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Annabelle Mourougane and Lukas Vogel

The Impact of Selected Structural Reforms: Speed of Adjustment and Distributional Effects

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THE IMPACT OF SELECTED STRUCTURAL REFORMS: SPEED OF ADJUSTMENT AND DISTRIBUTIONAL EFFECTS

By Annabelle Mourougane and Lukas Vogel[1]

1. Introduction and main findings

1. The long-term impact of labour market reforms on economic performance has been studied in depth, in particular in the context of the revisited 2006 OECD *Jobs Strategy*. The impact of institutions on adjustment to temporary shocks is also well-documented (Duval *et al.*, 2007; Ernst *et al.*, 2007; Inklaar and Timmer, 2006). By contrast, only very few analyses have focused on transitional effects of structural reforms and adjustments from one steady state to another. It is indeed not easy to disentangle effects coming from a shift in the steady state from transitional dynamic effects. The lack of analysis also reflects the limited temporal dimension of institutional variables.

2. Still, analysing the adjustment path is important for political economy reasons. It gives an idea of the time needed to see the impact of reforms on economic performance and the amplitude of the short-term transition costs, thereby putting long-term benefits in perspective. Having a clearer idea of the adjustment lags associated with structural policies is also useful for macroeconomic stabilisation decisions and helps policymakers gauge the complementarities between structural adjustment and monetary or fiscal accommodation.

3. Against this background, this paper examines the nature and the length of economic adjustment to selected structural reforms, drawing on a variety of approaches. *First*, the impact of institutional reforms on equilibrium unemployment is analysed through simple descriptive analyses. *Second*, simulations using two different types of models, namely small macro-economic neo-Keynesian models and a micro-founded dynamic general equilibrium (DGE) model, give insight on how existing rigidities in labour and product markets and characteristics of financial markets affect the pace of adjustment to structural reforms. They also help to quantify the impact of monetary policy reaction on the speed of adjustment and illustrate the distributional effects of labour market reforms.

4. The main conclusions are the following:

- The descriptive analysis suggests that the impact of labour market reforms, including a change in the tax wedge, the replacement ratio or anti-competitive product market regulation[2] on structural unemployment is very gradual and peak only after 5 to 10 years.

- Employment adjustment costs appear to have only a limited effect on the pace of adjustment to labour market reforms and the influence of price adjustment costs on output dynamics is found to be marginal. This result is robust to the choice of the policy variables (income tax, benefit

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2. Evidence of complementarities between product and labour market reforms can be found in Nicoletti and Scarpetta (2005).

replacement rate or employer social security contributions) and holds for both neo-Keynesian and DGE-based simulations.

- Full access to well-performing financial markets will also affect adjustment speed by easing firms and household liquidity constraints. DGE-based simulations suggest however that the presence of liquidity-constrained households would be partly offset by a stronger monetary policy reaction. The final effect on the adjustment of real variables would be limited. By omitting capital adjustments, these simulations may nonetheless underestimate the effects of easing household liquidity constraints on adjustment to structural reforms.

- Macro-economic policy can have a sizable impact on the magnitude of short-term transition costs. In particular, monetary policy reaction can speed up the adjustment to a new equilibrium though to a varying degree in the different OECD countries or regions. Reforms in individual euro area countries are likely to trigger only little or no policy reaction, unless there is an area-wide effort to implement structural reforms. The speed of adjustment is found to be faster in the United States than in the euro area, reflecting mostly a higher sensitivity of domestic demand to real interest rates. This result appears to be robust to the choice of the euro area monetary policy reaction.

- The size of international economic spillovers of structural reforms is found to be very small.

- Although the examined labour market reforms are estimated to boost *aggregate* consumption and output immediately after implementation, they are the source of substantial distributional effects. Liquidity-constrained households may incur transitional losses after a cut in the benefit replacement ratio. But a suitable compensation scheme could reduce these potential short-term losses. A reduction in income tax rates or employer social security contributions would not involve transitory losses for liquidity-constrained households.

2. Modelling the short-term impact of structural reforms

5. There is little analysis on the short-term impact of structural reforms on economic performance, the main reason being the limited temporal variation of institutional variables. Studies based on single-equation cross-country panel estimations or industry-level difference-in-differences approaches have been widely used in the literature (Belot and van Ours, 2001; Bassanini and Duval, 2006; OECD, 2007). In these approaches, transmission channels from structural policies to macroeconomic performance are considered in isolation and a relationship links a performance indicator (*e.g.* the unemployment rate or productivity) to institutional variables. These analyses can be useful to assess the long-term impact of structural reforms but provide little information on the dynamics of adjustment as they are most of the time based on static equations. Empirical studies using institutional variables in panel estimation usually display limited time variation, so that only a small set of variables can be tested at a time. Moreover, these approaches fail to properly capture the fact that institutions that work in one way in one country may work differently elsewhere because the rest of the institutional structure differs (Duval and Vogel, 2008; Freeman, 1998). Interactions between institutions are usually proxied by product terms of the respective regressors but the ability of this approach to analyse a sequence of reforms tends to be rather limited (Dreger *et al.*, 2007).

6. Most of the papers that have attempted to examine the short-term effects of structural reforms on economic performance rely on dynamic models, either neo-Keynesian or micro-founded DGE models (*e.g.* Bean, 1998; Coenen *et al*., 2007; Everaert and Schule, 2006).[3] Neo-Keynesian models incorporate most of

3. There is, on the other hand, a richer literature on the effects of institutions on macroeconomic resilience and the absorption of exogenous shocks. Examples include Campolmi and Faia (2007), Duval *et al.* (2007), Ernst *et al.* (2007), Grenouilleau *et al.* (2007) and Smets and Wouters (2005).

the traditional properties of large macroeconomic models (Box 1). They are well-suited to analyse the short-term impact of structural reforms as the lag structure of the model is determined by the empirical fit, *i.e.* country specificities. A major drawback is however, that it is not possible to introduce many relevant institutional variables directly in the model, the main exceptions being tax- and expenditure-related data. Simulations are thus generally limited to illustrative shocks on NAIRUs or mark-ups, the objective being to describe the adjustment mechanisms at play (Bean, 1998; Duval and Elmeskov, 2005; Hunt and Laxton, 2004). The *ex post* impact of reforms can also be examined using a two-step procedure whereby the shock on the NAIRU or mark-up is first calibrated off model using external information, for instance the impact of institutions on a reduced-form unemployment equation, and then simulated with a macroeconomic model. However, this strategy leads to unbiased estimates only if direct effects of institutions on economic performance are negligible.

Box 1. Main features of the neo-Keynesian small models

This box provides an overview of small models used to simulate a NAIRU shock in the United States, the euro area and France. A detailed description of the main equations is provided in Annex 2. Most behavioural equations are estimated in an error-correction form. The models are backward-looking: agents' expectations are treated implicitly by the inclusion of lags in the dependent variables. Real short-term rates are determined endogenously through a Taylor rule, with equal weights on inflation and the output gap.

The short-term behaviour of the model is influenced by standard Keynesian features through imperfectly flexible wages and prices, liquidity-constrained consumption, capital adjustment cost and labour hoarding. In the short term output is thus determined by demand. Unemployment and the output gap are important determinants of wage and price adjustments.

In the medium to long-run, the supply side of the economy, which is modelled through a neo-classical production function, plays a prominent role. Factor demands are derived from profit maximisation. Prices and wages adjust and modify price competitiveness as well as firms' profit and capital stock. Output and unemployment move back to their long-term equilibrium levels.

More precisely, a decline in the NAIRU will have the following effects:

- Potential output immediately jumps, leading to a negative output gap and a positive unemployment gap.
- Gaps put downward pressure on prices and wages.
- Employment rises following the decline in real wages and as labour supply increases very slowly the unemployment rate declines. Consumption and investment also react to these price and wage effects.
- Gaps and their resulting disinflationary effects trigger cuts in the real interest rate, which stimulate demand.

In the long run, the unemployment rate and output reach their equilibrium level, closing gaps. Inflation is coming back to baseline.

The main difference in an open economy is that price and demand dynamics also affect trade flows. Consequently, the implementation of a structural reform in one specific country generates externalities for its major trading partners.

7. Alternatively the impact of structural reforms can be evaluated using DGE models that are explicitly derived from the optimisation of agents' behaviour under constraints (Box 2). This approach allows a wide range of structural reforms to be examined and possible spillovers between the variables to

be taken into account.[4] The use of DGE models presents a number of advantages. *First*, these models are less subject to the Lucas critique as they are based on structural equations with sound microeconomic foundations. *Second*, it is possible to assess alternative policies through their effects on consumer welfare. *Third*, the DGE approach allows studying the distributional effects of reforms. *Finally*, DGE models encompass dynamic effects and are well-honed to examine the adjustment to changes in economic structure and policy. However, the lag structure reflects the optimisation-based micro-foundations and is generally limited and similar across regions or countries. Consequently, DGE results may tend to overemphasise similarities and to attribute differences to shocks rather than to economic structures. The empirical validation of DGE models is an important concern, but also an active field of economic research. Both the model dynamics and steady-state values can be quite sensitive to particular functional forms and parameter choices.

Box 2. Main features of the DGE model

This box describes the main features of the DGE model used to perform a number of policy simulations in the euro area, including a cut in the (unemployment) benefit replacement rate, an income tax rate cut and a cut in employer social security contributions. Details on the specification of the equations, the underlying theoretical framework and the calibration of the model are provided in Annex 3.

The DGE model assumes a closed economy with monopolistic competition in product and labour markets, which provides firms and unions with price and wage setting power. Firms use a bundle of differentiated labour services to produce a bundle of differentiated goods. Labour is the only production factor and yields constant returns to scale.

Firms incur both quadratic employment and price adjustment costs, which generate stickiness in employment and production and nominal price inertia.[1] This is calibrated using external information and imply costs of respectively 0.32% and 0.15% of GDP for a one percentage point change in employment in the euro area and the United States (Grenouilleau *et al.*, 2007). A one percentage point price adjustment incurs adjustment costs of 0.11% of output in the euro area and 0.02% in the United States. The latter numbers are compatible with the degrees of price rigidity in the euro area and the United States documented in other empirical research (*e.g.* Bils and Klenow, 2004; Altissimo *et al.*, 2006).

In addition to its traditional determinants, household consumption is affected by habit persistence. The higher the degree of habit persistence, the slower the adjustment of consumption and output to a structural reform. In the simulation this parameter has been set to 0.85, consistent with Grenouilleau *et al.* (2007).

In an enriched version of the model, a heterogeneous household sector with two groups of consumers is considered to assess the distributional consequences of structural reforms and the distribution of short-term gains or losses. The first group maximises intertemporal utility over an infinite planning horizon in the presence of habit persistence (*e.g.* Fuhrer, 2000; Smets and Wouters, 2003).[2] The second group of liquidity-constrained households (the so-called rule-of-thumb households) has no access to financial markets for intertemporal income transfers and consequently spends their disposable period income entirely on current consumption (*e.g.* Galí *et al.*, 2004, 2007).

In a different version of the model, the labour market is modeled using a search and matching framework instead of a neoclassical labour market. This allows checking the robustness of results.

The main mechanisms at play in the model following a cut in the policy variable (income tax, benefit replacement ratio or employer social security contributions) or increased goods and labour market competition are:

- An income tax rate cut increases the net real wage, labour supply and current disposable income, while a decrease in employer social security contributions directly reduces production costs and consequently

4. For instance, Coenen *et al.* (2007) examine the effects of temporary fiscal measures. Everaert and Schule (2006) use the IMF's global economy model to explore transitory costs of reforms. Imperfect competition in labour and product markets is modelled in a stylised manner through the existence of mark-ups. Similarly, Kilponen and Ripatti (2005) have investigated the quantitative effects of an increase in competition in both product and labour markets. Batini *et al.* (2005) examine the impact of combined fiscal adjustment and structural reforms for Japan.

dampens prices.

- Unemployment benefits can be assimilated to a reservation wage and reduce labour supply at given real wage levels. As a result, lower benefits will raise labour supply, even though they may temporarily reduce disposable income.

- Disposable income and consumption of liquidity-constrained households are affected by the way reforms are financed (self-financing of reforms or introduction of a scheme to balance the budget).

- Higher product and labour market competition will reduce price and wage mark-ups and increase steady-state employment, production and consumption levels. Lower prices unambiguously increase real wages in the short run. Lower wage mark-ups, by contrast, tend to compress labour income as long as neither rising employment nor falling prices compensate for the decline in hourly wages.

Forward-looking household and firm behaviour in the presence of price stickiness requires the introduction of a policy rule to ensure equilibrium stability and determinacy. For simplicity, interest rates are expected to react to current inflation: $i_t = -\ln\beta + \phi_\pi \pi_t$, with $\phi_\pi = 1.5$ in all DGE-based simulations.[3] The public budget is assumed to be balanced over the long-run.

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[1] Assuming quadratic adjustment costs is indeed crucial to generate a spread-out employment and price response to exogenous shocks. Quadratic costs imply step-wise adjustment to be less costly than abrupt changes in employment levels or prices. With linear or even decreasing costs, adjustment would be substantially faster. Different cost parameters would generate substantially different transition paths (Cahuc and Zylberberg, 2004).

[2] An alternative assumption to introduce lags in the consumption equation would be to use a rule-of-thumb behaviour à la Amato and Laubach (2003), where a fraction of households replicates previous consumption levels, considering the latter as the best available forecast of future consumption.

[3] The inclusion of an output gap in the policy rule would require the choice of a specific definition for potential output within the DGE framework. As the ECB usually focuses on price stability, a monetary reaction function with inflation as the main determinant is a plausible assumption.

8. In addition to the inherent limitations of these tools, the analysis of the short-term impact of structural reform is delicate it sometimes mixes the adjustment of potential output to the new steady state with the adjustment of actual to potential production. In the two types of models used in this paper, the adjustment of potential output to the new steady state is instantaneous. It could be possible to model a gradual adjustment of potential output to the new steady state in neo-Keynesian models, where potential output is computed using a production function approach. One possibility would be to make potential output depend on actual (rather than desired) capital stocks or, alternatively, to endogenise the desired capital stock.

9. This paper does not seek to establish a ranking amongst the different methodologies, but takes an eclectic approach drawing on available methods and evidence. All the instruments examined in this section display advantages and limitations to examine the short-term impact of structural reforms. They bring complementary information, emphasise several and different aspects of the topic and mutually provide some robustness checks of the results.

3. Impact of institutional changes on structural unemployment

10. The observation of past institutional data and how they have been related to economic performance in OECD countries over the last two decades provides some insights on the *ex post* effects of structural reforms. In particular, the empirical analysis undertaken in Bassanini and Duval (2006) helps to pinpoint the measures that had the most significant impact. In this work, the actual unemployment rate is

expressed as a function of the output gap and of a number of institutional variables, including average replacement ratio, tax wedge between labour costs and take-home pay, employment protection legislation and product market regulation in non-manufacturing sectors.[5] Time and country fixed effects are also included to account for omitted factors across countries and over time. A reduced form equation is then estimated in a sample of 20 OECD countries over the period 1983-2003. Tests indicate that the effects of these measures appear to be relatively robust across specifications.

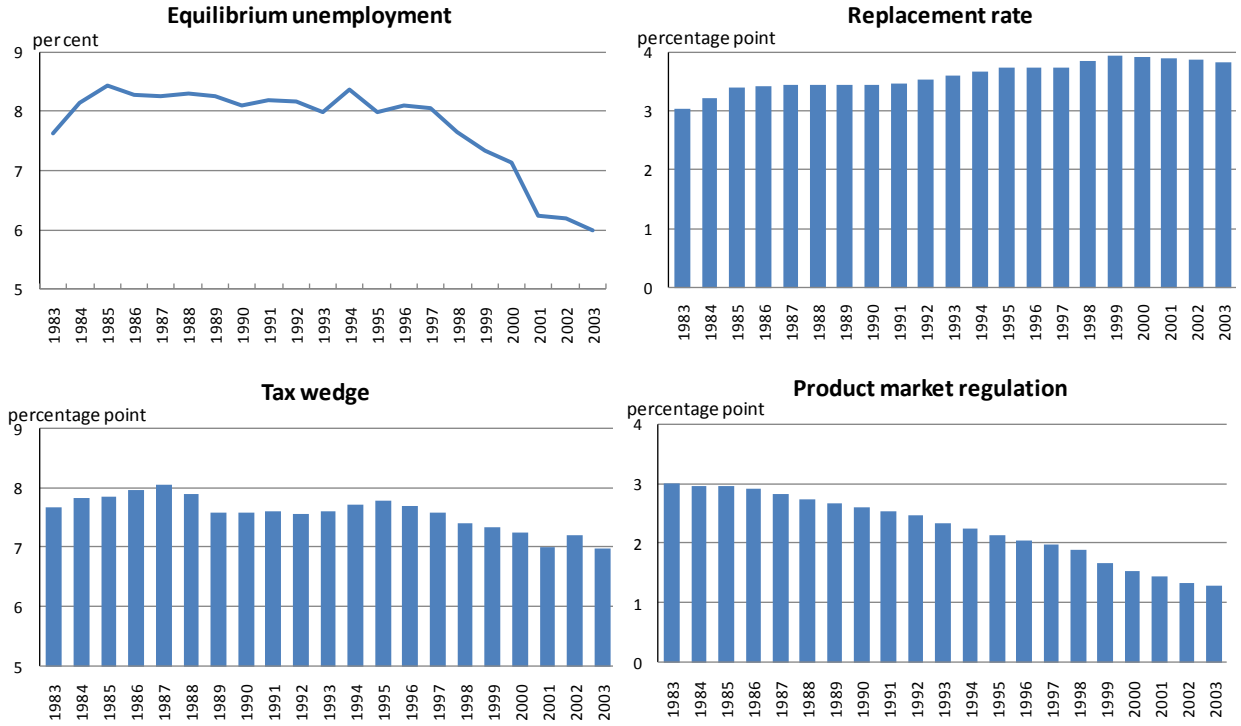
11. A time-series indicator of the structural unemployment rate has been constructed for each country by subtracting the output gap estimates, as well as the error term from the actual unemployment rate, using coefficients from the Bassanini and Duval equation. The resulting structural unemployment rates are generally more volatile than the OECD *Economic Outlook* NAIRU estimates, which are derived from a Kalman-filter estimation and core price Phillips curves. However, both measures broadly display common patterns. The associated unemployment gaps evolve generally in line, although there are significant differences in some countries at some points in time (especially for Germany). Removing the country fixed effects, as well as institutional variables that are not significant in the equation would shift the level of the structural unemployment rate up but would not significantly modify its pattern.

12. The estimated structural unemployment rate has declined markedly since 1995 in the OECD area, as well as on average in the seven largest economies or in the European Union (Figure 1 and Annex 1). This reflects a general trend toward product market liberalisation and a gradual decline in the tax wedge. Since the beginning of the decade, a reduction in the average replacement ratio also contributed to the fall. Arpaia *et al.* (2007) suggest that these trends have continued in recent years.

