EUROPEAN UNIVERSITY INSTITUTE
Department of Economics

Essays on Fiscal and Monetary Policy

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To my parents Odysseα and Maria

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Introduction to the Thesis

The title of my thesis is "Essays on Fiscal and Monetary Policy" The thesis is composed of three chapters that examine current policy related developments in the international economic environment. It examines issues related to the decision on undertaking labor market reform by the countries participating in a Monetary Union. Moreover, it does so by using a framework of analysis that adopts the conventional belief advocated by many international organizations (like the IMF and the OECD) that strict labor market institutions are related to the high unemployment problem in continental Europe, as well as, the proposed solutions that involve reduction of labor market rigidities by means of structural reform. Furthermore, it investigates empirically the transition and propagation mechanism of macroeconomic policy shocks through the labor market channel in the UK. In addition, it examines whether the labor market reforms undergone in the UK economy during the 1980s have affected the responsiveness of labor market variables over time. Last but not least, it analyses the effects that fiscal policy actions could have on private consumption in OECD countries. How these are altered when we consider upturns and downturns in economic activity, as well as, when a fraction of the population has limited access to financial markets.

More specifically, the first chapter (Labor Market Reform in a Monetary Union) builds on the idea that an improvement in labor market flexibility due to deregulation can be beneficial to the long run success of the Economic and Monetary Union (EMU). This happens because it will provide an alternative adjustment mechanism at the national level to symmetric and asymmetric shocks that might hit the Euro-zone economies. The importance of this labor market channel is attributed to the fact that exchange rate and monetary policies are no longer available at the national level as tools for macroeconomic adjustment, whereas, fiscal policy is restrained by the Pact on Stability and Growth and the tendency to fiscal harmonization. The paper examines the interaction between monopolistic labor unions and governments and its implications on the decisions for labor market reform, inside and outside a symmetric and an asymmetric monetary union (MU). The main findings of the analysis are as follows: Incentives for reform are increased inside the MU when governments and labor unions move simultaneously in the first stage of the policy game. Inside the MU there is also a possibility of a "race to the bottom" deregulation.

This can be avoided by cooperation of the two governments, only in the case of a symmetric MU and in particular when unions are powerful in wage setting. Area-wide reform is above its pre-MU levels when labor unions have incentives to coordinate their wage setting decisions in an asymmetric MU. In that case the governments have no incentive to set reform in a cooperative manner, because this would lead to higher nominal wage demands by the union members.

The second chapter (The Effects of Macroeconomic Policy Shocks on the UK Labor Market) aims at analyzing the effects of various macroeconomic policy shocks on the UK labor market (for the period 1970:Q1-2003:Q1), which has experienced a series of reforms that improved its flexibility and performance in the 1980s. It investigates whether the dynamic responses of the labor market variables (real wages, employment, total and average hours) obtained are in line with what the economic theory would suggest and whether they resemble relevant findings for the US economy and previous UK evidence. Furthermore, it examines how the responsiveness of labor market variables has evolved over time. The decomposition of total labor input to employment and average hours is crucial for two reasons. The first one is that the labor input in the UK was found to adjust both with respect to the intensive and extensive margin following cyclical movements in economic activity. While the second one is that several reforms that were introduced in the 1980s were aiming at reducing adjustment costs of labor input. The main findings are as follows: The responses of labor market variables to a monetary policy shock are in line with economic theory and previous evidence for the US economy. The adjustment of labor input is primarily along the extensive margin, however, contrary to the evidence for the US economy, there is also significant adjustment along the intensive margin one year after the shock. Moreover, when examining a smaller sample this result is overturned with average hours response being faster and of a bigger magnitude two quarters after the shock. This implies that labor market reforms undergone in the UK economy during the 1980s have reduced the adjustment cost of labor input over time. A spending shock leads to negative employment, hours and output responses, while real wages increase. This pattern of responses is attributed to the government consumption part of spending, and in particular its wage bill component (this is the "cost or labor market channel" of fiscal policy as is defined by Lane and Perotti (2003) and Alesina et al (2002), respectively). The effect of a net tax shock generates transitory negative effects on employment and hours, that become positive raising output after the second quarter. The output effects of both spending and tax shocks are in line with previous UK evidence.

