Gradual Wage-Price Adjustments in Keynesian Macrodynamics. Evidence from the U.S. and the Euro Area*

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Abstract

In this paper we formulate a disequilibrium AS-AD model based on sticky wages and prices, perfect foresight of current inflation rates and adaptive expectations concerning the inflation climate in which the economy operates. The model consists of a wage and a price Phillips curve, a dynamic IS curve as well as a dynamic employment adjustment equation and a Taylor interest rate rule. Through instrumental variables GMM system estimation with aggregate time series data for the U.S. and the Eurozone economies, we obtain structural parameter estimates which support the specification of our theoretical model and show the importance of the inflationary climate, as well as of the Blanchard-Katz error correction terms, and indirectly of income distribution, for the dynamics of wage and price inflation in the U.S. and the Eurozone economies.

Keywords: AS-AD disequilibrium, wage and price Phillips curves, real wage adjustment, monetary policy
JEL CLASSIFICATION SYSTEM: **E24**, **E31**, **E32**.

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Contents

1 Introduction

With the introduction of the Euro as the single official currency of the Member States of the European Monetary Union (EMU) in 1999, a great currency area of similar dimensions as the U.S. economy was created. The economic size, nevertheless, is not the only feature that these two common currency areas have in common: The increased synchronization of the national business cycles of the EMU Member States, caused by the economic integration and the process of monetary and fiscal convergence determined by the Maastricht Treaty, the structure of the goods and labor markets, as well as the relative degree of closeness of these two economic systems are also important macroeconomic characteristics that both common currency areas share to a significant degree.

We investigate in this paper the dynamics of wage and price inflation, as well as their interaction with the real side of the economy at an aggregate, currency area wide level. We formulate for this purpose a semi-structural Keynesian macroeconomic model and estimate it with aggregate U.S. and Euro area time series data. Our theoretical framework builds, just as recent New Keynesian macrodynamic models, on gradual wage and price adjustments by employing two Phillips curves to relate factor utilization rates with wage and price dynamics, permitting in this way for non-clearing markets, underutilized labor and capital stock. It also resembles macromodels of New Keynesian type in that it includes elements of forward looking behavior, in combination with adaptively formed medium-run expectations concerning the inflation climate of the economy and cross-over expectations, with price inflation expectations in the wage Phillips curve and wage inflation expectations in the price Phillips curve. This formulation of the wage-price dynamics permits an interesting comparison to New Keynesian work that also allows for both gradual price and wage setting. Indeed, as discussed in Fuhrer and Moore (1995), Mankiw (2001) and more recently in Eller and Gordon (2003), empirical estimations of wage and price Phillips curves based on the New Keynesian approach developed after the work of Taylor (1980) and Calvo (1983) have had, despite their sound microfoundations, only a poor performance in fitting the predictions of the underlying theoretical models of this approach with actual aggregate time series of both the United States and the Euro area. As Mankiw (2001) states, "although the new Keynesian Phillips curves has many virtues, it also has one striking vice: It is completely at odd with the facts".

Moreover, concerning the IS-curve of our model, we make use of a law of motion for the rate of capacity utilization of firms that depends on the level of capacity utilization (the dynamic multiplier), on the real rate of interest and finally on the real wage and thus on income distribution. New Keynesian authors, for comparison, often use only a purely forward-looking IS-curve (with only the real interest rate effect). Since we distinguish between the rate of employment of the labor force and that of the capital stock, the rate of capacity utilization, we employ also as link between capacity utilization and employment an equation which can be considered a dynamic form of Okun's law. And lastly, in order to model the stabilizing role of monetary policy, we include a nominal interest rate equation of Taylor rule type.

Some of the questions to be addressed in this paper on this basis are: To what extent is our D(isequilibrium)AS-D(isequilibrium)AD model able to fit the behavior of wages, prices and other macroeconomic variables in the U.S. and the Eurozone economies? Are there significant differences in wage and price inflation (the wage-price spiral) in both economies observable over the past thirty years? Which ones and how strong are the main Keynesian transmission channels in the U.S. and the Eurozone economies? And what are the implications of the wage-price spiral for the dynamics of income distribution in both economies?

The remainder of the paper is organized as follows. In section 2 we briefly discuss a simplified Keynesian disequilibrium AS-AD model as introduced in Asada, Chen, Chiarella and Flaschel (2006) and highlight its main conceptual differences from to the New Keynesian approach. In section 3 we estimate this simplified model to find out sign and size restrictions for its behavioral equations and to study which type of feedback mechanisms may apply to the U.S. and Eurozone economies after World War II. Section 4 concludes.

2 Disequilibrium Dynamics: A Baseline Semi-Structural Keynesian Model

In this section we formulate a simplified Keynesian AS-AD model in the line of Chiarella, Flaschel and Franke (2005) and Asada et al. (2006). The core of this theoretical framework, which allows for non-clearing labor and goods markets and therefore for under- or over- utilized labor and capital stock, is the modeling of the wage-price dynamics, which are specified through two separate Phillips Curves, each one lead by its own measure of demand pressure (or capacity bottlenecks), instead of a single one as usually done in many New Keynesian models as e.g. Galí and Gertler (1999) and Galí, Gertler and López-Salido (2001).[1] Indeed, in many theoretical models of New Keynesian type where only a price Phillips Curve is modeled (and where the resulting price dynamics are assumed to be determined

[1]The pairwise Granger causality tests discussed in section 4 will confirm our use of two different demand pressure terms in the wage and the price Phillips curves.

by the real marginal unit labor costs, often proxied by a measure of the output gap), a mark-up pricing strategy by the firms is implicitly (or explicitly) assumed.[2] This assumption is in our opinion far to restrictive since it assumes that the real wage, and therefore income distribution, remains constant over time, neglecting ad initio fluctuations in the real wage and therefore the existence of income distribution cycles of e.g. Goodwin (1967)-type.

The approach of estimating two separate wage and price Phillips curves is not altogether new: While Barro (1994) for example observes that Keynesian macroeconomics are (or should be) based on imperfectly flexible wages and prices and thus on the consideration of wage as well as price Phillips Curves, Fair (2000) criticizes the low accuracy of reduced form price equations. In the same study, Fair estimates two separate wage and price equations for the United States, nevertheless using a single demand pressure term, the NAIRU gap.[3] On the contrary, by the modeling of wage and price dynamics separately from each other, each one determined by its own measures of demand pressure in the market for labor and for goods, namely $e - \bar{e}$ and $u - \bar{u}$, respectively, where e denotes the rate of employment in the labor market, $\bar{e}$ the NAIRU-level of this rate, u the rate of capacity utilization of the capital stock and $\bar{u}$ its normal level, we are able to circumvent the identification problem pointed out by Sims (1987) for the estimation of separate wage and price equations with the same explanatory variables.[4] By these means, we can analyze the dynamics of the real wages in the economy and identify oppositely acting effects as they might result from different labor and goods markets developments. Indeed, we think that a Keynesian model of aggregate demand fluctuations should (independently of whether justification can be found for this in Keynes' General Theory) allow for under- (or over-)utilized labor *as well as* capital in order to be general enough from the descriptive point of view.

The structural form of the wage-price dynamics in our framework is given by:

$$\hat{w} = \beta_{we}(e - \bar{e}) - \beta_{wv}(\ln v - \ln v_o) + \kappa_{wp}\hat{p} + (1 - \kappa_{wp})\pi^c + \hat{z}, \tag{1}$$

$$\hat{p} = \beta_{pu}(u - \bar{u}) + \beta_{pv}(\ln v - \ln v_o) + \kappa_{pw}(\hat{w} - \hat{z}) + (1 - \kappa_{pw})\pi^c. \tag{2}$$

The demand pressure terms in both the wage and price Phillips Curves are augmented by three additional terms: first, by the log of the wage share v or real unit labor costs, the error correction term discussed in Blanchard and Katz (1999, p.71). The second additional term is a weighted average of corresponding expected cost-pressure terms, assumed to be model-consistent, with forward looking, cross-over

[2] See e.g. Galí et al. (2001, p.1244).

[3] Woodford (2003) also uses a single demand pressure term (the output gap) when modeling separate wage and price Phillips curves, as we will discuss below.

[4] See Erceg, Henderson and Levin (2000) and Sbordone (2004) for other alternative approaches.

wage and price inflation rates $\hat{w}$ and $\hat{p}$, respectively, and a backward looking measure of the prevailing inflationary climate of the economy, symbolized by π^c.[5] Here our approach differs again from the standard New Keynesian approach based on the work by Taylor (1980) and Calvo (1983). Instead of assuming that the aggregate price (and wage) inflation is determined in a profit maximizing manner solely by the expected future path of nominal marginal costs, or in the hybrid variant discussed in Galí et al. (2001), also by lagged inflation, we assume that not only the last period inflation, but also the inflationary climate, where the economy is embedded in, is taken into account. Indeed, while the agents might have in our model myopic perfect foresight with respect to future values, there is no reason to assume that they also act myopically with respect to the past, "forgetting" whole sequences of fully observable and highly informational values. The third additional term in both Phillips curves is labor productivity, which is expected to influence wages in a positive and prices in a negative manner (due to the associated easening in production cost pressure).