13. Although there has been a clear trend toward product market liberalisation with no subsequent reversals, there is no uniform pattern with regards to labour market reforms across OECD countries. Moreover, within a single country some labour market reforms may not be sustained over time and policy reversals can sometimes be observed (OECD, 2008). This renders the identification of the short-term impact of structural reforms particularly delicate: for instance, it is difficult to disentangle a weak impact of initial reforms on economic performance from an adverse impact of subsequent backtracking.

5. Other structural features such as union density or a measure of high corporatism are also included in the analysis, but their effects are found to be either very small or statistically insignificant.

Figure 1: Structural unemployment and contributions of institutions in the OECD



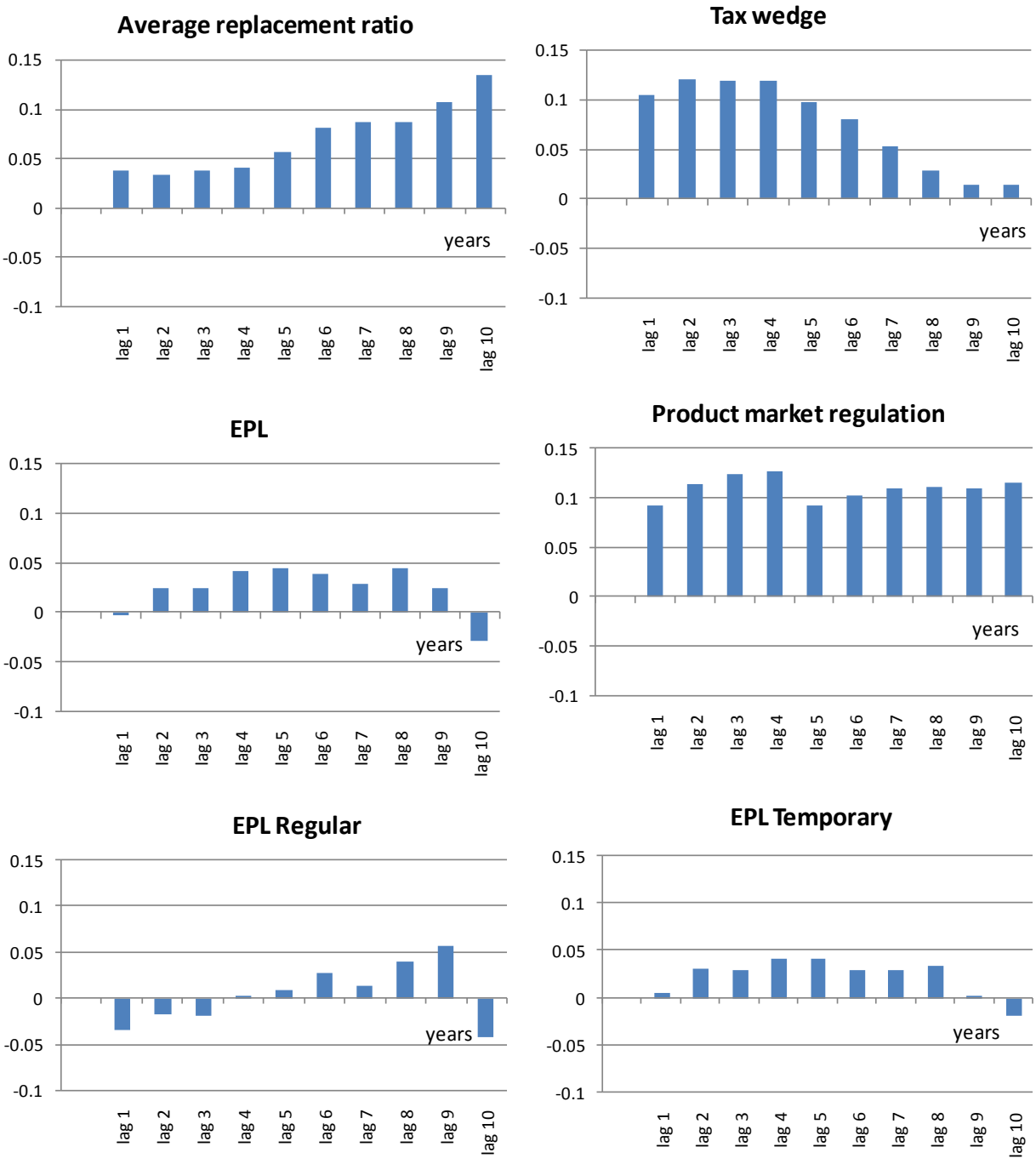
Note: The sample includes the 20 countries examined in Bassanini and Duval (2006). Germany, Finland and Sweden have been removed from the calculation because a break has been introduced for these countries in the estimations.

14. Aggregate developments can mask large differences across countries. However, three institutions appear to play a major role in explaining the evolution of structural unemployment in individual countries over the period 1983-2003:

- Amongst all the institutional variables, the tax wedge contributed the most to explain the level of structural unemployment in most OECD countries.[6] There is no clear pattern as to how the tax wedge has evolved over time or across OECD countries. It has steadily declined in the United States, Italy and the United Kingdom, but has risen in Japan, France and Canada. It has experienced ups and downs in Germany.
- A significant part of structural unemployment is also explained by the average replacement rate in selected countries. Here again, this variable displays no clear international trend.
- In addition to these labour market institutions, product market regulations are also estimated to have had a sizable impact on the structural unemployment rate. A consistent and marked decline in the indicator, signaling the move toward more competitive markets, is visible in most OECD economies. This is particularly true for Anglo-Saxon countries where product markets reforms started earlier than in continental Europe.
- By contrast, changes in employment protection legislation have played a minor role except in a few European countries like Germany, Italy or the United Kingdom.

6 . It should be noted however that this reflects the specific measure used. A national-accounts based measure would lead to a lower contribution.

Figure 2: Correlation between the change in institutions and cumulative changes in the NAIRU



15. In order to give some insights on the adjustment process and the lagged effects of structural reforms, correlations have been computed between the cumulative increase in the NAIRU between time t-i and t and the change in the institution at time t-i (Figure 2).[7] It appears that:

- A change in institutions, in particular the tax wedge, the replacement ratio and product market regulations, has a gradual effect on the NAIRU changes. The impact peaks after 5 to 10 years, depending on the measure considered.

- In the short-term the maximum correlation is obtained for the tax wedge and product market regulations and is significant.[8] The cumulative impact of a change in the tax wedge on the change in the NAIRU rises over the first four years and then gradually diminishes, ending up close to zero after 7 years. By contrast, product market regulations continue to display a significant though small effect over 10 years.

- The correlation between the change in the average replacement ratio and the change in the NAIRU is negligible in the short term but gradually increases over time, implying very long lags in the adjustment process. The correlation becomes significant only after a decade or so.

- The correlation between a change in employment protection legislation (EPL) and a change in the NAIRU remains insignificant over a ten-year period. This result holds for both temporary and regular contracts.

16. These results are subject to a number of caveats. The correlations have been computed using a small number of observations and may be distorted by the presence of other, omitted determinants of structural unemployment. Moreover, Granger tests fail to provide robust evidence of causality between institutions and NAIRUs across countries.[9]

17. Overall, these results suggest that the impact of reforms is likely to be gradual and spread out over many years. Structural reforms can lead to a costly reallocation of resources, so that efficiency gains may take time to materialise. The following sections seek to provide additional information on the shape and speed of adjustment following selected labour market reforms.

4. Labour and product market rigidities and adjustment speed

18. A number of previous studies have suggested that interactions between different areas of structural reforms are crucial for their aggregate economic impact: returns of doing one reform would be enhanced when other reforms have already been implemented (Bassanini and Duval, 2006). Political economy considerations also indicate that injecting competition in product markets eases opposition and political resistance to labour market reforms, because product market reforms tend to lower the rents to be redistributed between unions and firms (Blanchard and Giavazzi, 2003). The objective of this section is to examine whether policy complementarities may also affect short-term adjustment to structural reforms, in particular to what extent product and labour market flexibility accelerates the pass-through of subsequent reforms.

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7. In this subsection, OECD Economic Outlook NAIRUs rather than structural unemployment rates have been used as the latter are by construction correlated with institutions. NAIRUs and structural unemployments usually display similar trends in OECD countries but some levels differences can be observed for some countries.

8. A simple rule of thumb derived from regression analysis is that the correlation is significant when it exceeds 0.1.

9. Results are available on request.

Employment adjustment costs have a moderate impact on real adjustment…

19. To examine the impact of existing hiring and firing costs on the speed of adjustment to new labour market reforms, a one percentage point income tax cut in the euro area was simulated using the DGE model presented in Box 2. In this model, hiring and firing costs are modeled through quadratic adjustment costs and provide firms with an incentive to smooth supply adjustment over time.[10] These costs delay the transition of employment, production and consumption to the new steady state in the aftermath of structural reforms.

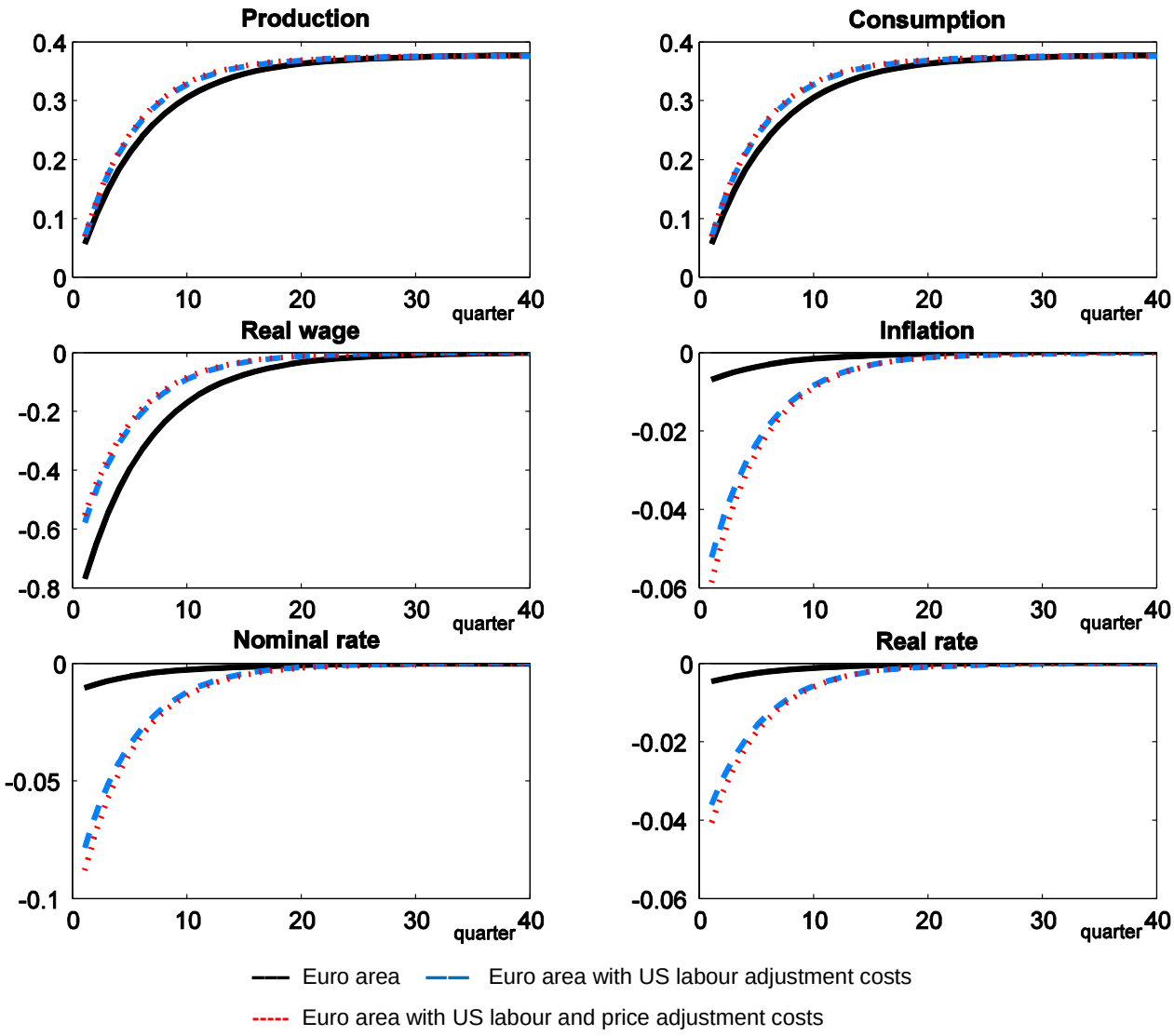
20. The introduction of adjustment costs to proxy nominal and real rigidities is standard in the DGE literature (*e.g.* Coenen *et al.*, 2007; Grenouilleau *et* al., 2007; Campolmi and Faia, 2007; Moyen and Sahuc, 2005) but a number of specifications has been used. Quadratic cost specifications allow the quantity and price adjustments to be smoothed over time. Other functional forms, such as linear or even declining marginal adjustment costs, imply much faster and more abrupt adjustment paths. From this perspective, the quadratic specification of adjustment costs in this paper provides an upper bound for the adjustment duration and the impact of adjustment costs on the reform pass-through. In addition, micro level research gives information on asymmetric cost patterns, with either hiring or firing being more costly for firms depending on the regulatory circumstances. Such asymmetric behaviour is less relevant however in the context of this paper, because the simulations focus on adjustment after reforms that lead to higher employment and not on adjustment within the business cycle.

21. Substituting lower US adjustment costs for higher euro area ones would accelerate adjustment towards the new equilibrium (Figure 3). Similar results obtain for a cut in the benefit replacement ratio or in employer social security contributions (see Annex 4, Figures A.4.1 and A.4.2). Overall, the gain in production and consumption adjustment speed from lower employment costs seems nevertheless very modest, amounting to no more than two or three quarters. The differences are more marked with regard to inflation as cuts in the income tax rate, benefit replacement rates or employer social security contributions all indirectly or directly reduce production costs. The cuts initially have a slightly deflationary effect, which in turn triggers an expansionary monetary reaction. Simulations suggest that if the euro area would have had US employment adjustment costs, price cuts could be more pronounced implying a stronger though temporary decline in real wages in the transition process. Introducing heterogeneity in the form of liquidity-constrained consumers within the household sector, if anything, lowers the impact of employment adjustment costs on the adjustment process (see section 5).

10. See Cahuc and Zylberberg (2004) for an excellent overview on labour adjustment costs.

Figure 3: Impact of a one percentage point cut in the income tax rate

(Change compared to baseline)

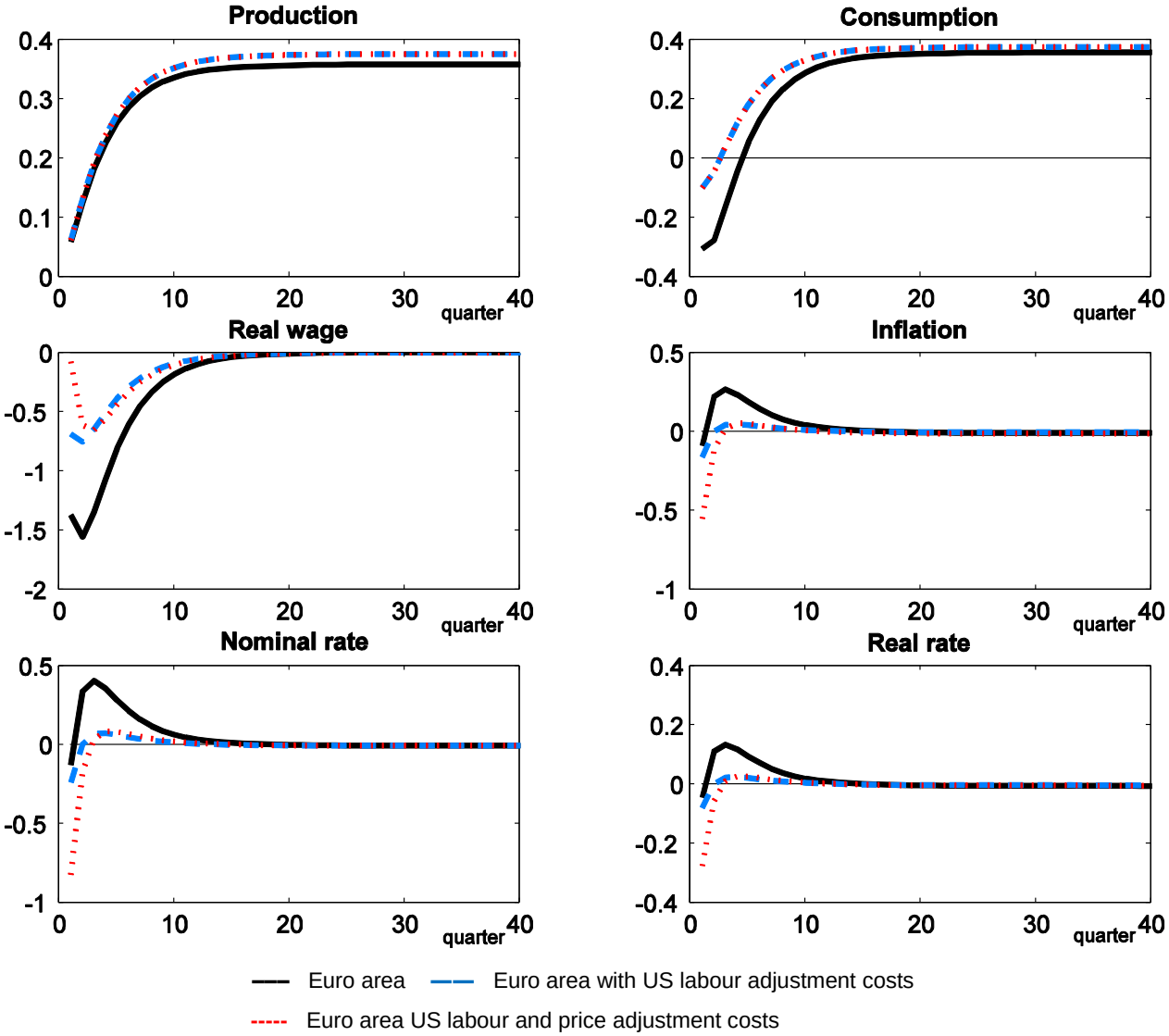


...while price adjustment costs almost exclusively affect nominal paths

22. Stronger competition and lower barriers to market entry can also quicken price adjustment. DGE-based simulations suggest that lowering euro area price adjustment costs to US levels, while leaving employment adjustment costs to their initial level, would have no visible impact on the real variables' speed of adjustment (Figure 3). The differences in the transition paths of production, consumption and real wages for higher and lower price adjustment costs are negligible. Smaller price adjustment costs only generate a more marked initial price decline, which in turn leads to a modestly stronger monetary expansion. Price adjustment costs tend to play a more important role after temporary shocks, by dampening the initial amplitude of impulse responses and delaying the return to long-run equilibrium (Duval and Vogel, 2008).