The last chapter the thesis ("The Asymmetric Effects of Fiscal Policy on Private Consumption over the Business Cycle") explores the effects of fiscal policy on private consumption. In particular, it analyzes the possibility of asymmetric effects in recessions and expansions, when a fraction of the population has limited access to financial markets (especially in Bad times). The simple theoretical framework employed illustrates the idea that unanticipated fiscal policy

changes will be more effective in stimulating private consumption and pushing the economy out of a recession, when liquidity constraints bind for a large fraction of the population. Whereas, the empirical analysis was conducted using a yearly panel of nineteen OECD countries (1970-2001) and it involved characterizing periods of recession (Bad times), using as proxy of the degree of credit constraints the maximum ratio of loan to the value of house in housing mortgages (LTV ratio), following related work by Jappelli and Pagano (1994) and Perotti (1999), as well as, extracting the fiscal policy shock. The empirical evidence confirmed the theoretical prediction suggesting that both a government spending and a tax shock have a stronger positive effect on private consumption in recessions than in expansions. The effect is more pronounced in countries characterized by less developed consumer credit markets that are more likely to have a larger group of liquidity constrained individuals. Furthermore, in countries with less developed consumer credit markets consumption is affected the most by expansionary spending shock and contractionary tax shocks in Bad times, while in more financially developed economies the effects on private consumption are driven by contractionary spending and tax shocks in Bad times, and solely by expansionary tax shocks in Good times. The conclusion of the paper casts doubt upon the usefulness of tight fiscal rules, which impair fiscal flexibility over the business cycle when countries have less developed financial systems.

Abstract of Thesis Chapters

Abstract of Chapter 1: Labor Market Reform in a Monetary Union

This paper examines the effect of monopolistic labor unions' behavior on governments' incentives to undertake labor market reform, inside and outside a symmetric and an asymmetric monetary union (MU). Incentives for reform are increased inside the MU when governments and labor unions move simultaneously in the first stage of the policy game. Inside the MU there is also a possibility of a "race to the bottom" deregulation. This can be avoided by cooperation of the two governments, only in the case of a symmetric MU and in particular when unions are powerful in wage setting. Area-wide reform is above its pre-MU levels when labor unions have incentives to coordinate their wage setting decisions in an asymmetric MU. In that case the governments have no incentive to set reform in a cooperative manner, because this would lead to higher nominal wage demands by the union members.

Keywords: Labor Market reform, monetary union, Labor Unions

JEL Classification: J50, J51, E50, E58

Abstract of Chapter 2: The Effects of Macroeconomic Policy Shocks on the UK Labor Market

This paper discusses the dynamic response of employment, average hours and real wages to monetary, government spending and net taxes shocks in the UK for the1970 Q1-2003 Q1 period. The response of labor market variables to a monetary policy shock are in line with economic theory and previous empirical evidence. The adjustment of labor input is primarily along the extensive margin. However, there is also significant adjustment along the intensive margin one year after the shock. Over the more recent period this result is overturned with bigger and faster response in average hours two quarters after the shock. We interpret this result as being suggestive of labor market reforms during the 1980s having reduced the labor adjustment costs. A government spending shock leads to negative employment, hours and output responses, while real wages increase. It is attributed to the government consumption part of spending, and in particular its wage bill component. The effect of a net tax shock generates transitory negative

effects on employment and hours, that become positive raising output after the second quarter. The output effects of both spending and tax shocks are in line with previous UK evidence.

Keywords: Monetary Policy Shocks, Fiscal Policy Shocks, Labor Market Adjustment, U.K.
JEL Classification: E24, E52, H20, H30

Abstract of Chapter 3: The Asymmetric Effects of Fiscal Policy on Private Consumption over the Business Cycle

This paper explores in a yearly panel of nineteen OECD countries from 1970-2001 the effects of fiscal policy changes on private consumption in recessions and expansions. In the presence of binding liquidity constraints on households, fiscal policy is more effective in boosting private consumption in recessions than in expansions. The effect is more pronounced in countries characterized by a less developed consumer credit market. This happens because the fraction of individuals that face binding liquidity constraints in a recession will consume the extra income generated following a unanticipated tax cut or government spending increase.