The microfoundations of our wage Phillips curve are thus of the same type as in Blanchard and Katz (1999), see also Flaschel and Krolzig (2006), which can be reformulated as expressed as in eq.(1) and eq.(2) with the unemployment gap in the place of the logarithm of the output gap if hybrid expectations formation is in addition embedded into their approach. Concerning the price Phillips curve, a similar procedure can be applied, based on desired markups of firms. Along these lines one in particular gets an economic motivation for the inclusion of – indeed the logarithm of – the real wage (or wage share) with negative sign into the wage PC and with positive sign into the price PC, without any need for loglinear approximations. We furthermore use the employment gap and the capacity utilization gap in these two PC's, respectively, in the place of a single measure (the log of the output gap). Our wage-price module is thus consistent with standard models of unemployment based on efficiency wages, matching and competitive wage determination, and can be considered as an interesting alternative to the – theoretically rarely discussed and empirically questionable – New Keynesian form of wage-price dynamics.

Somewhat alternative versions of the two Phillips curves given by eq.(1) and eq.(2) have been estimated for the U.S. economy in various ways in Flaschel and Krolzig (2006), Flaschel, Kauermann and Semmler (2006), Chen and Flaschel (2006) and Chen, Chiarella, Flaschel and Semmler (2005), and have been found to represent a significant improvement over the conventional single reduced-form Phillips curve. A particular finding of those studies was that wage flexibility was greater than price

[5] This last term is obtained by an adaptive updating inflation climate expression with exponential or any other weighting schemes which incorporates medium run developments and therefore inertia with respect to the past wage and price developments.

flexibility with respect to their demand pressure measure in the market for goods and for labor, (for lack of better terms we associate the degree of wage and price flexibility with the size of the parameters β_{we} and β_{pu}, though of course the extent of these flexibilities will also depend on the size of the fluctuations of the excess demand expression in the market for labor and for goods), respectively, and also found workers were more short-sighted than firms with respect to their cost pressure terms.[6]

For comparison, in more elaborated New Keynesian models as in Woodford (2003, p.225), the joint evolution of wages and prices is described by the following two loglinearized equations

$$\begin{aligned}\hat{w}_t &\overset{WPC}{=} \beta E_t(\hat{w}_{t+1}) + \beta_{wy}(y_t) - \beta_{w\omega} \ln \omega_t,\\ \hat{p}_t &\overset{PPC}{=} \beta E_t(\hat{p}_{t+1}) + \beta_{py}(y_t) + \beta_{p\omega} \ln \omega_t,\end{aligned}$$

where y_t represents the output gap, calculated as the deviation of output from its long-term level, and ω represents the deviation of the real wage from its "natural" level. As it can easily be observed the expected next period wage inflation does not influence in a direct manner the price inflation and viceversa, as it has been the case in eqs.(1) and (2). Note that we assumed model-consistent expectations with respect to short-run wage and price inflation, incorporated into our Phillips curves in a cross-over manner, with perfectly foreseen price- in the wage- and wage inflation in the price-Phillips curve. We stress that we can include forward-looking behavior here, without the need for an application of the jump variable technique of the rational expectations school in general and the New Keynesian approach in particular as will be shown in the next section.[7]

The corresponding across-markets or <u>reduced-form PC's</u> of (1),(2) are given by (with $\kappa = 1/(1 - \kappa_{wp}\kappa_{pw})$):

$$\begin{aligned}\hat{w} &= \kappa[\beta_{we}(e - \bar{e}) - \beta_{wv}(\ln v - \ln v_o) + \kappa_w(\beta_{pu}(u - \bar{u}) + \beta_{pv}(\ln v - \ln v_o))] + \pi^c + \hat{z},\\ \hat{p} &= \kappa[\beta_{pu}(u - \bar{u}) + \beta_{pv}(\ln v - \ln v_o) + \kappa_p(\beta_{we}(e - \bar{e}) - \beta_{wv}(\ln v - \ln v_o))] + \pi^c,\end{aligned}$$

with pass-through terms behind the κ_w, κ_p-parameters, which represent a considerable generalization of the conventional view of a single-market price PC with only one measure of demand pressure, namely the one in the labor market.

Note that for our current version of the wage-price spiral, the inflationary climate variable does not matter for the evolution of the real wage $\omega = w/p$, whose law of

[6]Note that such a finding is not possible in the conventional framework of a single reduced-form Phillips curve.

[7]For a detailed comparison with the New Keynesian alternative to our model type see Chiarella et al. (2005).

motion is given by :

$$\hat{\omega} = \kappa\left[(1-\kappa_{pw})(\beta_{we}(e-\bar{e})-\beta_{wv}(\ln v-\ln v_o))-(1-\kappa_{wp})(\beta_{pu}(u-\bar{u}) + \beta_{pv}(\ln v-\ln v_o))\right]+\hat{z}. \quad (3)$$

Eq.(3) shows the ambiguity of the stabilizing property of the real wage channel discussed by Rose (1967) which arises – despite of the incorporation of specific measures of demand and cost pressure on both the labor and the goods markets – if the dynamics of the employment rate are liked to the behavior of the capacity utilization and if inflationary cross-over expectations are incorporated in both Phillips curves. Indeed, as sketched in figure 1, a real wage increase can act, taken by itself, in a stabilizing or destabilizing manner, depending on whether the dynamics of the capacity utilization rate depend positively or negatively on the real wage (i.e. if consumption reacts more strongly than investment or viceversa) *and* whether price flexibility is greater than nominal wage flexibility with respect to its own demand pressure measure.

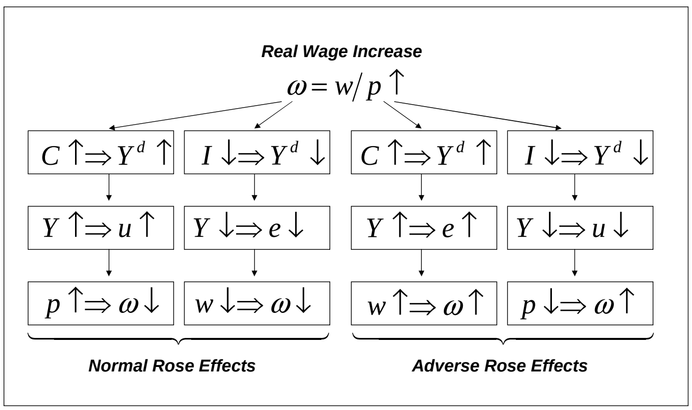

Figure 1: Normal (Convergent) and Adverse (Divergent) Rose Effects: The Real Wage Channel of Keynesian Macrodynamics

These four different scenarios can be jointly summarized as in table 1. As it can be observed, there exist two cases where the Rose (1967) real wage channel operates itself in a stabilizing manner: In the first case, aggregate goods demand (proxied in our analysis by the capacity utilization rate) depends negatively on the real wage, which can be denoted in a closed economy as the profit-led case[8] – and the dynamics

[8]In an open economy other macroeconomic channels as e.g. the real exchange rate channel would

of the real wage are led primarily by the nominal wage dynamics and therefore by the developments in the labor market. In the second case, aggregate demand depends positively on the real wage, and the price level dynamics, and therefore the goods markets, primarily determined the behavior of the real wages.[9]

	wage-led goods demand	profit-led goods demand
labor market-led real wage adjustment	adverse (divergent)	normal (convergent)
goods market-led real wage adjustment	normal (convergent)	adverse (divergent)

Table 1: Four Baseline Real Wage Adjustment Scenarios

Concerning the inflationary expectations over the medium run, π^c, i.e., the inflationary climate in which current inflation is operating, they may be formed adaptively following the actual rate of inflation (by use of some linear or exponential weighting scheme), may be based on a rolling sample (with hump-shaped weighting schemes), or on other possibilities for updating expectations. For simplicity of the exposition we shall make use of the conventional adaptive expectations mechanism in the theoretical part of this paper, namely

$$\dot{\pi}^c = \beta_{\pi^c}(\hat{p} - \pi^c).$$

With respect to the goods markets dynamics, we model them by means of a law of motion of the type of a dynamic IS-equation, see also Rudebusch and Svensson (1999) in this regard, here represented by the growth rate of the capacity utilization rate of firms:

$$\hat{u} = -\alpha_u(u - \bar{u}) \pm \alpha_v(v - v_o) - \alpha_i((i - \hat{p}) - (i_o - \bar{\pi})), \tag{4}$$

Eq.(4) has three important characteristics; (i) it reflects the dependence of output changes on aggregate income and thus on the rate of capacity utilization by assuming a negative, i.e., stable dynamic multiplier relationship in this respect, (ii) it shows the joint dependence of consumption and investment on the real wage (which in the aggregate may in principle allow for positive or negative signs before the parameter

also be influenced by the real wage and in turn influence the aggregate demand dynamics, so that the denotation "profit led" would not be appropriate anymore. Nevertheless, since we restrict our theoretical analysis to closed economies (or relatively closed as in our econometric analysis of the United States and the Euro area), we will adhere to the denomination used in table 1.

[9]Note here that also the cost - pressure parameters play a role and may influence the critical stability condition of the real wage channel, see Flaschel and Krolzig (2006) for details.

