).

[204] See Siebert (1998, pp. 191).

[205] The council of economic experts comes in its 1989/90 report to the same conclusion. It notes that wages increased only moderately over most of the 1980s and that by the end of the decade the share of labour in national income has fallen below its levels in the 1960s. See Sachverstaendigenrat (1989, p. 116).

[206] See Siebert (1998, p. 51).

in the East continued to lag behind.[207] Figure 25 shows that in the early nineties the wage gap in the united Germany was indeed much larger than the gap in West Germany, but since it is not really clear what the full-employment real wage in the united Germany is, the extent of this wage shock is difficult to quantify. The remainder of the nineties were followed by another period of wage moderation, and employment began finally increasing again in 1997.[208]

The remedy for the German unemployment problem from the viewpoint of monetarists is clear: trade unions need to reduce their wage aspirations and bring real wages back into line with the full-employment real wage.

4.2 The controversy on the causes of unemployment

Keynesian economists, not surprisingly, do not subscribe to the view that wage moderation is all that it takes to restore full employment in Germany. On the contrary, they disagree on a number of fundamental points regarding both the monetarist analysis of the causes of unemployment and the suggested cure.

First, Keynesians do not view the German unemployment problem as being only a natural rate problem. Instead, they argue that Germany has suffered in the past 30 years also from bouts of very high cyclical unemployment which could

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[207] See also the discussion in Arbeitsgemeinschaft (1996, pp. 28).

[208] It is often argued that the wage moderation in the 1990s had only a weak (and late) effect on employment because rising social contribution rates offset the effects of moderate wage growth by increasing the cost of labour to firms. For this argument, see Sachverständigenrat (1998, pp. 238). In Figure 25 the wage variable includes the social contributions paid by employees and employers to control for this. While this line of argument does not explain why wage moderation in the 1990s only had a late effect on employment, it nevertheless explains why there has been not more wage moderation given the high levels of unemployment. The widening of the wedge between wage costs and the net wage received by employees probably prevented a more pronounced wage moderation in this period. Kroker (1999, pp. 48). shows that real net wage income declined between 1998 and 1991 by 1.5%, whereas real wage costs increased by approximately 11%.

have been avoided if fiscal and monetary policy makers had pursued more expansionary policies. Put another way, Keynesians are likely to challenge the monetarist analysis that the natural rate of unemployment was in the past almost always higher than the actual unemployment rate. But since even the Keynesian Phillips curve model implies that the natural rate of unemployment has increased, most Keynesians would find it difficult to argue that the *entire* German unemployment problem is due to deficient demand. Nevertheless, a substantial disagreement on the role of cyclical unemployment in Germany between the two schools of thought remains. This controversy is not about trivial amounts of unemployment, since the Keynesian Phillips curve implies that in the 1980s unemployment could have been lower on average by approximately two percentage points. Monetarists, of course, disagree that this would have been possible, since they believe that the unemployment rate over most of this period was already lower than the natural rate, leading to substantial inflationary pressures, while Keynesians attribute the very same inflationary pressure to adverse supply shocks. Unfortunately, as we have seen in the discussion of the Keynesian and monetarist Phillips curve models, there is no straightforward way to resolve these differences empirically because both assertions are consistent with the respective models employed by the two schools of thought.

The second central proposition of monetarists that excessively high real wages are the source of the German unemployment problem leads to another fundamental objection by Keynesians. The monetarist argument above treats real wages as if they were under the direct control of the trade unions. That is, in the context of the wage gap discussion real wages are treated as exogenous. Keynesians do not think that this is a very attractive assumption. Solow (1986), for instance, asks: “Are not real wage rates and unemployment both endogenous

variables in any reasonable picture of a modern capitalist economy?".[209] In so called 'right-to-manage' approaches to wage bargaining it is often assumed that trade unions set *nominal* wages and firms determine employment. Even in the simplest version of these models prices and employment are endogenous, meaning that real wages are also endogenous. To investigate this issue in more detail, Solow (1986) considers a model with profit-maximizing monopolistically competitive firms, a standard production function and a quantity equation to determine aggregate demand as a function of money supply. In this model, the nominal wage and the money supply are exogenous, while prices, employment and real wages are endogenous. He finds that employment is a function of M/w, where M denotes the money supply and w the nominal wage, meaning that a situation with high unemployment and a real wage which is higher than the full-employment real wage can arise only when the money supply is too low and/or the nominal wage is too high.[210] In particular, concluding that in this situation unemployment occurs because real wages are too high is misleading. Solow (1986) writes: "In the model, firms do not 'face' the real wage w/p: they face the nominal wage w, and they *choose* the real wage by choosing p. There is no point in wishing that w/p were at the level corresponding to full employment because w/p is not available for wishing: wishing should be reversed for exogenous variables or for parameters, and, at least in this model, w/p is endogenous."[211]

Extending the model with imported raw materials as another factor of production, which serves to introduce an additional exogenous variable, Solow shows that if unemployment occurs one could achieve full employment by low-

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[209] Solow (1986, p. S24).

[210] Solow (1986, p. S27).

[211] Solow (1986, p. S27).

ering the nominal wage, leading to a lower real wage and higher employment, or one could achieve full employment with a larger money supply, in which case the real wage may remain unchanged or may end up to be even slightly higher than before. This shows again that it is not adequate to describe the unemployment problem simply as a problem of real wages being too high.

Finally, it should be noted that even the presumption that *nominal* wages are exogenous is hard to justify, because trade unions do not randomize their wage setting decisions. That is, unions are likely to set nominal wages in a systematic fashion, according to some reaction function. If this reaction function includes the unemployment rate as an argument, meaning that unions care about the unemployed, nominal wages are no longer exogenous with respect to unemployment. Solow (1986) notes that in this case it is no longer meaningful to say whether the real wage causes unemployment or unemployment causes the real wage.[212] Rather, to understand wage setting behavior it is necessary to determine the exogenous variables which influence the behavior of trade unions.