Figure 4: Impact of a one-percentage point income tax cut in a search-and-matching framework

(Change compared to baseline)



23. This result also holds when the labour market is modelled through an alternative search and matching framework (see Annex 3 for details). In this case, reduced employment adjustment costs would have fairly limited effects on the adjustment speed of production and consumption, while the contribution of lower price adjustment costs is negligible. Differences are more pronounced with regard to price, real wage and interest rate patterns. Labour supply increases faster than labour demand in the presence of adjustment costs and frictional unemployment. The mismatch between labour supply and demand exerts downward pressure on real wages, production costs and prices. In addition, higher employment adjustment

costs put additional pressure on real wages.[11] As these effects are quantitatively strong, the economy will experience stronger monetary accommodation than in the simulation based on the standard DGE model.

24. The small impact of price and employment adjustment costs on the pace of adjustment is also confirmed by simulations using neo-Keynesian models for the United States and the euro area (see Annex 5). Indeed, in the absence of an endogenous monetary policy reaction, the euro area and the United States are found to adjust to a shock on the NAIRU at a similar pace at least in the short-term, even though the United States displays greater wage flexibility than the euro area.

5. Financial markets and adjustment speed

25. Flexible and forward-looking financial markets can affect the adjustment speed to structural reforms. The United States deregulated its product and financial markets in the 1980s. Reforms have been more recent and less comprehensive within the euro area, even though major progress has been recently accomplished. Past reforms have increased the responsiveness of the economy to policy impulses and strengthened the direct impact of interest rates on financial decisions of both firms and households (Angeloni *et al.*, 2003; Edey and Hviding, 1995; Mishkin, 2007).

26. Full access to credit allows firms to adjust their investment to their desired level and is thus likely to fasten adjustments to structural reform. In particular, deep venture capital markets facilitate the creation of firms and are found to explain differences in labour market performance between Anglo-saxon economies and Continental Europe (Belke and Fehn, 2001; Acemoglu, 2001).

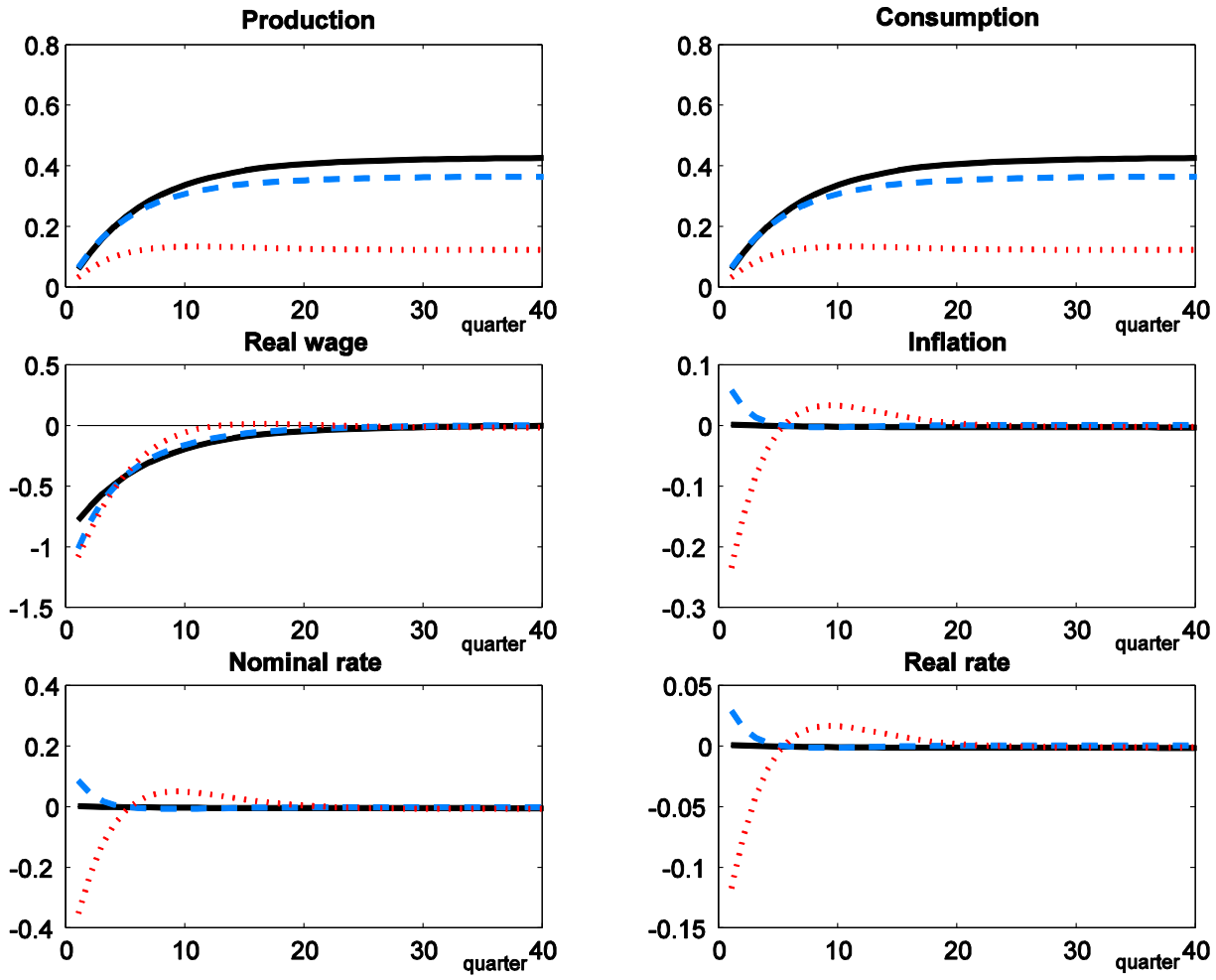
27. Financial sector reforms in the United States in the 1970s and 1980s are also estimated to have reduced the share of liquidity-constrained households (Sefton and In't Veld, 1999). The subsequent liberalisation of financial markets in the euro area is also expected to have had similar effects, though it is hard to quantify its precise magnitude. But the effect of easing households' liquidity constraints on adjustment speeds is *a priori* an empirical question. On the one hand, more households optimise their consumption decisions and smooth income over time. On the other hand, habit persistence in these households' consumption behaviour is likely to slow the speed of adjustment.

28. This question can be examined by enriching the DGE model with a heterogeneous household sector. Some households have full access to financial markets, while others get limited or no access to financial markets and can only consume their disposable labour income at each period. A one-percentage point income tax cut is then simulated under three alternatives: all households have full access to financial markets; 25% of the households are liquidity constrained; and 75% are liquidity constrained. Although the main differences are on the long term and reflect differences in utility functions between the two groups of households, changes to short-term adjustments can also be observed on inflation and monetary policy reaction (Figure 5). As the magnitude of the policy response varies with the share of liquidity-constrained households, the final effect on the pace of adjustment of real variables is negligible in the model. By omitting capital adjustments, these simulations may nevertheless underestimate the overall effect of liquidity constraints.

11. The higher adjustment costs result from adjustment costs relating to gross instead of net flows of labour in the search-and-matching extension. Each period a certain and fixed share of workers loses or quits a job for new positions or unemployment. Consequently, gross flows in and out of employment differ from net flows and are usually higher than the latter. Contrary to the baseline model, labour adjustment costs also affect the steady state production and consumption level in the search-and-matching framework. As there are separations in each period, positive adjustment costs will even accrue in the steady state, reducing the level of consumption and equilibrium employment.

Figure 5: Impact of a one percentage point income tax cut under alternative share of liquidity-constrained households in the euro area

(Change compared to baseline)



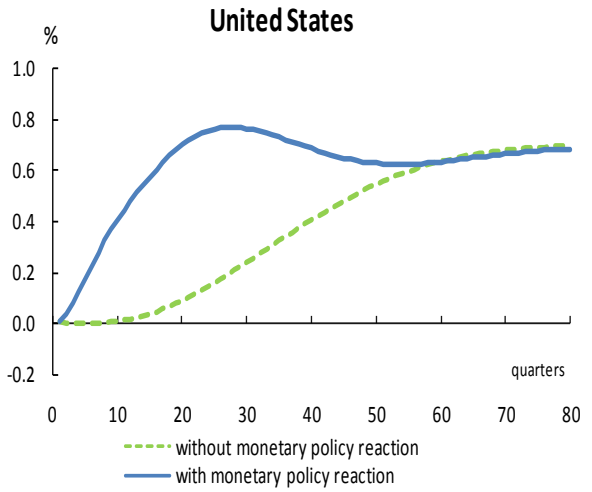
6. Interaction with monetary policy

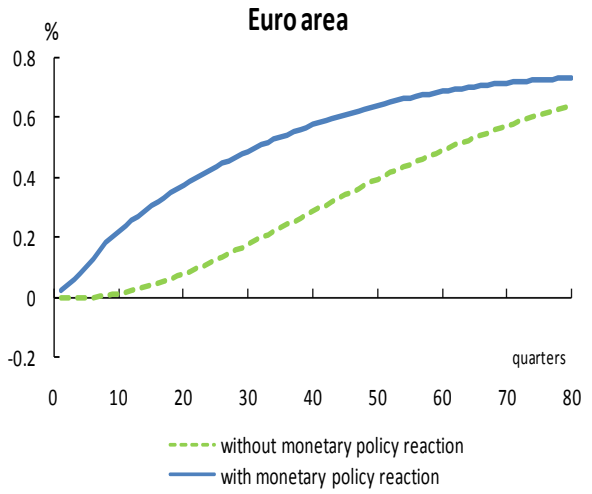
29. The implementation of labour market reforms has usually a significant macroeconomic impact in the short term and can call for a policy reaction. In turn, monetary policy decisions can affect the transition speed in the aftermath of structural reforms, though to a different degree across OECD countries, depending on the strength of the transmission channels and on the sensitivity of policy rates to output and inflation. Indeed, demand expansion reduces the transition costs of reform policies and lowers unemployment stemming from the required restructuring of particular industries. From a political economy point of view, the ability and willingness of central bankers to accommodate structural reforms may reduce transitory costs and political opposition and thereby facilitate implementation.

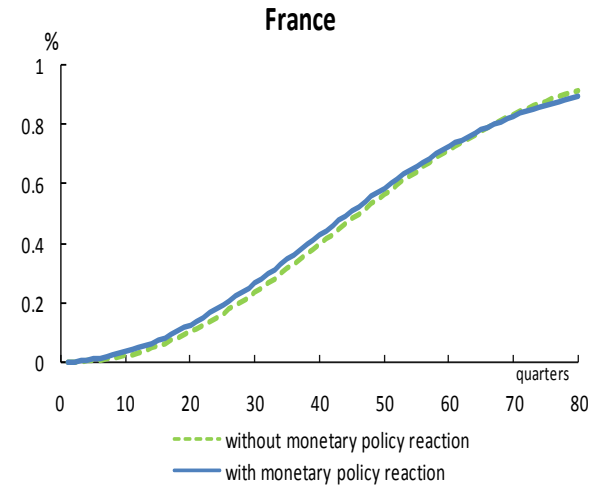
Figure 6: Effect of monetary policy on adjustment to a 1 percentage point NAIRU decline

Effect on real GDP

(change compared to baseline)

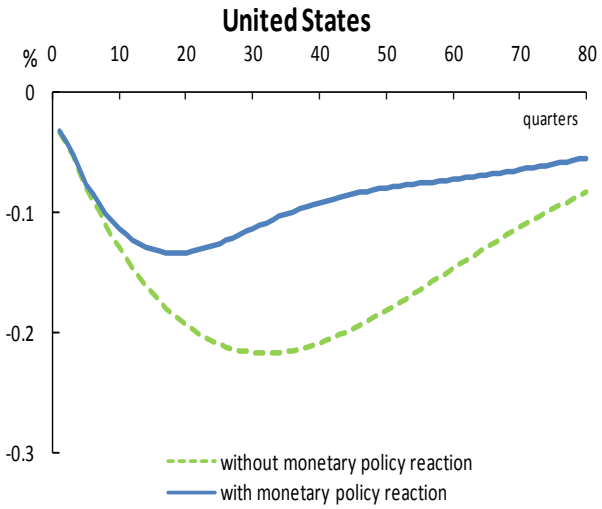


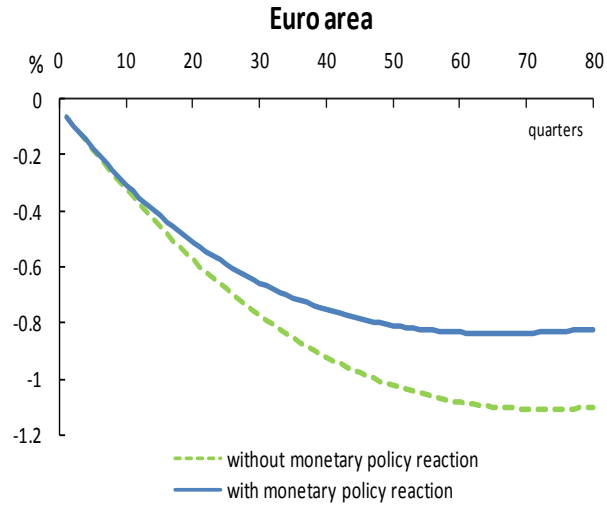


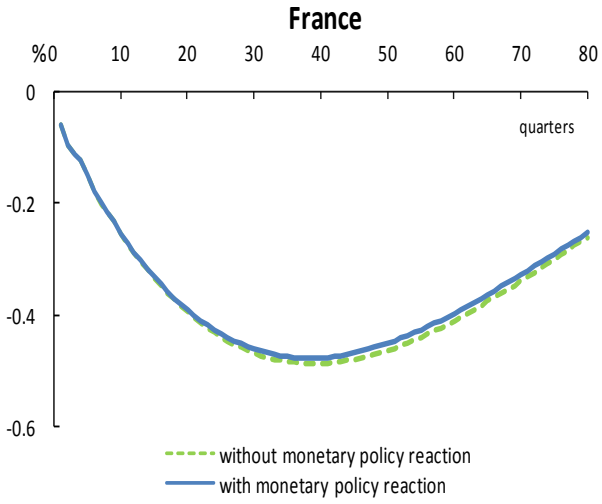


Effect on inflation

(change compared to baseline)



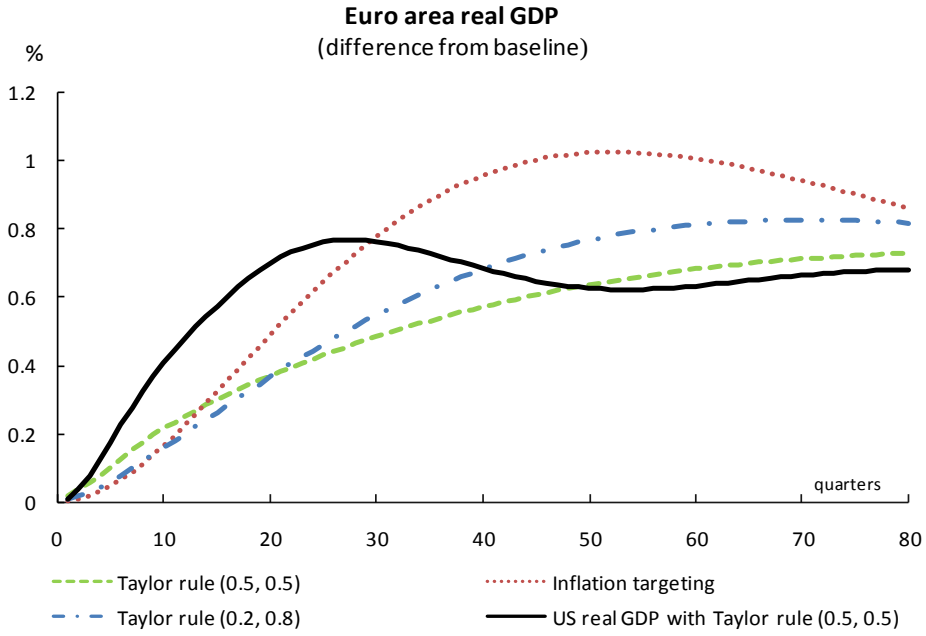




30. The interaction between structural reforms and monetary policy can be illustrated by simulating a one percentage-point decline in the NAIRU, using the neo-Keynesian small models described in Box 1. In the absence of a monetary policy reaction, a decline in the NAIRU generates disinflationary effects, while output and unemployment gaps are building up. The introduction of monetary policy, in the form of a Taylor rule with equal weights on output and inflation, dampens the disinflationary effect and accelerates the move to the new long-term equilibrium (Figure 6).

31. Expected gains from monetary policy reaction are estimated to be negligible for individual euro area economies. As the ECB focuses on aggregate euro area output and inflation, any monetary reaction to a reform implemented in an individual European country is improbable unless there is a coordinated effort to reform labour markets in a sufficient number of euro area countries. This holds for small but also large euro area economies. For instance, a domestic reform lowering the NAIRU by one percentage point in France, which accounts for about 20% of euro area GDP, would elicit almost no monetary policy reaction.

Figure 7: Impact of a one percentage point decline in the NAIRU under alternative monetary policy reactions



32. The contrast between the two sides of the Atlantic reflects differences in monetary transmission channels as modeled in the neo-Keynesian models. Demand components, especially business investment, are found to be more sensitive to real interest rates in the United States than in the euro area. Consequently, the United States would adjust much faster to the new steady state than the euro area in the presence of monetary policy reaction.[12]

33. Modifying the monetary policy reaction function can alter the pace of adjustment for the euro area. The impact of adopting a different monetary policy rule has been examined by simulating a cut in the NAIRU in the euro area under different policy reactions: a Taylor rule with equal weights on inflation and the output gap; a Taylor rule with a stronger weight on inflation; and pure inflation targeting, with no

12. Because consumption equations have not been estimated over the same period in the United States and the euro area, the traditional result that consumption is more sensitive to interest rates in the United States than in the euro area does not apply in this simulation. Hence, differences in the adjustment process between the United States and the euro area in the presence of monetary reaction may be underestimated.