α_v, depending on whether consumption or investment is more responsive to real wage changes), and (iii) it shows finally the negative influence of the real rate of interest on the evolution of economic activity.[10]

Concerning the labor market dynamics, we assume a simple empirical relationship which links the rate of capacity utilization and employment (in hours) in the following way

$$e_h/\bar{e}_h = (u/\bar{u})^b.$$

Obviously, the growth rate of employment (in hours) is then given by

$$\hat{e}_h = b\,\hat{u}. \tag{5}$$

Employment in hours is in fact the relevant measure for the labor input of firms and therefore for the aggregate production function in the economy. Nevertheless, due to the lack of available time series of this variable for the Eurozone (this series is available only for the U.S.) and for the sake of comparability of the parameter estimates in the next section, we will assume that the dynamics of employment in hours and actual employment are quite similar, so that eq.(5) in fact describes the dynamics of actual employment e, so that $\hat{e} = b\,\hat{u}$ holds.

The above three laws of motion therefore reformulate in a dynamic form the static IS-curve (and the rate of employment this curve implies) that was used in Asada et al. (2006). They only reflect implicitly the there assumed dependence of the rate of capacity utilization on the real wage, due to smooth factor substitution in production (and the measurement of the potential output this implies in Asada et al. (2006)), which constitutes another positive influence of the real wage on the rate of capacity utilization and its rate of change. This simplification helps to avoid the estimation of separate equations for consumption and investment C, I and for potential output Y^p.

These relatively straightforward modifications of the New Keynesian approach will imply for the dynamics of what we call a matured traditional Keynesian approach radically different solutions and stability features, as compared to the New Keynesian cases, with in particular no need to single out the steady state as the only relevant situation for economic analysis in the deterministic set-up here considered.

Finally, we no longer employ here a law of motion for real balances (a LM Curve) as it was still the case in Asada et al. (2006). Instead we endogenize the nominal interest rate by using a type of Taylor rule as it is customary in the literature, see

[10]Note here that we have generalized this law of motion in comparison to the one in the original baseline model of Asada et al. (2006), since we now allow for the possibility that also consumption, not only investment, depends on income distribution as measured by the real wage.

e.g. Svensson (1999). Indeed, as Romer (2000, p.154-55) states, "Even in Germany, where there were money targets beginning in 1975 and where those targets payed a major role in the official policy discussions, policy from the 1970s through the 1990s was better described by an interest rate rule aimed at macroeconomic policy objectives than by money targeting."[11] The target rate of the monetary authorities and the law of motion resulting from an interest rate smoothing behavior by the central bank are defined as

$$\begin{aligned} i^* &= (i_o - \bar{\pi}) + \hat{p} + \alpha_{ip}(\hat{p} - \bar{\pi}) + \alpha_{iu}(u - \bar{u}) \\ \dot{i} &= \alpha_i(i^* - i). \end{aligned}$$

The target rate of the central bank i^* is here made dependent on the steady state real rate of interest $i_o - \bar{\pi}$ augmented by actual inflation back to a nominal rate, and is as usual dependent on the inflation gap and the capacity utilization gap (as a measure of the output gap).[12] With respect to this target there is an interest rate smoothing dynamics with strength α_i. Inserting i^* and rearranging terms we obtain from this expression the following dynamic law for the nominal interest rate

$$\dot{i} = -\alpha_i(i - i_o) + \gamma_{ip}(\hat{p} - \bar{\pi}) + \gamma_{iu}(u - \bar{u}) \tag{6}$$

where we have $\gamma_{ip} = \alpha_i(1 + \alpha_{ip})$, i.e., $\alpha_{ip} = \gamma_{ip}/\alpha_i - 1$ and $\gamma_{iu} = \alpha_i\alpha_{iu}$.

Furthermore, the actual (perfectly foreseen) rate of inflation $\hat{p}$ is used to measure the inflation gap with respect to the inflation target $\bar{\pi}$ of the central bank. Note finally that we could have included (but have not done this here yet) a new kind of gap into the above Taylor rule, the labor share gap, since we have in our model a dependence of aggregate demand on income distribution and the labor share, i.e., the state of income distribution matters for the dynamics of our model and thus should also play a role in the decisions of the central bank.

Taken together the model of this section consists of the following five laws of motion (with the derived reduced form expressions as far as the wage-price spiral is concerned and with reduced form expressions by assumption concerning the goods and the labor market dynamics):[13]

[11] See also Clarida and Gertler (1997).

[12] All of the employed gaps are measured relative to the steady state of the model, in order to allow for an interest rate policy that is consistent with it.

[13] As the model is formulated we have no real anchor for the steady state rate of interest (via investment behavior and the rate of profit it implies in the steady state) and thus have to assume here that it is the monetary authority that enforces a certain steady state value for the nominal rate of interest.

$$
\begin{aligned}
\hat{v} &\overset{LaborShare}{=} \kappa[(1-\kappa_p)(\beta_{we}(e-\bar{e}) - \beta_{wv}(\ln v - \ln v_o)) \\
&\qquad -(1-\kappa_w)(\beta_{pu}(u-\bar{u}) + \beta_{pv}(\ln v - \ln v_o))], && (7)\\
\hat{u} &\overset{Dyn.IS}{=} -\alpha_u(u-\bar{u}) \pm \alpha_v(v-v_o) - \alpha_i((i-\hat{p}) - (i_o - \bar{\pi})), && (8)\\
\dot{i} &\overset{T.Rule}{=} -\alpha_i(i-i_o) + \gamma_{ip}(\hat{p}-\bar{\pi}) + \gamma_{iu}(u-\bar{u}), && (9)\\
\dot{\pi}^c &\overset{I.Climate}{=} \beta_{\pi^c}(\hat{p}-\pi^c) && (10)\\
\hat{e} &\overset{O.Law}{=} b\hat{u}, && (11)
\end{aligned}
$$

The above equations[14] represent, in comparison to the baseline model of New Keynesian macroeconomics, the law of motion (7) for the labor share $\hat{v} = \hat{w} - \hat{p} - \hat{z}$ that makes use of the same explaining variables as the New Keynesian approach (but with inflation rates in the place of their time rates of change and with no accompanying sign reversal concerning the influence of output and wage gaps), the IS goods market dynamics (8), the Taylor Rule (9), the law of motion (10) that describes the updating of the inflationary climate expression and finally Okun's Law as link between the goods and the labor market (11). Note that the model can be reduced to a 4D system if we recover from eq.(11) the actual level of employment by making use of the original formulation of Okun's Law, see the equation preceding(4), and insert the resulting functional relationship in the remaining equations of the system. We can thus abstract from eq.(11) (and the influence of e as an endogenous variable) in the stability analysis to be discussed below.

We have to make use in addition of the following reduced form expression for the price inflation rate or the price PC, our law of motion for the price level p in the place of the New Keynesian law of motion for the price inflation rate $\hat{p}$:

$$
\begin{aligned}
\hat{p} &= \kappa[\beta_{pu}(u-\bar{u}) + \beta_{pv}(\ln v - \ln v_o) \\
&\quad + \kappa_p(\beta_{we}(e-\bar{e}) - \beta_{wv}(\ln v - \ln v_o))] + \pi^c, && (12)
\end{aligned}
$$

which has to be inserted into the remaining laws of motion in various places in order to get an autonomous nonlinear system of differential equations in the state variables: labor share v, capacity utilization u, the nominal rate of interest i, and the inflationary climate expression π^c. We stress that one can consider the eq. (12) as a fifth law of motion of the considered dynamics which however – when added — leads to a system determinant which is zero and which therefore allows for zero-root hysteresis for certain variables of the model (in fact in the price level if the target

[14] which are very close to a linear system.

rate of inflation of the Central Bank is zero and if interest rate smoothing is present in the Taylor rule).

With respect to the empirically motivated restructuring of the original theoretical framework, the model is as pragmatic as the approach employed by Rudebusch and Svensson (1999). By and large we believe that it represents a working alternative to the New Keynesian approach, in particular when the current critique of the latter approach is taken into account. It overcomes the weaknesses and the logical inconsistencies of the old Neoclassical synthesis, see Asada et al. (2006), and it does so in a minimal way from a mature, but still traditionally oriented Keynesian perspective (and is thus not really "New"). It preserves the problematic stability features of the real rate of interest channel, where the stabilizing Keynes effect or the interest rate policy of the central bank is interacting with the destabilizing, expectations driven Mundell effect. It preserves the real wage effect of the old Neoclassical synthesis, where – due to an unambiguously negative dependence of aggregate demand on the real wage – we had that price flexibility was destabilizing, while wage flexibility was not. This real wage channel, summarized in the figure 1, is not really discussed in the New Keynesian approach, due to the specific form of wage-price and IS dynamics there considered.