To conclude, the endogeneity of real wages suggests that the debate on the causes of unemployment should be conducted within the framework of a *complete* model of the macroeconomy. In any case, the wage gap concept is no substitute for such a model and, therefore, does not provide a suitable framework for a discussion of these issues.

4.3 The controversy on the effectiveness of wage moderation

Keynesians are also doubtful whether a policy of wage moderation is effective in reducing unemployment. These doubts are both empirical and theoretical in nature. Beginning with the empirical argument, Keynesians notice that Germany has experienced long periods of wage moderation in the 1980s which practically

closed the wage gap, but the unemployment rate did not nearly return to its levels in the 1960s.[213] Note that the increase in employment occurring in this time period, which monetarists view as proof that wage moderation leads to higher employment, does not solve the puzzle that unemployment remained stubbornly high even though the wage gap closed. This increase in employment was apparently only sufficient to absorb the higher labor supply coming into the labor market at the time, and thus it did not have a major impact on the unemployment rate. But if the wage moderation was just enough to accommodate the increase in the labor supply, this would not have led to a closing in the wage gap.[214] That is, the wage moderation we observe in Figure 25 should have led to a substantial decline in unemployment in spite of the increase in labor supply. Not surprisingly, Keynesians conclude from the experience in the past twenty years that over long periods of time in the 1980s and 1990s trade unions followed monetarist advice but have little to show for in terms of lower unemployment rates.

However, it is not the case that Figure 25 provides conclusive evidence that wage moderation was ineffective in reducing unemployment. The reason for this is that this concept assumes that the underlying production function remained stable in the past 30 years. This is a strong assumption, because there are reasons to suspect that in a period of almost 15 years of aggressive union behavior firms eventually adjusted their production processes to this environment. One likely

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[212] Solow (1986, p. S25).

[213] See Flassbeck (1998).

[214] Recall that the wage gap measures the distance between the actual real wage and the full-employment real wage. If the labour supply increases, this induces the full-employment real wage to fall so that the additional labour supply can be integrated into the labour market. If the actual real wage falls by the same amount and the additional labour supply is integrated into the labour market, the wage gap and the unemployment rate remain unchanged. But in the 1980s we observe a closing in the wage gap, meaning that actual wage moderation was larger than required to integrate the additional labour supply. But this did not have the expected effect on the unemployment rate since we observe no major reduction in the unemployment rate.

response, which has been pointed out by Layard and Nickell, is that firms disinvest and opt for a smaller capital stock, because with high labor costs they find production in Germany not profitable enough to maintain high levels of investment.[215] When unions eventually decide to embark on a course of wage moderation, having faced persistently high unemployment, and bring wages down to a level which in the past used to be compatible with full employment, they find that full employment is not restored. With a smaller capital stock, firms are not prepared to employ the same number of employees as before for the same wage. Thus, the full-employment real wage has declined. Solow (1986) describes this situation as follows: "If persistent under-capitalization and unemployment reduces investment and the capital stock, then an equilibrium locus, like that in the diagram [the equilibrium locus is depicted in the real-wage employment plane and has a negative slope], may shift to the left, lowering the real wage corresponding to full employment."[216] This would explain why the closing of the wage gap in Figure 25 did not lead to a return to full employment in Germany. To achieve this, real wages would have to fall for some time below the full-employment wage of the 1960s so that firms have an incentive to rebuild the capital stock. Thus, the wage gap may not be a reliable measure on the distance between actual real wages and full-employment real wages.[217]

Moreover, in the past 20 years a large number of countries, particular in South East Asia, have been integrated into the world economy, giving firms a larger choice where to invest and place their production facilities. With competition for the factor capital intensifying, the full-employment real wage has to decrease

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[215] See Layard et al. (1991) for a detailed discussion.

[216] Solow (1986, p. S29).

[217] See Lapp and Lehment (1997) for another approach to investigate the link between wage moderation and employment. These authors find that wage moderation is effective in increasing employment. However, see also Kromphardt (1999) for a dissenting view, in particular regarding their empirical approach.

just to keep Germany attractive as a place for investment. This is another factor which is not taken into account in the calculation of the wage gap.

Finally, it is suggested that the large increase in recent decades in the importance of international trade (globalization) and skill-biased technical progress have contributed to the German unemployment problem by increasing the unemployment rate among low-skilled workers.[218] In this case the unemployment problem is not necessarily a reflection of the *average* wage level being too high, but may be a consequence of the wage structure being too compressed and too rigid. For example, it is possible that the wage of the low-skilled does not fall sufficiently to clear the low-skilled segment of the labor market, while at the same time labor shortages may persist in the high-skilled segment of the market, so that the average level of wages is compatible with full employment but the economy suffers nevertheless from high unemployment. If the lack of wage differentiation is an important factor for the German unemployment problem, the wage gap concept, which is concerned with the *average* level of real wages, does not help much in the analysis of the unemployment problem. Thus, even though wage moderation among the low-skilled could be effective in reducing unemployment, the wage gap depicted in Figure 25 would not necessarily indicate this.

Regarding the theoretical controversy, there are essential two channels how wage moderation may lead to higher employment.[219] On the one hand, lower real wages mean that labor becomes more attractive relative to other factors of production. This leads to substitution processes, and thereby to higher labor de-

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[218] See the discussion in Franz (1999).

