Rethinking the Role of Monetary Policy and Wage Bargaining in EMU

Sebastian Dullien*

Draft version, presented at the LSE on May 29, 2003

Abstract

In standard macroeconomic models (new classical, AS-AD, monopolistic competition etc.) monetary policy determines the price level. Output and employment are determined in the labour market where nominal wages are set (possibly under the influence of unions), which together with the price level yield real wages. This paper shows that including the wage sum instead of real balances in the aggregate demand function of a standard monopolistic competition model changes this conclusion completely. Wage setters now control the price level. Monetary policy determines output and employment. Neither actor can influence real wages and profits which are determined by parameters as the degree of monopolisation. If this world is extended by a monopoly union, there is wide range of employment/output equilibria with stable prices.

1 Introduction

For most of the last quarter century there has been a wide consensus in macroeconomics. After the breakdown of the Keynesian revolution, the fall of the Samuelson and Solow (1960)-Phillips curve as a policy tool and the triumph of Lucas’ (1976) rational expectation revolution, the role of monetary policy and nominal wage contracts in macroeconomic models has been widely undisputed.¹ The real wage and thus employment and output are determined in the labour market,

¹Financial Times Deutschland, Friedrichstr. 71, 10551 Berlin, +49 (0) 30 22074 - 170, dullien@web.de.

¹The features presented here are standard in textbook models as AS-AD (McCallum (1989, Chapter 5) or Romer (1996, Chapter 5)) or the New Classical Model (Lucas 1972, Lucas 1973).
while inflation is determined by the central bank’s monetary policy. Any attempt by the central bank to push employment above what grinds out as the labour market equilibrium only leads to accelerating inflation. In both the medium and long run, monetary policy cannot influence output and employment.

Frictions in the labour market can increase the real wage contracted and thus decrease output and employment. One of such possible friction would be a monopoly trade union bargaining for economy wide wages. As the trade union would use its monopoly power to extract higher real wages than were paid in a competitive labour market, output and employment are lower than in the competitive labour market set-up (Burda and Wyplosz 1997, p. 150f).

In this paper, I will show that by altering a small assumption of standard macroeconomic models, namely dropping real balances from the aggregate demand function, these conclusions change completely. In this case, employment and output is not any longer determined in the labour market, but by aggregate demand. Moreover, real wages cannot be influenced anymore by a variation of nominal wages. Instead, economic parameters like the degree of monopolisation and the weight of labour in the production function determine real wages. When introducing a monopoly union into this model, there will be a wide range of equilibria in labour and goods markets (with a wide range of different levels of output and employment) in which prices are stable. The monopoly union is not able to influence real wages or output anymore. It is then up to monetary policy to chose the level of output and employment.

This paper is structured as follows: In section 2, I will first review more in detail the distribution of macroeconomic responsibilities between unions and the central bank in standard textbook theory. In this section, I will also explain what role the real balance effect plays in standard theory. In section 3, I will
then argue that there are good theoretical reasons to remove real balance effects from macroeconomic models if one wishes to explain what is happening in real world EMU. In section 4, I will consequently present a model of monopolistic competition in which aggregate demand is not a function of real balances, but of income streams. Section 5 will highlight what happens in such a world if wage bargaining is either highly monopolised or highly coordinated which can be argued to be the case for the core of the euro-zone. Section 6 presents a different set of macroeconomic responsibilities for the single actors given these results and section 7 concludes.

2 Macroeconomic Responsibilities in the Old Theory

In standard theory, output and employment are determined in the labour market in which individuals offer their labour up to the point at which their marginal disutility to work equals the real wage paid. At the same time, firms hire until labour’s marginal product equals the real wage they have to pay. While it is a nominal wage that is contracted in the labour market, it is the real wage that counts for production and work decisions. This real wage is determined by the nominal wage and the price level which is set via some quantity equation by the central bank.

As individuals anticipate the central bank’s policy stance and at the same time aim at a given real wage for their work, they will adjust their nominal wage demands in a way that after the central bank’s monetary policy move the real wage remains unaltered. Only if they are surprised by the central bank’s monetary policy, the unanticipated change in prices will transitorily alter real wages and consequently employment and output. However, it is not possible to
exploit this mechanism for macroeconomic policy as individuals will rationally expect the central bank’s move in advance.

Thus, inflating the economy does not yield lasting improvements in output or employment. In such a world, all remaining unemployment is voluntary or due to some institutional labour market features which keep nominal wages from adjusting downwards so that real wages fall and employment increases. One possible barrier to downward flexible wages and thus full employment could be unions which collectively bargain for wages, using their market power to achieve a wage which is above what is compatible with full employment (Burda and Wyplosz 1997, p. 150).

For monetary policy, this view of the world yields the conclusion that all a central bank should do is maintain a low and stable rate of inflation. As monetary policy leaves output and employment unaffected in both the medium and the long term, the central bank does not have any responsibility for unemployment or growth. Moreover, as politicians might be inclined to inflate to reap short term gains from a temporarily lower rate of unemployment, control over monetary policy should be given to some independent central bank, preferably headed by a central banker who has a strong distaste for inflation (Rogoff 1985). Since economic agents rationally expect the anti-inflationary stance of such an independent central bank, they adjust their inflation expectations downwards. Reducing inflation thus comes without any real costs, an independent central bank just yields more macroeconomic stability quasi as a “free lunch” (Grilli, Masciandaro, and Tabellini 1991).

When adding some wage or price stickiness to models like these, it is possible that demand falls short of supply in the short term thus causing transitional unemployment (e.g. Fischer 1977, Taylor 1980). In those settings stabilisation
policy by the central bank can be beneficial as the central bank can dampen short term fluctuations.

However, in the long run, the central bank cannot influence output or employment. Moreover, while there might be some preference by the society for the central bank to stabilise output in the short term, there is no necessity to do so. In the AS-AD-world as well as in the New Classical world or extensions of Blanchard and Kiyotaki’s (1987) world of monopolistic competition, the economy will eventually find back to full employment even when a passive central bank does not react to a negative demand shock: In these models, aggregate demand is a function of real money balances. Any shortfall of aggregate demand below aggregate supply eventually leads to a fall in prices, which in turn increases real money balances. These increased real balances push up aggregate demand until equilibrium is again reached. While deviation of aggregate demand from aggregate (equilibrium) supply is possible in the short term, it is not possible in the long term.²

When those models are extended by monopoly unions, those unions have responsibility for unemployment. It is their monopoly power which pushes wages above what would be a full employment wage. By restraining wage demands, they can lower real wages, thus making employing an additional unit of labour at the margin more profitable which in turn leads to higher employment. For the unions, there is thus a pay-off between high real wages and high employment. Consequently, it is the central bank which is responsible for price stability while the unions can be blamed if full employment is not reached.

²In this respect, newer models like Clarida, Gali, and Gertler (1999) or Romer (1999, 2000) differ from the older textbook models. As in these models, real balance effects do not exist, the central bank has to be actively stabilising the economy in order to keep it from spiraling into accelerating inflation or deflation.
tion of responsibilities is further elaborated in recent contributions following the seminal work of Hall and Franzese (1998). Soskice and Iversen (2000) and Coricelli, Cukierman, and Dalmazzo (2000) (SICCD thereafter) construct a model of monopolistic competition in which unions consciously make use of the possibility to trade wage restraint for higher employment. Aggregate demand in those models again is a function of real money balances. When faced with a non-accommodating central bank which does not try to influence employment, but keeps the nominal money supply at a given level, the unions can increase aggregate demand and thus employment by wage restraint. With lower wage demands,\(^3\) the price level falls, thus increasing real money balances. Those higher real money balances translate into higher aggregate demand, output and employment.

