Gradual Wage-Price Adjustments and Keynesian Macrodynamics: Evidence from the U.S. and Major European Countries

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February 15, 2008

Abstract

In this paper an alternative Keynesian macromodel based on gradually adjusting wages and prices and hybrid, cross over inflation expectation formation is discussed and analyzed. The model consists of a wage and a price Phillips curve, a dynamic IS and employment adjustment equations and a Taylor interest rate rule. Through GMM system estimation with aggregate data of the U.S. the euro area as well as the major European economies structural parameter estimates are obtained which support the general specification of the model and show the importance of the Blanchard-Katz error correction terms, and thus of income distribution, for the dynamics of wage and price inflation, and of the macroeconomy as a whole in the analyzed countries.

Keywords: (D)AS-AD, monetary policy, international transmission mechanisms, income distribution.

JEL CLASSIFICATION SYSTEM: E12, E31, F41

1 Introduction

During the last decade Dynamic Stochastic General Equilibrium (DSGE) models in the line of Erceg, Henderson and Levin (2000), Smets and Wouters (2003) and Christiano, Eichenbaum and Evans (2005) have become the workhorse framework for the study of monetary policy and inflation in the academic literature. Based on solid microfoundations, the representation of the dynamics of the economy by theoretical frameworks of this type is derived from first principles (which result from a rational, forward-looking maximizing behavior by firms and households) and the condition of general equilibrium holding at every moment in time. However, though intellectually appealing at first sight, this approach has nevertheless been questioned from both the theoretical and empirical point of view by a numerous amount of researchers like Mankiw (2001), Estrella and Fuhrer (2002) and Solow (2004), among others, primarily due to its highly unrealistic assumptions concerning the alleged "rationality" in the forward-looking behavior of the economic agents. 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 have, despite their sound microfoundations, only a poor performance in fitting the predictions generated by the underlying theoretical models of this approach with aggregate time series of both the United States and the euro area. As Mankiw (2001) states, "although the new Keynesian Phillips curve has many virtues, it also has one striking vice: It is completely at odds with the facts".

Alternatively, in Chiarella and Flaschel (1996) and Chiarella and Flaschel (2000) a theoretical macroeconomic framework has been proposed where wages and prices react sluggishly to disequilibrium situations in both the goods and labor markets. As it will be discussed in this paper, despite of the apparent similarity that the gradual wage and price inflation adjustment equations along the lines of Chiarella and Flaschel (2000) share with their recent New Keynesian and DSGE analogues (which, among other things, also include elements of forward and backward looking behavior concerning the inflation dynamics of the economy), their approach is based on the notion of non-clearing goods and labor markets, and therefore of underutilized labor and capital stock. This alternative approach to the modeling of wage and price inflation dynamics thus permits an interesting comparison to New Keynesian work which, knowingly, models the dynamics of wage and price inflation as the result of the reoptimization by the economic agents under a staggered wage and price setting

mostly in the line of Rotemberg (1982) and Calvo (1983).

In this paper the semi-structural baseline Disequilibrium AS-AD model discussed in Chen, Chiarella, Flaschel and Semmler (2006) is described and estimated using aggregate macroeconomic time series not only of the U.S. economy, but also of the Euro Area, the U.K., Germany and France. On this basis, some of the questions to be addressed in this paper are: To what extent is this semi-structural Keynesian macroeconomic model able to fit the behavior of wages, prices and other macroeconomic variables in the major industrialized economies? Are there significant differences in wage and price inflation (the wage-price spiral) among these economies observable over the past twenty years? Of the main Keynesian transmission channels, which ones are functioning and how strong are they in the analyzed countries? What are the implications of the wage-price spiral for the dynamics of income distribution in those economies?

The remainder of this paper is organized as follows. In section 2 the Keynesian semi-structural macroeconomic framework introduced in Chen et al. (2006) is briefly discussed and its main conceptual differences from to the New Keynesian approach are highlighted. In section 4 the model is estimated by means of GMM with aggregate time series of the U.S., the Euro Area, the U.K., Germany and France in order to find out sign and size restrictions for its behavioral equations and to study which feedback mechanisms may have primarily influenced these economies in the past twenty years. Section 5 focuses on the eigen-value stability analysis of the system. Section 6 concludes.

2   A Baseline Semi-Structural Macromodel

In this section the baseline Keynesian macromodel introduced in Chen et al. (2006) is briefly presented. As it will be discussed in more detail below, this theoretical framework builds on gradual wage and price inflation adjustments as recent New Keynesian macroeconometric models, but assumes in contrast to those models that such adjustments are not the result of the agents' reoptimization to new economic conditions, but instead occur as a reaction to disequilibrium situations in both the goods and the labor markets.

2.1 The Goods and Labor Markets

Since the focus of this theoretical framework is indeed the modeling of the wage-price dynamics, the goods and labor markets are modeled in a rather parsimonious manner. Concerning the goods markets dynamics, a dynamic IS-equation is assumed (see also Rudebusch and Svensson (1999) in this regard) where the growth rate of output gap (represented by the growth rate of the capacity utilization rate of firms u) is determined by

$$\hat{u} = -\alpha_u(u - u_o) + \alpha_v(v - v_o) - \alpha_r((i - \hat{p}) - (i_o - \pi_o)), \tag{1}$$

Eq.(1) has three important characteristics; (i) it reflects the dependence of output changes on aggregate income 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 joint parameter may in the aggregate be positive ($\alpha_v > 0$) or negative ($\alpha_v < 0$), depending on whether consumption or investment is more responsive to real wage changes[1] – and finally (iii) it shows the negative influence of the real rate of interest on the evolution of economic activity.

Concerning the labor market dynamics, a simple empirical relationship is assumed which links output and employment (in hours) according to

$$e_h/e_o^h = (u/u_o)^b.$$

Consequently, the growth rate of employment (in hours) is accordingly given by

$$\hat{e}^h = b\,\hat{u}. \tag{2}$$

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 European economies (this series is available only for the U.S.) and for the sake of comparability of the parameter estimates in the next section, it will be assumed here that the dynamics of employment in hours and actual employment are quite similar, so that eq.(2) in fact describes the dynamics of actual employment e, so that $\hat{e} = b\,\hat{u}$ holds.

2.2 The Wage-Price Dynamics

As stated before, the core of our theoretical framework, which allows for non-clearing labor and goods markets and therefore for under- or over- utilized labor and cap-

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[1] This simplifying formulation helps to avoid the estimation of separate equations for consumption and investment.

ital stock, is the modeling of wage-price dynamics, as being specified through two separate Phillips Curves, each one led by its own measure of demand pressure (or capacity bottlenecks), instead of a single one as is usually done in many New Keynesian models as for example by Galí and Gertler (1999) and Galí, Gertler and López-Salido (2001).

The approach of estimating two separate wage and price Phillips curves is not altogether new: While Barro (1994) 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 equations, 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, using nevertheless a single demand pressure term, the NAIRU gap. In contrast, 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 $e - e_o$ and $u - u_o$, respectively,[2] the identification problem pointed out by Sims (1987) for the estimation of separate wage and price equations with the same explanatory variables is circumvented.[3] By these means, the dynamics of the real wages in the economy can be analyzed and converse effects which might result from different developments on labor and goods markets can be identified.