[219] For a detailed discussion of how wage moderation supposedly leads to higher employment, see Sachverstaendigenrat (1977), pp. 7. For a more recent account, see Sachverstaendigenrat (1998), pp. 238. For a dissenting view, see the minority opinion on this issue in Sachverstaendigenrat (1980), pp. 200. For an excellent account of the controversy between the six leading German economic research institutes regarding this issue, see Tober (1998).

mand. Since there is ample empirical evidence that real wages enter labor demand functions with a negative sign, this channel is fairly uncontroversial.[220]

According to the second channel, wage moderation leads to lower real wages, thereby improving the profitability of firms and inducing them to undertake new investment projects which create new jobs. That is, wage moderation strengthens the supply side of the economy. Regarding the demand side of the economy, monetarists are confident that prices are sufficiently flexible to ensure that no demand deficiencies occur. In particular, they argue that even if workers accept a reduction in their nominal wages, this does not mean that aggregate demand in the economy falls even though the purchasing power of worker falls. They point out that since wage moderation increases the profitability of firms, this leads to additional income in the business sector, which is spent on goods and services or is distributed to shareholders, thereby creating additional demand. To the extent that firms or their shareholders do not spend their income on investment and consumption goods directly, they are likely to invest it in the capital market, leading to lower interest rates and stimulating investment demand. Moreover, competition will force firms to pass their gains on to consumers in form of lower prices. This helps workers to restore some of their lost purchasing power. Finally, it is argued that since the improved supply side conditions make additional investment projects feasible, the resulting demand for investment goods and the income generated from increased employment ensure that demand conditions remain favorable.

In more general terms, monetarists argue that on the aggregate level any shortfall in demand due to wage moderation will lead to lower prices, which increases the real value of money balances (real balance effect). That is, as long as monetary authorities supply the economy with sufficient money balances to

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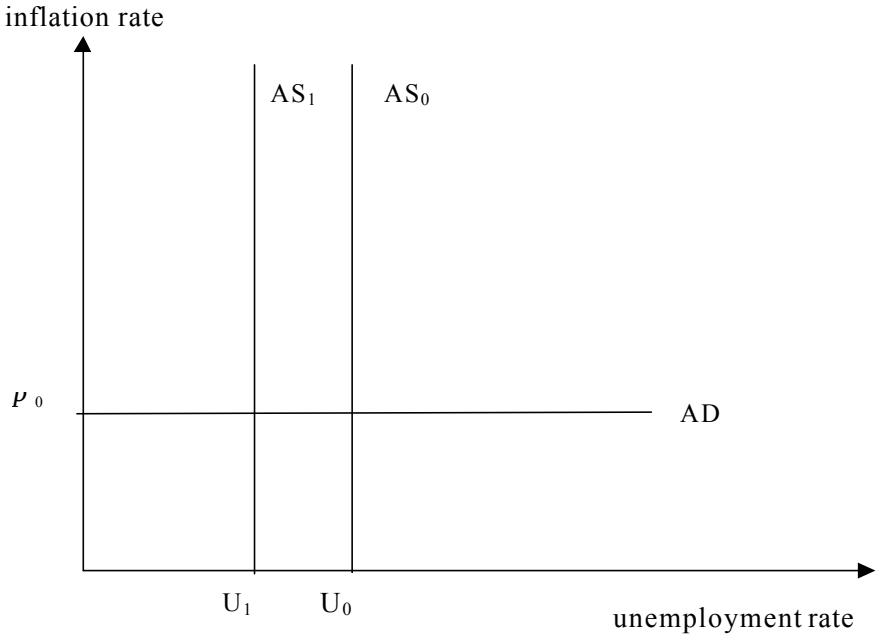
[220] For recent evidence on a labour demand function estimated for German data, see Boss et al. (1998), who estimate a real wage elasticity of –0.45 for the labour demand function.

keep the nominal money supply constant, the real balance effect ensures that wage moderation does not adversely affect demand conditions. From this follows that supply creates its own demand, so there is no need to accompany a policy of wage moderation with expansionary demand policies. This is also a direct implication of the assumption of superneutrality in monetarist models. This assumption leads in Figure 26 to the vertical aggregate supply curve, denoted as AS. Wage moderation induces the supply curve to shift from AS_0 to AS_1. In the short-run, this is likely to lead to a deceleration in inflation as firms reduce prices to stimulate demand for their products. In this period, investment and employment increases while the unemployment rate falls. In the long-run, the economy expands with the same growth rate as in AS_0, but in AS_1 the capital stock is larger and the unemployment rate is permanently lower. Regarding inflation, recall that in monetarist models inflation is determined via the quantity theory. If we assume that velocity is constant and that the central bank maintains the same growth rate of money over the entire experiment, inflation returns in the long-run to the level $\bar{p}$ which already prevailed when the economy was still in AS_0. Thus, in the long-run inflation and unemployment are independent from each other, consistent with the monetarist proposition of a dichotomy between the real and nominal variables. Since in the monetarist model inflation is an indicator of demand conditions, this also means that in the long-run demand conditions remain unchanged.

Figure 26: Wage moderation in the monetarist model



In the monetarist view, wage moderation in itself is sufficient to restore full employment. However, Keynesians who question whether the Phillips curve is indeed vertical in the long-run, or who think that a long-run horizon is too long to be relevant for actual policy making, have their doubts on the effectiveness of wage moderation. In particular, they argue that wage moderation cannot be successful in increasing employment if demand conditions are weak. In such a situation firms find that at present prices they cannot sell on product markets as much as they desire, and, hence, a reduction in real wages is not going to persuade them to hire more labor since they would not be able to sell the additional output resulting from an increase in employment.[221] In monetarist models, firms would cut their prices in this situation, thereby increasing demand. In Keynesian models, however, prices are initially sticky. With sticky prices, a policy of wage moderation is likely to lead to a further deterioration in demand conditions. When nominal wages fall while prices are sticky, the purchasing power of workers is eroded, so that firms become even more rationed in product markets.