3 4D Feedback-Guided Stability Analysis

In this section we illustrate a method to prove local asymptotic stability of the interior steady state of the dynamical system given by eqs.(7)-(10) (with eq. (12) inserted wherever needed) through partial considerations from the feedback chains that characterize this empirically oriented baseline model of Keynesian dynamics. The Jacobian of the 4D dynamic system, calculated at its interior steady state, is:

$$J = \begin{pmatrix} - & \pm & 0 & 0 \\ \pm & + & - & + \\ \pm & + & - & + \\ \pm & + & 0 & 0 \end{pmatrix}.$$

Since the model is an extension of the standard AS-AD growth model, we know from the literature that the real rate of interest, first analyzed by formal methods in Tobin (1975), see also Groth (1992), typically affects, in a negative manner, the dynamics of the economic activity (J_{23}). Additionally, there is the activity stimulating (partial) effect of increases in the rate of inflation (as part of the real rate of interest channel) that may lead to accelerating inflation under appropriate conditions (J_{24}). This transmission mechanism, known as the Mundell effect, is the stronger the faster the inflationary climate adjusts to the present level of price inflation, since we have a positive influence of this climate variable both on price as well as on wage inflation and from there on rates of employment of both capital and labor. Concerning the Keynes effect, due to our use of a Taylor rule in the place of the conventional LM curve, it is here implemented in a more direct way towards a stabilization of the economy (coupling nominal interest rates directly with the rate of price inflation) and it works the stronger the larger the choice of the parameters γ_{ip}, γ_{iu}.

As it is formulated, the theoretical model also features further potentially (at least partially) destabilizing feedback mechanisms due to the Mundell-effect and the Rose-effect in the dynamics of the goods-market and the opposing Blanchard-Katz error correction terms in the reduced form price Phillips curve. There is first of all J_{12}, see eq.(7), the still undetermined influence of the rate of capacity utilization on the labor share, which depends on the signs and values of the parameter estimates of the two structural Phillips curves, and therefore on the cross-over expectations formation of the economic agents. In the second place, see eq.(8), we have J_{21}, the ambiguous influence of the labor share on (the dynamics of) the rate of capacity utilization, which should be a negative one if investment is more responsive than consumption to real wage changes and a positive one in the opposite case. Concerning also the effects of the labor share on capacity utilization, we have aggregate price inflation determined by the reduced form price Phillips curve given by eq.(12) and thus additional, though ambiguous channel through which the labor share affects the dynamics of the capacity utilization rate on the one hand and the inflationary climate of the economy (J_{41}) through eq.(10) on the other hand. Mundell-type, Rose-type and Blanchard-Katz error-correction feedback channels therefore make the dynamics indeterminate on the theoretical level.

The feedback channels just discussed will be the focus of interest in the now following stability analysis of our D(isequilibrium)AS-D(isequilibrium)AD dynamics. We have employed reduced-form expressions in the above system of differential equations whenever possible. We have thereby obtained a dynamical system in four state variables that is in a natural or intrinsic way nonlinear (due to its reliance on growth rate formulations). We note furthermore that there are many items that reappear in various equations, or are similar to each other, implying that stability analysis can exploit a variety of linear dependencies in the calculation of the conditions for local asymptotic stability. A rigorous proof of the local asymptotic stability of this dynamical system and its loss by way of Hopf bifurcations can be found in Asada et al. (2006), there for the original baseline model.

In order to focus on the interrelation between the wage-price and the capacity utilization dynamics, we make use of the following proposition.

Proposition 1:

Assume that the parameters $\beta_{\pi^c}, \beta_{wv}, \beta_{pv}$ are not only close to zero but in fact equal to zero. This decouples the dynamics of π^c from the rest of the system and the system becomes 3D. Assume furthermore that the partial derivative of the second law of motion J_{22} depends negatively on v, and that $(1-\kappa_p)\beta_{we} > (1-\kappa_w)\beta_u$ holds. Then: The interior steady state of the implied 3D dynamical system

$$\hat{v} = \kappa[(1-\kappa_p)(\beta_{we}(e(u)-\bar{e})) - (1-\kappa_w)(\beta_{pu}(u-\bar{u}))], \quad (13)$$

$$\hat{u} = -\alpha_u(u-\bar{u}) - \alpha_v(v-v_o) - \alpha_i((i-\hat{p})-(i_o-\bar{\pi})), \quad (14)$$

$$\dot{i} = -\alpha_i(i-i_o) + \gamma_{ip}(\hat{p}-\bar{\pi}) + \gamma_{iu}(u-\bar{u}), \quad (15)$$

is locally asymptotically stable.

Sketch of proof: In the considered situation we have for the Jacobian of the reduced dynamics at the steady state:

$$J = \begin{pmatrix} - & + & 0 \\ - & - & - \\ 0 & + & - \end{pmatrix}.$$

According to the Routh-Hurwitz stability conditions for the characteristic polynomial of the considered 3D dynamical system, asymptotic local stability of a steady state is fulfilled when

$$a_i > 0, \quad i = 1,2,3 \quad \text{and} \quad a_1 a_2 - a_3 > 0,$$

where $a_1 = -\text{trace}(J)$, $a_2 = \sum_{k=1}^{3} J_k$ with

$$J_1 = \begin{vmatrix} J_{22} & J_{23} \\ J_{32} & J_{33} \end{vmatrix}, J_2 = \begin{vmatrix} J_{11} & J_{13} \\ J_{31} & J_{33} \end{vmatrix}, J_3 = \begin{vmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{vmatrix},$$

and $a_3 = -\det(J)$. The determinant of this Jacobian is obviously negative if the parameter γ_i is chosen sufficiently small. The sum of the minors of order 2: a_2 is unambiguously positive. The validity of the full set of Routh-Hurwitz conditions then easily follows, since trace $J = -a_1$ is obviously negative. ■

Proposition 2:

Assume now that the parameter β_{π^c} is positive, but chosen sufficiently small, while the error correction parameters β_{wv}, β_{pw} are still kept at zero. Assume furthermore that α_i is sufficiently small, and that $\gamma_{ip} > 1$.

Then: The interior steady state of the resulting 4D dynamical system (where the state variable π^c *is now included)*

$$\begin{aligned}
\hat{v} &= \kappa[(1-\kappa_p)(\beta_{we}(e(u)-\bar{e}))-(1-\kappa_w)(\beta_{pu}(u-\bar{u}))], && (16)\\
\hat{u} &= -\alpha_u(u-\bar{u})-\alpha_v(v-v_o)-\alpha_i((i-\hat{p})-(i_o-\bar{\pi})), && (17)\\
\dot{i} &= -\alpha_i(i-i_o)+\gamma_{ip}(\hat{p}-\bar{\pi})+\gamma_{iu}(u-\bar{u}), && (18)\\
\dot{\pi}^c &= \beta_{\pi^c}(\hat{p}-\pi^c) && (19)
\end{aligned}$$

is locally asymptotically stable.

Sketch of proof: Under the mentioned assumptions, the Jacobian of the 4D system is equal to

$$J = \begin{pmatrix} - & + & 0 & 0 \\ - & - & - & + \\ 0 & + & - & + \\ 0 & + & 0 & 0 \end{pmatrix}.$$

We can clearly see that J_{34} describes the reaction of the nominal interest rate with respect to inflation. According to the Taylor (1993) principle, as long as $\gamma_{ip} > 1$, monetary policy stabilizes the economy. Together with sufficiently small β_{π^c} and α_i, the incorporation of the inflationary climate as a state variable in the dynamical system does not disturb the local stability properties of the system. ■

Summing up, we can state that a weak Mundell effect, the neglect of Blanchard-Katz error correction terms, a negative dependence of aggregate demand on real wages, coupled with higher nominal wage than price level flexibility, and a Taylor rule that stresses inflation targeting therefore are here (for example) the basic ingredients that allow for the proof of local asymptotic stability of the interior steady state of the dynamics (7) – (10). We expect however that indeed a variety of other and also more general situations of convergent dynamics can be found, but have to leave this here for future research and numerical simulations of the model.

Instead we now attempt to estimate the signs and also the sizes of the parameters of the model in order to gain insight into the question to what extent the U.S and the Euro area supports one of the real wage effects considered in figure 1 and also the possibility of overall asymptotic stability for such an economy, despite a destabilizing Mundell effect in the real interest rate channel. The question that naturally arises here is whether the economy can be assumed to be in the convergent regime of its alternative dynamical possibilities. This of course can only be decided by an empirical estimation of its various parameters which is the subject of the next section.

4 Econometric Analysis

In this section we empirically estimate the theoretical Keynesian disequilibrium model discussed in the previous section with aggregate time series data of the U.S. and the Euro area economies.[15] While, on the one hand, we intend to demonstrate the consistency of our theoretical model with the empirical data, we on the other hand expect to identify the main similarities and differences of the determinants of wage and price dynamics in the two economies. Indeed, despite of the remarkably similar patterns of wage and price inflation in the U.S. and the Euro area over the last three decades, the similar economic development, market structure and labor market conditions in the two economies, as well as a similar fiscal and monetary policy conduction in the U.S. and the majority of the countries participating in the European Monetary Union, the significant differences for example in the aggregate employment rates of the two economies open up the question whether the influence of the labor and goods markets on the dynamics of wage and price inflation has been somewhat or even significantly different in the two economies.