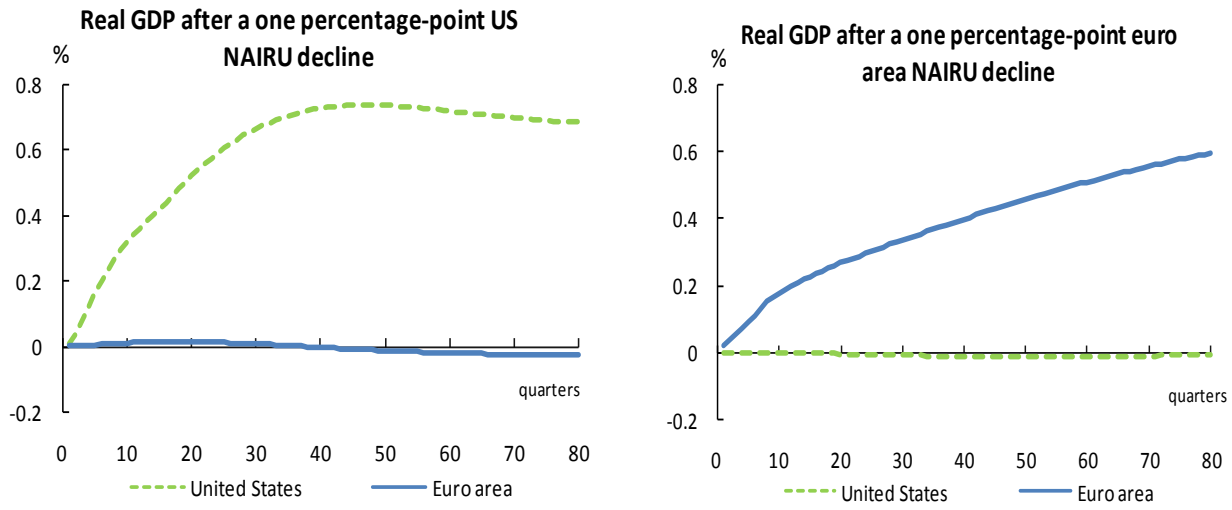
weight on the output gap. Increasing the weight of inflation in the monetary reaction function appears to slow the adjustment in the very short term but quicken it thereafter. As a result, the economy reaches its long-term equilibrium much earlier, but with some overshooting (Figure 7). Even in the case of pure inflation targeting, the adjustment speed would nevertheless remain slower in the euro area than in the United States. Interest rate persistence, which implies that central banks are reluctant to move the policy rate too rapidly to limit output volatility, can slow the adjustment to structural reforms. However, both DGE and neo-Keynesian-based simulations suggest that interest rate persistence has to be very high (with a weight close to unity) to have visible effects on adjustment of real variables.

7. International spillovers of structural reforms

34. With globalisation, trade and financial linkages have intensified across countries. Still, the magnitude of spillover effects from the implementation of a structural reform is found to be very small, at least when evaluated in terms of trade linkages in the neo-Keynesian approach (Figure 8). This reflects the relatively low, albeit increasing, degree of openness of the euro area and the United States. These simulations remain nonetheless purely illustrative as they do not incorporate international capital flows and assume fixed nominal exchange rates. It is likely that structural reforms in a euro area country will have stronger spillovers onto other euro area members, given the high level of intra-trade within the area. Taking on board trade and financial linkages Dao (2008) finds that labour market reforms in Germany have positive though small spillover effects on the rest of the euro area.

Figure 8: Spillover effects from labour markets reforms

(Change compared to baseline)



8. Distributional effects of reforms

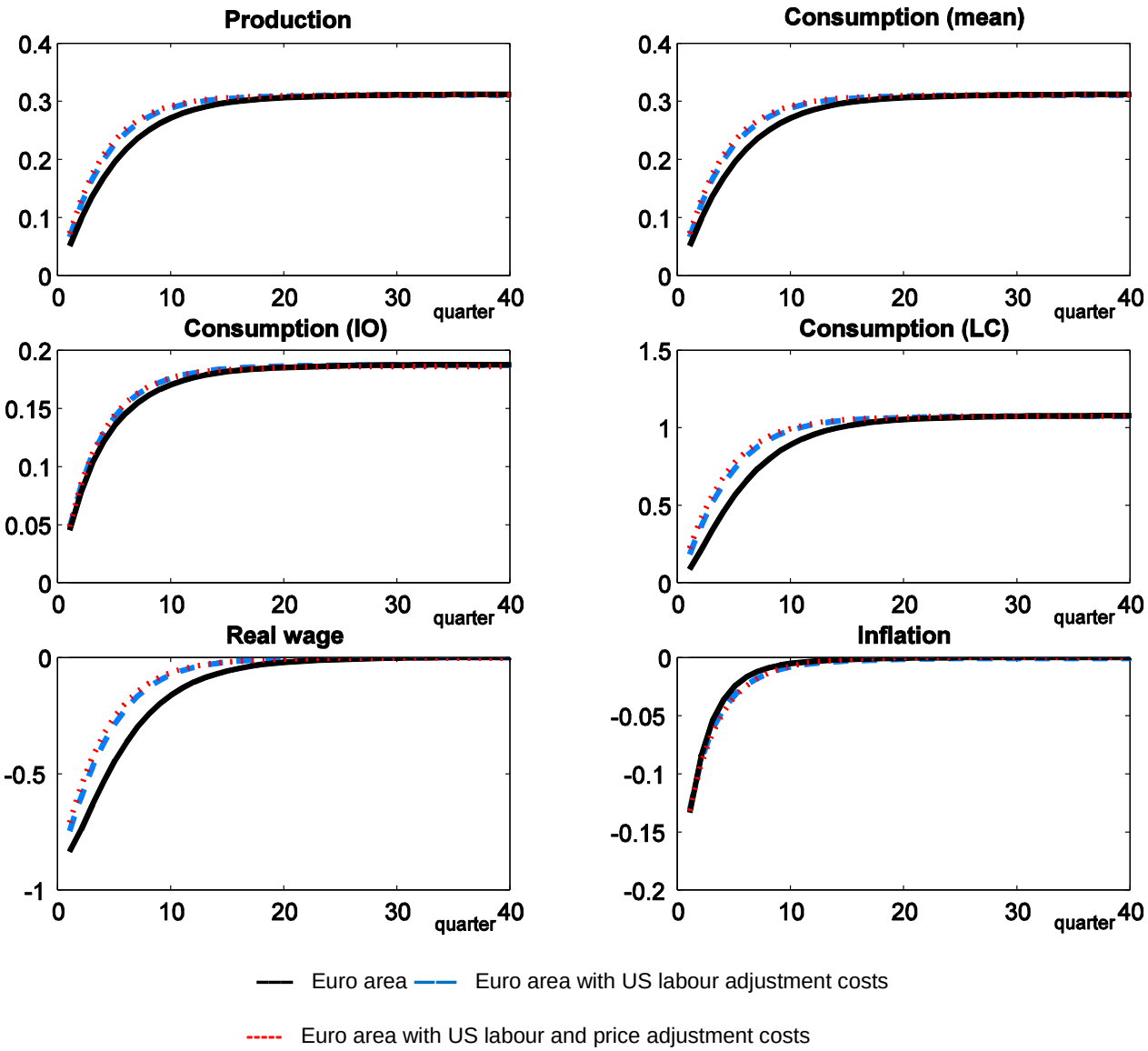
Some reforms can entail short-term costs…

35. One major impediment to the implementation of structural reforms is that even beneficial reforms can generate (transitory) losses for specific population groups (*e.g.* Alesina and Drazen, 1991; Drazen, 2000). The distributional effects of reforms can be analysed by using the enriched version of the DGE

model with a heterogeneous household sector. Following the estimates of Coenen *et al.* (2007), the simulations assume that liquidity-constrained consumers account for 25% of the household sector.

Figure 9: Impact of a one percentage point income tax cut in the presence of liquidity-constrained households

(Change compared to baseline)

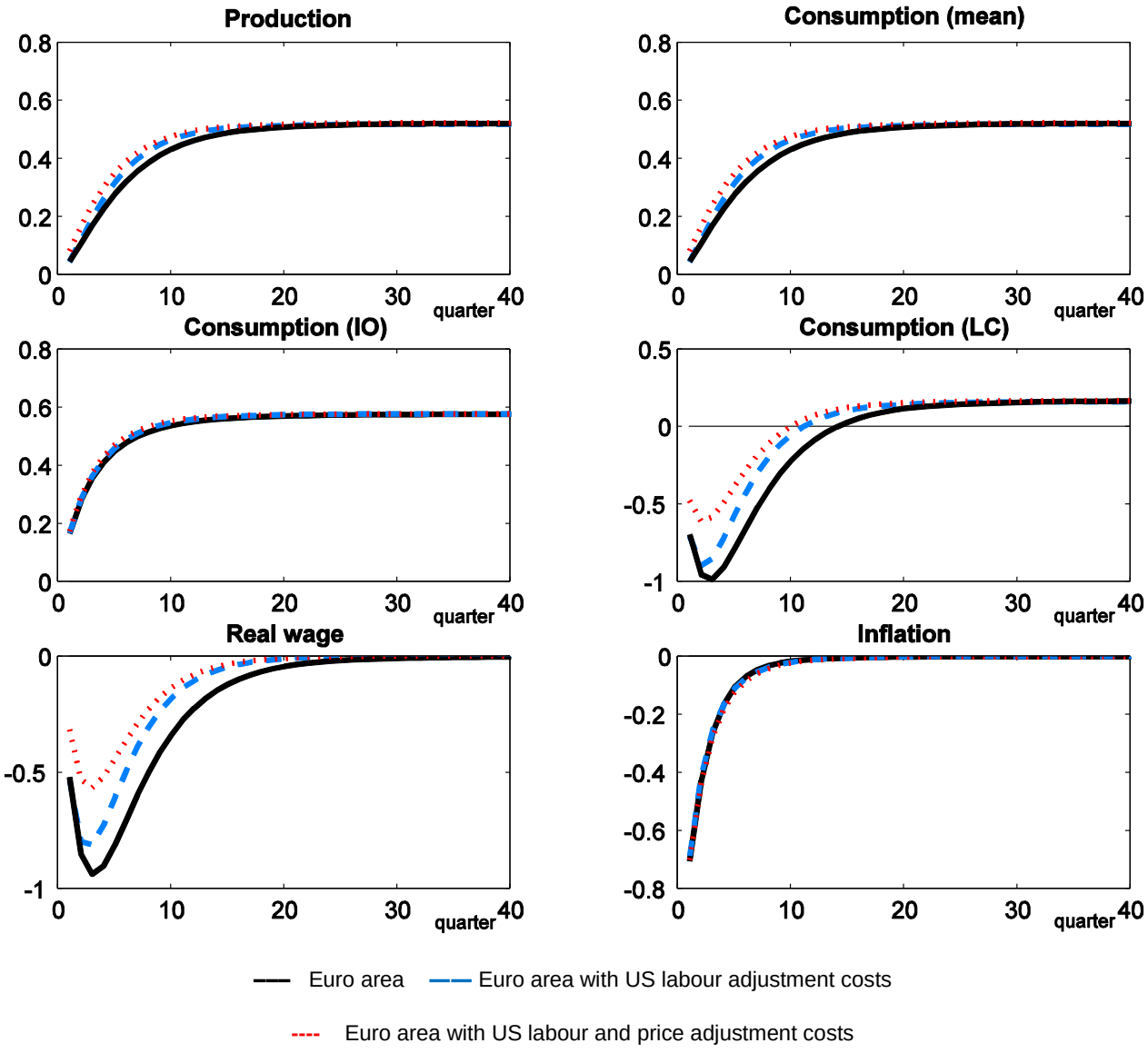


36. The distributional effects of reforms vary widely across the different policy measures. In particular, the impact on consumption of a cut in income tax or in social security contributions is positive in the short term for both types of households, but significant differences can be observed in the case of a reduction in the benefit replacement rate (Figures 9 and 10). In the latter case, liquidity-constrained households experience an initial decline in their level of consumption while non-constrained households do not, suggesting that structural reforms can display short-term costs concentrated on specific groups of the population.

37.

Figure 10: Impact of a one percentage point cut in the benefit replacement rate in the presence of liquidity-constrained households

(Change compared to baseline)



38. Employment adjustment costs have temporary but moderate effects on the distribution of income and consumption gains between households. Reducing euro area employment adjustment costs to their US levels has virtually no effect on the consumption path of intertemporally optimising households but a

significant impact on liquidity-constrained households.[13] Indeed, it reduces the amplitude of the decline in real wages during the transition, so that the consumption of liquidity-constrained agents is higher.

39. Price adjustment costs are found to have a marginal impact on real adjustment after structural reforms, the main exception being in the case of a benefit replacement rate cut (Figure 8). The reduction of the reservation wage puts downward pressure on real wages and lowers production costs. The faster the reaction of prices to lower production costs, the weaker the reaction of real wages and the decline in consumption from liquidity-constrained households.

40. The impact of these costs varies across policy measures (Annex 4 Figures A.4.5). Lower employment adjustment costs accelerate the adjustment of real wages and liquidity-constrained consumption after an income tax rate cut or a cut in employer social security contributions. However, the difference is more pronounced after a benefit replacement rate reduction, as liquidity-constrained consumers initially lose income. Lower adjustment costs attenuate and shorten the temporary real wage decline and the transitory real consumption loss for liquidity-constrained households.

…but budgetary compensation schemes can reduce these costs

41. The introduction of a fiscal rule to balance the government budget after the implementation of structural reforms can have a marked impact on the short-term adjustment and the long-run distribution of efficiency gains (Figure 11). Under a deficit-neutral reform, the government budget is balanced at each point in time, assuming for simplicity, the availability of lump-sum taxes and transfers. The baseline scenario assumes that liquidity-constrained households proportionately share the fiscal burden, after a tax cut or the reduction in social security contributions, or the fiscal gains from a reduction in the benefit replacement rate. Under an alternative scenario, the fiscal burden or gain is entirely shifted to the intertemporally optimising households. Lump-sum measures offset the wealth effect of reforms without introducing further substitution effects.[14] Relying on distortionary taxation and demand components instead would affect incentives and either reinforce or soften the initial impact of the reform.

42. Shifting the entire fiscal burden of an income tax cut or a reduction in employer social security contributions to intertemporally optimising households diminishes the latters' gains from structural reforms. By contrast, liquidity-constrained consumers experience an increase in disposable income and consumption. Depriving liquidity-constrained households from the fiscal gains from lower unemployment transfers would have the opposite effect. Liquidity-constrained households would lose in net wealth terms, while optimising consumers would gain compared to the baseline redistribution scheme, where costs are shared between the two types of households.

43. A budget consolidation scheme would affect not only the relative long-term position of the two types of consumers, but also aggregate production and consumption in the long run. Exempting liquidity-constrained consumers from fiscal consolidation reduces aggregate output (Figure 11), while excluding them from the redistribution of fiscal surpluses would moderately raise long-run production (Figure A.4.6). These effects stem from the modelling of the labour market and reflect mostly the assumption of diminishing marginal utility of income. Liquidity-constrained households do not receive profits and dividends from firms and thus consume less than unconstrained households in the steady state. The

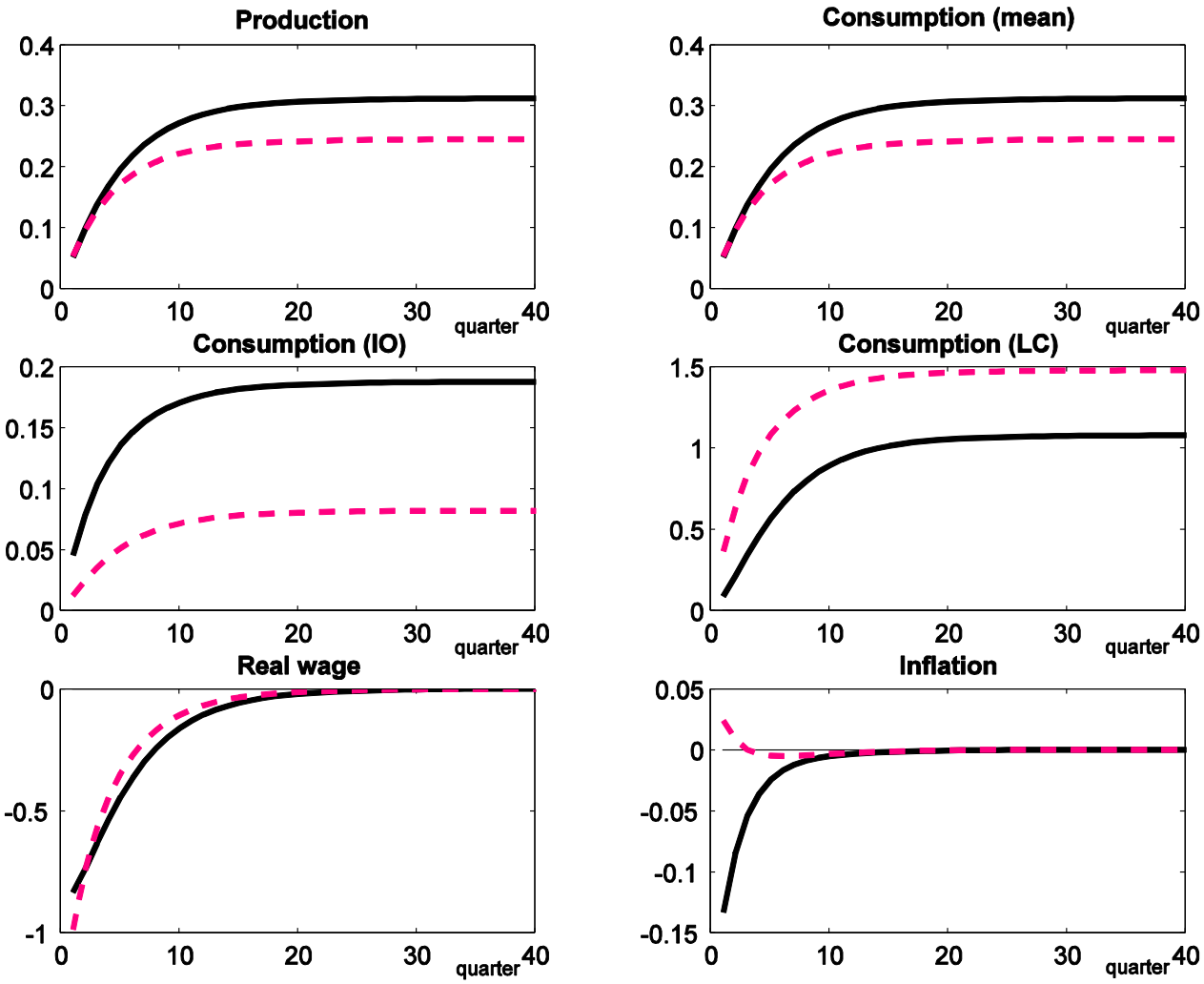
13. We assume a budget-neutral policy that immediately offsets the wealth effect of fiscal measures by proportionate lump-sum transfers and where each household type receives a proportionate share of these transfers. The subsequent section discusses the impact of the wealth effect on the impulse responses.

14. As the intertemporal optimisers operate under an infinite planning horizon the time structure of budget consolidation does not affect private sector behaviour in this case. Budget balancing may even only occur in the distant future.

exemption from fiscal consolidation raises liquidity-constrained consumers' disposable income and consumption. Given the decreasing marginal utility of consumption, labour supply declines and wage claims rise, reducing equilibrium employment and production. Excluding liquidity-constrained households from the redistribution of fiscal gains reduces their disposable income and leads to wage moderation and higher production. As structural reforms have a permanent budgetary impact in the model these income effects are also long-lasting.