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

$$\hat{w} = \beta_{we}(e - e_o) - \beta_{wv}\ln(v/v_o) + \kappa_{wp}\hat{p} + (1 - \kappa_{wp})\pi_c + \kappa_{wz}\hat{z}, \quad (3)$$

$$\hat{p} = \beta_{pu}(u - u_o) + \beta_{pv}\ln(v/v_o) + \kappa_{pw}(\hat{w} - \hat{z}) + (1 - \kappa_{pw})\pi_c. \quad (4)$$

where $\hat{w} = \dot{w}/w$ and $\hat{p} = \dot{p}/p$ denote the growth rates of nominal wages and prices, respectively, that is, the wage and price inflation rates. The demand pressure terms $e - e_o$ and $u - u_o$ in the wage and price Phillips Curves are augmented by three additional terms: the log of the wage share v or real unit labor costs (the error correction term discussed in Blanchard and Katz (1999, p.71)), a weighted average of corresponding expected cost-pressure terms, assumed to be model-consistent, with forward looking, cross-over wage and price inflation rates $\hat{w}$ and $\hat{p}$, respectively, and a backward looking measure of the prevailing inertial inflation in the economy (the

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[2]hereby e denotes the rate of employment in the labor market (e_o being the NAIRU-level of this rate) and u the rate of capacity utilization of the capital stock –knowingly closely linked with the output gap– (u_o being its normal level).

[3]See Erceg et al. (2000) and Sbordone (2004) for other alternative approaches.

"inflationary climate", so to say) symbolized by π_c, and labor productivity growth $\hat{z}$ (which is expected to influence wages in a positive and prices in a negative manner, due to the associated easing in production cost pressure). Concerning the latter variable we assume for simplicity that it is always equal to the growth rate of trend productivity, namely $\hat{z} = g_z =$ const.[4]

Concerning the inertial inflation term, this may be formed adaptively following the actual rate of inflation (by use of some linear or exponential weighting scheme), a rolling sample (with bell-shaped weighting schemes), or other possibilities for updating expectations. For simplicity of exposition the use of a conventional adaptive expectations mechanism will be assumed in the theoretical part of this paper, namely

$$\dot{\pi}_c = \beta_{\pi_c}(\hat{p} - \pi_c). \tag{5}$$

Note that here the Chiarella and Flaschel (1996) approach differs again from the standard New Keynesian framework based on the work by Rotemberg (1982) 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), which includes the effects of lagged inflation, it assumes that instead of last period inflation, the medium run inflationary development in the economy is taken into account by the economic agents.

The microfoundations of the 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.(3) and eq.(4) 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 an economic motivation for the inclusion of – indeed the logarithm of – the real wage (or wage share) with negative sign in the wage PC and with positive sign in the price PC is obtained, without any need for loglinear approximations. Furthermore the employment- and the output gap are incorporated in these two wage- and price-Phillips Curves equations, respectively, in the place of a single measure (the log of the output gap). This 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 a valid alternative to the – at least empirically

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[4]Even though explicitly formulated, we will assume in the theoretical framework of this paper $g_z = 0$ for simplicity and leave the modeling of the labor productivity growth for future research.

questionable – New Keynesian formulation of wage-price dynamics.

Note additionally, that model-consistent expectations with respect to short-run wage and price inflation are assumed, incorporated into the Phillips curves in a cross-over manner, with perfectly foreseen price- in the wage- and wage inflation in the price-inflation adjustment equations. It should be stressed that forward-looking behavior is indeed incorporated here, without the need for an application of the jump variable technique of the rational expectations school in general and of the New Keynesian approach in particular .[5]

Slightly different versions of the two Phillips curves given by eq.(3) and eq.(4) have been estimated for the U.S. economy in various ways in Flaschel and Krolzig (2006), Flaschel, Kauermann and Semmler (2007), Chen and Flaschel (2006) and Chen et al. (2006), and have been found to represent a significant improvement over the conventional single reduced-form Phillips curve. A particular finding of these studies is that wage flexibility is larger than price flexibility with respect to their demand pressure measures in the labor and goods markets,[6] respectively, and that workers are more short-sighted than firms with respect to their cost pressure terms.

The corresponding across-markets or *reduced-form Phillips Curve* equations resulting from eqs.(1) and (2) are given by (with $\kappa = 1/(1 - \kappa_{wp}\kappa_{pw})$):

$$\hat{w} = \kappa \left[\beta_{we}(e - e_o) - \beta_{wv}\ln(v/v_o) + \kappa_{wp}(\beta_{pu}(u - u_o) + \beta_{pv}\ln(v/v_o)) \right.$$
$$\left. + (\kappa_{wz} - \kappa_{wp}\kappa_{pw})g_z \right] + \pi_c, \tag{6}$$
$$\hat{p} = \kappa \left[\beta_{pu}(u - u_o) + \beta_{pv}\ln(v/v_o) + \kappa_{pw}(\beta_{we}(e - e_o) - \beta_{wv}\ln(v/v_o)) \right.$$
$$\left. + \kappa_{pw}(\kappa_{wz} - 1)g_z \right] + \pi_c, \tag{7}$$

with pass-through terms behind the $\kappa_{wp}, \kappa_{pw}-$parameters, representing 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 this current version of the wage-price spiral, the inflationary climate variable π_c does not matter for the evolution of the labor share $v = w/(pz)$, which

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[5] For a detailed comparison with the New Keynesian alternative to this model type see Chiarella, Flaschel and Franke (2005).

[6] 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.

law of motion is given by :

$$
\begin{aligned}
\hat{v} &= \hat{w} - \hat{p} - \hat{z} \\
&= \kappa \left[(1 - \kappa_{pw})(\beta_{we}(e - e_o) - \beta_{wv}\ln(v/v_o)) - (1 - \kappa_{wp})(\beta_{pu}(u - u_o) \right. \\
&\quad \left. + \beta_{pv}\ln(v/v_o)) + (\kappa_{wz} - 1)(1 - \kappa_{pw})g_z \right].
\end{aligned}
\tag{8}
$$

Eq.(8) shows the ambiguity of the stabilizing property of the real wage channel discussed by Rose (1967) which arises – despite 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 linked to the behavior of output and if inflationary cross-over expectations are incorporated in both Phillips curves. Indeed, as illustrated in Figure 1, a real wage increase can act, taken by itself, in a stabilizing or destabilizing manner, depending on whether the output dynamics depend positively or negatively on the real wage (i.e. if consumption reacts more strongly than investment or vice versa) *and* on whether price flexibility is larger than nominal wage flexibility with respect to its own demand pressure measure.
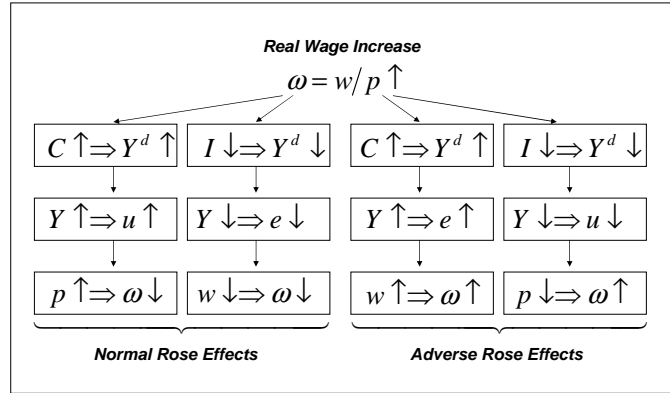

Figure 1: Normal (Convergent) and Adverse (Divergent) Rose Effects: The Real Wage Channel of Keynesian Macrodynamics

These four different scenarios can be jointly summarized as in Table 1. As Table 1 clearly shows, the combination of these four possibilities sets up four different scenarios where the dynamics of the real wage (in their interaction with the goods and labor markets) might turn out to be *per se* convergent or divergent. As it can be observed in Figure 1, there exist two cases where the Rose (1967) real wage channel operates in a stabilizing manner: In the first case, aggregate goods demand

(approximated in this framework by the output gap) depends negatively on the real wage, which can be denoted in a closed economy as the profit-led case[7] – and the dynamics 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 inflation dynamics (and therefore the goods markets) determine primarily the behavior of the real wages.[8]

Table 1: Four Baseline Real Wage Adjustment Scenarios

	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)

One of the goals of this paper will thus be the categorization within this setup of the real wage dynamics in the U.S. and the euro area.