[221] See also the discussion in Franz (1997, p. 188).

Consequently firms are unlikely to increase production even though wage moderation implies an improvement in supply conditions. On the contrary, since it is a hallmark of Keynesian models that deficient labor and product demand tend to reinforce each other, this process could lead the economy even into a recession. In fact, the decrease in product demand due to the reduction in labor income makes it likely that firms cut back on employment, and lower employment reduces the wage income of the labor force even further, so that product demand continues to fall.[222] In contrast to the monetarist model, in the Keynesian sticky price model profits are likely to fall when nominal wage growth slows down. Hence, even though the monetarist assertion that wage moderation leads to additional income in the business sector is entirely consistent with the monetarist model, it is apparently not consistent with the Keynesian view of short-run fluctuations.[223] In the latter type of model weak demand conditions and low profits mean also that there is little reason to expect an increase in investment demand to pick up the slack in product demand, which is another source of demand stimulus in monetarist models. In this regard it should be noted that Keynesians often make a distinction between 'autonomous' investment projects, which are related to product innovations, projects increasing the efficiency of the production process, etc., and 'induced' investment projects, which refer to projects increasing the firm's capacity to produce goods.[224] Keynesians argue that most employment creation is related to the latter type of investment, which in contrast to 'autonomous' investment is very sensitive to demand conditions.

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[222] Monetarists argue that wage moderation leads to an improvement in the external competitiveness of the economy, leading to an increase in export demand. Keynesians acknowledge that foreign demand is likely to increase, but maintain that this is a 'beggar thy neighbour' policy which is in itself undesirable. See the discussion of this point in Tober (1998, pp. 16).

[223] This point is acknowledged, for example, by the Sachverstaendigenrat (1977, p. 8).

[224] For a detailed discussion see Sachverstaendigenrat (1980, pp. 200).

With the economy heading for a recession, firms have little reason to invest in projects enlarging their production capacity. Thus, deficient demand conditions prevent positive effects of wage moderation on employment since no investment response is forthcoming.[225]

The discussion proceeded up to now under the assumption that prices are sticky. It is tempting to argue that the ineffectiveness of wage moderation in Keynesian models is due to this assumption which is at best relevant for very short horizons. Indeed, even in Keynesian models prices are not indefinitely sticky, so eventually prices will tend to fall in these models too. Nevertheless, Keynesians who are skeptical about the long-run superneutrality assumption in monetarist (and in many modern Keynesian) models tend also to have substantial doubts whether a reduction in the price level is sufficient to restore demand conditions.[226] Tobin (1993) expresses this skepticism as follows: "Even if money wages and prices were more flexible, even if excess supplies of labor were to lead more rapidly to cuts in money wages, this greater flexibility would not prevent or cure unemployment."[227] This claim is based on a number of arguments:[228]

In general, Keynesians do not challenge the efficacy of the price adjustment mechanism in clearing single markets, but they object to the notion that this mechanism is also effective in the economy at large. For instance, if there is an excess supply of labor in a local market, in a competitive market this would cause

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[225] The Sachverstaendigenrat (1977), which generally makes a monetarist argument in favor of the effectiveness of wage moderation, concedes that if demand conditions turn indeed out to be deficient, there would be a rationale for expansionary demand policies to provide an initial increase in demand, which then would trigger additional investment demand in the private sector which would fill the demand gap. See Sachverstaendigenrat (1977, p. 8).

[226] For a detailed discussion of this issue see Tobin (1993, pp. 57).

[227] Tobin (1993, p. 57).

[228] This section draws on Tobin (1993, pp. 58).

nominal wages to fall. Since this does not affect the economy at large, it is fair to assume that other prices remain broadly unchanged. Consequently the real wage in this market would be falling relative to the rest of the economy while the adjustments themselves would not have any noticeable effect on the labor demand and supply schedules in the local market. With constant labor demand and supply schedules the reduction in real wages is effective in clearing the local labor market. But if there is an *economy wide* excess supply of labor, Keynesians point out that the price adjustment mechanism will lead to shifts in labor demand schedules in the economy, because it is the *nominal* value of marginal products which determines the relevant labor demand curves. If product prices fall, the nominal value of marginal products will fall, and consequently the labor demand curve shifts down.[229] The downward shift in the labor demand curve means that a reduction in real wages does not necessarily lead to an increase in labor demand. Tobin (1993) summarizes this case as follows: "Here, then, is a case in which demand and supply schedules do not stay put while the price adjustment to excess supply takes place. It is illegitimate to appeal to the intuition that seems so credible for single markets. Instead, the question is whether proportionate deflation of all nominal prices will or will not increase aggregate effective real demand."[230] Put another way, the flexibility of wages and prices alone does not ensure that the labor market returns to a full employment equilibrium. One has to assume in addition that the deflation of nominal prices is effective in increasing aggregate demand, because this will limit the downward shift in the labor demand curve, making it possible for employment to increase.

In monetarist models, it is the real balance effect which ensures that lower prices lead to an increase in aggregate demand. Many Keynesians do not believe

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[229] Recall that the fall in product prices is likely because nominal labor incomes decline along with wage rates and, hence, workers' money demands for the products they produce will decline too.