Figure 11: Impact of a one percentage point cut in income tax with budget balance rule

(Change compared to baseline)



8. Conclusions

44. Economic adjustment to structural reforms is a gradual process. Drawing on various methodologies – descriptive analysis, macro-economic neo-Keynesian models, and a micro-founded dynamic general equilibrium model – this paper investigates the lag between the implementation of

reforms and their economic effects, the impact of markets rigidities, the role of monetary policy in the transition period and questions of distributional effects.

45. The complementarities of these three different approaches motivate their combined use. The descriptive part seeks to draw conclusions from past OECD country experience in structural reforms. But, it strongly relies on data that often lack reliability and timeliness. Neo-Keynesian models have the advantage of using estimated behavioural equations for the euro area and the United States. However, the effect of some relevant institutions can be included only very indirectly, using off-model information, and this approach is subject to the Lucas critique. Finally, the micro-founded DGE model illustrates the respective transmission channels of several types of structural reforms (tax policy, social security schemes, competition policy). However, the introduction of employment and price adjustment costs as well as habit persistence in consumption in the model is insufficient to generate substantial cross-country heterogeneity in the adjustment speed. Methodological eclecticism is also a way to test the robustness of findings, where possible. In this regard, it is reassuring that the results of the paper for which robustness could be tested hold independently from the methodological approach adopted (*e.g.* limited role of price adjustment costs in the speed of adjustment to reforms).

46. The paper leaves ample room for extensions in particular on the modelling side. *First*, the introduction of explicit households' accounts would allow simulating explicitly the impact of tax reforms in the neo-Keynesian framework. *Second*, one could examine whether monetary policy has become more or less important over time in accommodating structural reforms by examining whether the impact of interest rates on the main behavioural equations has been modified in recent years. *Third*, the DGE model could be substantially refined by introducing additional frictions such as wage rigidities or capital adjustment costs, although this would considerably increase the complexity of the framework. In the same vein, the work could be extended to a framework with a multi-factor production function and instead of calibrating the parameters, Bayesian techniques could be used to estimate DGE models for different countries.

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ANNEX 1: ADDITIONAL RESULTS FROM THE DESCRIPTIVE ANALYSIS

Figure A.1: Structural unemployment and contributions of institutions in the European Union

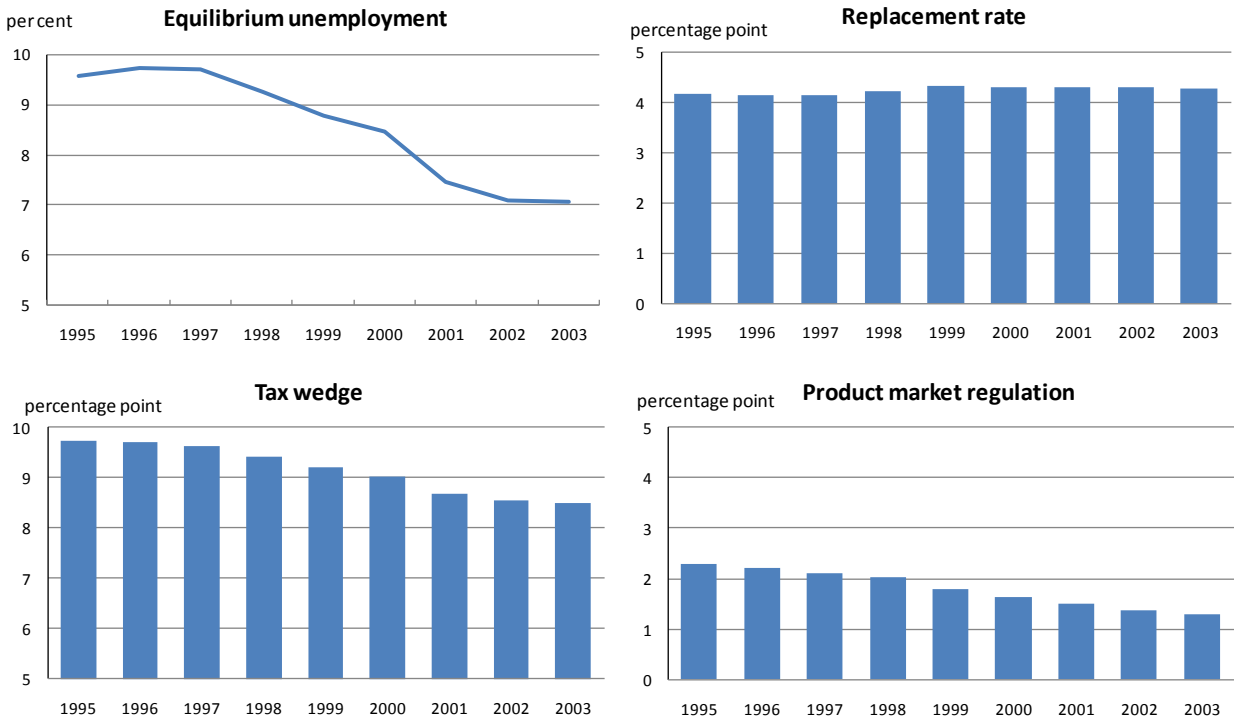


Figure A.2: Structural unemployment and contributions of institutions in the United States

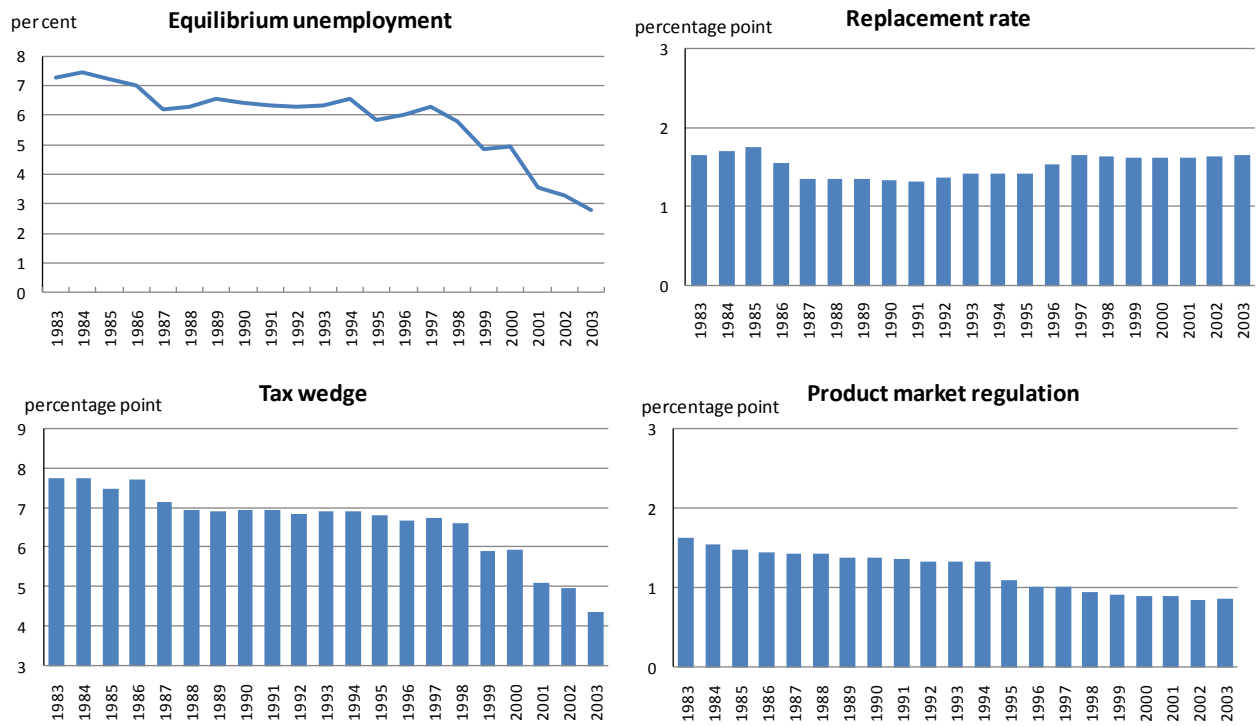
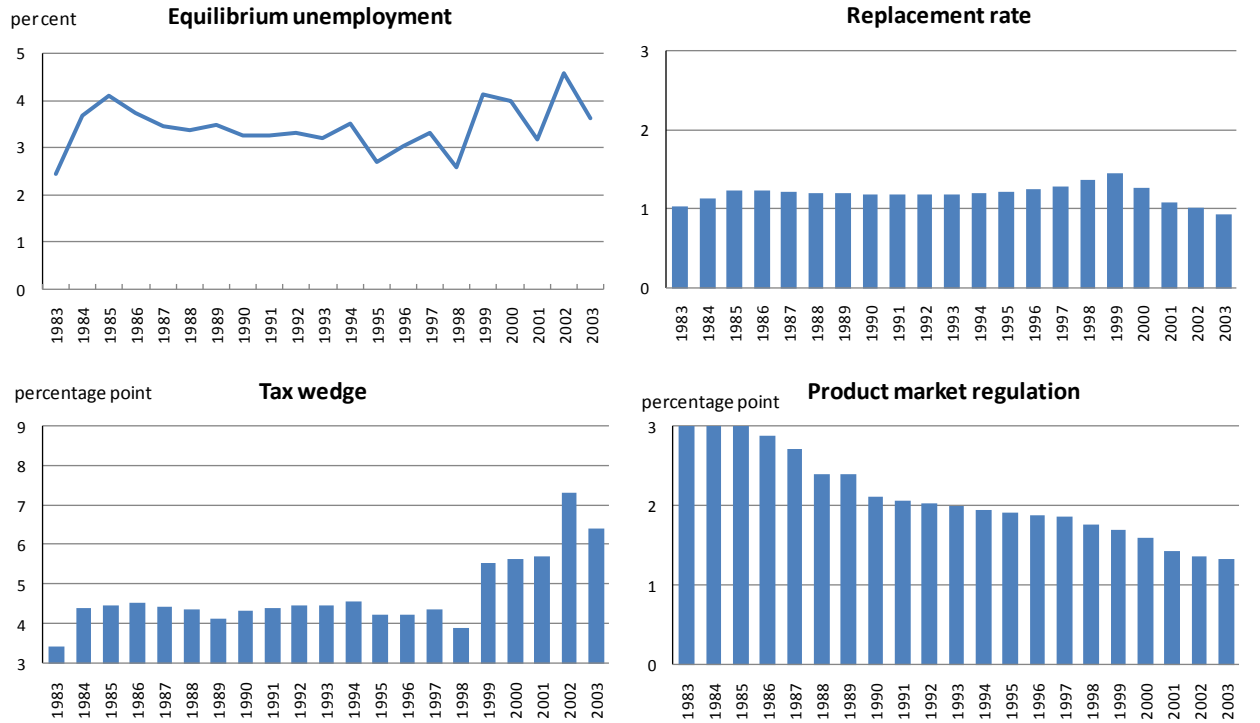


Figure A.3: Structural unemployment and the contribution of institutions in Japan



ANNEX 2: MAIN EQUATIONS OF THE NEO-KEYNESIAN MODELS

Equations are usually estimated in an error correction form using a general to specific approach.

Keys to variables	
c	private consumption
gap	output gap
h	hours
*h**	trend hours
i	investment
ih	housing investment
n	employment
*n**	potential employment
p	production prices
pcore	core consumer price
pih	price of housing
pm	import price all goods and services
rs	short-term real interest rate
rl	long-term real interest rate
u	unemployment rate
ugap	unemployment gap
w	wage
y^d	household disposable income
*y**	potential output

Test	
WHITE	White heteroskedasticity test
LM(2)	Breusch-Godfrey Serial Correlation LM Test - 2 lags
CHOW STABILITY	Chow Breakpoint Test: 2000Q1
CHOW PREDICTIVE	Chow Forecast Test: Forecast from 2006Q4 to 2007Q2
NORMALITY	Jarque-Bera Normality test

Consumption : Δc	**USA**		**EURO AREA**		**FRANCE**	
	COEF.	TSTAT	COEF.	TSTAT	COEF.	TSTAT
cst	-1.85	-2.12	-0.01	-3.17	0.03	2.03
Δy^d	0.26	4.44	0.28	4.08		
mov (Δy^d, 4)					0.41	2.08
c(-1) - y(-1)	-0.21	-4.05	-0.17	-4.05	-0.13	-2.47
rs			-0.06	-2.30		
rs(-1)	-0.04	-3.47				
mov (rs,4)					-0.001	-2.69
Δu			-0.01	-4.31		
u					-0.001	-1.47
Estimation period	1980Q2 2007Q2		1991Q2 2007Q2		1985Q1 2007Q2	
SE	0.50		0.00		0.01	
R^2	0.30		0.40		0.19	
DW	1.78		2.14		2.06	
RESET	0.00		0.00		0.14	
WHITE	0.00		0.00		0.14	
LM(2)	0.05		0.41		0.46	
CHOW STABILITY	0.41		0.08		0.02	
CHOW PREDICTIVE	0.99		0.83		0.61	
NORMALITY	0.68		0.01		0.08	

Note: MOV means moving average

Business investment : Δi	**USA**		**EURO AREA**		**FRANCE**	
	COEF.	TSTAT	COEF.	TSTAT	COEF.	TSTAT
cst	-10.56	-3.51	-38.00	-5.81	-19.35	-3.68
mov (Δi(-2), 2)	0.32	2.75				
Δy	1.60	6.15			2.16	9.16
mov (Δy(-1),7)	1.93	2.68			2.09	4.77
mov (Δy(-1), 2)			2.01	5.16		
i(-1) - y(-1)	-0.05	-3.55	-0.19	-5.84	-0.08	-3.62
mov (rl (-1), 4)	-0.64	-4.58			-0.15	-1.76
mov (rl (-1), 6)			-0.52	-5.96		
Estimation period	1982Q1 2007Q2		1992Q3 2007Q2		1982Q1 2007Q2	
SE	1.50		0.93		0.93	
R^2	0.55		0.64		0.65	
DW	1.94		2.69		2.06	
RESET	0.78		0.38		0.70	
WHITE	0.55		0.61		0.51	
LM(2)	0.88		0.02		0.14	
CHOW STABILITY	0.13		0.12		0.61	
CHOW PREDICTIVE	0.87		0.79		0.58	
NORMALITY	0.83		0.67		0.27	

Housing investment: Δih	**USA**		**FRANCE**	
	COEF.	TSTAT	COEF.	TSTAT
cst	-38.46	-3.92	-16.88	-1.84
Δih(-1)	0.70	8.31		
Δy^d	0.90	3.42		
$\Delta y^d(-1)$			0.31	1.44
ih(-1) - $y^d(-1)$	-0.14	-4.00	-0.07	-2.10
(rl+rl(-1))/2	-0.51	-2.32	-0.36	-3.42
Δpih(-1)			-0.33	-1.55
mov (Δpih(-1),2)	0.86	1.56		
Estimation period	1990Q1 2007Q2		1990Q1 2007Q2	
SE	1.82		1.30	
R^2	0.57		0.32	
DW	2.02		1.95	
RESET	0.00		0.96	
WHITE	0.09		0.62	
LM(2)	0.64		0.99	
CHOW STABILITY	0.02		0.22	
CHOW PREDICTIVE	0.05		0.77	
NORMALITY	0.90		0.15	

Employment equation : Δ(n-h)	**USA**		**EURO AREA**		**FRANCE**	
	COEF.	TSTAT	COEF.	TSTAT	COEF.	TSTAT
cst	0.28	2.1	0.42	1.78	0.07	2.69
Δ(n-h)	0.1	1.19	0.63	8.24	0.53	5.47
Δ(n(-1)-h(-1))					0.33	2.96
Δ(n(-2)-h(-2))	0.19	2.7			-0.31	-3.51
Δy	0.3	4.6	0.2	4.35	0.18	3.39
Δy(-1)	0.19	2.73				
Δ(w-p)			-0.16	-3.54	-0.18	-3.92
mov (Δ(w-p),4)	-0.29	-3.59				
n(-1)-h(-1)-y(-1)+(w(-1)-p(-1))	-0.04	-2.1	-0.006	-1.79	-0.01	-2.69
Estimation period	1990Q1 2007Q2		1991Q1 2007Q2		1990Q1 2007Q2	
SE	0.25		0.13		0.18	
R^2	0.69		0.84		0.74	
DW	1.62		2.38		1.99	

Phillips curve: ΔΔpcore	**USA**		**EURO AREA**		**FRANCE**	
	COEF.	TSTAT	COEF.	TSTAT	COEF.	TSTAT
cst	0.09	2.54	0.02	0.85	0.01	0.24
ΔΔpcore(−1)	-0.63	-6.45	-0.48	-3.57	-0.27	-2.92
ΔΔpcore(−2)	-0.43	-3.99	-0.25	-1.71	-0.44	-5.30
ΔΔpcore(−3)	-0.18	-2.00	-0.23	-1.70	-0.33	-3.66
ugap	-0.03	-1.85	-0.06	-2.94	-0.06	-1.70
ω*ΔΔpm(-1)	0.24	1.16				
Δpcore(-1)-Δw(-1)	-0.15	-3.19	-0.02	(c, p=0.22)	-0.10	-2.81
Sacrifice ratio	-4.3		-2.0		-2.2	
Estimation period	1981Q2 2007Q2		1992Q1 2007Q2		1981Q2 2007Q2	
SE	0.16		0.11		0.26	
R^2	0.51		0.23		0.33	
DW	1.82		1.86		2.10	
RESET	0.13		0.49		0.01	
WHITE	0.04		0.87		0.00	
LM(2)	0.04		0.17		0.05	
CHOW STABILITY	0.41		0.45		0.82	
CHOW PREDICTIVE	0.36		0.21		0.89	
NORMALITY	0.87		0.90		0.00	

Wage : Δw	**USA**		**EURO AREA**		**FRANCE**	
	COEF.	TSTAT	COEF.	TSTAT	COEF.	TSTAT
cst	-0.01	-0.99				
Δw(-1)	-0.22	-3.28				
Δp	1.00	c	1.00	c	1.00	c
w(-1)-p(-1)-n*(-1)-y*(-1)	-0.04	-1.43	-0.003	-2.78	-0.02	-2.81
Δugap	0.00	-1.43				
mov (ugap, 2)			-0.002	-2.91	-0.001	-2.18
mov (ugap, 4)						
Estimation period	1980Q4 2007Q2		1991Q2 2007Q2		1980Q2 2007Q2	
SE	0.01		0.00		0.00	
R^2	0.61		0.58		0.75	
DW	1.43		1.81		1.97	
WHITE	0.14		0.00		0.00	
LM(2)	0.00		0.71		0.95	
CHOW STABILITY	0.67		0.00		0.00	
CHOW PREDICTIVE	0.06		0.34		0.22	
NORMALITY	0.11		0.02		0.78	

Producer price : Δp	**USA**		**EURO AREA**		**FRANCE**	
	COEF.	TSTAT	COEF.	TSTAT	COEF.	TSTAT
cst	-0.01	-0.36	0.20	3.39	0.07	1.78
Δp(-1)	0.50	5.46				
Δp(-2)	0.16	1.55				
Δp(-3)	0.34	(c)				
mov(Δp(-1),8)					0.78	21.17
mov(Δp(-1),3)			0.61	6.18		
mov (gap,4)	0.03	2.26				
mov (gap,2)					0.04	2.42
gap(-1)			0.03	1.55		
Estimation period	1981Q1 2007Q2		1992Q1 2007Q2		1982Q2 2007Q2	
SE	0.22		0.17		0.23	
R^2	0.66		0.42		0.83	
DW	2.18		2.35		1.58	
RESET			0.13		0.13	
WHITE	0.00		0.61		0.00	
LM(2)	0.00		0.23		0.15	
CHOW STABILITY	0.84		0.42		0.02	
CHOW PREDICTIVE	0.25		0.82		0.64	
NORMALITY	0.75		0.63		0.30	

ANNEX 3: THE MICRO-FOUNDED DYNAMIC GENERAL EQUILIBRIUM MODEL

This annex details the features of the DGE model used in the paper and provides the micro-foundations of the different equations. It subsequently describes the calibration of the model for the euro area.