2.3 Monetary Policy

Concerning monetary policy, the nominal interest rate is endogenized by using a simple Taylor rule as is customary in the literature, see 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 paid 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."[9] 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

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[7]In an open economy other macroeconomic channels, such as the real exchange rate channel, would also be influenced by the real wage and in turn influence aggregate demand dynamics, so that the designation "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 designation used in Table 1.

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

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

as

$$i_{\mathrm{T}} = (i_o - \pi_o) + \hat{p} + \phi_\pi(\hat{p} - \pi_o) + \phi_y(u - u_o)$$
$$\dot{i} = \alpha_i(i_{\mathrm{T}} - i).$$

The target rate of the central bank i_{T} is thus assumed here to depend on the steady state real rate of interest $i_o - \pi_o$ augmented by actual inflation back to a nominal rate, and as usual also on the inflation and on the output gap.[10] With respect to this target there are interest rate smoothing dynamics with strength α_i. Inserting i_{T} and rearranging terms we obtain from this expression the following dynamic law for the nominal interest rate

$$\dot{i} = -\alpha_i(i - i_o) + \gamma_\pi(\hat{p} - \pi_o) + \gamma_y(u - u_o) \tag{9}$$

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

Furthermore, the actual (perfectly foreseen) rate of inflation $\hat{p}$ is used to measure the inflation gap with respect to the inflation target π_o of the central bank. Note finally that a new kind of gap, namely the labor share gap, could have included into the above Taylor rule since in this model aggregate demand depends on income distribution (and therefore on the labor share), so that the state of income distribution matters to the dynamics of the model and thus should also play a role in the decisions of the central bank. However this has not been done here.

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):[11]

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[10]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.

[11]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 that it is the monetary authority that enforces a certain steady state value for the nominal rate of interest.

The Model

$$\hat{v} \overset{LaborShare}{=} \kappa[(1 - \kappa_{pw})(\beta_{we}(e - e_o) - \beta_{wv}\ln(v/v_o))$$
$$- (1 - \kappa_{wp})(\beta_{pu}(u - u_o) + \beta_{pv}\ln(v/v_o)) + \delta g_z], \qquad (10)$$
$$\text{with } \delta = (\kappa_{wz} - 1)(1 - \kappa_{pw})$$

$$\hat{u} \overset{Dyn.IS}{=} -\alpha_u(u - u_o) + \alpha_v(v - v_o) - \alpha_r((i - \hat{p}) - (i_o - \pi_o)), \qquad (11)$$

$$\dot{i} \overset{T.Rule}{=} -\alpha_i(i - i_o) + \gamma_{ip}(\hat{p} - \pi_o) + \gamma_{iu}(u - u_o), \qquad (12)$$

$$\dot{\pi}_c \overset{I.Climate}{=} \beta_{\pi_c}(\hat{p} - \pi_c) \qquad (13)$$

$$\hat{e} \overset{O.Law}{=} b\,\hat{u}, \qquad (14)$$

Note that the law of motion given by eq.(10) for the labor share: $\hat{v} = \hat{w} - \hat{p} - \hat{z}$ makes use of the same explanatory variables as the New Keynesian approach but contains inflation rates in the place of their time rates of change and features no accompanying sign reversal concerning the influence of output and wage gaps, as is the case in the 4D baseline New Keynesian models as discussed e.g. in Walsh (2003). Together with the IS goods market dynamics (11), the Taylor Rule (12), the law of motion (13) that describes the updating of the inflationary climate expression and finally Okun's Law (14) as link between the goods and the labor markets, eq.(10) represents a simple theoretical framework which nevertheless features the main transmission channels operating in modern economies. Note that the model can be reduced to a 4D system if the actual level of employment is recovered from eq.(14)by making use of the original formulation of Okun's Law (see the equation preceding eq.(2)), the resulting functional relationship is inserted in the remaining equations of the system. We can thus prescind from eq.(14) (and the influence of e as an endogenous variable) in the stability analysis to be discussed below.

In order to get an autonomous nonlinear system of differential equations in the state variables labor share v, output gap u, the nominal rate of interest i, and the inflationary climate expression π_c, we have to make use of eq. (7) (the reduced-form price Phillips Curve equation). This then has to be inserted into the remaining laws of motion in various places.

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 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, Chen, Chiarella and Flaschel (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 – it was the case that price flexibility was destabilizing, while wage flexibility was not. This real wage channel, summarized in the Figure 1, is not normally discussed in the New Keynesian literature due to the specific form of wage-price and IS dynamics there considered.

3   4D Feedback-Guided Stability Analysis

In this section the local stability properties of the interior steady state of the dynamical system given by eqs.(10)-(13) (with eq.(7) inserted wherever needed) are analyzed through partial considerations from the feedback chains that characterize this empirically oriented baseline model of Keynesian macrodynamics. 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 is known as the Mundell effect. The stronger the Mundell Effect, the faster the inflationary climate adjusts to the present level of price inflation. This is due to the 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 the use of a Taylor rule in the place of the conventional LM curve, it is here implemented in a more direct way towards the stabilization of the economy (coupling nominal interest rates

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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- and Rose-effects in the goods-market dynamics and the converse Blanchard-Katz error correction terms in the reduced form price Phillips curve. There is first of all J_{12}, see eq.(10), the still undetermined influence of the output gap (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.(11), we have J_{21}, the ambiguous influence of the labor share on (the dynamics of) the rate of capacity utilization. This should be a negative relationship if investment is more responsive than consumption to real wage increases and a positive relationship 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.(7). Thus there is an additional, though ambiguous channel through which the labor share affects the dynamics of the output gap on the one hand and the inflationary climate of the economy (J_{41}) through eq.(13) 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 following stability analysis of the D(isequilibrium)AS-AD dynamics. Reduced-form expressions have been employed in the above system of differential equations whenever possible. Thereby a dynamical system in four state variables was obtained that is in a natural or intrinsic way nonlinear (due to its reliance on growth rate formulations). We can see 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 for the original model version and its loss by way of Hopf bifurcations can be found in Asada et al. (2006).

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

Proposition 1:

Assume that the parameter β_{π^c} is 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

$$
\begin{aligned}
\hat{v} &= \kappa[(1 - \kappa_{pw})(\beta_{we}(e(u) - e_o) - \beta_{wv}\ln(v/v_o)) \\
&\quad -(1 - \kappa_{wp})(\beta_{pu}(u - u_o) + \beta_{pv}\ln(v/v_o))], \quad\quad (15) \\
\hat{u} &= -\alpha_u(u - u_o) - \alpha_v(v - v_o) - \alpha_r((i - \hat{p}) - (i_o - \pi_o)), \quad (16) \\
\dot{i} &= -\alpha_i(i - i_o) + \gamma_{ip}(\hat{p} - \pi_o) + \gamma_{iu}(u - u_o), \quad\quad (17)
\end{aligned}
$$

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. ∎

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Proposition 2:

Assume now that the parameter β_{π_c} is positive, but its specific value is chosen sufficiently small, 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)

$$\hat{v} = \kappa[(1 - \kappa_{pw})(\beta_{we}(e(u) - e_o) - \beta_{wv}\ln(v/v_o))$$
$$- (1 - \kappa_{wp})(\beta_{pu}(u - u_o) + \beta_{pv}\ln(v/v_o))], \qquad (18)$$

$$\hat{u} = -\alpha_u(u - u_o) - \alpha_v(v - v_o) - \alpha_i((i - \hat{p}) - (i_o - \pi_o)), \quad (19)$$

$$\dot{i} = -\alpha_i(i - i_o) + \gamma_{ip}(\hat{p} - \pi_o) + \gamma_{iu}(u - u_o), \qquad (20)$$

$$\dot{\pi}^c = \beta_{\pi^c}(\hat{p} - \pi^c) \qquad (21)$$

is locally asymptotically stable.