[230] Tobin (1993, p. 58).

that this effect is very powerful. The monetarist argument regarding the power of the real balance effect is twofold. On the one hand they argue that an increase in real money leads to a reduction in interest rates because money supply exceeds money demands. This channel is closely related to that of classical models where interest rates are the equilibrators of goods and capital markets, with interest rates always adjusting to keep investment equal to saving at their full employment levels. However, Keynesians point out that nominal interest rates would not fall by enough to restore full employment if money demand is interest elastic, since in this case lower interest rates would mean that the opportunity costs of holding money balances fall and, hence, money demand increases.[231]

Monetarist also argue that higher real money balances have a direct effect on the purchasing power of agents in the economy. This is also called the Pigou effect. Keynesians counter that this effect is of dubious strength, and even of uncertain strength, because most nominal assets in the economy are inside assets. That is, most assets are debts of private agents to other private agents. Since these cancel out in the aggregate, this leaves only the government's nominal debt to the private sector as net wealth. And some of this debt is internalized by taxpayers, reducing net wealth even further. Thus, the base of the real balance effect is quite small relative to the economy. Moreover, even though inside assets wash out in aggregation, this does not mean that the consequences of falling prices on the real value of these assets wash out. Tobin (1993) notes: "Price declines make creditors better off and debtors poorer. Their marginal propensities to spend from wealth need not be the same. Common sense suggests that debtors have the higher spending propensities — that is why they are in debt! Even a small differential could easily swamp the Pigou effect — gross inside dollar-denominated assets are 200 percent of United States GNP." In this case lower prices would have even a contractionary effect on the economy.

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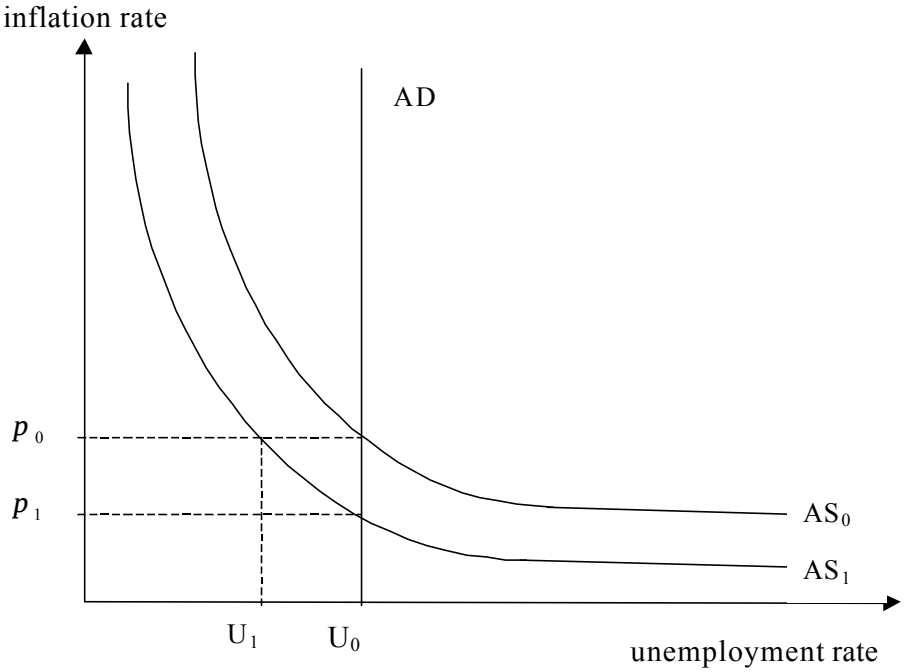
[231] For a detailed discussion see Tobin (1993, pp. 52).

The preceding discussion suggests that falling prices do not necessarily increase aggregate demand markedly, if at all. This situation is shown in Figure 27. As in the monetarist model, wage moderation leads to a shift in the aggregate supply curve from AS_0 to AS_1. Unlike in the monetarist model, the aggregate supply curve is not vertical but is depicted as a traditional downward sloping Phillips curve, consistent with the assumption that superneutrality does not hold, which is central to the Keynesian argument outlined above. Regarding demand conditions, we assume again that that the central bank keeps the growth rate of the money supply constant throughout the experiment. In the short-run, when prices are still sticky, wage moderation is likely to lead to a decline in aggregate demand. In the long-run, prices fall and, depending on the strength of the real balance effect, aggregate demand conditions may improve relative to the demand conditions prevailing in AS_0, leading to an unemployment rate to the left of U_0, or they may turn out to be worse, leading to an unemployment rate to the right of U_0.[232] In Figure 27 the case is shown where aggregate demand conditions remain unchanged. Note that in the monetarist model, the economy ends up at U_1 regardless of what the demand conditions are. Here, supply does not create its own demand and, hence, the unemployment rate remains stuck at U_0. In this example the growth potential resulting from a policy of wage moderation remains unexploited unless expansionary demand policies are pursued at the same time. In the new equilibrium given by U_0 and p_1, nominal wage growth is lower than in the old equilibrium. The inflation rate is lower too since prices are assumed to be determined as a mark-up on wages. The size of the capital stock has not changed, since firms have had no reason to increase or decrease their production capacity. The growth rate of output has not changed ei-

[232] See also the discussion in Summers (1992), who argues that Keynesian economics are best represented in models allowing for multiple or for fragile equilibria.

ther.[233] The growth rate of real wages is presumably also the same as before, provided that competition denies firms the opportunity to turn the lower wage aspirations of unions to their advantage by increasing the firms' share in national income. In sum, in this model all the economy has gained from this wage moderation experiment is that it has shifted towards a lower inflation rate, and this was paid for with a recession.

Figure 27: Wage moderation in the Keynesian model



4.4 The controversy on the policy assignment

Given these substantial differences in the analysis of the causes of unemployment and its cure, it is not surprising that Keynesians and monetarists also disagree on the policy assignment. In Figure 27 it is apparent that in the Keynesian model wage moderation alone is not sufficient to restore full employment.