3 The Case for Dropping Real Balances from the Demand Function

Central to both the notion of an economy finding back to equilibrium by itself as well as the notion of unions being able to increase aggregate demand by their wage demands is the assumption of aggregate demand being a function of real money balances. However, while the assumption of a relevant real balance effect is element of many textbook macroeconomic models,\(^4\) its theoretical foundations are highly problematic.\(^5\)

\(^3\)In fact, Soskice and Iversen (2000) build closely on Blanchard and Kiyotaki (1987) so that workers also produce. Therefore, their products’ sales price equals their wage. Coricelli, Cukierman, and Dalmazzo (2000) model firms which maximise their profits and hire workers according to their maximisation result.

\(^4\)It should be noted that some very recent contribution such as Romer (1999), Romer (2000) or Clarida, Galí, and Gertler (1999) completely drop the real balance effect as mechanism of monetary policy transmission. See below.

\(^5\)For more on the discussion of the possible relevance of real balance effects, see Dullien (2003, Chapter 3).
In standard models such as AS-AD or the New Classical approaches, real balances influence aggregate demand via two channels: First, as real balances are part of the private sector’s net wealth, and consumption is a function of net wealth, consumption increases with increasing real balances (Pigou effect). Second, when individuals suddenly face higher real balances than they would hold in equilibrium, they start reallocating their assets. They will start buying bonds against their money holdings which will drive down the interest rate. Lower interest rates then translate into higher investment demand (Keynes effect).

Thus for the Pigou effect to work, money needs to be net wealth for the private sector. For the Keynes effect to work, the money supply has to be set exogeneously. Both assumptions are questionable on empirical and theoretical terms. In the Euro area, money comes into circulation by banks borrowing money from the European Central Bank to lend it out to their clients. An increased money stock always comes with equivalently increased liability of some private party. In consequence, with changes in the price level the net wealth position of the private sector remains unchanged: As the money stock is backed by the same amount of private sector liabilities to the central bank, private sectors debt increases at the same time and by the same amount as does gross private sector wealth. Thus, private net wealth does not change with changes in the price level.

As a counter-argument, one could argue that at least a small share of money circulating in the Euro area is in fact backed by government debt⁶ and that this part could be seen as net wealth for the private sector. But, even for money backed by government debt, it is questionable if a Pigou effect can be at work: If Ricardian equivalence holds and thus the private sector does not get richer when the stock of government debt rises, also a fall in the price level would not increase the net wealth from this part of the money stock: The real value of government

⁶This stock mostly dates from the time before the beginning of European Monetary Union.
debt outstanding would rise exactly by the same amount the real value of money in the individuals’ portfolios increases. The net effect would be zero.

The fact that money comes into existence when commercial banks borrow from the central bank also calls into question the notion of a Keynes effect when prices change. In standard textbook models, the real value of money available for credit in the economy increases with a falling price level. However, as in reality the money stock is not exogeneously fixed, and money is created as a reflex to credit demand, one can assume that the money stock moves proportionally with the price level: As households and firms need credits in order to conduct real investment or to consume more in real terms, they will demand accordingly less credit when prices are falling (Betz 2001, p. 58ff). For those firms and households who are credit constrained, it is the banking sector who will change their nominal credit volume with a changing price level. With all prices decreasing, also future nominal household or firm earnings will decrease. The banks will lower their nominal credit ceilings. The opposite is true for rising prices. As expected future nominal cash-flows increase, credit ceilings are raised. As neither banks nor firms live under money illusion, the real credit constraint does not change when the price level changes.

These problems with real balance effects have led to a recent trend away from models which rely on the real balance effect as a mechanism of monetary policy transmission. Romer (1999, 2000) as well as modern literature on the efficiency of monetary policy rules building on New Keynesian models as presented in Clarida, Gali, and Gertler (1999) use the short term (real) interest rate as the way monetary policy affects the real economy and drop real balances completely from the picture. This path will also be followed by the model presented in this paper.
4 A Baseline Model without Real Balances

The model used in this paper builds on the formulation of Dixit and Stiglitz (1977), Blanchard and Fischer (1989, chapter 8) and Blanchard and Kiyotaki (1987) as also used by Soskice and Iversen (2000) and Coricelli, Cukierman, and Dalmazzo (2000). Especially the derivation of the demand function a single firm faces for its products remains essential the same as in Blanchard and Fischer (1989, chapter 8) or in the preceding work of Dixit and Stiglitz (1977). Instead of having worker-producers who directly provide the economy with their products as in the early Blanchard-contributions, a profit maximising firm is modelled following Coricelli, Cukierman, and Dalmazzo (2000). Consequently, there is not only a price for the single product sold (which would the worker-producer receive), but also an explicit nominal wage paid to workers employed by the single firms.

What is different from these standard models, however, is the introduction of a capital stock and a different formulation of aggregate demand. While in the standard models of monopolistic competition, only labour enters as input into the production function, the single firm in my model chooses both capital and labour employed. Moreover, while in the original formulations, aggregate demand depends on real balances $\frac{M}{P}$, the model presented here does not incorporate this chain of causation. Monetary policy thus does not work by changing the money supply $M$, but by setting the rate of interest. This rate of interest then leads firms to change their decision about capital input which leads to a higher capital stock on the supply side and to higher investment demand on the demand side.\footnote{In equilibrium, investment demand changes with the capital stock as more replacement investment is necessary. In disequilibrium, changes in the equilibrium capital stock lead to changes in net investment.}

The economy is composed of $n$ monopolistically competitive firms each producing a good $i$ given a simple Cobb-Douglas-production function. Labour $N_i$
and capital $K_i$ are the two input factors of firm $i$. In addition, some technological level $A$ also enters the production function as Hick-neutral technological progress:

$$y_i = AN_i^\alpha K_i^{1-\alpha}, \quad 0 < \alpha < 1$$ (1)

Each firm faces a (real) demand $y_i^D$ for its output being a function of the price of its good $P_i$, the price level $P$, the number of goods $n$ which are produced and thus enter in the individuals’ CES-utility function, the (absolute value of the) elasticity of demand facing the individual firm $\eta$ (which is also the constant elasticity of substitution in the CES-utility function)\(^9\) and the aggregate nominal demand $Y^D$ which will be specified more in detail later on:

$$y_i^D = \frac{1}{n} \left( \frac{P_i}{P} \right)^{-\eta} Y^D$$ (2)

As standard in models of monopolistic competition, for a stable equilibrium to exist, $\eta > 1$ must hold (Blanchard and Fischer 1989, p. 377). The aggregate price level is given by:

$$P = \left( \frac{1}{n} \sum_{j=1}^{n} P_j^{(1-\eta)} \right)^{\frac{1}{1-\eta}} = \left( \frac{1}{n} \sum_{j=1}^{n} P_j^{(1-\eta)} \right)^{\frac{1}{1-\eta}}$$ (3)

For the long run equilibrium, each firm choses its capital stock and its employment per unit of output so that unit costs $uc_i$ are minimized given the capital costs (interest rate $i^K$ it has to pay on the nominal capital employed\(^10\) plus the technical rate of depreciation $\delta^{11}$) and the wage $W_i$ the single firm has to pay:

\(^8\)Blanchard and Fischer (1989, p. 376ff) show how to derive this demand function from the consumers’ maximisation decisions. See also Dixit and Stiglitz (1977) or Blanchard and Kyotori (1987).

\(^9\)Note that all firms are faced with the same elasticity of demand $\eta$.

\(^10\)Alternatively, this interest rate might represent the opportunity costs for not investing in some financial market asset.