More specifically we provide here empirical estimates by means of a system estimation of the laws of motion (1)–(5) of our disequilibrium AS-AD model, namely the structural wage and price Phillips curves, the dynamic multiplier equation, Okun's law and the interest rate policy rule. Indeed, since the five endogenous variables (the nominal wage, the price level, the capacity utilization and employment rates, as well as the nominal interest rate) are assumed to be interdependent in the theoretical model of the last sections, the econometric estimation of their parameters should take this interdependency into account as well.

At this stage we would like to point out nevertheless that the parameter estimates for the Euro area must be handled with care since they, despite of the many similarities in the macroeconomic development of the participant economies and the possibility of cross-country aggregation, represent the theoretical values of an artificial economy. Indeed, since country-specific labor market conditions as e.g. the respective bargaining power of national labor unions have played an important role in the wage and price differentials among the member countries of the Euro area before and after the introduction of the Euro, a different development of the competitiveness and of the economic performance of the respective economies has taken place which cannot be identified through the estimation of aggregate data.

The estimated parameters serve the purpose of confirming the parameter signs we

[15]From the theoretical point of view the Euro area could be considered as a single economy also before the introduction of the Euro 1999 due to the economic convergence process which lead to it as well as due to the great economic integration of the participating countries.

have specified in the initial theory-guided formulation of the model and to determine the sizes of these parameters in addition.However, as discussed in the previous section, we have three different situations where we cannot specify the parameter signs on purely theoretical grounds and where we therefore aim at obtaining these signs from the empirical estimates of the equations whenever this happens: the ambiguous influence of labor share on (the dynamics of) the rate of capacity utilization, see eq.(8), on the nominal interest rate (through its effect on the price inflation) as well as on the inflationary climate. Mundell-type, Rose-type and Blanchard-Katz error-correction feedback channels therefore make the dynamics indeterminate on the general level.

We conduct our estimates in conjunction with time-invariant estimates of all the parameters of our model. This in particular implies that Keynes' (1936) explanation of the trade cycle, which employed systematic changes in the propensity to consume, the marginal efficiency of investment and liquidity preference over the course of the business cycle, find no application here and that – due the use of detrended measures for income distribution changes and unit-wage costs – also the role of technical change is downplayed to a significant degree, in line with its neglect in the theoretical equations of the model presented in section 2. As a result we expect to obtain from our estimates long-phased economic fluctuations, since important fluctuations in aggregate demand (based on time-varying parameters) are still ignored and since the dynamics is then driven primarily by slowly changing income distribution, indeed a slow process in the overall evolution of especially the U.S. economy after World War II.

4.1 Data Description

The empirical data of the corresponding time series stem from the Federal Reserve Bank of St. Louis data set (see http:/www.stls.frb.org/fred) and the OECD database for the U.S. and the Euro area, respectively. The data are quarterly, seasonally adjusted and concern the period from 1961:1 to 2004:4 for the U.S. and from 1975:1 to 2004:4 for the Euro area.

Table 2: Data used for the empirical investigation

Variable	Description of the original series
e	US : Employment Rate
	EZ : Employment Rate
u	US : Capacity Utilization: Manufacturing, Percent of Capacity
	EZ : Output Gap
w	US : Nonfarm Business Sector: Compensation Per Hour, 1992=100
	EZ : Business Sector: Wage Rate Per Hour,
p	US : Gross Domestic Product: Implicit Price Deflator, 1996=100
	EZ : Gross Domestic Product: Implicit Price Deflator, 2000=100
z	US : Nonfarm Business Sector; Output Per Hour of All Persons, 1992=100
	EZ : Labor Productivity of the business economy,
v	US : Nonfarm Business Sector: Real Compensation Per Output Unit, 1992=100
	EZ : Business Sector: Real Compensation Per Output Unit,
i	US : Federal Funds Rate
	EZ : Short Term Interest Rate

The logarithms of wages and prices are denoted $\ln(w_t)$ and $\ln(p_t)$, respectively. Their first differences (backwardly dated), i.e. the current rate of wage and price inflation, are denoted $\hat{w}_t$ and $\hat{p}_t$,

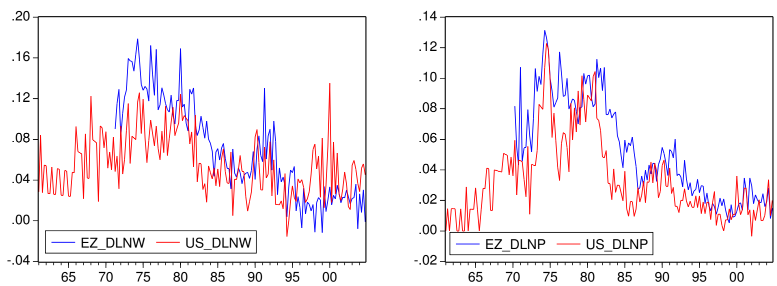

Figure 2: U.S. and Eurozone Wage and GDP Deflator Inflation

In figure 2 we can observe the remarkably similar pattern of wage and price inflation in the U.S. and the Euro area over the last three decades. We can particularly identify the high periods of wage and price inflation following the oil shocks in the 1970s, as well as the "Volcker" disinflation of 1981-85 especially in the U.S. as well as the subsequent low inflation periods in the late 1980s and the 1990s, respectively.

The inflationary climate π^c of the theoretical part of this paper is approximated here in a very simple way by a linearly declining moving average of price inflation rates with linearly decreasing weights over the past 12 quarters.[16] The capacity utilization rates of the capital stock u and the nominal interest rate i for the U.S. and the Euro area are shown in figure 3.

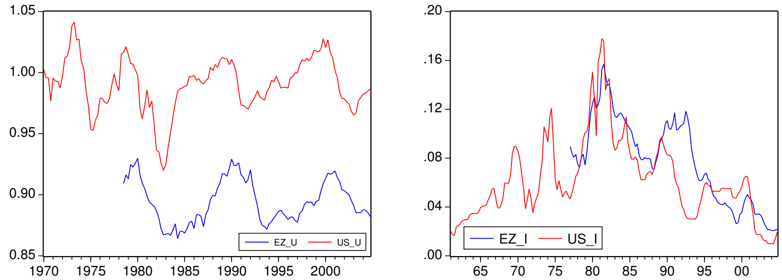

Figure 3: U.S. and Euro area Capacity Utilization and Nominal Interest Rates

An important difference in the macroeconomic performance of the United States and the Euro area in the last twenty years can be observed in figure 4: While the U.S. unemployment rate has fluctuated, roughly speaking, around a constant level (what would speak for a somewhat constant or at least for a not all too varying NAIRU) over the last two decades, the European employment (unemployment) rate has described a persistent downwards (upwards) trend over the same time period. This particular European development has been explained by Layard, Nickell and

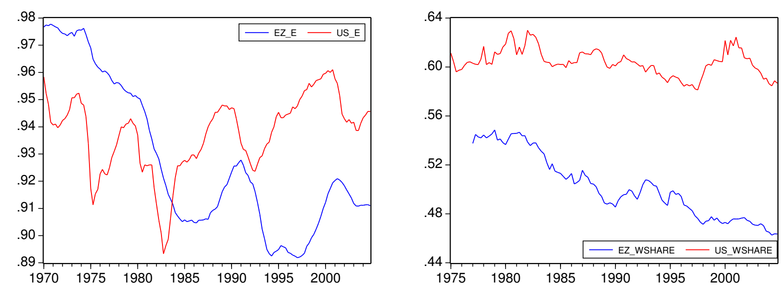

Figure 4: U.S. and Eurozone Aggregate Employment Rate and Wage Share

Jackman (1991) and Ljungqvist and Sargent (1998) by an over-proportional increase in the number of long-term unemployed (i.e. workers with an unemployment duration over 12 months) with respect to short term unemployed (workers with an

[16]We also estimated the structural model shown in table 5 with other proxies for the inflationary climate besides, which also covered the four, six and eighteen last quarters and which estimates could be rejected even at the 10% significance level.

unemployment duration of less than 12 months) and the phenomenon of hysteresis especially in the first group. One main explanation for the persistence in long-term unemployment is that human capital, and therefore the productivity of the unemployed, tend to diminish over time, what makes long-term unemployed less "hirable" for firms, see Pissarides (1992) and Blanchard and Summers (1991). Because long-term unemployed become less relevant, and primarily the short-term unemployed are taken into account in the determination of nominal wages, the potential downward pressure on wages resulting from the unemployment of the former diminishes, with the result of a higher level of the NAIRU.[17] When the long-term unemployment is high, the aggregate unemployment rate of an economy thus, "becomes a poor indicator of effective labor supply, and the macroeconomic adjustment mechanisms – such as downward pressure on wages and inflation when unemployment is high – will then not operate effectively."[18] Indeed, Llaudes (2005) for example, by using a modified wage Phillips curve which incorporates the different influences of long-and short-term unemployed in the wage determination, finds empirical evidence for some OECD countries for the fact long-term unemployed have only a negligible influence on the wage determination.