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

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

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 larger nominal wage- than price level flexibility; and a Taylor rule that stresses inflation targeting are here (for example) the basic ingredients that allow for the proof of local asymptotic stability of the interior steady state of the dynamics (10) – (13).

In order to investigate in more detail the stability properties concerning variations in the parameter values, in the next section the theoretical model discussed here will be estimated with aggregate data of major industrialized economies in order to obtain empirical parameter values. These in turn will serve as baseline parameters in the eigen-value analysis below.

4 Econometric Analysis

In this section the estimation results of the theoretical model of the previous section obtained with aggregate time series data of the U.S., the euro area, the U.K., Germany and France are reported. The objective of these estimations is twofold: On the one hand they are supposed to demonstrate the consistency of theoretical model discussed in the previous section with aggregate empirical data and; on the other hand, to highlight the main similarities and differences of the determinants of wage and price inflation dynamics in these economies.

4.1 Model Estimation

As discussed in the previous section, the law of motion for the real wage rate given by eq.(10) represents a reduced form expression of the two structural equations for $\hat{w}_t$ and $\hat{p}_t$. 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 (3) – (9) can be then reformulated as:

$$\hat{w}_t = \beta_{we}(e_{t-1} - e_o) - \beta_{wv}\ln(v_{t-1}/v_o) + \kappa_{wp}\hat{p}_t + (1 - \kappa_{wp})\pi_t^{12} + \kappa_{wz}\hat{z}_t$$

$$\hat{p}_t = \beta_{pu}(u_{t-1} - u_o) + \beta_{pv}\ln(v_{t-1}/v_o) + \kappa_{pw}(\hat{w}_t - \hat{z}_t) + (1 - \kappa_{pw})\pi_t^{12}$$

$$\ln u_t = \ln u_{t-1} + \alpha_u(u_{t-1} - u_o) - \alpha_{ui}(i_{t-1} - \hat{p}_t) + \alpha_{uv}(v_t - v_o)$$

$$\hat{e}_t = \alpha_{eu-1}\hat{u}_{t-1} + \alpha_{eu-2}\hat{u}_{t-2} + \alpha_{eu-3}\hat{u}_{t-3}$$

$$i_t = \phi_i i_{t-1} + (1 - \phi_i)\phi_{ip}\hat{p}_t + (1 - \phi_i)\phi_{iu}(u_{t-1} - u_o) + \epsilon_{it},$$

with sample means denoted by a subscript o (with the exception of e_o, which is supposed to represent the (eventually time-varying) NAIRU-equivalent employment rate). We estimate this model with time series of the U.S., the Euro Area, the UK, Germany and France. The corresponding time series stem from the Federal Reserve Bank of St. Louis data set (see http:/www.stls.frb.org/fred) for the U.S. and the OECD database for the European countries and the Euro Area as a whole (where also estimates for the U.S. NAIRU are available). The data is quarterly, seasonally adjusted and concerns the period from 1980:1 to 2004:4. The logarithms of wages and prices are denoted by $\ln(w_t)$ 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 $\hat{p}_t$.

As stated above, in eq. (22) $e - e_o$ represents the deviation of the employment rate from its NAIRU consistent level, and not the deviation of the former from

Table 2: Data Description

Variable	Description of the original series
e	Employment Rate
u	Capacity Utilization: Manufacturing, Percent of Capacity
w	Nonfarm Business Sector: Compensation Per Hour, 1992=100
p	Gross Domestic Product: Implicit Price Deflator, 1996=100
z	Output Per Hour of All Persons, 1992=100
v	Real Compensation Per Output Unit, 1992=100
i	Short Term Interest Rate

its sample mean, as it is the case with the other variables. This differentiation is particularly important for the estimation of the European countries, since while the U.S. unemployment rate has fluctuated, roughly speaking, around a constant level (what would suggest a somewhat constant or at least a not all too varying NAIRU) over the last two decades, the European employment (unemployment) rate has displayed a persistent downwards (upwards) trend over the same time period.

This particular European phenomenon has been explained by Layard, Nickell and 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 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, which makes the long-term unemployed less "hirable" for firms, see Pissarides (1992) and Blanchard and Summers (1991). Because the 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.[12] When 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."[13] Indeed, Llaudes (2005) for example, by using a modified wage Phillips curve which incorporates the different influences of

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[12]See Blanchard and Wolfers (2000).
[13]OECD (2002, p.189).

long-and short-term unemployed in the wage determination, finds empirical evidence of the fact that for some OECD countries the long-term unemployed have only a negligible influence on the wage determination.
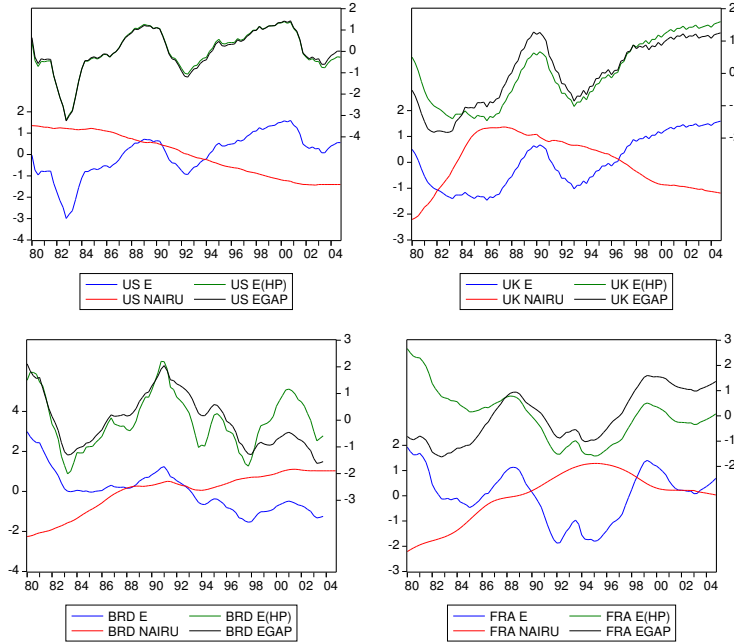

Figure 2: Employment Rate and NAIRU (left axis) and Employment Rate Deviation from NAIRU-consistent Level (HP Methodology and OECD Data) (right axis) (normalized data)

Since time series data for long-term unemployment in the euro area is not available as is the case for the other analyzed countries, we have tried to approximate it in a rather simple way: First we ran the HP-filter on the euro area unemployment rate with a high smoothing factor ($\lambda = 640000$). The resulting smoothed series are then normalized 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) was extremely low on the European continent. This smoothed series can be interpreted 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 the alternative employment

rate measure $e = 1 - u^{st}$ for the euro area is calculated. In Figure (2) the equivalent time series for the U.S., the U.K., Germany and France calculated according to this procedure are contrasted with the actual employment gap,[14] showing that indeed this procedure, though quite simple an ad-hoc, can nevertheless deliver an acceptable proxy for the short-term unemployed in the euro area.[15]