\(^11\)Again, for making the system solvable, the rate of depreciation is assumed to be constant.
\[
\min_{K_i, N_i} uc_i = W_i \left( \frac{N_i}{y_i} \right) + P \left( \delta + i^K \right) \left( \frac{K_i}{y_i} \right)
\]  
(4)

For simplicity, it is assumed that the central bank can set the interest rate \( i^K \).

Using (1) as a constraint, (4) yields capital and labour employed in equilibrium per unit of output produced:\(^\text{12}\)

\[
\frac{K_i^*}{y_i} = \frac{1}{A} \left( \frac{W_i}{P} \right)^\alpha \frac{(1 - \alpha)^\alpha}{(\delta + i^K)^{\alpha \alpha} \alpha^\alpha}
\]  
(5)

\[
\frac{N_i^*}{y_i} = \frac{1}{A} \left( \frac{P}{W_i} \right)^{1 - \alpha} \frac{(\delta + i^K)^{1 - \alpha} \alpha^{1 - \alpha}}{(1 - \alpha)^{1 - \alpha}}
\]  
(6)

Equilibrium unit costs \( uc_i^* \) are given by:

\[
uc_i^* = W_i \left( \frac{N_i^*}{y_i} \right) + P \left( \delta + i^K \right) \left( \frac{K_i^*}{y_i} \right)
\]  
(7)

\[
= W_i \frac{1}{A} \left( \frac{P}{W_i} \right)^{1 - \alpha} \frac{(\delta + i^K)^{1 - \alpha} \alpha^{1 - \alpha}}{(1 - \alpha)^{1 - \alpha}} + P \frac{1}{A} \left( \frac{W_i}{P} \right)^\alpha \frac{(\delta + i^K)^{1 - \alpha} (1 - \alpha)^\alpha}{\alpha^\alpha}
\]  
(8)

\[
= \frac{1}{A} P^{1 - \alpha} W_i^\alpha \frac{(\delta + i)^{1 - \alpha}}{\alpha^\alpha (1 - \alpha)^{1 - \alpha}}
\]  
(9)

Given the unit costs in this cost minimum equilibrium, the single firm in a second stage maximises its profits \( \Pi_i \) by choosing the price for its product \( P_i \) given the general price level and the demand function it faces. The firm then produces as much as is demanded for the price it asks:

\[
\max_{P_i} \Pi_i = [P_i - uc_i^*] y_i^D
\]  
(10)

\[
= [P_i - uc_i^*] \frac{1}{n} \left( \frac{P_i}{P} \right)^{-\eta} Y_i^D
\]  
(11)

\(^{12}\)Details about the mathematics can be found in appendix A.
Maximizing yields:

\[ P_i^* = \frac{-\eta}{(1 - \eta) u c_i^*} \quad (12) \]

When all firms are faced with the same wage level \( W \) and the same technological conditions (expressed in a similar total factor productivity \( A \) and similar share of labour in the Cobb-Douglas production function \( \alpha \) among all firms), all prices \( P_i \) are necessarily identical. We can thus solve for all prices and the general equilibrium price level \( P^* \) by substituting (6) and (5) as unit costs (7) into (12):

\[ P^* = P_1 = ... = P_n = A^{-\frac{1}{A^*}} \left( \frac{-\eta}{1 - \eta} \right)^{\frac{1}{A^*}} \left( \frac{\delta + i K}{\alpha (1 - \alpha)^{\frac{1}{A^*}}} \right) W \quad (13) \]

Thus, the price level is proportional to the nominal wage level. The assumption of a uniform wage level is not as restrictive as it seems at first sight: A uniform wage level would either be the result of a monopoly trade union bargaining for wages in the whole economy or of a completely flexible (that is atomistic and friction-free) labour market in which free movement of labour would guarantee that wages in a single firm do not deviate from the market wage \( W \).

With all prices being identical, (2) simplifies to:

\[ y_i^D = \frac{1}{n} \frac{Y_D}{P} \quad (14) \]

Equilibrium capital \( K_i^* \) and labour \( N_i^* \) employed in each firm is given by multiplying capital (5) and labour (6) per unit of output by the firm’s actual production (14):

\[ ^{13}\text{For computational details, see the appendix. This price level can be interpreted in the tradition of Keynes (1930), Riese (1986) or Collignon (1999, 2002) as an interest rate related mark-up over wage costs.} \]

\[ ^{14}\text{It should be added that this model abstracts from different kinds of labour or different qualifications among workers.} \]
\[ K_i^* = \frac{1}{nA} \left( \frac{W}{P} \right) ^\alpha \frac{(1 - \alpha)^\alpha}{(\delta + \iota K)^\alpha \alpha^\alpha} \cdot \frac{Y^D}{P} \] 

\[ N_i^* = \frac{1}{nA} \left( \frac{P}{W} \right) ^{1 - \alpha} \left( \frac{\delta + \iota K}{\alpha^\alpha} \right) ^{1 - \alpha} \frac{Y^D}{(1 - \alpha)^{1 - \alpha} P} \] 

These results are not very startling yet: As standard also in neo-classical models, the higher real wages, the more capital and the less labour is employed per unit of output. The higher the rate of interest, the less capital and the more labour is employed per unit of output. The results also embody Keynes’s (1936, p. 135) notion of marginal efficiency of capital: The firm employs an additional unit of capital if the proceeds from selling the additional production are at least equal the cost of employing the additional unit of capital.\textsuperscript{15}

\subsection{4.1 Macroeconomic Aggregates}

Aggregating the firms’ capital stocks and employment and substituting (13), the aggregate equilibrium capital stock \( K^* \) and aggregate equilibrium employment level \( N^* \) are thus:

\[ K^* = \frac{1}{A} \left( \frac{W}{P} \right) ^\alpha \frac{(1 - \alpha)^\alpha}{(\delta + \iota K)^\alpha \alpha^\alpha} \frac{Y^D}{P} \] 

\[ = \left( \frac{1 - \eta}{-\eta} \right) \frac{1 - \alpha}{\delta + \iota K} \frac{Y^D}{P} \] 

\[ N^* = \frac{1}{A} \left( \frac{P}{W} \right) ^{1 - \alpha} \left( \frac{\delta + \iota K}{\alpha^\alpha} \right) ^{1 - \alpha} \frac{Y^D}{(1 - \alpha)^{1 - \alpha} P} \] 

\[ = \left( \frac{-\eta}{1 - \eta} \right) ^{1 - \alpha} \left( \frac{\delta + \iota K}{\alpha^\alpha} \right) ^{1 - \alpha} \frac{Y^D}{A^{1/\alpha} (1 - \alpha)^{1 - \alpha} P} \] 

\textsuperscript{15}Note that the proceeds from one additional unit are less than the sales price as for a firm facing monopolistic competition, the supply of an unit of production drives down not only the marginal price it gets for its goods, but also the price for all other units produced.
What is interesting here is that the nominal wage disappears from both capital stock and labour employed. The reason is that the price level (13) is itself proportional to the nominal wage level $W$, thus leaving the real wage being independent from the nominal wage.

So far, this result also holds when we use an aggregate demand function with real money supply $M/P$ as an argument. In this case (and with an exogenously set $M$), unions could actually increase employment by lowering their wage demands. Lower wages would translate into lower prices via (13) and higher real balances. As higher real balances then would lead to higher demand, employment and output would be higher than before. The direct link proclaimed in the models of Soskice and Iversen (2000) and Coricelli, Cukierman, and Dalmazzo (2000) from lower nominal wage demands to higher output when the central bank is not active, would still be intact.