Since time series data for long-term unemployment in the Euro area are not available, we try to approximate it in a rather simple way: We first run the HP-filter on the Euro area unemployment rate with a high smoothing factor ($\lambda = 640000$). We normalize the resulting smoothed series so that the 1970:1 value equals zero, implicitly assuming that in 1970:1 the number of long-term unemployed was not too different from zero, since before the oil shocks in the 1970s unemployment (and also long-term unemployment) were extremely low in the European continent. We interpret this smoothed series as a proxy for the actual development of long-term unemployment. The difference between this series and the aggregate unemployment rate, denoted u^{st}, can then be interpreted as a proxy for the short term unemployment rate, which is the relevant variable in the wage bargaining process. With this series we calculate for the Euro area the alternative employment rate measure $e = 1 - u^{st}$.[19] In our econometric estimation, thus, we implicitly assume the existence of a variable NAIRU in the Euro area, despite the fact that we did not explicitly model it in the theoretical framework of the previous section.

Concerning the wage share in the Euro area (normalized to 0.60 in 1970), we see in figure 5 that it possesses a pronounced downward trend over the whole sample period. To focus on the cyclical implications of changes in income distribution, and

[17]See Blanchard and Wolfers (2000).

[18]OECD (2002, p.189).

[19]Note nevertheless that, by the construction of the Hodrick-Prescott filter, the calculated course of the proxy for the long-term unemployed (the smoothed series) depends on the whole sample period.

along the way to ensure the stationary of the time series, we use again the cyclical component calculated by the Hodrick-Prescott filter with the same smoothing factor $\lambda = 640000$. We depict the considered short- and long-term time series in figure 5.

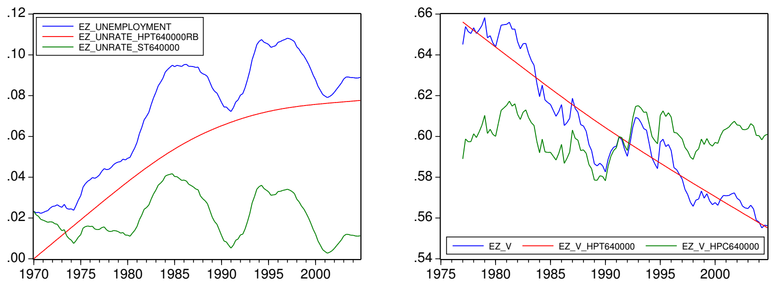

Figure 5: Modified Euro area Long- and Short Term Unemployment Rate and Wage Share

We carry out Phillips-Perron unit root tests for each series in order to account, besides of residual autocorrelation as done by the standard ADF Tests, also for possible residual heteroskedasticity when testing for stationary. The Phillips-Perron test specifications and results are shown in table 3.

Table 3: Phillips-Perron Unit Root Test Results

Country	Variable	Sample	Lag Length	Determ.	Adj. Test Stat.	Prob.*
	dln(p)	1960:1-2004:4	1	const.	-3.5995	0.0067
U.S.	dln(w)	1960:1-2004:4	1	const.	-9.4177	0.0000
	dln(e)	1960:1-2004:4	-	-	-6.3869	0.0000
	u	1960:1-2004:4	1	-	-0.1052	0.6461
	i	1960:1-2004:4	1	const.	-2.2817	0.1790
	dln(p)	1975:1-2004:4	1	-	-2.3464	0.0189
Eurozone	dln(w)	1977:3-2004:4	1	const.	-3.4567	0.0110
	dln(e)	1975:2-2004:4	1	-	-3.6923	0.0003
	u	1979:1-2004:4	-	-	-0.2751	0.5844
	i	1977:2-2004:4	1	-	-1.0099	0.2792

*McKinnon (1996) one-sided p-values.

The applied unit root tests confirm our presumptions with the exception of the nominal interest rate i and the capacity utilization rate u. Although the test cannot reject the null of a unit root, there is no reason to expect both time series to be a unit root process. Indeed, we reasonably expect these rates to be constrained to certain limited ranges in the Euro area and the US economy. Due to the generally low power of the unit root tests, we interpret these results as providing only a hint for the situation that the nominal interest and the capacity utilization rates exhibit a strong autocorrelation.

4.2 Model Estimation

As discussed in section 2, the law of motion for the real wage rate, given by eq.(7), represents a reduced form expression of the two structural equations for $\mathrm{dln}(w_t)$ and $\mathrm{dln}(p_t)$. Noting again that the inflation climate variable is defined in the estimated model as a linearly declining function of the past twelve price inflation rates, the dynamics of the system (1) – (6) can be reformulated as

$$\begin{aligned}
\hat{w}_t &= \beta_{we}e_{t-1} - \beta_{wv}\ln(v_{t-1}) + \kappa_{wp}\hat{p}_t + \kappa_{w\pi^c}\pi_t^c + \kappa_{wz}\hat{z}_t + c_w + \epsilon_{wt} \\
\hat{p}_t &= \beta_{pu}u_{t-1} + \beta_{pv}\ln(v_{t-1}) + \kappa_{pw}\hat{w}_t + \kappa_{p\pi^c}\pi_t^c - \kappa_{pz}\hat{z}_t + c_p + \epsilon_{pt} \\
u_t &= \gamma_u u_{t-1} - \alpha_{ui}(i_{t-1} - \hat{p}_t) \pm \alpha_{uv}v_{t-1} + c_u + \epsilon_{ut} \\
\hat{e}_t &= \alpha_{eu-1}\hat{u}_{t-1} + \alpha_{eu-2}\hat{u}_{t-2} + \alpha_{eu-3}\hat{u}_{t-3} + \epsilon_{et} \\
i_t &= \gamma_i i_{t-1} + \gamma_{ip}\hat{p}_t + \gamma_{iu}u_{t-1} + c_i + \epsilon_{it},
\end{aligned}$$

with $\gamma_{uu} = 1 - \alpha_u$, $\gamma_i = 1 - \alpha_i$, with the intercept terms in these equations assumed to contain the steady state values. The pairwise Granger-causality test statistics obtained from an unrestricted VAR(12) for the Euro area, shown in table 4, deliver some interesting insights on the interdependency of the system variables: In the first place they confirm our modeling approach of two different demand pressure terms for wage and price inflation determination, $e - \bar{e}$ and $u - \bar{u}$, respectively. In the second place they show, as expected, a close relationship between the capacity utilization and the employment rate which gives an empirical motivation for the specific law of motion of the labor market given by eqs.(11). In the third place we see that while the null hypothesis that the real marginal costs (proxied by the labor share or the real average unit costs) do not Granger cause wage inflation cannot be rejected at the 5% significance level, the relationship between this variable and price inflation seems not to be very close one.

In order to account for regressor endogeneity, we estimate the discrete time version of the structural model formulated above by means of instrumental variables system GMM (General Method of Moments). Indeed, a GMM estimation, as stated in Wooldridge (2001, p.92), possesses several advantages with respect to more traditional estimation methods such as OLS and 2SLS, especially in time series models, where heteroskedasticity in the residuals is a common feature: "The optimal GMM estimator is asymptotically no less efficient than two-stage least squares under homoskedasticity, and GMM is generally better under heteroskedasticity." This and

Table 4: Euro Area Pairwise Granger Causality Tests: Significance Probabilities

H0:	$\hat{w}$	$\hat{p}$	u	e	i	$\hat{z}$	$\ln(v)$	π^c
$\hat{w}$ does not Granger cause	-	0.742	0.566	0.138	0.831	0.295	0.139	0.369
$\hat{p}$ does not Granger cause	0.367	-	0.034	0.198	0.761	0.000	0.198	0.000
u does not Granger cause	0.017	0.068	-	0.024	0.011	0.255	0.119	0.199
e does not Granger cause	0.012	0.885	0.001	-	0.618	0.652	0.025	0.015
i does not Granger cause	0.015	0.008	0.777	0.426	-	0.074	0.906	0.002
$\hat{z}$ does not Granger cause	0.232	0.090	0.645	0.188	0.389	-	0.405	0.653
$\ln(v)$ does not Granger cause	0.026	0.885	0.570	0.165	0.636	0.652	-	0.940
π^{12} does not Granger cause	0.408	0.184	0.240	0.670	0.514	0.001	0.246	-

the additional robustness property of GMM estimates, of not relying on a specific assumption with respect to the distribution of the residuals, make the GMM methodology appropriate and advantageous for our estimation.[20]

The weighting matrix in the GMM objective function was chosen in order to allow the resulting GMM estimates to be robust against possible heteroskedasticity and serial correlation of an unknown form in the error terms. Concerning the instrumental variables used in our estimations, since at time t only past values are contained in the information sets of the economic agents, for all five equations we use, besides the strictly exogenous variables, the last four lagged values of the employment rate, the labor share (detrended by the Hodrick-Prescott Filter) and the growth rate of labor productivity. In order to test for the validity of the overidentifying restrictions, the J-statistics for both system estimations were calculated. We present the structural parameter estimates for the U.S. and the Euro area economies (t-statistics in brackets), as well as the J-statistics (p-values in brackets) in table 5. In-sample one-period ahead forecasts as well as in-sample dynamic forecasts for both economies (calculated solely by endogenously generated time series) are presented in the appendix.