Table 3: Phillips-Perron Unit Root Test Results

			Sample: 1980:1 - 2004:4		
Country	Variable	Lag Length	Determ.	Adj. Test Stat.	Prob.*
	$\hat{p}_t$	1	-.	-2.106	0.034
U.S.	$\hat{w}_t$	1	-	-2.589	0.010
	$d(e_t)$	-	-	-4.909	0.000
	$d(u_t)$	1	-	-7.122	0.000
	i	1	-	-1.856	0.061
	$d\ln(p)$	1	-	-2.362	0.018
Euro area	$d\ln(w)$	1	-	-2.197	0.027
	$d(e)$	1	-	-3.152	0.001
	$d(u)$	1	-	-8.089	0.000
	i	1	-	-1.481	0.129
	$\hat{p}_t$	1	-	-5.289	0.000
U.K.	$\hat{w}_t$	1	-	-3.139	0.002
	$d(e_t)$	1	-	-8.576	0.000
	$d(u_t)$	1	-	-23.695	0.000
	i	1	-	-1.697	0.085
	$\hat{p}_t$	1	-	-3.788	0.000
Germany	$\hat{w}_t$	1	-	-4.386	0.000
	$d(e_t)$	1	-	-3.657	0.000
	$d(u_t)$	1	-	-7.969	0.000
	i	1	-	-1.405	0.148
	$\hat{p}_t$	1	-	-2.316	0.021
France	$\hat{w}_t$	1	-	-2.376	0.018
	$d(e_t)$	1	-	-2.977	0.003
	$d(u_t)$	1	-	-8.494	0.000
	i	1	-	-1.550	0.113

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

In order to test for stationarity, Phillips-Perron unit root tests were carried out for each series in order to account, not only for residual autocorrelation as is done by the standard ADF Tests, but also for possible residual heteroskedasticity when testing for stationarity. The Phillips-Perron test specifications and results are shown

[14]defined as the deviation of the employment rate from the time-varying NAIRU-employment rate calculated by the OECD

[15]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.

in Table 3. As it can be observed there, the applied unit root tests confirm the stationarity of all series with the exception of the short term nominal interest rate i in all countries. Nevertheless, although the Phillips-Perron test on these series cannot reject the null of a unit root, there is no reason to expect both time series to be unit root processes. Indeed, it is reasonable to expect these rates to be constrained to certain limited ranges. Due to the general low power of the unit root tests, these results can be interpreted as providing only a hint of the possibility that the nominal interest rates exhibit a strong autocorrelation.

The discrete time version of the structural model formulated above was estimated by means of instrumental variables system GMM (Generalized Method of Moments).[16] The use of an instrumental variables estimator such as GMM is indeed adequate since it allows for eventual regressor endogeneity to be accounted in the case that some of the explaining variables are not completely exogenous. Additionally, since among the explaining variables contained in our general specification there are also expected future variables, the use of an instrument set composed solely by lagged variables allows for the approximation of expected values of those forward-looking variables on the basis of the information available at time t. In order to test for the validity of the overidentifying restrictions (since we have more instrumental variables as coefficients to be estimated) we calculate the J-statistics as proposed by Hansen (1982).

The weighting matrix in the GMM objective function was chosen 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, 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 were incorporated. In order to test for the validity of the overidentifying restrictions, the $J-$statistics for both system estimations were calculated. We present and discuss the structural parameter estimates for the analyzed economies

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[16] As stated in Wooldridge (2001, p.92), a GMM estimation possesses several advantages in comparison to more traditional estimation methods such as OLS and 2SLS. This is especially true 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 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.

(t-statistics in brackets), as well as the $J-$statistics (p-values in brackets) in the next subsections.

Before discussing the estimation results for each country individually, it should be pointed out at a general level, that the GMM parameter estimates shown in the following tables deliver an empirical support for the theoretical Keynesian disequilibrium model specified in the previous section. This confirms for the Euro Area, UK, Germany and France some of the empirical findings of Flaschel and Krolzig (2006) and Flaschel et al. (2007) for the U.S. economy. Especially, the specification of cross-over inflation expectation terms, with the wage inflation entering in the price Phillips curve and the price inflation entering in the wage Phillips Curve, as well as the inclusion of lagged price inflation (as a proxy for the inflationary climate term) in both equations seems to be supported by the data. Nevertheless, the role of this term in the wage and price inflation determination in the two analyzed economies seems to be somewhat heterogeneous: While for example in the estimated wage Phillips curves for the U.S. and the U.K. the influence of the perfectly foreseen actual price inflation κ_{wp} is around 0.4 and in the Euro area, Germany and France it is around 0.8; in the estimated price Phillips curves the corresponding parameter κ_{pw} is around 0.10 for all economies with the exception of the U.K., where this parameter is around 0.35. The lagged price inflation thus seems to have a predominant role in the price determination by the firms, while actual price inflation apparently influences to a higher extent the dynamics of wage inflation.

Also in line with Flaschel and Krolzig (2006) and Flaschel et al. (2007) the empirical evidence from the analyzed countries suggests that wage flexibility is larger than price flexibility (towards their demand pressure terms in the labor and goods markets, respectively) by and large, in all economies. Concerning the (log of the) wage share, namely the Blanchard-Katz error correction terms, we find by and large statistically significant and numerically similar coefficients in both wage and price adjustment equations with a similar influence on the price inflation dynamics in all analyzed economies and a larger effect of this variable on the wage dynamics in the European countries, confirming (from a qualitative perspective) the empirical findings of Blanchard and Katz (1999).

Next the estimations of the individual countries are discussed in detail.

4.1.1 Estimation Results: U.S. Economy

As stated before, the theoretical model specification discussed in the previous section is confirmed by parameter estimates shown in Table 4 for the U.S. economy. As expected, we find a large responsiveness of wage inflation towards the labor market gap, which is higher than the responsiveness of price inflation towards the goods markets gap. Concerning the (log of the) wage share, statistically significant coefficients (with the expected negative sign in the wage inflation- and the positive sign in the price inflation equations) were estimated. This result contradicts the findings of Blanchard and Katz (1999), which found these coefficients to be significant only in Europe. Concerning the effect of the wage share in the dynamic IS equation

Table 4: GMM Parameter Estimates: U.S.

Estimation Sample: $1980:1 - 2004:4$							
Kernel: Bartlett, Bandwidth: Andrews (2.59)							
$\hat{w}$	β_{we}	β_{wv}	κ_{wp}	κ_{wz}	const.	$\bar{R}^2$	DW
	0.948	-0.234	0.350	0.278	0.016	0.354	1.871
	[12.055]	[5.824]	[3.152]	[8.809]	[11.457]		
$\hat{p}$	β_{pu}	β_{pv}	κ_{pw}	const.		$\bar{R}^2$	DW
	0.293	0.116	0.046	-		0.763	1.263
	[13.277]	[5.107]	[3.167]				
$\hat{u}_t$	α_u	α_{ui}	α_{uv}	const.		$\bar{R}^2$	DW
	-0.077	-0.040	-0.176	0.002		0.902	1.521
	[9.028]	[4.256]	[8.163]	[3.511]			
$\hat{e}$	α_{eu-1}	α_{eu-2}	α_{eu-3}	α_{eu-4}		$\bar{R}^2$	DW
	0.202	0.114	0.040	-		0.387	1.638
	[22.780]	[8.204]	[3.884]				
i	ϕ_i	ϕ_{ip}	ϕ_{iu}			$\bar{R}^2$	DW
	0.831	2.173	0.423			0.929	1.916
	[71.464]	[36.152]	[5.113]				

Determinant Residual Covariance: 7.95E-21   J-Statistic [p-val]: 0.373 [0.975]

represented by the coefficient α_{uv}, a negative and statistically significant influence was found which supports the standard notion that real wage increases lead to a de-acceleration of the economy due to its effects on aggregate investment and on net exports. With respect to the labor market dynamics, the sum of the estimated lagged coefficients of $\hat{u}$ is quite close to 0.3, what also confirms Okun's (1970) notion about the relationship between goods and labor markets. This result is consistent

across all estimated economies with the exception of Germany.