However, as I have argued above, a significant real balance effect cannot be expected to work in the real world. Instead, one should include income flows from wages and profits as well as investments derived from the firms’ individual decisions into the aggregate demand function. The part of consumption which depends on income is modelled as a constant share $c$ of the wage bill.\textsuperscript{16} Investment demand is derived from the fact that firms maximise their profits by varying labour and capital input and thus production of their product. Given the demand conditions, firms will aim at some equilibrium capital stock. For given demand conditions and given nominal wages, firms will employ more capital the lower the interest rate $i_K$. As soon as they have attained this capital stock, they will only

\textsuperscript{16}The basic results do not rely on the assumption that in this model all profits are saved and only part of the wage bill is consumed. One could easily solve the model for the classical saving hypothesis, thus setting $c$ to 1. In this case, the multipliers would just get a little larger. Just the same, it is straightforward to assume that also profits are to a certain extent consumed. As is shown in the appendix, the multiplier in this case gets a little more complicated, but output and employment still are not functions of the nominal wage level.
invest exactly the amount necessary to replace depleted capital stock. In equilibrium, investment demand is thus exactly equal to the depreciation on the capital stock employed.\textsuperscript{17} In situations in which the equilibrium is not yet reached, there is also some net investment bridging a share $\xi$ between the actual capital stock $K$ and the desired equilibrium capital stock $K^*$.\textsuperscript{18} Real capital demand is thus a function of the interest rate $i^K$ which is set by the central bank. As capital is a real variable, to deduct nominal demand, we have to multiply investment demand by the price level $P$.\textsuperscript{19} Finally, we will allow for one further autonomous\textsuperscript{20} real demand component $y_0^D$ which could either be government demand or autonomous consumption demand:

$$Y^D = cNW + \xi P (K^* - K) + \delta PK + Py_0^D \quad (21)$$

For the equilibrium case $K = K^*$, this simplifies to:

$$Y^D = cNW + \delta PK^* + Py_0^D \quad (22)$$

Substituting (21) into (20) yields an equilibrium aggregate real output for the whole economy as well as an equilibrium aggregate employment being independent from the nominal wage level:

$$y^* = \frac{-\eta}{\eta + (\eta - 1) \left(c\alpha + \frac{\delta(1 - \alpha)}{(\delta + i^K)}\right)} y_0^D \quad (23)$$

$$N^* = \left(\frac{-\eta}{1 - \eta}\right)^{\frac{1 - \alpha}{\alpha}} \frac{-\eta \left(i + i^K\right)^{\frac{1 - \alpha}{\alpha}}}{A^{\frac{1}{\alpha}} (1 - \alpha)} \left[-\eta + (\eta - 1) \left(c\alpha + \frac{\delta(1 - \alpha)}{(\delta + i^K)}\right)\right] y_0^D \quad (24)$$

\textsuperscript{17}This model abstracts from steady state growth and thus from autonomous investment.

\textsuperscript{18}The fact that firms do not invest at once as to meet there desired capital stock can be explained either by technical factors limiting the amount of capital adjustment possible in one period or by adjustment costs. See Romer (1996, p. 348ff).

\textsuperscript{19}In this model, it is assumed that one unit of investment has the same composition of the single firms' products as one unit of consumption.

\textsuperscript{20}Not being a function of current income.
Both output and employment are proportional to autonomous demand. However, the respective multipliers differ both in form and in the way they depend on other parameters. While output clearly increases with lower interest rates, the employment effect of a change in interest rates is ambiguous due to the fact that a substitution between capital and labour takes place depending on the level of nominal interest rates $i^K$. This mechanism will be covered more in detail in section 4.2.

Dividing aggregate output (23) by labour employed (24), we get for labour productivity $\lambda$:

$$\lambda = A^\frac{1}{\alpha} \left( \frac{1-\eta}{-\eta} \right)^{\frac{1-\alpha}{\alpha}} \frac{(1-\alpha)^{\frac{1-\alpha}{\alpha}}}{(\delta + i^K)^{\frac{1-\alpha}{\alpha}}}$$

(25)

These three terms can be interpreted as follows: The first term represents the technological progress component. With increasing total factor productivity, labour productivity increases by its share in the production function. The second term is a competition term. The larger the degree of monopoly power of the single firm (and thus the smaller $\eta$)\textsuperscript{21}, the larger is the mark-up of goods over labour costs. As the prices of capital goods move with the prices of all goods, this larger mark-up leads to higher prices of capital relative to labour. The more expensive capital, the less is used in the production process relative to the labour input. Consequently, the higher the monopoly power, the less capital-intensive will be produced and the lower will thus be labour productivity. Finally, the last term is a capital employment term. The higher the cost of capital, the smaller the capital stock employed and the less productive each unit of labour.

The real wage per unit of labour employed is given by:

$$w = \frac{W}{P} = \alpha A^\frac{1}{\alpha} \left( \frac{1-\eta}{-\eta} \right)^{\frac{1}{\alpha}} \frac{(1-\alpha)^{\frac{1-\alpha}{\alpha}}}{(\delta + i^K)^{\frac{1-\alpha}{\alpha}}}$$

(26)

\textsuperscript{21}Remember that $\eta > 1$. 

16
\[
= \alpha \left( \frac{1 - \eta}{-\eta} \right) \lambda
\]

Thus, as can be expected, the real wage depends on the productivity of labour \( \lambda \). However, it also depends on the weight labour has in the production function and on the degree of monopolization in the economy. If firms have high monopoly power (and \( \eta \) is thus low), workers receive a smaller share of their labour productivity in wages.

Profits per unit of production are given by:

\[
\frac{\Pi^*}{P_y} = 1 - \frac{1 - \eta}{\eta} \left( \alpha + \delta \frac{1 - \alpha}{\delta + iK} \right)
\]

And aggregate real profits (including both capital rent and entrepreneurs’ profits) by:

\[
\Pi^* = \left( 1 - \frac{1 - \eta}{\eta} \left( \alpha + \delta \frac{1 - \alpha}{\delta + iK} \right) \right) \frac{-\eta}{-\eta + (\eta - 1) \left( \alpha + \frac{\delta(1-\alpha)}{(\delta+\kappa)} \right)} \delta D
\]

### 4.2 Interpretation

These results which are again summarised in table 1 are quite interesting: First, it has to be noted that the price level (13) is proportional to the wage level. In addition, the price level is a positive function in the nominal interest rate. **The higher interest rates, the higher are also prices.** This conclusion might at first be startling (as higher interest rates are used by central banks to fight inflation), but is only a result of the fact that higher interest rates in this model translates into higher capital costs for the single firm.\(^{22}\) Additionally, the higher

\(^{22}\)This is much in line with the recent findings of Barth and Ramey (2001) who proclaim a cost-channel of monetary policy transmission. It does not however yet explain the Sims (1992) effect: Sims had found that empirically, an interest rate hike even led to rising prices in the very short term which only fall thereafter. The mechanism explained in this section cannot explain this behaviour as it looks at the long run equilibrium price level. However, the reaction
the elasticity of substitution between different products, the lower the price level. As the elasticity of substitution can be interpreted as the inverse degree of the firms’ monopoly power (Blanchard and Giavazzi 2000, p. 10ff), this is easily explainable: The higher the degree of monopoly power, the higher monopoly profits the higher thus the mark-up over wage and capital costs.

Second, output and employment are not functions of the nominal wage level. Variations in the wage level therefore do not have any influence on the level of output or employment. Instead, both output and employment are functions of the parameters concerning the technological production function, the technological progress and the elasticity of substitution of the single goods (which can be interpreted as some measure of monopoly power), the interest rate, the rate of depreciation and autonomous demand. Employment is proportional to output and, in addition to being a function of output, itself a function of the degree of monopolisation as well as the capital costs. The higher the capital costs, the more labour is used to produce a single unit of output and the less capital is used. Thus, with higher interest rates, production becomes more labour intensive. Just the same, the higher the degree of monopoly power, the less efficient the production which takes place. Consequently, employment per unit produced is a positive function of $\eta$.