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[233] With the growth rate of money and output unchanged and a lower inflation rate the quantity equation implies that the rate of change in velocity must have decreased. That is, money demand must have increased, which is a plausible outcome if nominal interest rates

Hence, trade unions alone cannot do the job. To achieve full employment, the support of demand management policies is required. Since in the 1970s it became clear that there are limits to what fiscal policy can achieve, it is monetary policy that Keynesians call on to expand demand so that the economy can move from U_0 to U_1. In their view such a demand push does not pose a threat to the inflation objective of the central bank, since the policy of wage moderation ensures that inflation is at U_1 not higher than it was when the economy was still operating at AS_0 with an unemployment rate of U_0. The demand for supportive demand policies is also entirely consistent with the Keynesian policy assignment where it is the primary task of unions and employers to ensure that price stability is maintained, while it is the task of the central bank to maintain full employment by managing demand conditions accordingly. When unions embark on a course of wage moderation, they make it possible for the central bank to expand demand without triggering an increase in inflation. If the central bank fails to expand demand, the employment gains from a policy of wage moderation are bound to be limited. Keynesians therefore see a strong case for policy coordination between wage and demand policies to lower the unemployment rate in Germany.[234] Solow (2000), for example, writes on the German unemployment problem: "Yes, the German labor market is too rigid, and more flexibility would be a good thing. But merely creating a more flexible labor market by itself has two disadvantages. The first is that it will work to increase employment, production and income only very slowly, if at all. Business firms will not leap to create more jobs just because unemployment benefits are a bit less generous and wages can perhaps be driven a bit lower. The second disadvantage is that pure supply-side policy is redistributive. It will transfer income from workers to

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have fallen due to the lower inflation rate, thereby lowering the opportunity costs of holding money.

[234] See also the discussion in Tober (1998, pp. 26).

firms. It is bound to be socially divisive. Simultaneous expansion of demand, by significant though not necessarily very large amounts, will make labor-market policy more effective and less divisive. Employment will rise more rapidly if firms see expanding markets. Some of the wage reduction that might come about in the pure supply-side scenario will be offset by demand-induced job creation. The extra employment will provide some tangible compensation to the workers' side of the labor market, making the whole package more equitable and more acceptable."[235]

From the Keynesian viewpoint, the failure of the policy of wage moderation to have a sizeable impact on the German unemployment rate is a failure of the central bank to expand demand sufficiently so that the employment potential resulting from this policy can be realized. Observing that the central bank preferred to use the unions' policy of wage moderation as an opportunity to lower its inflation target instead of expanding employment, in the past unions saw often little benefit in continuing with this policy. This explains why periods of wage moderation were often interrupted by episodes of high wage demands.

In addition, Keynesians blame the Bundesbank to have contributed to the German unemployment problem by cutting short periods when the German economy was booming, with the Bundesbank always citing the dangers a boom poses for its goal of maintaining price stability.[236] From the Keynesian viewpoint boom periods are necessary to induce firms to invest to expand their capacity, creating new jobs in the process. As regards this point, it is important to recall that in the Keynesian view most jobs are created when firms expand their capacity, and firms undertake such projects only in periods when the economy

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[235] Solow (2000, p. 13).

operates at very high levels of capacity. With the Bundesbank responding to booms by tightening monetary policy aggressively, Keynesians argue that the Bundesbank prevented a build up in the capital stock and in employment, thereby adversely affecting the German growth performance. Moreover, Keynesians maintain that the economy is at its efficient level when it is booming, so this is a desirable state of the economy and there is no reason to cut boom periods short. Regarding the inflationary pressures arising in booms, Keynesians argue that these are limited as long as unions stay on a course of wage moderation.

Put another way, Keynesians allege that the Bundesbank pursued in the past 20 years an asymmetric policy in the sense that it was willing to create recessions or prolong periods of weak demand in order to lower inflation, while it was unwilling to allow the economy to enter into boom periods because of its fear that this would cause the inflation rate to increase again. While Keynesians acknowledge that this policy was very effective in reducing inflation rates over time, they maintain that this was very costly in terms of employment since it meant that the economy was frequently denied the opportunity to recreate the jobs which were lost in the recession. In terms of the Phillips curve depicted in Figure 27 this policy implies that the economy has been moving downward on the long-run Phillips curve. If a hysteretic mechanism is at work, it is also possible to describe the effects of this policy in terms of Figure 26 where the asymmetric policy of the Bundesbank would tend to shift the natural rate of unemployment over time to the left.[237] As Solow (1999) puts it, the long-run aggregate supply curve may be vertical, but its location could be endogenous to macroeconomic policy.[238]

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[236] For a similar line of argument see the minority view in the joint report of the six leading German economic research institutes on the state of the economy, Arbeitsgemeinschaft (2000, pp. 66).

[237] Such a mechanism is described in detail in Ball (1997).

[238] See Solow (1999, p. 11).

Monetarists, of course, disagree strongly with the Keynesian analysis of the appropriate policy response to the unemployment problem. They argue that any cooperation between trade unions and the central bank to achieve their respective objectives is liable to blur the lines of responsibility and is therefore deemed to be undesirable.[239] In particular, the expansionary monetary and fiscal policies in the 70s are seen by monetarists as having contributed to excessive wage aspirations of trade unions by giving them the impression that fiscal and monetary authorities will take care of the unemployment problem resulting from their drive for higher real wages. Thus, monetarists conclude that if monetary policy makers agree to assist trade unions in their task to reduce unemployment, the latter are likely to use this as a way to fudge their responsibility. Since the Bundesbank endorses the monetarist paradigm in full since the late 1970s, it consequently did not heed frequent demands by trade unions to expand demand. It sees instead the failure of trade unions to follow through its policy of wage moderation as the main reason why this policy has not yielded the hoped for success in reducing unemployment.[240]

V. Conclusion

Keynesians and monetarists debate each other in Germany since more than 20 years, essentially exchanging always the same arguments. This stalemate in the public discussion of important policy issues like wage policy is due to the fact that both sides base their arguments on fundamentally different models. In other words, the problem is not that trade unions do not understand the logic of the monetarist argument urging them to follow a course of wage moderation, but trade unions do not heed this advice because they do not believe in the monetar-

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[239] See Siebert (1998, pp. 160).