4.1.2 Estimation Results: Euro Area

Concerning the parameter estimates for the Euro Area (shown in Table 5), the main finding is the quite significant and numerically high coefficient of the (log of the) wage share in the wage inflation equation, what corroborates (also from the qualitative perspective) the findings of Blanchard and Katz (1999). But also the numerically

Table 5: GMM Parameter Estimates: Euro Area

| | | | Estimation Sample: $1980:1 - 2004:4$ | | | | |
			Kernel: Bartlett, Bandwidth: Andrews(3.20)				
$\hat{w}$	β_{we}	β_{wv}	κ_{wp}	κ_{wz}	const.	$\bar{R}^2$	DW
	0.346	-0.383	0.886	0.223	0.005	0.692	1.606
	[4.724]	[8.613]	[7.579]	[9.587]	[8.027]		
$\hat{p}$	β_{pu}	β_{pv}	κ_{pw}	const.		$\bar{R}^2$	DW
	0.291	0.089	0.075	-		0.887	1.389
	[9.320]	[3.551]	[4.229]				
$\hat{u}_t$	α_u	α_{ui}	α_{uv}	const.		$\bar{R}^2$	DW
	-0.104	-0.061	-0.238	-0.068		0.926	2.012
	[10.997]	[-6.968]	[-14.889]	[14.622]			
$\hat{e}$	α_{eu-1}	α_{eu-2}	α_{eu-3}	α_{eu-4}		$\bar{R}^2$	DW
	0.128	0.115	0.057	0.159		0.645	1.501
	[28.448]	[19.691]	[7.972]	[14.994]			
i	ϕ_i	ϕ_{ip}	ϕ_{iu}			$\bar{R}^2$	DW
	0.936	1.539	1.782			0.981	1.385
	[105.06]	[15.977]	[6.056]				
Determinant Residual Covariance: 2.18E-22			J-Statistic [p-val]: 0.316 [0.996]				

large (and statistically significant) coefficient of the wage share in the goods markets dynamics equation suggest that the link between the wage share and the dynamics of output might be stronger in the euro area than in the U.S.. In addition, the estimated parameter β_{we} (which measures the wage flexibility with respect to labor market developments) is found to be not significantly higher in the United States than in the euro area, as pointed out by Nickell (1997), if the proxy variable for the euro area short term unemployed (which as stated before is the relevant group in the wage bargaining process) is used instead of the aggregate unemployment rate.

4.1.3 Estimation Results: U.K.

Concerning the model estimation with U.K. time series shown in Table 6, it corroborates the overall formulation of the theoretical model and the related sign restrictions on the variables of the system, delivering by and large similar structural coefficients to those of the U.S. and the euro area. The main differences between the U.K. and

Table 6: GMM Parameter Estimates: U.K.

			Estimation Sample: $1980:1 - 2004:4$				
			Kernel: Bartlett, Bandwidth: Andrews: 2.62				
$\hat{w}$	β_{we}	β_{wv}	κ_{wp}	κ_{wz}	const.	$\bar{R}^2$	DW
	0.345	-0.212	0.289	0.360	0.010	0.589	1.183
	[15.84]	[16.678]	[21.971]	[21.784]	[20.998]		
$\hat{p}$	β_{pu}	β_{pv}	κ_{pw}	const.		$\bar{R}^2$	DW
	0.357	0.219	0.383	-		0.353	2.338
	[4.647]	[7.081]	[16.262]				
$\hat{u}_t$	α_u	α_{ui}	α_{uv}	const.		$\bar{R}^2$	DW
	-0.361	-0.015	-0.095	-		0.426	1.995
	[23.217]	[4.089]	[12.046]				
$\hat{e}$	α_{eu-1}	α_{eu-2}	α_{eu-3}	α_{eu-4}		$\bar{R}^2$	DW
	0.124	0.057	0.122			0.266	1.396
	[33.624]	[9.420]	[26.413]				
i	ϕ_i	ϕ_{ip}	ϕ_{iu}			$\bar{R}^2$	DW
	0.949	0.249	1.181			0.934	1.805
	[221.371]	[4.460]	[6.703]				

Determinant Residual Covariance: 1.91E-21   J-Statistic [p-val]: 0.241 [0.961]

the euro area are the significantly lower values of κ_{wp}, α_{uu} and α_{uv}, as well as the larger value of κ_{pw} compared with the two previous cases. Besides of these differences, an interesting finding in the U.K. estimation is the remarkable similarity in all coefficients in the wage and price inflation equations, what follows from the fact that these two macro-variables have exhibited in the U.K. a quite similar dynamic behavior in the last twenty years.

4.1.4 Estimation Results: Germany

With respect to the Germany estimation, Table 7 shows three main findings which highlight the differences in the dynamics of wage and price inflation in the German

economy with respect to the U.S. and the U.K. In the first place, we have at first

Table 7: GMM Parameter Estimates: Germany

Estimation Sample: $1981:2 - 2003:4$							
Kernel: Bartlett, Bandwidth: Andrews (2.06)							
$\hat{w}$	β_{we}	β_{wv}	κ_{wp}	κ_{wz}	const.	$\bar{R}^2$	DW
	0.809	-0.887	1.149	0.190	0.001	0.371	2.035
	[22.012]	[45.026]	[50.048]	[12.076]	[2.543]		
$\hat{p}$	β_{pu}	β_{pv}	κ_{pw}	const.		$\bar{R}^2$	DW
	0.086	0.199	0.124	0.005		0.427	2.166
	[30.861]	[27.069]	[47.469]	[48.653]			
$\hat{u}_t$	α_u	α_{ui}	α_{uv}	const.		$\bar{R}^2$	DW
	-0.157	-0.044	-0.784	0.002		0.893	1.804
	[57.542]	[7.691]	[75.529]	[7.369]			
$\hat{e}$	α_{eu-1}	α_{eu-2}	α_{eu-3}	α_{eu-4}		$\bar{R}^2$	DW
	0.042	0.031	0.051	-		0.341	0.976
	[31.334]	[25.827]	[32.280]				
i	ϕ_i	ϕ_{ip}	ϕ_{iu}	const.		$\bar{R}^2$	DW
	0.926	0.631	1.195	0.002		0.966	1.309
	[438.31]	[10.827]	[35.775]	[26.713]			
Determinant Residual Covariance: 1.03E-20				J-Statistic [p-val]: 0.476 [0.754]			

glance a counterintuitive finding that wage flexibility towards the labor market gap is indeed of a comparable dimension to that in the U.S.; This, however, becomes understandable when one recalls that it is indeed the deviation of the actual employment rate to its NAIRU-consistent- and not to its long-run average level the variable included in the wage adjustment equation. In the second place, we find a quite high numerical value of β_{wv}, the effect of income distribution on wage inflation, compared to those in the other economies, showing the significant influence of trade unions in the German wage setting. And lastly, the relatively low value of β_{pu} should also be highlighted, which is indeed the lowest among all analyzed countries.