However, this increased employment per unit produced stands against the fact that overall output is reduced when interest rates are higher as well as with

---

Sims describes could be explained by the dynamics of the model which are further elaborated in Dullien (2003): If demand shows a certain inertia and only reacts with a delay while the firms’ input costs react as one, it is plausible that an interest rate hike leads to an increased price level, before demand depresses prices again and pushes the disequilibrium price level down. This reaction is also in line with what Collignon (2002, p. 184ff) predicts for an economy in which interest rates on credit contracts are changed every time market interest rates change (spot market economy).

Details on the determination of the sign of the multipliers as well as proofs for the relationships stated here can be found in the mathematical appendix to this chapter.
a higher degree of monopoly power. Higher interest rates translate into a lower aggregate capital stock and thus lower investment demand. A higher degree of monopolisation lowers real wages and thus the workers’ consumption demand.

In this world, unemployment could persist, even if there was a completely competitive labour market: As it is the nominal wage level which is contracted in the labour market, excess unemployment in a setting with completely flexible wages would only put downward pressure on nominal wages and prices, but would not lead to a return to some (however defined) full employment equilibrium.

Third, real wages and real profits are independent from nominal wages. Instead, they are a function of the technological parameters $A$, $\delta$ and $\alpha$, the monopoly power $\eta$ and the interest rate. For the real wage and the profit per unit of production, the influence is as expected: a higher weight of labour in the production function increases real wages and decreases real profits per unit of production. A higher degree of monopoly power increases profits per unit and decreases real wages. Higher interest rates translate into lower real wages and higher unit profits. For aggregate profits, things get more complicated. As a higher monopoly power leads to less demand via the demand multiplier in (23), the effect of higher unit profits is countered by a volume effect dampening aggregate production. However, the overall effect of higher monopoly power on aggregate profits remains positive.

Fourth, as the interest rate influences the amount of capital employed, both supply and demand of goods rise with lower interest rates: With a larger capital stock per worker, productivity and output per head are higher. At the same time, a higher capital stock needs higher equilibrium (gross) investments to sustain, thus increasing aggregate demand. Lower interest rates thus lead to
higher output in this setting.

Real output (23):

\[
y^* = \frac{-\eta}{-\eta + (\eta - 1) \left( \alpha + \frac{\delta (1 - \alpha)}{(\delta + i^K)} \right)} y_0^D
\]

Employment (24):

\[
N^* = \frac{1}{A} \left( \frac{P}{W} \right)^{1-\alpha} \frac{\left( \delta + i^K \right)^{1-\alpha} \alpha^{1-\alpha}}{(1-\alpha)^{1-\alpha}} y^*
\]

\[
= \left( \frac{-\eta}{1-\eta} \right)^{1-\alpha} \frac{-\eta (\delta + i^K)^{1-\alpha}}{A \left(1-\alpha\right)^{1-\alpha} \left(\alpha + \frac{\delta (1-\alpha)}{(\delta + i^K)} \right)} y_0^D
\]

Price level (13):

\[
P^* = A^{\delta (1-\alpha)} \left( \frac{-\eta}{1-\eta} \right)^{1-\alpha} \frac{\left( \delta + i^K \right)^{1-\alpha}}{\alpha (1-\alpha)^{1-\alpha}} W
\]

Productivity (25):

\[
\lambda = A^{\frac{\delta}{\alpha}} \left( \frac{1-\eta}{\eta} \right)^{\frac{1-\alpha}{\alpha}} \frac{(1-\alpha)^{1-\alpha}}{(\delta + i^K)^{1-\alpha}}
\]

Real wage (27):

\[
\varpi = \alpha \left( \frac{1-\eta}{\eta} \right) \lambda
\]

Aggregate real profits (29):

\[
\Pi^* = \left( 1 - \frac{1-\eta}{\eta} \left( \alpha + \delta \frac{1-\alpha}{(\delta + i^K)} \right) \right) y^*
\]

Variables used:

- \( A \): Technological progress
- \( \alpha \): Capital coefficient in Cobb-Douglas production function
- \( c \): Consumption share
- \( \eta \): Elasticity of substitution between different goods
- \( \delta \): Technological rate of depreciation
- \( i^K \): Interest rate to be paid by firms
- \( \lambda \): Labour productivity
- \( N^* \): Aggregate Employment
Table 1: Macroeconomic Variables in the Baseline model

The fact that some kind of substitution between labour and capital takes place at the firm level leads to somewhat ambiguous results as how changes in the interest rate translate into changes in employment as two effects with different signs appear. On the one hand, lower interest rates lead to a substitution of labour against capital on the firm level. At the same time, demand increases as real wages increase and the equilibrium capital stock per unit of output gets bigger, thus leading to a higher investment demand. At low interest rates, the demand effect is larger than the substitution effect. At very high interest rates, on the other hand, the capital stock is already very low. A variation here does not bring much variation in the demand of investment goods to replace depreciated capital. Here, the substitution effect is bigger than the income effect, lower interest rates here would lead to lower employment.

Differentiating (24) with respect of the interest rate $i^K$ and solving shows that the employment effect of lower interest rates is positive as long as

$$i^K < \frac{\delta ((\eta - 1) \, c \, \alpha - 1)}{\eta - \eta \, c \, \alpha + c \, \alpha}$$

(30)

holds. Unfortunately, the interpretation of this term is not trivial. Partial differentiation shows that the right hand term is a positive function in $\alpha, c, \eta$ and $\delta$. This can be explained as with an increase in any of these parameters, the amount by which an additional unit of capital employed increases aggregate demand in-
creases: With less monopoly power, real wages are higher, thus consumption increases more strongly when employment raises. The same is valid for $\alpha$: With a higher weight of labour in the production function, the effect of an increase in aggregate demand on the real wage bill and thus on aggregate consumption is higher. For $c$ and $\delta$ the argument is that higher parameter values lead to a higher increase in aggregate demand for any given increase in the capital stock.

However, for a wide range of plausible parameter values, the interest rates observed in the real world are clearly in the range in which an increase in interest rates would lead to a fall in employment: Assuming that $\eta$ is in the range of 20, $\alpha$ around 0.7, $\delta$ around 0.2, interest rate increases up to roughly 20 percent would lead to a decrease in equilibrium employment. For the rest of this paper, I will thus assume that the parameters are in a range such that a cut in interest rates actually also leads to an increase in employment.

The conclusions that employment and output are independent from the general wage level would explain why unit labour cost increases below inflation and target inflation in Italy, France or Germany during parts of the 90s did not lead to a significant increase in employment. In a closed economy as depicted in this model, cutting nominal wages does not create employment as aggregate demand falls with falling costs and firms are not able to demand the same prices for their products as they used to before the change in wages.

This is a conclusion completely at odds with macroeconomic textbook models: While it is usually not disputed that a cut in wages also diminishes the workers’ consumption demand, real money balances in standard models do the trick to increase aggregate demand when wages are falling. Lower wages and prices lead then to an increase in private wealth which translates either in higher consump-

\footnote{This combination between $\alpha$ and $\eta$ would mean that although the weight of labour in the production function is 0.7, an often assumed value (Romer 1996, p. 22), labour would only earn roughly 65 percent of the production.}
tion demand (via the Pigou effect) or into higher investment demand (via the Keynes effect).

In the model presented here, real balance effects do not exist. A cut in nominal wages thus dampens directly and proportionally nominal demand. As all firms are faced with both lower costs and a shifted nominal demand curve, they cut their prices until their profit maximum is reached. In this new equilibrium, real variables have not changed. Only prices have adjusted.