1. Main equations of the DGE model

Keys to variables:

C	Consumption	τ^w	Tax on labour income
C^o	Consumption by intertemporal optimisers	τ^e	Employer social security contribution
λ^o	Marginal utility of consumption of intertemporal optimisers	R	Gross benefit replacement rate
C^k	Consumption under liquidity constraints	T	Lump-sum taxes
λ^k	Marginal utility of consumption of liquidity-constraint households	Y	Output
N	Employment	B	Government bonds bought at the start of period *t*
W	Nominal wage	i	Nominal interest rate
P	Price	π	Inflation
τ^c	Tax on consumption		

Consumption:

$$C_t = (1-\omega)C_t^o + \omega C_t^k$$

$$1 = \beta(1+i_t)E_t[\lambda_{t+1}^o/\lambda_t^o]$$

$$\lambda_t^o = \frac{1}{(1+\tau_t^c)P_t}\left(\frac{1}{C_t^o - hC_{t-1}^o} - \frac{\beta h}{C_{t+1}^o - hC_t^o}\right)$$

$$C_t^k = \frac{1-\tau_t^w}{1+\tau_t^c}\frac{W_t}{P_t}N_t + \frac{1-\tau_t^w}{1+\tau_t^c}(1-N_t)\frac{W_t}{P_t}R_t - \frac{\varpi}{1+\tau_t^c}\frac{T_t}{P_t}$$

Wages:

$$\frac{W_t}{P_t}\left[(1-\omega)\left(\frac{1}{C_t^o - hC_{t-1}^o} - \frac{\beta h}{C_{t+1}^o - hC_t^o}\right) + \omega\frac{1}{C_t^k}\right] = \frac{1+\tau_t^c}{1-\tau_t^w}\frac{\kappa\eta N_t^\varphi}{(1-R_t)\eta - 1}$$

Production:

$$Y_t = N_t$$

Demand:

$$Y_t = C_t + \frac{\phi}{2}\left(\frac{N_t}{N_{t-1}} - 1\right)^2 N_{t-1} + \frac{\theta}{2}\left(\frac{P_t}{P_{t-1}} - 1\right)^2 Y_t$$

Prices:

$$\theta\left(\frac{P_t}{P_{t-1}} - 1\right)\frac{P_t}{P_{t-1}} = 1 + \theta E_t\left[\beta\frac{\lambda^o_{t+1}}{\lambda^o_t}\left(\frac{P_{t+1}}{P_t} - 1\right)\frac{P_{t+1}}{P_t}\frac{Y_{t+1}}{Y_t}\right] + \varepsilon\left[\frac{(1+\tau^e_t)W_t}{P_t} + \phi\left(\left[\frac{Y_t}{Y_{t-1}} - 1\right] - \beta E_t\left[\left(\frac{Y_{t+1}}{Y_t} - 1\right)\frac{Y_{t+1}}{Y_t}\right] + \frac{1}{2}\left(\frac{Y_t}{Y_{t-1}} - 1\right)^2\frac{P_t Y_{t-1}}{P_{t-1}Y_t}\right) - 1\right]$$

Government budget:

$$(1-\tau^w_t)(1-N_t)W_t R_t + (1+i_t)B_t = (\tau^w_t + \tau^e_t)W_t N_t + \tau^c_t P_t C_t + T_t + B_{t+1}$$

Monetary policy rule:

$$i_t = -\ln\beta + \phi_\pi \pi_t$$

2. Micro-foundations of the equations

The model equations can be derived from assumptions on the behaviour of households, firms and policy makers.

Households

The household sector consists of a continuum of households $i \in [0,1]$. A share ω of these households faces liquidity constraints. Liquidity-constrained households, labelled $k \in [0, \omega]$, have no access to financial markets and consume their current disposable income at each period. By contrast, unconstraint households, labelled $o \in [\omega, 1]$, have full access to financial markets. They can buy and sell assets and transfer income over time.

Lifetime utility is the expected discounted value of utility at each period over an infinite horizon. Utility is additive in the utility from consumption C_t and the disutility from work N_t:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(ln\left(C^i_t - hC^i_{t-1}\right) - \frac{\kappa}{1+\varphi}\left(N^i_t\right)^{1+\varphi}\right) \quad \textbf{(1)}$$

where $0 \leq h \leq 1$ indicates the degree of habit persistence, and κ the weight of leisure . The parameters β and φ^{-1} respectively denote the discount factor and the labour supply elasticity. h is assumed to be zero for the liquidity-constrained households.

Each household i supplies differentiated labour services in a monopolistically competitive labour market. For simplicity the labour services of liquidity-constrained and intertemporally optimising households are assumed to be of comparable quality. Labour inputs are then combined in a CES bundle of the differentiated labour services:

$$N_t = \left[\int_0^1 \left(N_t^i\right)^{\frac{\eta-1}{\eta}} di\right]^{\frac{\eta}{\eta-1}}$$

η is the elasticity of substitution between services. Demand for variety i is a function of relative wage and of total labour demand:

$$N_t^i = \left(\frac{W_t^i}{W_t}\right)^{-\eta} N_t \quad \textbf{(2)}$$

The budget constraint of unrestricted households is:

$$(1-\tau_t^w)W_t^i N_t^o + (1-\tau_t^w)(1-N_t^o)W_t R_t + P_t D_t = (1+\tau_t^c)P_t C_t^o + B_{t+1} - (1+i_t)B_t + (1-\varpi)T_t \quad \textbf{(3)}$$

with W_t^i the nominal wage of household i, W_t the average nominal wage, τ_t^w is the labour income tax, R_t the replacement ratio for the non-employed part of the household, $P_t D_t$ profits, $P_t C_t^o$ nominal consumption, τ_t^c the consumption tax rate $B_t$are one-period government bonds bought at the start of period t, i_t the nominal interest rate, and T_t lump-sum taxes. The parameter $1-\varpi$ is the share of lump-sum taxes levied from the non liquidity-constrained households.

Liquidity-constrained households can neither save income nor borrow against future income. They do not receive any profit. As a result, net household expenditure equals net spending at each period:

$$(1-\tau_t^w)W_t^i N_t^k + (1-\tau_t^w)\left(1-N_t^k\right)W_t R_t = (1+\tau_t^c)P_t C_t^k + \varpi T_t \quad \textbf{(4)}$$

Consumption

Households consume a bundle of differentiated goods, each one being provided by a firm $j \in [0,1]$. Aggregate consumption thus equals:

$$C_t = \left[\int_0^1 \left(C_t^j\right)^{\frac{\varepsilon-1}{\varepsilon}} dj\right]^{\frac{\varepsilon}{\varepsilon-1}}$$

with ε as the elasticity of substitution between C_t^j. Demand for C_t^j depends on the relative price of the variety and on the aggregate demand for consumption goods:

$$\boldsymbol{C_t^j = \left(\frac{P_t^j}{P_t}\right)^{-\varepsilon} C_t} \quad \textbf{(5)}$$

Intertemporally optimising households choose the consumption path that ensures equality of the discounted marginal utility of consumption expenditure at each point of time. Differentiating utility (2) under the budget restriction (3) gives the marginal utility of consumption:

$$\lambda_t^o = \frac{1}{(1+\tau_t^c)P_t}\left(\frac{1}{C_t^o - hC_{t-1}^o} - \frac{\beta h}{C_{t+1}^o - hC_t^o}\right) \quad \textbf{(6)}$$

Moreover, the intertemporal optimality condition that determines income transfers, *i.e.* the optimal amount of saving, reads:

$$\lambda_t^o = \beta(1+i_t)E_t\lambda_{t+1}^o \quad \textbf{(7)}$$

Combining the first-order conditions (6) and (7) yields the optimal consumption path:

$$1 = \beta(1+i_t)E_t\left[\frac{1+\tau_t^c}{1+\tau_{t+1}^c}\frac{P_t}{P_{t+1}}\frac{(C_{t+1}^o - hC_t^o)^{-1} - \beta h(C_{t+2}^o - hC_{t+1}^o)^{-1}}{(C_t^o - hC_{t-1}^o)^{-1} - \beta h(C_{t+1}^o - hC_t^o)^{-1}}\right] \quad \textbf{(8)}$$

The liquidity-constrained households spend all their currently disposable income on current consumption. The marginal utility of income, derived from maximising (2) with $h = 0$ under restriction (4) is:

$$\lambda_t^k = \frac{1}{(1+\tau_t^c)P_t C_t^k} \quad \textbf{(9)}$$

Consumption under the budget constraint (4) equals:

$$C_t^k = \frac{1-\tau_t^w}{1+\tau_t^c}\frac{W_t^i}{P_t}N_t^k + \frac{1-\tau_t^w}{1+\tau_t^c}\left(1-N_t^k\right)\frac{W_t}{P_t}R_t - \frac{\varpi}{1+\tau_t^c}\frac{T_t}{P_t} \quad \textbf{(10)}$$

Finally, aggregate consumption equals the weighted average of the consumption levels of both types of households:

$$C_t = (1-\omega)C_t^o + \omega C_t^k \quad \textbf{(11)}$$

Labour market

Labour unions set wage for the differentiated services in a monopolistically competitive labour market. It is assumed that optimising and liquidity-constrained consumers are uniformly distributed across types of labour and hence across unions (see *e.g.* Galí *et al.*, 2007). At each period, a typical union, representing workers of type *i*, sets the wage to maximise the marginal value of income subject to the labour demand function **(2)**. The optimum wage obtained from differentiating (1) under the constraints (2**)** and (3) or (4) with respect to W_t^i is: **[15]**

[15] This first-order condition assumes that unions neglect the effect of wage levels on unemployment transfer levels, *e.g.* that unions care only about the working insiders. If unions took into account that, given the replacement rate, higher wages imply higher transfers to the unemployed and higher household income, the first-order condition would become $\kappa\eta\left(\frac{W_t^i}{W_t}\right)^{-\eta(1+\varphi)}\frac{N_t^{1+\varphi}}{W_t^i} + \lambda_t(1-\tau_t^w)(1-\eta)\left(\frac{W_t^i}{W_t}\right)^{-\eta}N_t + \lambda_t\left[1-(1-\eta)\left(\frac{W_t^i}{W_t}\right)^{-\eta}N_t\right](1-\tau_t^w)R_t = 0$ and the subsequent wage setting equation would change accordingly.

$$\kappa\eta\left(\frac{W_t^i}{W_t}\right)^{-\eta(1+\varphi)}\frac{N_t^{1+\varphi}}{W_t^i}+\lambda_t(1-\tau_t^w)(1-\eta)\left(\frac{W_t^i}{W_t}\right)^{-\eta}N_t+\lambda_t\eta(1-\tau_t^w)\left(\frac{W_t^i}{W_t}\right)^{-(1+\eta)}N_tR_t=0$$

All unions target the same wage and wages are fully flexible, so that $W_t^i = W_t$, the previous expression simplifies to:

$$W_t=\frac{\kappa}{1-\tau_t^w}\frac{N_t^{\varphi}}{\lambda_t}\frac{\eta}{(1-R_t)\eta-1}$$

The replacement rate, a proxy of the reservation wage, exerts upward pressures on wages. Because consumption generally differs across both types of households, the union weights labour income using a weighted average of constrained and unconstrained households' marginal utility of consumption, *i.e.* $\lambda_t=(1-\omega)\lambda_t^o+\omega\lambda_t^k$. Inserting (6) along this weighting scheme yields:

$$\frac{W_t}{P_t}\left[(1-\omega)\left(\frac{1}{C_t^o-hC_{t-1}^o}-\frac{\beta h}{C_{t+1}^o-hC_t^o}\right)+\omega\frac{1}{C_t^k}\right]=\frac{1+\tau_t^c}{1-\tau_t^w}\frac{\kappa\eta N_t^{\varphi}}{(1-R_t)\eta-1} \quad \textbf{(12)}$$

Because firms allocate labour demand uniformly across different workers employment is equal across households, *i.e.* $N_t=N_t^o=N_t^k$.

Production and prices

The production sector consists of a continuum of firms $j \in [0,1]$ producing a differentiated product and setting price in a monopolistically competitive goods market. Labour is the only input, which yields constant returns to scale. Without loss of generality, the technology parameter can be normalised to one. Consequently, gross output of firm *j* under this simple production function is:

$$Y_t^j=N_t^j \quad \textbf{(13)}$$

Each firm faces quadratic employment and price adjustment costs Φ_t and Θ_t respectively. Adjustment costs are sunk costs that use part of output and drive a wedge between production and consumption. Labour adjustment costs can be interpreted as hiring and firing costs. A common specification of quadratic per-unit adjustment costs of firm *j* (see *e.g.* Cahuc and Zylberberg, 2004; Hamermesh, 1995; Rotemberg, 1982) is:

$$\Phi_t^j=\frac{\phi}{2}\left(\frac{N_t^j}{N_{t-1}^j}-1\right)^2$$

$$\Theta_t^j=\frac{\theta}{2}\left(\frac{P_t^j}{P_{t-1}^j}-1\right)^2$$

The aggregate level of output is:

$$Y_t = \int_0^1 Y_t^j \, dj = \int_0^1 C_t^j \, dj + \int_0^1 \Phi_t^j N_{t-1}^j dj + \int_0^1 \Theta_t^j Y_t^j \, dj$$

Assuming synchrony of the price adjustment across firms operating under identical constraints as in the Rotemberg (1982) model, there is no relative price dispersion and $P_t^j = P_t$. Following equation (5), consumption demand equally spreads across the product varieties j. Symmetry also implies adjustment costs are identical across firms, so that $\int_0^1 \Phi_t^j N_t^j \, dj = \Phi_t N_t$ and $\int_0^1 \Theta_t^j Y_t^j \, dj = \Theta_t Y_t$. Consequently, aggregate output equals:

$$Y_t = C_t + \Phi_t N_{t-1} + \Theta_t Y_t \tag{14}$$

Firms set sales price P_t^j so as to maximise their discounted stream of profits:

$$\max_{P_t^j} D_0^j = \sum_{t=0}^{\infty} \beta^t \left[\frac{P_t^j}{P_t} Y_t^j - (1 + \tau_t^e) \frac{W_t}{P_t} N_t^j - \Phi_t^j N_t^j - \Theta_t^j Y_t^j \right]$$

Differentiating this equation with respect to P_t^j given the production function (13) together with the definition of employment and price adjustment costs, the demand function $Y_t^j = \left(P_t^j / P_t\right)^{-\varepsilon} Y_t$ and $P_t^j = P_t$ and $Y_t^j = Y_t$, yields the dynamic price setting equation:

$$\begin{aligned} &\theta \left(\frac{P_t}{P_{t-1}} - 1 \right) \frac{P_t}{P_{t-1}} \\ &\quad = 1 + \theta E_t \left[\beta \frac{\lambda_{t+1}^o}{\lambda_t^o} \left(\frac{P_{t+1}}{P_t} - 1 \right) \frac{P_{t+1}}{P_t} \frac{Y_{t+1}}{Y_t} \right] \\ &\quad + \varepsilon \left[\frac{(1 + \tau_t^e) W_t}{P_t} + \phi \left(\left[\frac{Y_t}{Y_{t-1}} - 1 \right] - \beta E_t \left[\left(\frac{Y_{t+1}}{Y_t} - 1 \right) \frac{Y_{t+1}}{Y_t} \right] + \frac{1}{2} \left(\frac{Y_t}{Y_{t-1}} - 1 \right)^2 \frac{P_t Y_{t-1}}{P_{t-1} Y_t} \right) - 1 \right] \end{aligned} \tag{15}$$

Equation (15) demonstrates that quadratic price adjustment costs reduce the elasticity of goods prices to current production costs and introduce a forward-looking component into pricing decisions. Aggregate demand influences the current level of output and employment because of the sluggish price adjustment. Both employment and price adjustment costs generate gaps between actual output and the production level that would prevail under perfectly flexible markets.[16] The marginal value of income in equation (15) refers to intertemporal optimisers only, because liquidity-constrained consumers do not own firms. Without adjustment costs, $\theta = \phi = 0$, equation (15) reduces to $P_t = \varepsilon(\varepsilon - 1)^{-1}(1 + \tau_t^e) W_t$. The latter is the standard pricing rule under monopolistic competition and flexible prices, when $(1 + \tau_t^e) W_t$ are the marginal costs of production.

[16] Note that although price adjustment costs introduce persistence in goods *prices*, they do not generate *inflation* persistence. In order to generate inflation persistence one would have to include some form of price indexation (*e.g.* Smets and Wouters, 2003) or backward-looking behaviour in the formation of expectations.

Government

The Government collects wage income tax τ_t^w, consumption tax τ_t^c, and employer social security contributions τ_t^e. It pays transfers at the replacement rate R_t to unemployed household members and issues bonds B_{t+1} to balance the budget. It can also levy lump-sum taxes T_t to this aim. Public final demand is omitted for simplicity, but this would not substantially modify the results. The government budget constraint is:

$$(1-\tau_t^w)(1-N_t)W_tR_t + (1+i_t)B_t = (\tau_t^w + \tau_t^e)W_tN_t + \tau_t^c P_tC_t + T_t + B_{t+1} \quad \textbf{(16)}$$

Forward-looking consumption and price setting behaviour requires a policy rule to ensure the uniqueness and stability of the equilibrium. To keep the analysis simple, policy rates are assumed to react to current inflation:

$$i_t = -\ln\beta + \phi_\pi \pi_t \quad \textbf{(17)}$$

Extension: A search and matching model of the labour market

A number of recent contributions have adopted the search-and-matching approach in DGE models to incorporate the effect of frictional unemployment in the analysis (*e.g.* Blanchard and Galí, 2008; Campolmi and Faia, 2006; Christoffel and Linzert, 2005; Faia, 2006).