[240] See also Sachverständigenrat (1998, p. 239).

ist paradigm underlying this argument in the first place. Instead, they believe in the Keynesian paradigm and here the monetarist argument is considerably less persuasive than it is in the opinion of monetarists. Of course, monetarists are not persuaded by the Keynesian paradigm either and therefore it is not surprising that the Bundesbank does not heed Keynesian advice to expand demand in order to achieve full employment.

When two theories disagree sharply on one subject, economists usually attempt to determine on empirical grounds which of the two theories is right and which is wrong. In the present case it has become apparent in this paper that this cannot be done in a straightforward manner. The key parameter which determines whether a model has Keynesian or monetarist characteristics is the slope of the long-run Phillips curve. However, estimating this parameter is complicated by the fact that this parameter is a structural parameter since it derives from the structural wage/price setting relation of the underlying theoretical model. From this follows that in order to test whether the long-run Phillips curve is vertical or not it is not sufficient to consider the correlation between the inflation and unemployment time series and to test the significance of the resulting correlation coefficient. Rather, for estimating the slope coefficient it is necessary to identify the Phillips curve model first. At this stage the empirical researcher has to decide whether he imposes a Keynesian or monetarist structure on the model, which, of course, predetermines the long-run slope of the Phillips curve. Thus, it is not possible to test the slope of the long-run Phillips curve in a 'theory-free' manner since Keynesian and monetarist Phillips curve models are observationally equivalent as long as no over-identifying restrictions are imposed on the model. Nevertheless, it is possible to check whether the resulting models yield plausible results. In this regard this paper finds that most economists would probably find the monetarist model identified under the assumption that inflation is in the long-run a monetary phenomenon the most convincing model consid-

ered here. But since this model implies that there is a significant long-run trade-off between inflation and unemployment, this does not represent an unambiguous triumph of the monetarist position, even though the long-run trade-off is quantitatively small. In particular, if a vertical long-run Phillips curve is imposed on the model, the resulting 'natural rate' model displays the characteristics of a RBC model and therefore is implausible from a monetarist viewpoint. Finally, it should be noted that even though most economists are unlikely to find the Keynesian Phillips curve model very plausible, this does not represent compelling evidence against this model. What makes this models implausible is that it implies that virtually all recessions in the past 30 years were entirely due to adverse demand shocks. Although most economists would think that adverse supply shocks played a role too, the notion that business cycle fluctuations reflect fluctuations in aggregate demand is entirely consistent with the traditional Keynesian position and therefore Keynesians may simply choose to disagree with the majority position on this issue. In sum, this paper does not produce evidence which decisively refutes either the Keynesian or the monetarist position, but it shows what exactly these positions imply for the long-run Phillips curve and for the source of business cycle fluctuations, thereby hoping to clarify the debate.

The current stalemate in the public discussion is nevertheless unsatisfying. One avenue to resolve this impasse is to consider what developments in modern macroeconomics have to add to the debate. Since the late 1990s a new consensus in macroeconomics has been forming under the label 'New Keynesian economics' which, despite its label, comprises elements of both traditional Keynesian and monetarist models. The public debate on the German unemployment problem would probably benefit greatly if the insights of this new paradigm were to enter the debate. Also, this paper has shown that the causes of unemployment cannot be understood using relatively simple concepts like the

wage gap. Instead a fully specified macroeconomic model is needed. Since labor market economics have made great progress in the past 20 years and yielded a variety of such models, this offers another avenue to shed light on the German unemployment problem and to go beyond the Keynesian-monetarist debate on this issue. However, both tasks are beyond the scope of the present paper and are therefore left for future research.

Appendix

Figure 1A: Estimating the Phillips curve — the time series (in percentage points)