5 The Labour Market and Wage Dynamics

So far, we have not analysed wage setting in detail. In the section above, it was just stated that both in a highly competitive labour market and in a labour market with a centralised wage setting, the wage level \( W \) would be uniform across firms. However, as we know from equation (13), even though the nominal wage level \( W \) does not influence output and employment, nominal wage dynamics are central for understanding inflation dynamics. This section will therefore try to explain how wages develop in a world without the real balance effect. To this end, I will first take a look on a situation in which a perfect neo-classical labour market exists. In a second step, I will show how a setting with a single large, strategically acting wage setter changes the picture.

5.1 Theoretical Considerations: A Neo-classical Labour Market

In a standard neo-classical or textbook atomistic labour market, there is a natural rate of unemployment or more precisely the non-accelerating-inflation-rate of unemployment (NAIRU). Whenever actual unemployment rises above the NAIRU, labour supply is bigger than demand for labour. Consequently, nominal wage increases start to moderate. When actual unemployment falls below the NAIRU,
excess demand for labour triggers rising nominal wage increases (Romer (1996, p. 225ff) or Blanchard and Fischer (1989, p. 544)). Figure 1 illustrates this concept. Unemployment below $U_{NAIRU}$ leads to accelerating wage increases, unemployment below $U_{NAIRU}$ to decelerating wage increases.\footnote{I am well aware of all the methodological problems of the NAIRU-concept as described in Galbraith (1997) and other contributions of the Winter 1997 issue of the Journal of Economic Perspectives or which have recently been voiced by Beyer and Farmer (2002). By using the NAIRU here, I do not want to adhere to this concept, but rather illustrate the difference in working of an idealistic atomistic labour market and a labour market with a large, strategically acting wage setter.}

Adding such a labour market to the model presented in this paper would not change any of the conclusions from the last section. However, such a labour market would provide significant instability to the system. As falling nominal wages do not help to bring unemployment back to $U_{NAIRU}$, any shortfall in demand would finally turn into a deflationary spiral. Such a system would not show any tendency to stabilise itself. Instead, monetary and fiscal policy would have to take on an active role and keep aggregate demand exactly at the point where unemployment equals the NAIRU. In such a system, conclusions would be very
similar to those of the reduced form models of Clarida, Gali, and Gertler (1999).

It is interesting to note that in such a system increased rigidities in the labour market can help to stabilise the system. The quicker the overall wage level reacts to deviations of aggregate demand from the level at which unemployment equals the NAIRU, the easier might the system experience high inflation or deflation. However, the speed with which wages adjust depends critically on labour market rigidities: The less frequent for example wage readjustments, the smaller the danger of the system spiraling into deflation or inflation.

5.2 A Monopoly Union

The picture changes completely when there is a monopoly trade union setting wages for the whole economy. In standard theory, there would still be a single point NAIRU with a monopoly union. By pushing for higher nominal wages, the union could influence real wages and unemployment (Burda and Wyplosz 1997, p. 150). The case why a union cares about its members real wages is clear-cut. Real wages translate into union members’ higher personal incomes and thus higher utility. There are several reasons why a union might also care about unemployment. First, in countries with developed unemployment or welfare systems, there are costs associated with higher unemployment. If these costs are financed either by general or payroll taxes, unions have an interest in keeping them low. Second, as Blanchard and Summers (1987) note, a fall in employment might also lead to a fall in union membership. Union leaders should fear such a development as they would lose power and revenue. Third, higher unemployment increases the union members’ fear to get unemployed. This fear lowers their respective utility and they can be expected to push their leaders into caring about unemployment as well.

A rational monopoly union would thus take into account if its wage demands
increase unemployment and chose an optimum level of unemployment and real wages. According to standard theory, the union would use its monopoly power to push for somewhat higher wages than in the atomistic labour market case, accepting unemployment above the NAIRU in an atomistic labour market. However, if aggregate demand would lead to unemployment rising above that threshold, it would be rational for the union to take back its wage demands to get unemployment back to that optimum. If increased aggregate demand would push unemployment below that point, the union would increase wage demands to find its optimum.

In this paper’s model, however, the wage level set by centralised wage bargaining $W$ does not influence employment or the real wage. Different from the argumentation in the models of Soskice and Iversen (2000) and Coricelli, Cukierman, and Dalmazzo (2000), there is thus no reason for unions restraining their wage demands in order to increase employment. At the same time, there is no reason for unions to push for generally higher nominal wages to improve their real wage position. Thus, the monopoly union should be completely indifferent to the nominal wage level. As long as wage bargaining structures (and thus the union’s monopoly to bargain for wages) remain stable, there are multiple equilibria of stable wage inflation and unemployment: Price stability is thus compatible with a wide range of unemployment.

This does not necessarily mean that stable prices are compatible with every level of unemployment. From a certain unemployment rate downwards, there might be real shortages in the labour market. A single firm looking for workers might just offer them higher wages or non-monetary benefits in order to lure them into its factories. The rate of wage increases would accelerate.

Similarly, from a certain rate of unemployment upwards, it could be hard to
Figure 2: Wage increases and unemployment in a world with a large wage setter uphold union monopoly power. A small union bargaining wages for a single firm or even a small group of firms is able to increase employment in its constituency at the expense of the rest of the economy by cutting its nominal (and given that the price level is determined by the average wage its real) wage. If unemployment gets too pressing, there is the danger that unemployed try to price themselves back into the market via this mechanism. Monopolised wage bargaining would break down. Thus, from a certain point of unemployment upwards, wage increases would decelerate.

Figure 2 illustrates this argument: In the range between $U_1$ and $U_2$, there are multiple equilibria for stable wage inflation. If unemployment falls below $U_1$, labour market shortages lead to rising nominal wage pressure. If unemployment raises above $U_2$, centralised wage setting structures might endogenously break up. However, as nominal wages do not change anything in aggregate employment, this change in bargaining structures would not lower unemployment.

In a setting of highly coordinated wage bargaining, unions can be expected to behave similarly to monopoly unions. With the union setting the wage contract
closely followed by the rest of the economy knowing that changes in the nominal wage level do neither translate into real wage increases (neither for their members nor for the other unions’ members) nor into changes in employment, this single union will behave as a monopoly union.

5.3 Empirics: Euro area vs. the United States

For the Euro area, it can be argued that wage bargaining is implicitly quite co-ordinated, even if not centralised or formally co-ordinated. Soskice and Hancké (2002) argue that in the important core countries of EMU, wage setting has converged towards agreeing on wage increases in relation to the changes in relative competitiveness of main trading partners. Belgium has an explicit law to this extent. The Dutch unions have for a long time taken wage developments in Germany into account. According to Soskice and Hancké (2002), in France, a decentralised wage setting mechanism which is centered around a few large firms exposed to foreign competition acts de facto as a centralised wage setting taking into account the relative unit labour costs developments. As Germany is the biggest economy in EMU and especially important in the export of tradables goods, these mechanisms lead to an implicit co-ordinated wage setting for EMU in which the rest of EMU follows wage developments in Germany.