Frictional unemployment allows gross to differ from net flows into and out of unemployment. The framework in the present paper uses the wage setting relationship (12). The derivation explicitly accounts for the impact of structural policies on steady-state labour supply instead of adopting the common assumption of exogenous and constant labour supply. For simplicity we restrict this model extension to an economy without liquidity-constrained consumers, *i.e.* to $\omega = 0$.

Employment N_t is modelled as the level of previous employment net of job separations plus current job matches:

$$N_t = (1-\rho)N_{t-1} + m(U_t, V_t) \quad \textbf{(18)}$$

where ρ is an exogenous separation rate, and $m(U_t, V_t)$ are current job matches given initial unemployment U_t and vacancies V_t. The matching function has a Cobb-Douglass form (*e.g.* Campolmi and Faia, 2006; Faia, 2006):

$$m(U_t, V_t) = \mu U_t^{\xi} V_t^{1-\xi}$$

with $\mu \in (0,1)$ as the matching technology and $\xi \in (0,1)$ specifying the elasticity of matches with respect to unemployment. Unemployment at the start of the period U_t, is the gap between labour supply, *i.e.* optimal employment, in the absence of employment and price adjustment costs L_t^s, and actual beginning-of-period employment: $U_t = L_t^s - (1-\rho)N_{t-1}$.[17] The ratio of vacancies over unemployment $\vartheta_t = V_t/U_t$, is a measure of labour market tightness that allows rewriting the matching function:

[17] This contrasts with the previously cited research. The latter generally defines unemployment as the gap between a constant work force, often normalised to unity, and actual employment. The definition adopted here accounts for the

$$m(\vartheta_t, U_t) = \mu \vartheta_t^{1-\xi} U_t$$

The probability for an unemployed to find a job is $q_t = m_t/U_t = \mu \vartheta_t^{1-\xi}$, which yields:

$$m(\vartheta_t, U_t) = q_t U_t \tag{19}$$

The level of employment in the absence of employment or price adjustment costs can be derived from combining equations (12) and (15) under $\theta = \phi = 0$. Further using $C_t = L_t^s$ in this case from equation (14) yields:

$$\frac{1}{L_t^s - hL_{t-1}^s} - \frac{\beta h}{E_t L_{t+1}^s - hL_t^s} = \frac{\varepsilon}{\varepsilon - 1} \frac{(1+\tau_t^c)(1+\tau_t^e)}{1-\tau_t^w} \frac{\kappa \eta (L_t^s)^{\varphi}}{(1-R_t)\eta - 1}$$

Thus, L_t^s is full employment consistent with a level of production distorted labour and price costs. The rate of unemployment is U_t/L_t^s.

Adjustment costs are assumed to apply to gross flows, $N_t - (1-\rho)N_{t-1}$, consistent with Hamermesh (1995) The adjustment cost term then reads:

$$\Phi_t^{g,j} = \frac{\phi}{2}\left(\frac{N_t^j}{N_{t-1}^j} + \rho - 1\right)^2$$

The dynamic price setting equation becomes:

$$\theta\left(\frac{P_t}{P_{t-1}} - 1\right)\frac{P_t}{P_{t-1}}$$

$$= 1 + \theta E_t\left[\beta \frac{\lambda_{t+1}^o}{\lambda_t^o}\left(\frac{P_{t+1}}{P_t} - 1\right)\frac{P_{t+1}}{P_t}\frac{Y_{t+1}}{Y_t}\right] + \varepsilon\left[\frac{(1+\tau_t^e)W_t}{P_t} - 1\right]$$

$$+ \phi\varepsilon\left(\left[\frac{Y_t}{Y_{t-1}} + \rho - 1\right] - \beta E_t\left[\left(\frac{Y_{t+1}}{Y_t} + \rho - 1\right)\frac{Y_{t+1}}{Y_t}\right] + \frac{1}{2}\left(\frac{Y_t}{Y_{t-1}} + \rho - 1\right)^2 \frac{P_t Y_{t-1}}{P_{t-1} Y_t}\right) \tag{20}$$

The overall resource constraint of the economy with adjustment costs on gross labour flows is

$$Y_t = C_t + \Phi_t^g N_{t-1} + \Theta_t Y_t \tag{21}$$

fact that distortions from fiscal policy and monopolistic competition affect optimal labour supply and consequently also the labour market tightness.

3. Calibration

The calibration of the model parameters builds on the estimated euro area DGE models of Coenen *et al.* (2007) and Grenouilleau *et al.* (2007), mark-up estimates of Christopoulou and Vermeulen (2008) and tax and benefit data from OECD (2007) (see Table A.3.1).

The parameter of price adjustment costs matches the empirical evidence on average price duration in the euro area and the United States (Bils and Klenow, 2004; Altissimo *et al*., 2006). The value of 25% for the share of liquidity-constrained households in Figures 7-8 and A.4.5-A.4.8 is taken from Coenen *et al*. (2007). The fiscal parameters follow the OECD (2007) tax and benefits data for euro area countries and coincide with those in Coenen *et al*. (2007). The average replacement rate is the one for spouse in work, because unemployment in the model is for second earner in the model. The estimated average elasticity of substitution in the goods market in Christopoulou and Vermeulen (2008) suggests a 25% price mark-up. Following Coenen *et al.* (2007) for the elasticity of substitution between labour services, the steady-state wage mark-up is 20%. The remaining parameter values are taken from the euro area models of Coenen *et al.* (2007) and Smets and Wouters (2003) and are in line with other empirical studies.

Table A.3.1: Calibration of the parameters

Name	Symbol	Value	Source
Employment adjustment costs Euro area United States	θ	 63 30	Grenouilleau *et al.* (2007)
Price adjustment costs Euro area United States	ψ	 21 3.40	Grenouilleau *et al.* (2007)
Consumption tax	τ^c	0.18	OECD (2007)
Labour income tax	τ^w	0.24	OECD (2007)
Employer social security contributions	τ^e	0.22	OECD (2007)
Replacement rate	R	0.25	OECD (2007)
Elasticity of substitution between types of labour	η	6.00	Coenen *et al.* (2007)
Elasticity of substitution between types of goods	ε	5.00	Christopoulou and Vermeulen (2008)
Habit persistence	h	0.85	Grenouilleau *et al.* (2007)
Share of liquidity-constrained households	ω	0.25	Coenen *et al.* (2007)
Disutility weight of labour	κ	1.00	Coenen *et al.* (2007)
Discount factor	β	0.99	Coenen *et al.* (2007)
Inverse of labour supply elasticity	φ	2.20	Smets and Wouters (2003)
Policy response to inflation	ϕ_π	1.50	Galí *et al.* (2007)
Job finding probability	q	0.60	Campolmi and Faia (2007)
Exogenous job separation rate	ρ	0.08	Christoffel and Linzert (2005)

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ANNEX 4: ADDITIONAL IMPULSE RESPONSES FROM THE DGE MODEL

Figure A.4.1: Impact of a one percentage point cut in the benefit replacement rate

(Change compared to baseline)

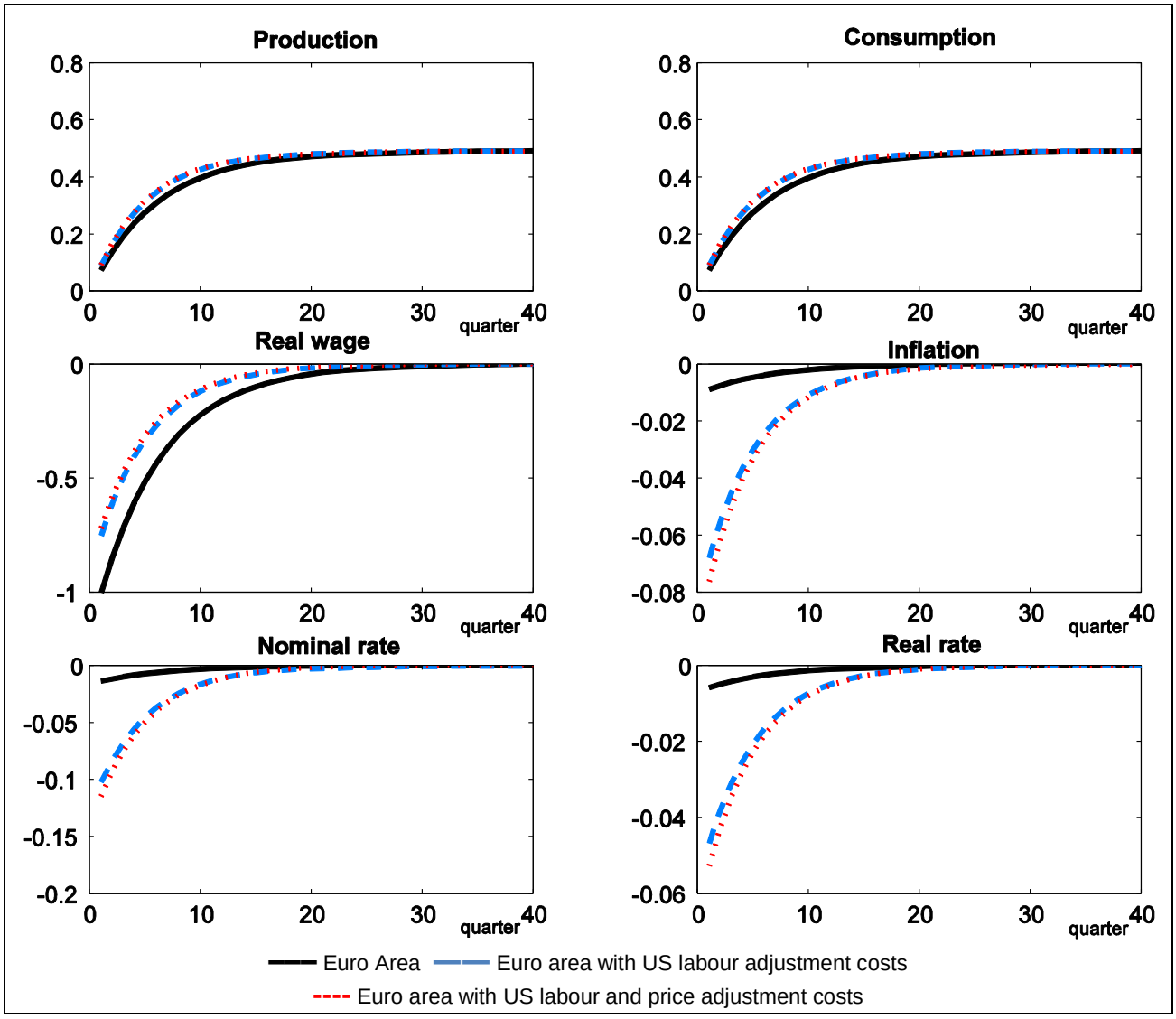


Figure A.4.2: Impact of a one percentage point cut in social security contributions

(Change compared to baseline)

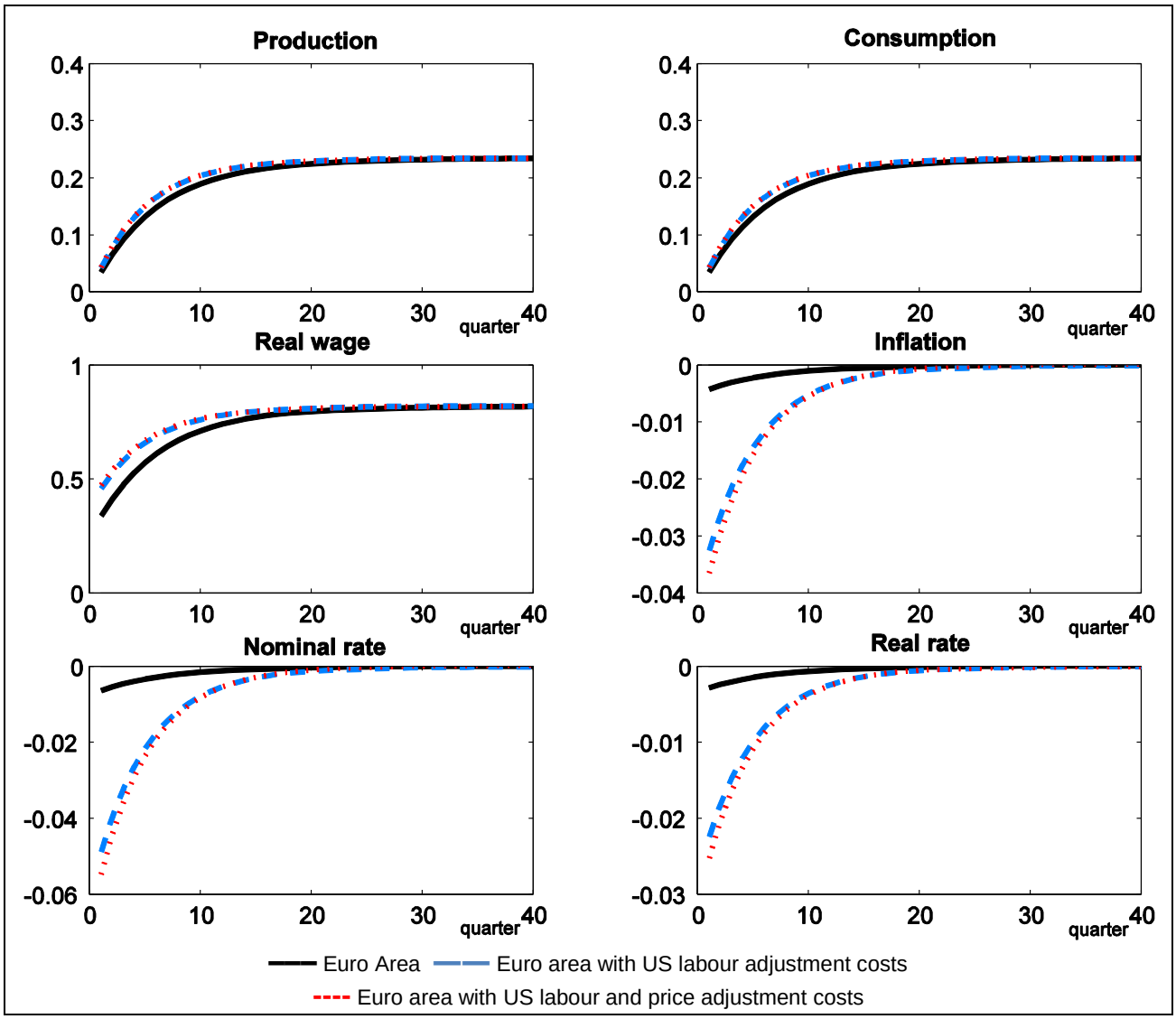


Figure A.4.3: One percentage point cut in the benefit replacement rate in the search-and-matching model

(Change compared to baseline)

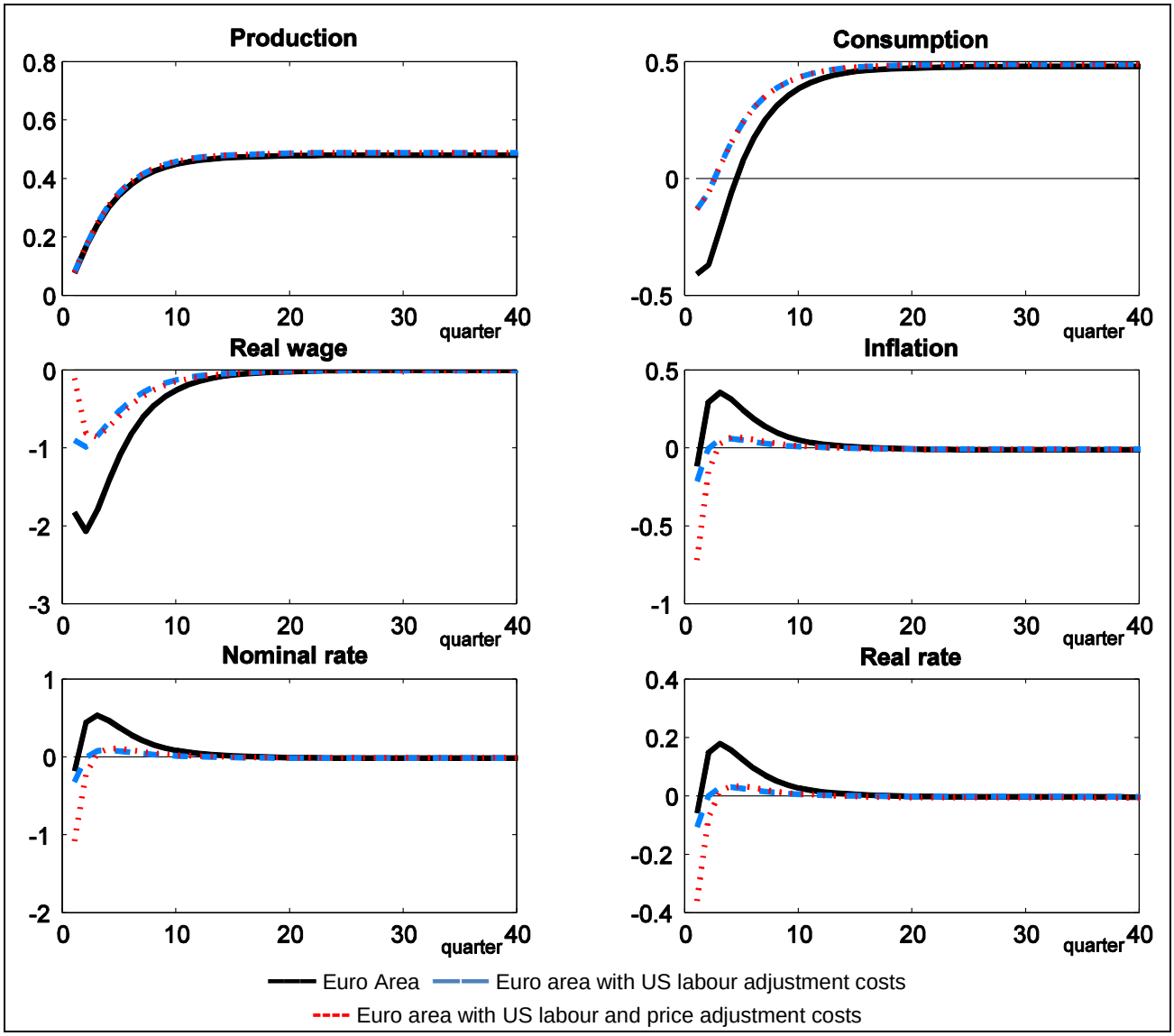


Figure A.4.4: One percentage point cut in the social security contributions in the search-and-matching model

(Change compared to baseline)