At a general level the GMM parameter estimates shown in table 5 deliver empirical support for the specification of our theoretical Keynesian disequilibrium model and confirm, for the Euro area, some of the empirical findings of Flaschel and Krolzig (2006) and Flaschel et al. (2006) for the U.S. economy. Especially, we find empirical support for the specification of cross-over expectational terms, with the wage inflation entering in the price Phillips curve and the price inflation entering in the wage Phillips Curve, as well as for the inclusion of the inflationary climate term in both equations, something that relativizes in a significant manner the findings based

[20] In a wage equation estimation, Wooldridge (2001, p.94) shows that "the GMM estimates and standard errors are very similar to those for two-stage least squares. [...] using GMM does not hurt anything, and perhaps [*it might offer*] greater precision."

Table 5: GMM Parameter Estimates of the Structural Model

Estimation Sample: U.S. :1961 : 1 − 2004 : 4, Euro area : 1979 : 4 − 2004 : 4
Kernel: Bartlett, Bandwidth: variable Newel-West (U.S.: 7, Euro area: 4)

$\hat{w}_t$	β_{we}	β_{wv}	κ_{wp}	$\kappa_{w\pi^c}$	κ_{wz}	c_w	R^2	DW
U.S.	0.588	-0.263	0.480	0.494	0.226	-0.670	0.496	1.985
	[13.286]	[-8.416]	[23.246]	[13.560]	[13.473]	[-15.551]		
Euro area	0.541	-0.469	0.656	0.504	0.212	-0.770	0.714	1.591
	[18.790]	[-22.033]	[21.365]	[13.463]	[20.577]	[-24.341]		
$\hat{p}_t$	β_{pu}	β_{pv}	κ_{pw}	$\kappa_{p\pi^{12}}$	κ_{pz}	c_p	$\bar{R}^2$	DW
U.S.	0.157	0.215	0.547	0.568	-	-0.062	0.630	1.650
	[6.113]	[8.913]	[14.127]	[15.390]		[-2.650]		
Euro area	0.115	0.205	0.440	0.471	-	-	0.850	1.689
	[15.711]	[15.895]	[46.250]	[41.758]				
u_t	γ_{uu-1}	γ_{uu-2}	γ_{uu-3}	α_{ui}	α_{uv}	c_u	$\bar{R}^2$	DW
U.S.	0.907	-	-	-0.050	-0.169	0.196	0.899	1.598
	[132.39]			[-8.760]	[-8.753]	[13.222]		
Euro area	0.927	-	-	-0.023	-0.038	0.084	0.916	1.575
	[171.28]			[-3.979]	[-9.159]	[15.004]		
$\hat{e}$	α_{eu-1}	α_{eu-2}	α_{eu-3}	α_{eu-4}	α_{eu-5}		$\bar{R}^2$	DW
U.S.	0.169	0.116	0.055	-	-		0.380	1.558
	[26.789]	[19.664]	[9.792]					
Euro area	0.140	0.110	0.054	0.077	0.093		0.690	1.449
	[34.779]	[27.382]	[11.322]	[23.350]	[12.067]			
i	γ_i	γ_{ip}	γ_{iu}	c_i			$\bar{R}^2$	DW
U.S.	0.912	0.110	0.099	-0.097			0.922	1.697
	[143.51]	[10.593]	[16.409]	[-16.263]				
Euro area	0.920	0.127	0.133	-0.119			0.981	1.431
	[186.58]	[19.611]	[25.518]	[-25.997]				

Determinant Residual Covariance	U.S.: 2.31E-20, Euro area: 7.88E-23
J-Statistic [p-val]	U.S.: 0.129 [0.999], Euro area: 0.215[0.999]

on standard New Keynesian Phillips curves as in Galí et al. (2001, p.1256), where nominal wages are assumed to be perfectly flexible and prices depend only on future expected marginal costs.

Also confirming the results of Flaschel and Krolzig (2006) and Flaschel et al. (2006), we find that wage flexibility is greater than price flexibility (with respect to their demand pressure terms in the labor and goods markets, respectively) in both economies (though we have a greater fluctuation amplitude in the capacity utilization than in the employment rate). Additionally we find that the estimated parameter β_{we}, which measures the wage flexibility with respect to labor market developments, is not significantly higher in the United States than in the Euro area, as pointed out by Nickell (1997), if we make use of our proxy variable for the Euro area short term unemployed (which as stated before is the relevant group in the wage bargaining process) instead of using the aggregate unemployment rate.

Concerning the (log of the) wage share, the Blanchard-Katz error correction term, we find a similar influence on the price inflation dynamics in both economies, and a higher effect of this variable on the wage dynamics in Europe is observable, confirming the empirical findings of Blanchard and Katz (1999). Income distribution, thus, seems to play indeed a more important role in the determination of wage inflation in Euro area than in the United States. By contrast, while the growth rate of labor productivity appears to influence positively, in a significant way and to a similar extent the wage inflation rate in the two economies (the parameter estimates equal 0.262 for the U.S. and 0.212 for the Euro area), it does not seem to be significant for the price dynamics in both economies.

The estimated effect of a one percent increase of the real interest rate on the dynamics of the capacity utilization (its rate of change) in the U.S. and the Euro area is 0.537 for the U.S. and 0.315 for the Euro area.[21] Concerning the effect of the wage share on the annualized growth rate, we find for the U.S. an estimated reaction of 0.454 and for the Euro area 0.130.

Concerning the role of monetary policy in both economies, our empirical estimates confirm other studies such as Gerlach and Schnabel (2000) and Carstensen (2006), for example, where the validity of the Taylor principle, i.e. of an active interest rate policy with respect to the inflation gap is confirmed, since $\gamma_{ip} = \alpha_i(1 + \alpha_{ip}) > 1$. Additionally, we find for both economies a similar responsiveness of the nominal interest rate to the output gap (proxied by the capacity utilization gap), since $\gamma_{iv} = \alpha_i(1 + \alpha_{iv}) > 1$.

Taken together, these results deliver a insight on the role of interacting price – wage determination. While the New Keynesian approach is based on the assumption that only next period expected values are relevant for the respective wage and price determination, our estimation results deliver a twofold innovation: Indeed, the cross over expectation formation (where future price (wage) inflation influences the future wage (price) inflation rate) as well as the inflationary climate cannot be rejected as significant explaining variables in the wage and price Phillips Curves.

By inserting the estimated values of the structural parameters in the reduced-form price Phillips curve (which must be included at several places in the dynamical system given by eqs. (7), (8), (9) and (10)), a positive and unambiguous dependency of price inflation $\hat{p}$ with respect to capacity utilization u and the (log of the) labor share v for the United States and the Euro area is found (the net effect of the (log

[21]The parameter values reported in table 5 refer to the level of the capacity utilization rate, not to its rate of change.

of the) labor share is 0.099 and 0.026 respectively), so that

$$\hat{p} = f(\underset{+}{u}, \underset{+}{v})$$

Focusing on the three main equations of the dynamical system

$$\begin{aligned}
\hat{v} &= \kappa[(1-\kappa_p)(\beta_{we}(e-\bar{e}) - \beta_{wv}(\ln v - \ln v_o)) \\
&\quad -(1-\kappa_w)(\beta_{pu}(u-\bar{u}) + \beta_{pv}(\ln v - \ln v_o))], \\
\hat{u} &= -\alpha_u(u-\bar{u}) \pm \alpha_v(v-v_o) - \alpha_i((i-\hat{p}) - (i_o - \bar{\pi})), \\
\dot{i} &= -\alpha_i(i-i_o) + \gamma_{ip}(\hat{p} - \bar{\pi}) + \gamma_{iu}(u-\bar{u}),
\end{aligned}$$

these parameter estimates provide us, after their inclusion in the resulting reduced form price Phillips curve of the dynamical system, with the following signs for the 3D Jacobian for the United States and the Euro area,

$$\text{U.S.:} \quad J = \begin{pmatrix} - & + & 0 \\ - & - & - \\ + & + & - \end{pmatrix}$$

$$\text{Euro area:} \quad J = \begin{pmatrix} - & + & 0 \\ - & - & - \\ + & + & - \end{pmatrix}.$$

These Jacobians deliver some additional interesting insights on the macroeconomic interaction of the analysed variables: In the first place we find that, because the trace of both Jacobians is unambiguously negative, the endogenous system variables v, u, i and π^c in both economies do not act per se in a destabilizing manner, implying that both systems are intrinsically stable and that possible unstable scenarios are thus generated by cross-effects. Additionally, the fact that all elements of the estimated Jacobians for the U.S. and the Euro area economies possess the same sign, supports the notion that no significant differences in the basic macroeconomic interaction of the analyzed variables between the U.S. and the Euro area economies can be detected. The calculated influence of the capacity utilization on the labor share, which implies a pro-cyclical income distribution in favor of workers in both economies, is nevertheless very weak in both countries and probably cannot be considered as determining its actual outcome.

Concerning the capacity utilization equation, we find evidence for a principally profit led goods markets dynamics in both countries (determined by the negative sign of J_{21}), a result which supports the Classical point of view, see Goodwin (1967), whereby lower real wages lead to a higher employment and production levels. Taken together, these two empirical findings allow us to identify in table 1 the upper right case as the relevant one for the U.S. and the Euro area economies, where the Rose real wage channel operates in a convergent and therefore not destabilizing manner. Additionally, we find here empirical evidence for the positive influence of the Mundell effect (J_{14}) – which influences aggregate production through the real interest rate channel – in both economies.