Concerning the dynamics of the capacity utilization rate, particularly interesting is the high numerical value of α_{uv}, which is the reaction coefficient of $\hat{u}$ with respect to the wage share for the German economy. This value, though, should be interpreted not as coming about from the importance of income distribution for the goods markets dynamics, but rather from the clear export-orientation of the German economy. Under this interpretation, a higher wage share leads to a slowdown

of economic activity not due to the predominant decrease of investment over consumption, but rather due to the loss of competitiveness in the international goods markets. And finally, concerning Germany's employment rate dynamics, there are the low values of α_{eu} for several estimated lags, which clearly show the decoupling of the labor and the goods markets in the German economy.

4.1.5 Estimation Results: France

The estimated French parameter values (shown in Table 8), are also consistent with the parameter values obtained from the other economies, corroborating again the empirical validity of the present model specification. Particularly we find highly

Table 8: GMM Parameter Estimates: France

Estimation Sample: $1980:1 - 2004:4$							
Kernel: Bartlett, Bandwidth: Andrews (4.87)							
$\hat{w}$	β_{we}	β_{wv}	κ_{wp}	κ_{wz}	const.	$\bar{R}^2$	DW
	0.354	0.109	0.745	0.025	0.027	0.767	1.434
	[16.701]	[5.627]	[23.770]	[1.628]	[27.857]		
$\hat{p}$	β_{pu}	β_{pv}	κ_{pw}	const.		$\bar{R}^2$	DW
	0.403	0.158	0.070	-		0.888	1.172
	[31.699]	[12.668]	[7.028]				
$\hat{u}_t$	α_u	α_{ui}	α_{uv}	const.		$\bar{R}^2$	DW
	-0.113	-0.026	-0.047	0.001		0.906	1.609
	[17.295]	[9.983]	[25.074]	[7.605]			
$\hat{e}$	α_{eu-1}	α_{eu-2}	α_{eu-3}	α_{eu-4}		$\bar{R}^2$	DW
	0.209	0.188	0.106	-		0.436	0.689
	[31.442]	[25.941]	[12.588]				
i	ϕ_i	ϕ_{ip}	ϕ_{iu}			$\bar{R}^2$	DW
	0.935	1.236	1.649			0.958	1.716
	[214.86]	[20.367]	[7.697]				
Determinant Residual Covariance: 2.00E-21			J-Statistic [p-val]: 0.217 [0.975]				

significant coefficients of the cross-over inflation expectations terms in both wage and price inflation adjustment equations. Again, the coefficient κ_{wp} is found to be higher than κ_{pw}, as it was the case in all analyzed countries with the U.K. as the sole exception.

The main particularity in Table 8 is, however, that the estimation with French

aggregate data delivers the Blanchard-Katz error correction terms coefficients with the lowest numerical values (though statistically significant) of all economies, and that the corresponding coefficient of the wage share in the goods markets equation is also the lowest estimated. Income distribution, though, seems to play a lesser role for both the dynamics of wage and price inflation in a direct manner as well as in an indirect manner through its effect on the dynamics of the capacity utilization rate.

5 Eigen-Value Stability Analysis

After having obtained empirical numerical values for the parameters of the theoretical model, in this section the effect of parameter value variations –and especially of wage-and price flexibility– for the stability of the economic system is further investigated.[17] For this, following Chen et al. (2006), I focus on the effect of parameter variations for the maximum value of the real parts of the eigenvalues of the model using exemplarily the estimated parameters of the U.S. economy.[18]

These maximum eigen-value diagrams concerning variations in the structural parameters of the wage-price module are depicted in Figure 3. They clearly show in a graphical manner what was indeed proven in the local stability analysis of section 3, namely the relevance of the cross-over inflation expectations terms κ_{pw} and κ_{wp} in both wage and price Phillips Curves, of the degree of price flexibility to goods markets disequilibria β_{pu} as well as of the adjustment speed of the inflationary climate variable β_{π^c} for the stability of the system.

Indeed, in Figure 3 we can clearly observe that higher values of these parameters lead ceteris paribus to a loss of local stability of the steady state of the system. This leads to the conclusion that a somehow sluggish adjustment of the system variables is indeed needed to ensure local stability if the dynamics of the system are not driven by the rational expectations assumption, where possible unstable paths are simply not possible by definition.[19]

Concerning the parameters determining the goods markets dynamics, the second panel in the first row of figure 4 shows the destabilizing influence of Mundell-Effect, which would increase for higher values of the goods markets real interest rate sen-

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[17]The calculations underlying the plots in this section were performed using the SND package described in Chiarella, Flaschel, Khomin and Zhu (2002).

[18]An analogous analysis was also performed using the estimated parameters of the other countries which led to similar conclusions. These graphs are available upon request.

[19]See Flaschel, Groh, Proaño and Semmler (2008, ch.1) for an extensive discussion of this issue.
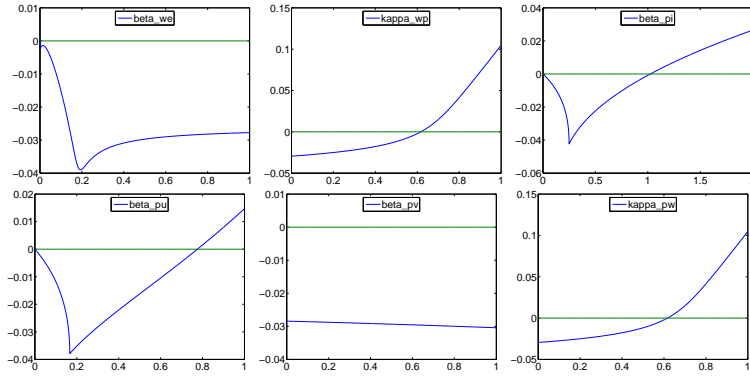
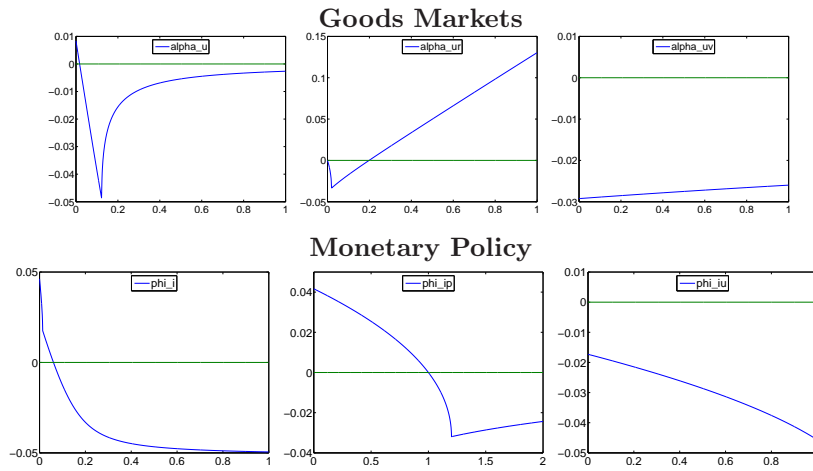Figure 3: Eigen-Value-based Stability Analysis: Wage-Price Dynamics

Figure 4: Eigen-Value Stability Analysis: Goods Markets Dynamics and Monetary Policy

sitivity parameter α_{ur}. As expected, the monetary policy parameters, shown in the second row of figure 4, confirm two standard notions in the monetary policy literature (see e.g. Woodford (2003)): First, that a too large interest rate smoothing term might reduce the effectiveness of monetary policy and, second, that the validity of the Taylor principle, i.e. of a sufficiently active interest rate policy (what implies $\phi_{ip} = \phi_{ip}/(1 - \phi_i) - 1 > 0$) is central for the stability of the economy.

6 Concluding Remarks

In this paper a significant extension and modification of the traditional approach to AS-AD growth dynamics developed by Chen et al. (2006) was discussed and estimated with aggregate time series of the main industrialized countries.