Wage bargaining in Germany, on the other hand, is traditionally highly co-ordinated, even if not highly centralised. A single union for some region (usually the metal workers’ union26) negotiates the first contract of a wage round. The other districts follow that contract, which then is closely followed by the rest of the economy with small corrections for the other sectors’ current and structural situation. If EMU wage bargaining is coordinated around German wage

26On some recent instances, the chemical workers have taken the lead from the metal workers.
Figure 3: Unit labour cost increases and unemployment in the US, 1994-2003

bargaining, it is in fact coordinated around the German pilot contract.27

Thus, the fact that EMU wage bargaining is significantly more coordinated than originally thought seems to be well established by now. Consequently, the NAIRU curve should be twisted as described above. When comparing the correlation of productivity-corrected wage increases and unemployment in the US and the euro-zone during the last decade, we can indeed see that empirics seem to confirm this notion. While for the US labour market, a linear approximation of the relationship between unemployment and unit labour cost increases gives the best fit (see figure 3), for the euro-zone, a polynomial of the degree 3 gives a better fit (see figure 4). It looks as if there indeed is a quite wide range of

27It should be noted here that even though the Soskice and Hancke (2002) hypothesis has gained supporters lately and is quite plausible, it is not yet proven that Euro area wage bargaining really takes place in this way. While it is quite evident that wage setting takes increasingly wages in neighbouring countries into account, it is not quite obvious which wage level (or change) EMU countries exactly relate to. As German unit labour costs developed very similarly to EMU-11 unit labour costs during the last years, even if the rest of core EMU would relate its wages to German wage developments, this cannot be for sure distinguished from a system in which they relate their wages to EMU-11 average wage developments.
unemployment in the Euro zone in which unit labour costs increase with a rate of between one and two percent which is around the European Central Bank’s implicit target range of inflation of 1.5 percent. Unfortunately, as this reasoning implies the assumption of a stable policy environment (as expressed in stable monetary policy target and broadly unaltered labour-market institutions), time series both for the euro zone as well as for the US are to short to use rigorous econometrical methods to test our hypothesis.

6 New Macroeconomic Responsibilities

So what does it mean for economic policy when there is a wide range of multiple equilibria with stable prices but different rates of unemployment? As the trade

[28] Until May 2003, the ECB’s target of keeping changes in consumer prices “below 2 percent” has been widely interpreted as an implicit inflation target of 1.5 percent. In May 2003, the ECB moved its target to “around 2 percent”.

[29] For the US one could only sensibly include the years after Reagan’s labour market reforms and after Volcker’s monetary policy experiments.
union is not able to influence employment with its nominal wage demands anymore, it cannot be made responsible for unemployment. However, as the price level is proportional to the wage level set by the trade union, unions are now responsible for stable prices.

At the same time, the responsibility for output and employment shifts to the central bank: Which of the points in the range $U_1$ to $U_2$ is reached depends on aggregate demand, which is influenced by the central bank’s interest rate. The central bank can opt for a low employment or high employment situation with stable prices. Thus, responsibilities between unions and central bank have switched compared to the standard textbook theory (see table 2).

However, it would be overly simplified to blame the Central Bank alone for unemployment. If we include short-run price rigidities into the above model, an increase in nominal wages would temporarily lead to real wage gains when nominal wages increase, even though the equilibrium real wage remains unchanged. In such a set-up, a monopoly union would have an incentive to push for higher nominal wage increases. The central bank’s task would then be to threaten that it would increase the interest rate and thereby decrease output and employment if the union should behave inflationary. Such a threat can be expected to work reasonably well as long as it is credible, as the trade union could only win tem-

<table>
<thead>
<tr>
<th>Wage Bargainers</th>
<th>Textbook Theory</th>
<th>This paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low real wages</td>
<td></td>
<td>Low nominal wage increases</td>
</tr>
<tr>
<td>$\Rightarrow$ High employment</td>
<td></td>
<td>$\Rightarrow$ Low inflation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Central Bank</th>
<th>Low growth in money supply</th>
<th>High aggregate demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Rightarrow$ Low inflation</td>
<td></td>
<td>$\Rightarrow$ High employment</td>
</tr>
</tbody>
</table>

Table 2: Responsibilities of macroeconomic actors
porarily, while the losses might be permanent. However, the central bank would have to be able to communicate this threat to the trade unions. While this communication seems to have worked reasonably well for the Bundesbank (Hall and Franzese 1998), it is unclear how it works in EMU. Let alone for political reasons, the ECB would scarcely admit that it targets German wages. Thus the political setup of EMU might at the moment contribute to the high EMU unemployment.

The ECB’s task is further complicated by the uncertainty about how wage bargaining works in EMU, especially in connection with the institutionalised macroeconomic responsibilities in EMU. The ECB has been given the primary objective of pursuing price stability. This is also the standard by which the public will judge the ECB’s work. If inflation would run strongly above 2 percent, the central bankers would be blamed for their failure. The blame for unemployment, on the other hand, does not fall to the same extent on the ECB as the standard textbook’s distribution of responsibilities between macroeconomic actors is ingrained in public conscience. Thus, it is only rational for risk averse central bankers to choose a point close to $U_2$ to be on the safe side.

Improved information exchange between wage bargainers and monetary policy makers as embodied in the EMU’s Macroeconomic Dialogue might help a little as it could alleviate the uncertainty and information asymmetry. However, as von Hagen and Mundschenk (2001) note, the wage bargainers in the Macroeconomic Dialogue themselves lack the possibility to enforce any possible commitment they make as independent national and regional unions finally make decisions on wage contracts. Thus, even the dialogue by itself is not very promising to alleviate unemployment in EMU.
7 Conclusion

This paper has shown that the textbook model’s distribution of macroeconomic responsibilities between wage bargainers and the central bank changes completely when the assumption of a relevant real balance effect is dropped and a monopoly union is introduced. While in standard models, the real balance effect guarantees that aggregate demand increases when wages and prices fall, in this paper’s model, such a stabilising effect does not occur. Falling nominal wages therefore only lead to falling prices, without altering real wages or employment. Thus, lower nominal wage demands by a monopoly union only lead to lower prices, but not to higher output. In this world, it is the central bank’s interest rate which influences (real) demand, output and inflation.

Consequently, unions by themselves cannot be made responsible for high unemployment in this model. At the same time, the central bank does not directly influence prices anymore. It can only influence inflation indirectly by threatening to increase higher interest rates and thus lower output and employment should wage bargainers act inflationary. High levels of unemployment must thus be interpreted not as a consequence of unions’ greed, but as the central bank’s reaction to uncertainty about the wage setting process and the actual dangers of inflationary wage increases.
References


A Mathematical appendix

The wage level $W$ is uniform across all firms.

A.1 The firms’ maximisation problem

Minimizing unit cost $uc_i$ by choosing the optimum combination of $k_i^*$ and $\frac{K_i}{y_i}$ under the constraint of (1) yields (5) and (6). Given this combination of labour and capital per unit of production, the firm $i$ maximises its profit:

$$\max_{P_i} \Pi_i = \left[ P_i - uc_i \right] y_i^D$$

$$= \left[ P_i - uc_i \right] \frac{1}{\eta} \left( \frac{P_i}{P} \right)^{-\eta} Y^D \quad (31)$$

$$\frac{\partial \Pi}{\partial P_i} = \alpha_i P_i^{-\eta} \frac{1}{P^{1-\eta}} Y^D - \alpha_i \eta \left[ P_i - uc_i \right] P_i^{-\eta} \frac{1}{P^{1-\eta}} Y^D$$

$$= \alpha_i \frac{1}{P^{1-\eta}} \left[ P_i^{-\eta} - \eta P_i^{-\eta} (P_i - uc_i) \right] = 0$$

$$\Leftrightarrow P_i^{-\eta} - \eta P_i^{-\eta} (P_i - uc_i) = 0 \quad (34)$$

$$\Leftrightarrow (1 - \eta) P_i^{-\eta} + \eta P_i^{-\eta} uc_i = 0 \quad (35)$$

$$\Leftrightarrow P_i = \frac{-\eta}{1-\eta} uc_i \quad (37)$$

$$= \frac{-\eta}{1-\eta} A P^{1-\alpha} W^\alpha (\delta + i)^{1-\alpha} \left( \frac{\alpha^{1-\alpha}}{(1-\alpha)^{1-\alpha} + (1-\alpha)^\alpha} + \frac{1}{\alpha^\alpha} \right)$$

$$\Leftrightarrow P_i = A^{1-\alpha} \left( \frac{-\eta}{1-\eta} \right)^{\frac{1}{\alpha}} (\delta + i)^{\frac{1-\alpha}{\alpha}} \frac{1}{\alpha (1-\alpha)^{1-\alpha} W} \quad (38)$$