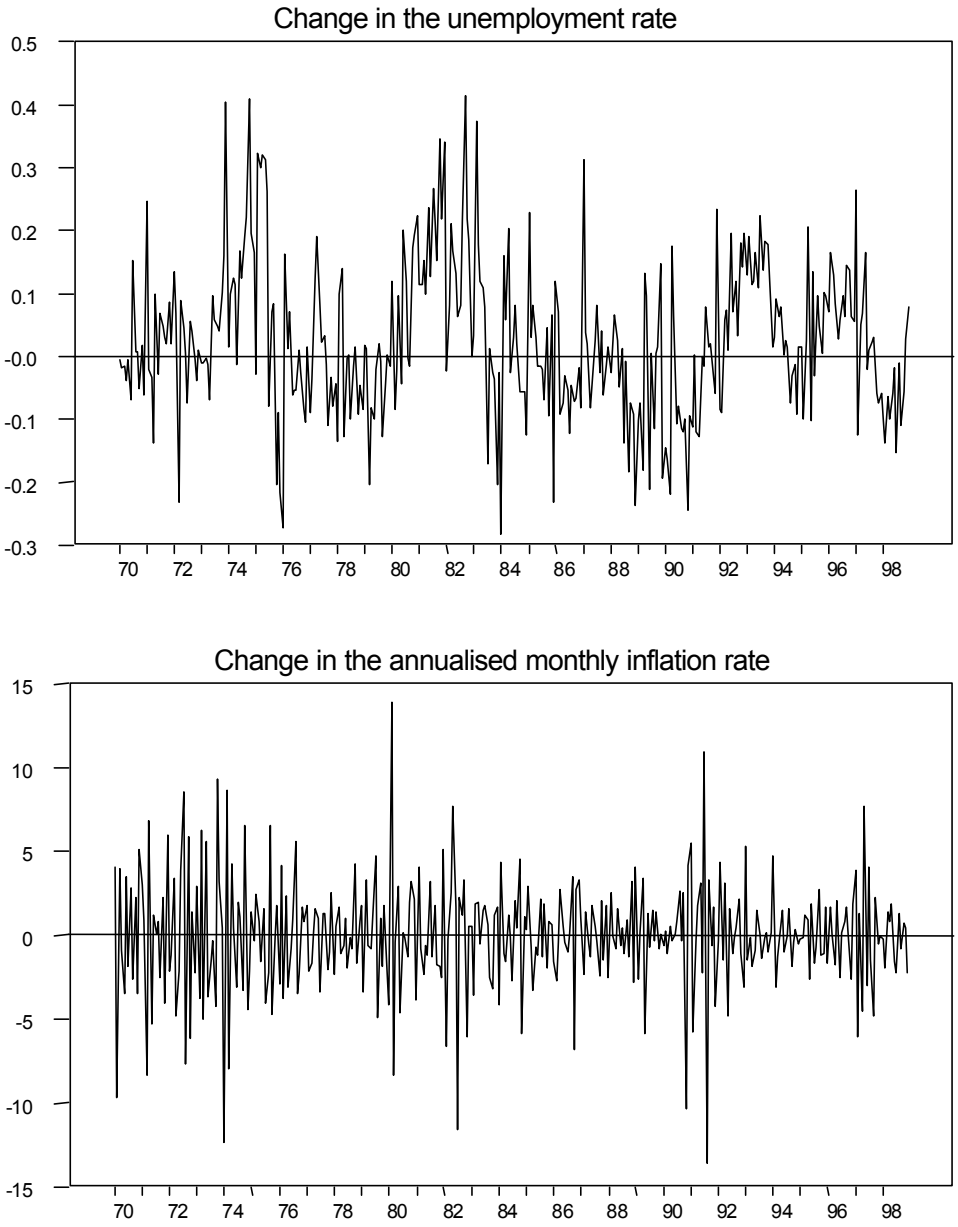

Figure 2A: Stability of the reduced form Phillips curve relationship

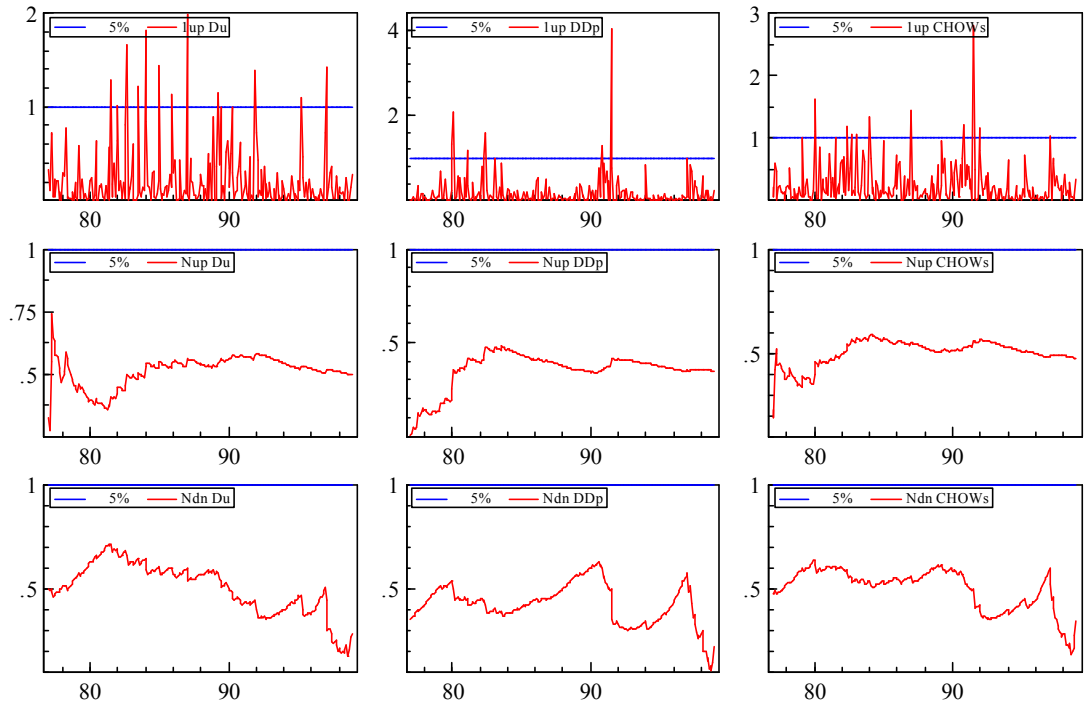

Table 1A: Misspecification Tests

Test	Testing the system	Testing the single equations	
		Δu	$\Delta^2 p$
AR (1–13)	1.15	0.50	2.59**
Jarque-Bera	31.95**	1.37	32.71**
White	1.07	1.13	0.99

Notes: The asterisks indicate a rejection of the null hypothesis at the 5% (*) or the 1% (**) level.
The AR (1-13) statistic gives the result of a LM-test for autocorrelated residuals up to order 13. For single equations this test statistic has a F(13,308) distribution, in the multivariate case F(52,588). Jarque-Bera is a normality test with a chi-square (4) distribution in the multivariate and a chi-square (2) in the univariate case. The White statistic is the test statistic of a test for heteroscedasticity. The respective distributions are F(52,268) and F(156,798).

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Figure 25: Index of full-employment labour cost in West Germany