The various estimations of the structural model equations for the different economies, besides confirming the theoretical sign restrictions of the dynamical system, delivered some interesting insights into the similarities and differences of both economies with respect to the analyzed macroeconomic variables. In the first place a remarkable similarity in nearly all of the estimated coefficients in the structural equations was found. For the euro area this is indeed a rather 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 eight years ago, on January 1999, so that for a long interval of the estimated sample the estimated coefficients reflect only the theoretical values of an artificial economy. Nonetheless, the euro area and all other analyzed economies seem to share more common characteristics than is commonly believed, specially concerning the wage inflation reaction to labor market developments, once a proxy for the rate of short term unemployed rather than the aggregate unemployment rate is taken into account.

Taken together, these results deliver a different perspective on the dynamics of wage and price inflation. While the alternative New Keynesian approach is based on the assumption that primarily future expected values are relevant for the respective wage and price determination, the estimation results of this paper deliver empirical support for an alternative specification of the wage-price inflation dynamics. Indeed, the cross over expectation formation (where current price (wage) inflation influences the current wage (price) inflation rate) as well as the inflationary climate cannot be rejected as significant explanatory variables in the wage and price Phillips Curves. In sum, the system estimates for all analyzed countries discussed in the previous section provide empirical evidence that supports the theoretical sign restrictions in all economies. They, moreover, provide more clear answers with respect to the role of income distribution in the considered disequilibrium AS-AD or DAS-AD dynamics. In particular, they also confirm 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 depends – through Blanchard-Katz error correction terms – negatively on its own level.

More empirical work is indeed needed in order to check for the model's parameter stability and so to account Lucas's (1976) Critique. However, given the empirical cross-country evidence discussed in this paper, this framework (which may be called a disequilibrium approach to business cycle modeling of mature Keynesian type) seems to provide an interesting alternative to the DSGE framework for the study of monetary policy and inflation dynamics.

A   The Time Series Data

As previously stated, the time series data used in the econometric estimations of this paper stem from the FRED database of the Federal Reserve Bank of St. Louis for the U.S. and the OECD database for the euro area and the individual European countries. DLNP and DLNW denote price and nominal wage inflation rates, respectively, **u** the capacity utilization rate (or output gap, when the former to available), **e** the deviation of the actual employment rate from its NAIRU-equivalent, **v** the HP cyclical component of the wage share and **i** the short term nominal interest rate.

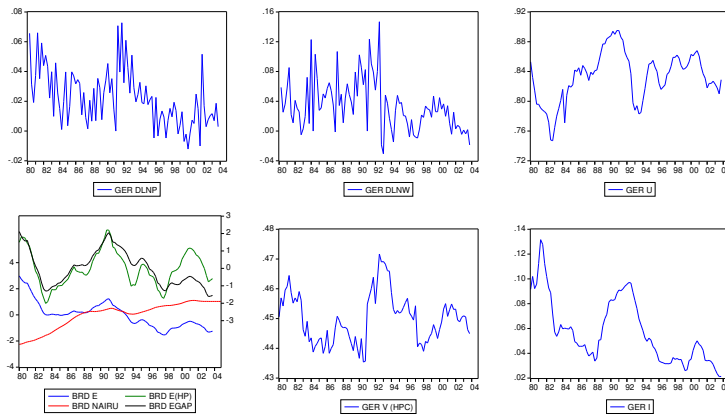Time Series: U.S. Economy
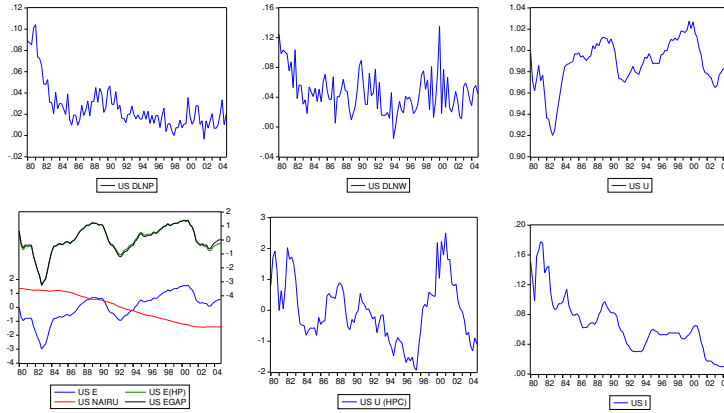
Time Series: Euro Area
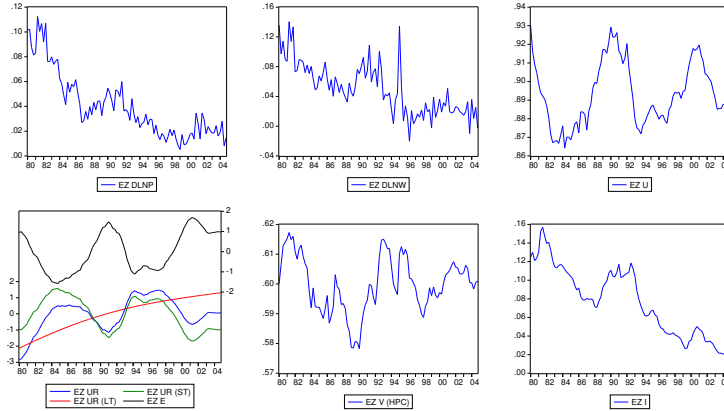
Note: In the first panel in the second row UR stands for the unemployment rate, LT for long-term, ST for short term (calculated through the procedure discussed in this paper) and E the resulting deviation of the employment rate from its NAIRU-equivalent.
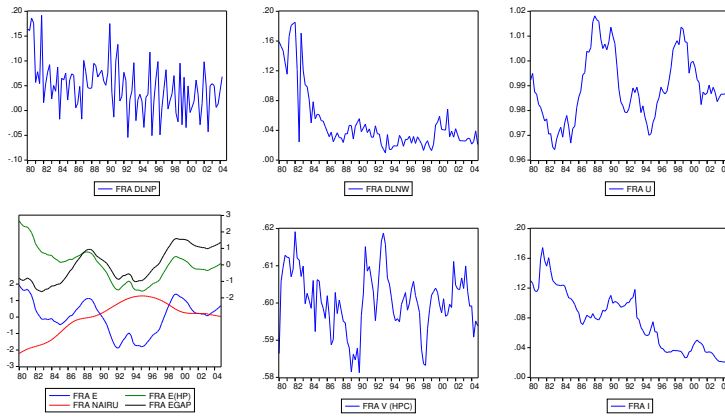
Time Series: U.K.
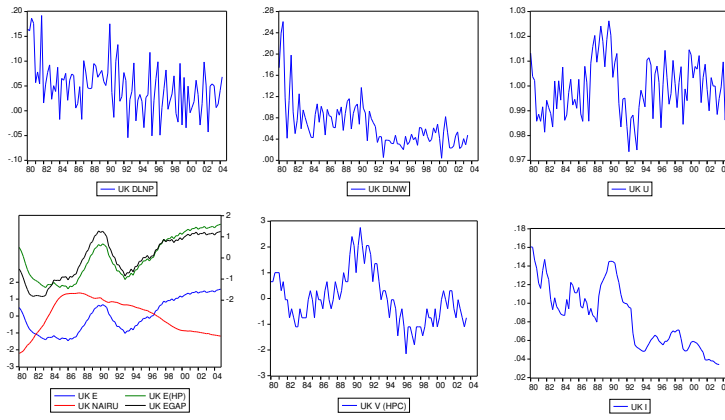
Time Series: Germany

Time Series: France

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