For the symmetric case of $P = P_i$ this becomes:

$$P_i^\alpha = \frac{-\eta}{1-\eta} W^\alpha (\delta + i)^{1-\alpha} \left( \frac{\alpha^{1-\alpha}}{(1-\alpha)^{1-\alpha} + (1-\alpha)^\alpha} + \frac{1}{\alpha^\alpha} \right)$$

$$\Leftrightarrow P_i = A^{\frac{1}{1-\alpha}} \left( \frac{-\eta}{1-\eta} \right)^{\frac{1}{\alpha}} (\delta + i)^{\frac{1-\alpha}{\alpha}} \frac{1}{\alpha (1-\alpha)^{1-\alpha} W}$$

A.2 Aggregate Demand and Output I: Only Workers Consume

Assuming that all of the firms’ profits and all interest incomes are saved, we get for nominal aggregate demand $Y^D$, aggregate real demand $y^D$ and output $y$: 37
\[ Y^D = cN^*W + \delta PK^* + P_y^D \]  
\[ = cW \left( \frac{-\eta}{1-\eta} \right) \left( \delta + i^K \right)^{1-\beta} \frac{1}{\alpha} \frac{Y^D}{P} + \delta P \left( \frac{1-\eta}{-\eta} \right) \left( \frac{1-\alpha}{\delta + i^K} \right) \frac{1}{\alpha} \frac{Y^D}{P} + P_y^D \]  
\[ \Leftrightarrow Y^D = \frac{-\eta}{-\eta + (\eta - 1) \left( c\alpha + \frac{\delta(1-\alpha)}{(\delta + i^K)} \right)} P_y^D \]  
\[ \Leftrightarrow y^D = y^* = \frac{-\eta}{-\eta + (\eta - 1) \left( c\alpha + \frac{\delta(1-\alpha)}{(\delta + i^K)} \right)} y_0^D \]  

Substituting (44) into (20), yields total aggregate employment:

\[ N^* = \left( \frac{-\eta}{1-\eta} \right) \frac{1}{\alpha} \left( \frac{-\eta}{-\eta + (\eta - 1) \left[ c\alpha + \frac{\delta(1-\alpha)}{(\delta + i^K)} \right]} \right) y_0^D \]  

Differentiating with respect to \( i^K \) yields:

\[ \frac{\partial N^*}{\partial i^K} = \left( \frac{-\eta}{1-\eta} \right) \left( \frac{\delta (1-\eta)}{A^{1-\beta} (\delta + i^K)^2 (1-\alpha) \frac{1}{\alpha} \left( -\eta + (1-\eta) \left[ c\alpha + \frac{\delta(1-\alpha)}{(\delta + i^K)} \right] \right)^2} \right) \]

\[ - \frac{1}{\alpha (\delta + i^K) A^{1-\beta} (1-\alpha) \frac{1}{\alpha} \left( -\eta + (1-\eta) \left[ c\alpha + \frac{\delta(1-\alpha)}{(\delta + i^K)} \right] \right)} \]

which can be shown to be positive for positive \( i^K \) which fulfill

\[ i^K < \frac{\delta ((\eta - 1) c\alpha - 1)}{\eta - \eta c\alpha + c\alpha} \]  

Thus, in this range, a cut in interest rate leads to increased employment.

**A.3 Aggregate Demand and Output II: Entrepreneurs Consume**

By subtracting the firm’s wage costs and capital depreciation from its revenue, we get the profit for each firm (including interest payments):
\[ \Pi_i = P_i y_i^D - W N_i^* - \delta K_i^* \]
\[ = \alpha_i P_i \frac{Y^D}{P} - \alpha_i W \left( \frac{-\eta}{1-\eta} \right)^{\frac{1-\alpha}{\alpha}} \left( \frac{\delta + iK}{P} \right)^{\frac{1-\alpha}{\alpha}} Y^D \]
\[ - \alpha_i \delta \frac{1 - \eta}{-\eta} \left( \frac{1 - \alpha}{\delta + iK} \right) \frac{Y^D}{P} \]
\[ \Leftrightarrow \frac{\Pi_i}{P} = \alpha_i \left[ 1 - \frac{1 - \eta}{-\eta} \left( \alpha + \delta \frac{1 - \alpha}{\delta + iK} \right) \right] \frac{Y^D}{P} \]

Aggregating for the whole economy yields for aggregate profits (including interest costs):
\[ \Pi = \sum \Pi_i = \sum \alpha_i \left[ 1 - \frac{1 - \eta}{-\eta} \left( \alpha + \delta \frac{1 - \alpha}{\delta + iK} \right) \right] Y^D = \]
\[ \left[ 1 - \frac{1 - \eta}{-\eta} \left( \alpha + \delta \frac{1 - \alpha}{\delta + iK} \right) \right] Y^D \]

Assuming that rentiers and entrepreneurs consume a share \( c_\Pi \) of their income yields for aggregate demand \( Y^{D+} \) and output \( y^{t+} \):
\[ Y^{D+} = c N^* W + c_\Pi \left( 1 - \frac{1 - \eta}{-\eta} \left( \alpha + \delta \frac{1 - \alpha}{\delta + iK} \right) \right) Y^{D+} \]
\[ + \delta PK^* + P y_0^D \]
\[ = c W \left( \frac{-\eta}{1-\eta} \right) \frac{\left( \delta + iK \right)^{\frac{1-\alpha}{\alpha}}}{A^2 (1-\alpha)^{\frac{1-\alpha}{\alpha}} P} Y^{D+} + \]
\[ c_\Pi \left( 1 - \alpha \delta \frac{1 - \eta}{-\eta} \right) Y^{D+} \]
\[ + (1 - c_\Pi) \delta P \left( \frac{1 - \eta}{-\eta} \right) \frac{1 - \alpha}{\delta + iK} \frac{Y^{D+}}{P} + P y_0^D \]
\[ \Leftrightarrow \left( -\eta - (1 - \eta) \left[ c \alpha + (1 - c_\Pi) \delta \frac{1 - \alpha}{\delta + iK} \right] - c_\Pi (-\eta - \alpha \delta) \right) Y^{D+} = P y_0^D \]
\[ y^{t+} = \left( -\eta - (1 - \eta) \left[ c \alpha + (1 - c_\Pi) \delta \frac{1 - \alpha}{\delta + iK} \right] - c_\Pi (-\eta - \alpha \delta) \right) y_0^D \]
Thus, only the multiplier changes. The basic notion that changes in the nominal wage do not lead to changes in real output remains intact.

A.4 Return on Capital

Using (52), we can compute a real product yield per unit of capital employed:

\[
R = \frac{\Pi_{real}}{K^*} = \left(1 - \frac{1 - \eta}{-\eta} \left(\alpha + \delta \frac{1 - \alpha}{\delta + iK}\right)\right) \frac{y^*}{K^*}
\]

(58)

\[
= \left(1 - \frac{1 - \eta}{-\eta} \left(\alpha + \delta \frac{1 - \alpha}{\delta + iK}\right)\right) \left(\frac{-\eta}{1 - \eta}\right) \left(\frac{\delta + iK}{1 - \eta}\right)
\]

(59)

\[
= \left(\frac{-\eta}{1 - \eta} - \alpha\right) \left(\frac{\delta + iK}{1 - \eta}\right) - \delta
\]

(60)