In sum the system estimates for the U.S. and the Euro area discussed in this section provide us with a result that confirms the theoretical sign restrictions for both economies. They moreover provide definite answers with respect to the role of income distribution in the considered disequilibrium AS-AD or DAS-DAD dynamics, confirming in particular the orthodox point of view that economic activity is likely to depend negatively on real unit wage costs. We have also a stabilizing effect of real wages on the dynamics of income distribution in the U.S. and the Euro area, in the sense that the growth rate of the real wages, see our reduced form real wage dynamics in section 2, depends – through Blanchard-Katz error correction terms – negatively on its own level. Its dependence on economic activity levels however is somewhat ambiguous, but in any case small. Real wages therefore only weakly increase in the U.S. and the Euro area, with increases in the rate of capacity utilization which in turn however depends in an unambiguous way negatively on the real wage, implying in sum that the Rose (1967) real wage effect is present, but may not dominate the dynamic outcomes in both economies.

5 Conclusions

We have considered in this paper a significant extension and modification of the traditional approach to AS-AD growth dynamics, primarily by means of an appropriate reformulation of the wage-price block of the model, that principally allows us to avoid the empirical weaknesses and theoretical indeterminacy problems of the so-called New Keynesian approach that arise from the existence of only purely forward looking behavior in baseline models of staggered price and wage setting.

The empirical estimation of the structural model equations with aggregate time series data for the U.S. and the Euro area economies, besides of confirming the theoretical signs of the dynamical system, delivered some interesting insights in the similarities and differences of both economies with respect to the analyzed macroeconomic variables. In the first place we found a remarkable similarity in nearly all of the estimated coefficients in the structural equations. This is a somewhat surprising result if we keep in mind that the Euro area became a factual currency union with a unique and centrally determined monetary policy only seven years ago, on January 1^{th} 1999, so that the estimated coefficients reflect only the theoretical values of a, for a long interval of the estimated sample, actually artificial economy. Nevertheless, at the macroeconomic level, the U.S. and the Euro area economies seem to share more common characteristics as usually thought, especially concerning wage flexibility with respect to labor market developments if indeed not the aggregate unemployment rate but only a proxy for the rate of the short term unemployed is used. Furthermore, the high significance of our proxy for the inflationary climate within an economy is operating, as well as of the Blanchard-Katz error correction terms introduced in the wage and price Phillips curve equations of both economies, are empirical findings which relativize in a significant manner way the wage and price modeling as it is based on the "standard" New Keynesian approach. Our overall approach, which may be called a disequilibrium approach to business cycle modeling of mature Keynesian type, thus provides a theoretical framework within the contributions of authors such as Zarnowitz (1999), who also stresses the dynamic interaction of many traditional macroeconomic building blocks, can be reconsidered.

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Appendix

In-Sample One-Period-Ahead Forecasts

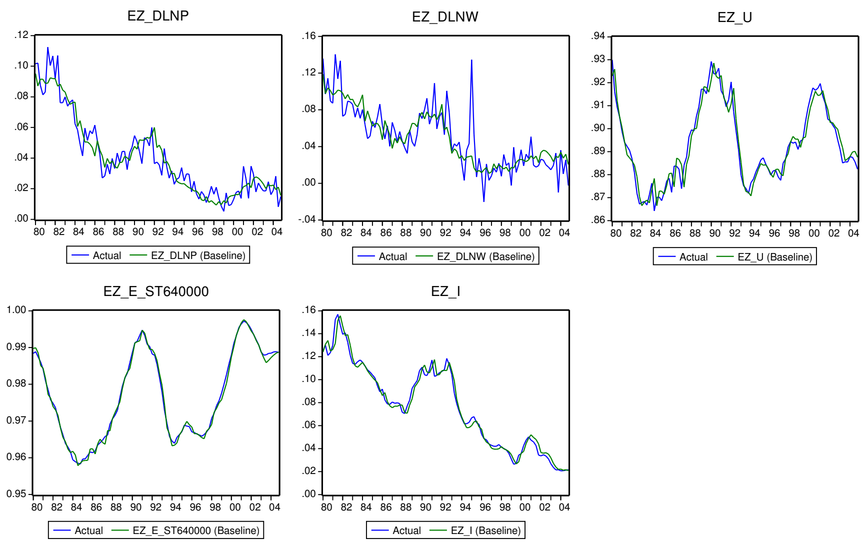

Figure 6: Euro Area In-Sample One-Period-Ahead Forecasts

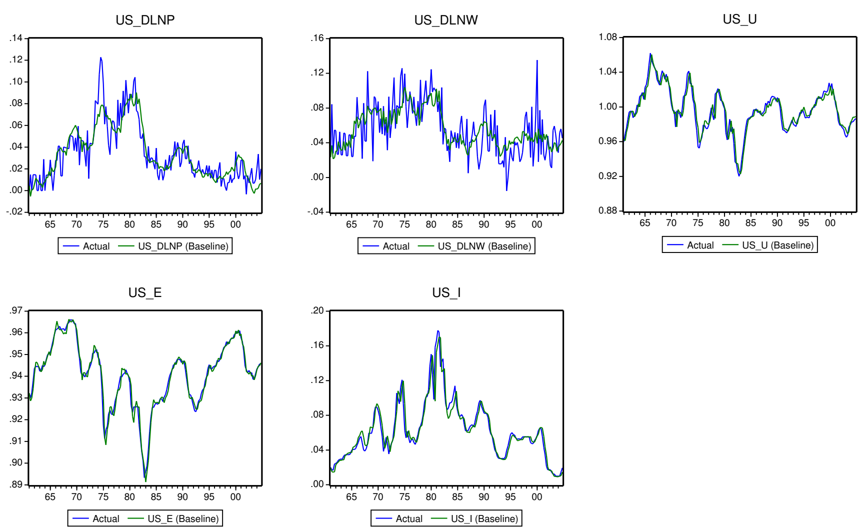

Figure 7: U.S. In-Sample One-Period-Ahead Forecasts

In-Sample Dynamic Forecasts

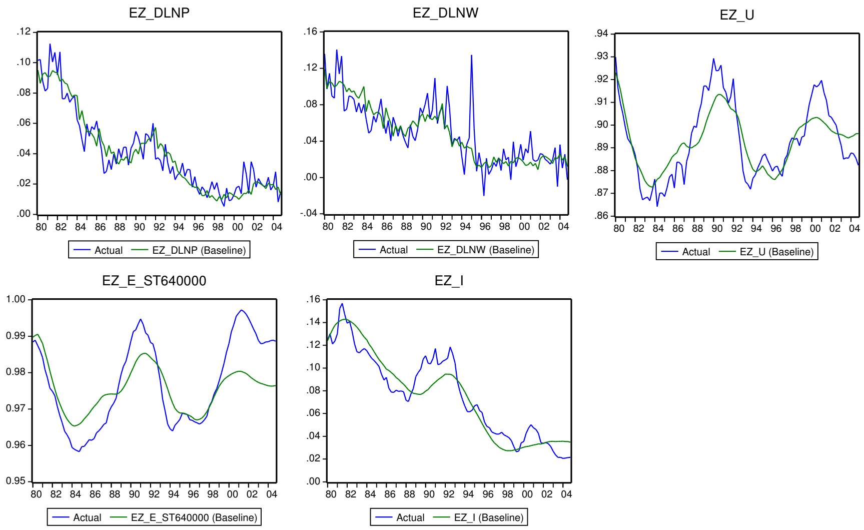

Figure 8: Euro Area Dynamic Forecasts

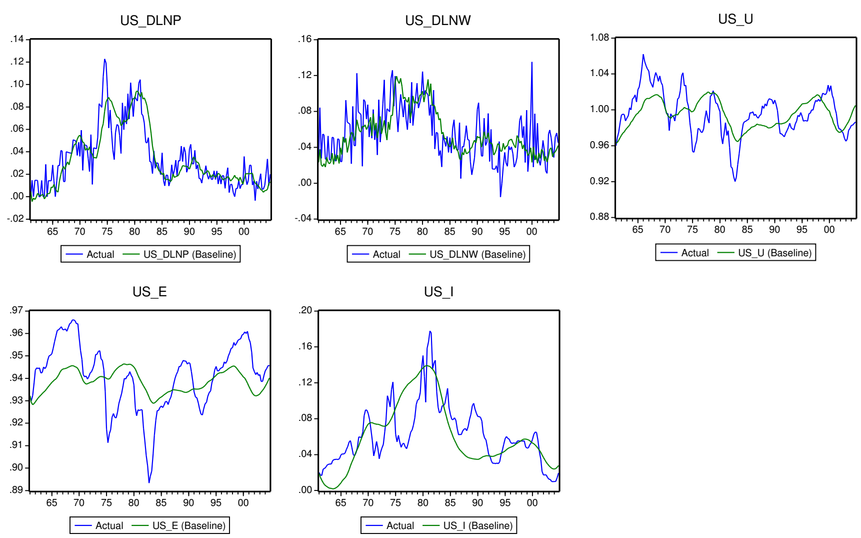

Figure 9: U.S. Dynamic Forecasts