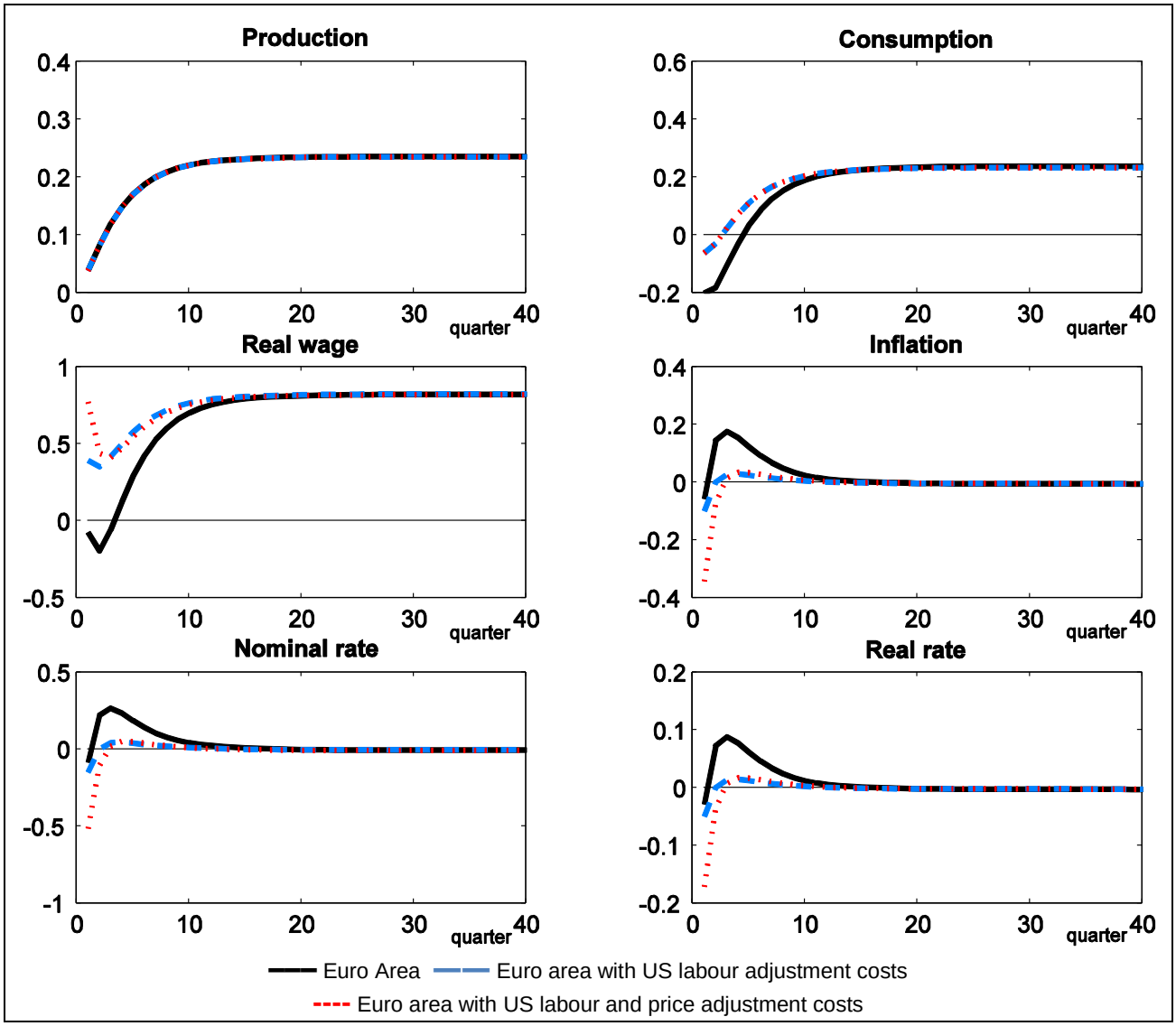


Figure A.4.5: One percentage point cut in social security contributions in the model with liquidity-constrained households

(Change compared to baseline)

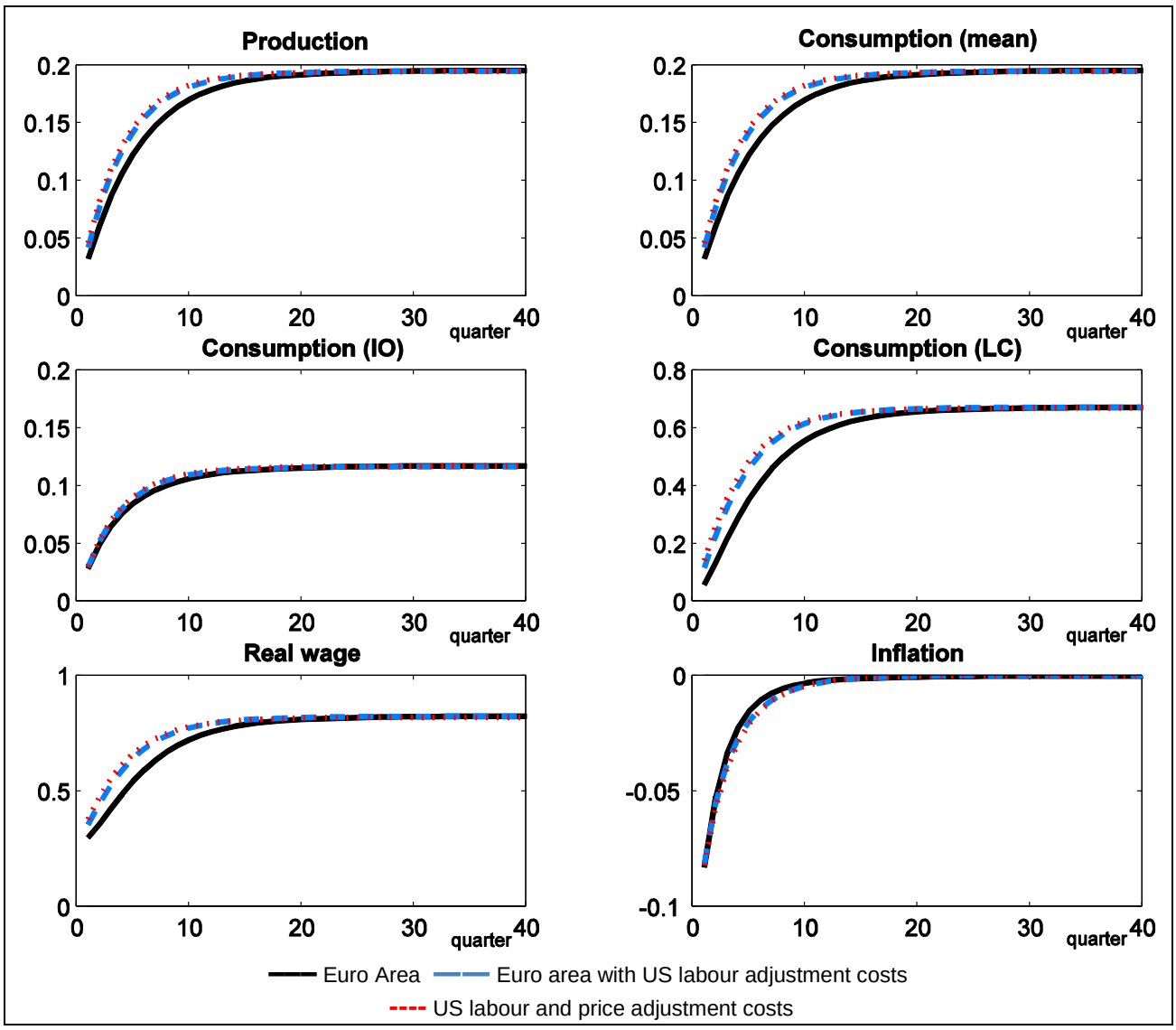


Figure A.4.6: One percentage point cut in the benefit replacement rate in the model with liquidity-constrained households under alternative budget-balancing schemes

(Change compared to baseline)

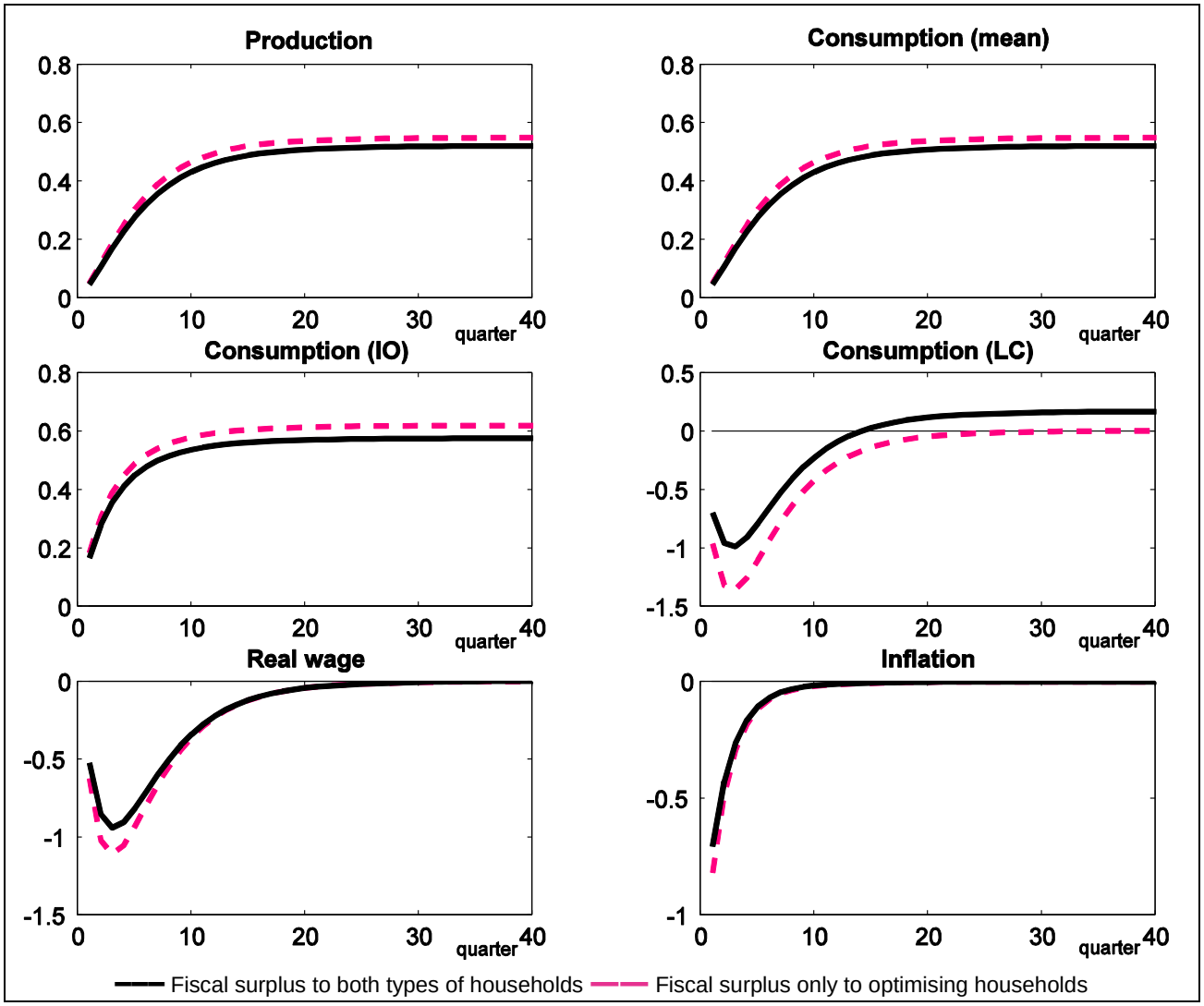
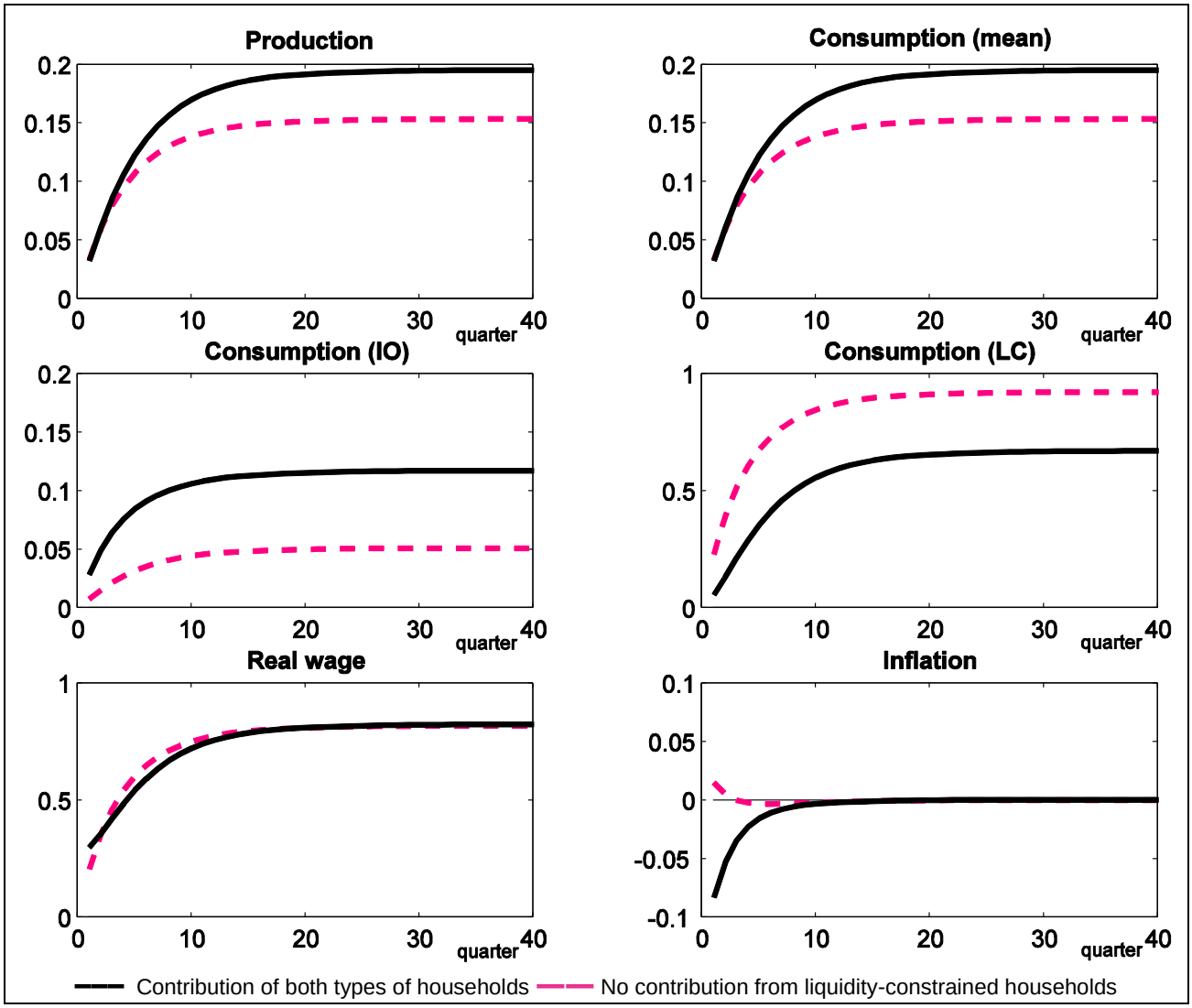


Figure A.4.7: One percentage point cut in social security contributions in the model with liquidity-constrained households under alternative budget-balancing schemes

(Change compared to baseline)



ANNEX 5: DETAILED RESULTS OF THE NEO-KEYNESIAN SIMULATION

Effects of a one percentage-point NAIRU reduction

Change compared to baseline

	Quarters	1	4	10	20	40	80	Long-term
UNITED STATES								
Real GDP	without monetary reaction	0.0	0.0	0.0	0.1	0.4	0.7	0.7
	with monetary reaction	0.0	0.1	0.4	0.7	0.7	0.7	0.7
Core inflation	without monetary reaction	0.0	-0.1	-0.1	-0.2	-0.2	-0.1	0.0
	with monetary reaction	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0
Employment	without monetary reaction	0.0	0.0	0.0	0.1	0.4	0.8	1.0
	with monetary reaction	0.0	0.1	0.3	0.6	0.8	0.9	1.0
Wage	without monetary reaction	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
	with monetary reaction	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	without monetary reaction	0.0	0.0	0.0	0.0	0.3	0.6	0.7
	with monetary reaction	0.0	0.0	0.2	0.5	0.7	0.7	0.7
Investment	without monetary reaction	0.0	0.0	0.0	0.3	1.2	1.0	0.7
	with monetary reaction	0.0	0.6	2.8	4.1	1.8	1.5	0.7
Real interest rate	with monetary reaction	-0.4	-0.3	-0.2	-0.1	-0.1	0.0	0.0
EURO AREA								
Real GDP	without monetary reaction	0.0	0.0	0.0	0.1	0.3	0.6	0.7
	with monetary reaction	0.0	0.1	0.2	0.4	0.6	0.7	0.7
Core inflation	without monetary reaction	-0.1	-0.1	-0.3	-0.6	-0.9	-1.1	0.0
	with monetary reaction	-0.1	-0.1	-0.3	-0.5	-0.8	-0.8	0.0
Employment	without monetary reaction	0.0	0.0	0.0	0.1	0.3	0.7	1.0
	with monetary reaction	0.0	0.0	0.1	0.3	0.5	0.8	1.0
Wage	without monetary reaction	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	with monetary reaction	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumption	without monetary reaction	0.0	0.0	0.0	0.0	0.1	0.4	0.7

	with monetary reaction	0.0	0.1	0.1	0.3	0.4	0.6	0.7
Investment	without monetary reaction	0.0	0.0	0.0	0.1	0.4	0.7	0.7
	with monetary reaction	0.0	0.3	1.2	1.8	2.2	2.2	1.2
Real interest rate	with monetary reaction	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.1
FRANCE								
Real GDP	without monetary reaction	0.0	0.0	0.0	0.1	0.4	0.9	0.7
	with monetary reaction	0.0	0.0	0.0	0.1	0.4	0.9	0.7
Core inflation	without monetary reaction	-0.1	-0.1	-0.3	-0.4	-0.5	-0.3	0.0
	with monetary reaction	-0.1	-0.1	-0.3	-0.4	-0.5	-0.3	0.0
Employment	without monetary reaction	0.0	0.0	0.0	0.1	0.3	0.8	1.0
	with monetary reaction	0.0	0.0	0.0	0.1	0.3	0.8	1.0
Wage	without monetary reaction	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0
	with monetary reaction	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0
Consumption	without monetary reaction	0.0	0.0	0.0	0.0	0.1	0.6	0.7
	with monetary reaction	0.0	0.0	0.0	0.0	0.1	0.6	0.7
Investment	without monetary reaction	0.0	0.0	0.1	0.3	0.9	1.4	0.7
	with monetary reaction	0.0	0.0	0.2	0.5	1.1	1.4	0.7
Real interest rate	with monetary reaction	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0