Keywords: Fiscal policy, liquidity constraints, consumption, recessions.
JEL: E62, E21, E32.

Chapter 1

Labor Market Reform in a Monetary Union

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1.1 Introduction

The performance of labor markets in Europe after the Economic and Monetary Union (EMU) is crucial for the long-run success or failure of the monetary union: with the introduction of the euro, exchange rate and monetary policies are no longer available at the national level as tools for macroeconomic adjustment. Furthermore, fiscal policy is restrained by the Pact on Stability and Growth and the tendency to fiscal harmonization. Without the nominal exchange rate as shock absorber mechanism, asymmetric and possibly symmetric shocks might exert increased pressure on national labor markets and entail a substantial risk of rising unemployment. Hence, the national governments should undertake reforms that enhance labor market flexibility, providing thus an alternative adjustment mechanism to these shocks.

Andersen et al (2000), as well as Bertola and Boeri (2002) have put forward a "real effects"of EMU argument that leads to more reform in the post-EMU era. According to which, economic

[1] I am grateful to Michael J. Artis for his valuable comments and constant support, as well as, for urging me to finish this paper. I would like to thank Roberto Perotti, and two anonymous referees of the Oxford Economic Papers whose comments improved significantly the paper. At the first stage of the project the author has been benefited from helpful discussions with Karl Schlag and Giuseppe Bertola. I also thank conference participants at the University of Nice-S.A., as well as seminar participants at the European University Institute (Florence) for useful suggestions. The paper is in submission (second round) to the Oxford Economic Papers. The usual disclaimer applies.

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stability, higher product market competition, and increased economic integration will be characterizing the post-EMU era. Thus, in this context relative labor costs will become a crucial factor in firms' locational decisions. Hence, governments will try to make the environment more attractive for firms in order to encourage capital investments; which will lead to more labor market reform that lowers labor costs[2].

Calmfors (2001a) argues that although there is a need for labor market reform inside the EMU, it has been substituted by a consensus among social partners to moderate wages in order to avoid the painful and politically costly reform efforts. Moreover, Calmfors (2001a) claims that the observed wage moderation was successful so far in substituting reform efforts because the macroeconomic environment was favorable, since major shocks were absent and there was good growth performance. However, unfavorable economic conditions will increase the pressure for structural reform of the labor market. Notice, however, that according to Bertola and Boeri (2002) the pace of labor market deregulation accelerated in the build up to the EMU.

An alternative perspective on labor market reform is provided by the "time inconsistency" approach. In this context, the monetary authority wants to get inflation and unemployment close to their targeted levels. Monetary policy decisions are taken after inflation expectations have been formed so there exists a short-run trade off between inflation and unemployment that governments try to exploit. Moreover, product and labor market imperfections lead to divergence of the natural level of unemployment from the targeted level. Under the rational expectation hypothesis employed in this model, the private sector correctly anticipates the government's reaction. This will lead to even higher inflation without reducing unemployment.

Notice that in this framework, the higher the gap between the natural rate of unemployment and the targeted unemployment rate, the higher the equilibrium inflation. So inflation bias (arising from discretionary monetary policy) can be reduced by appointing a conservative central banker (Rogoff 1985), by establishing a linear contract between the government and the central banker (Walsh 1995), by introducing an inflation target (Svensson 1997), or by reducing distortions in the labor market (Calmfors 2001b). Incentives for (costly) reform will be greater when the time inconsistency problem has not been addressed. However, these incentives are fewer inside the EMU since the act of delegation of the monetary policy to the "very conservative" European Central Bank (ECB) eliminates the inflationary bias, reducing the need for reforms[3]. In

[2] According to this view labour market deregulation might result in a "race to the bottom".

[3] Hallett and Viegi (2001) support this view in a slightly different setting. They distinguish the labour market institutions according to the degree of centralization of the wage bargaining (WB), and have the fiscal authority influencing the labour costs. Centralized WB (less flexibility/reform) provides an extra instrument of economic policy because wage restraint by the union increases the competitiveness of the national economy relative to member states. On the contrary, under Decentralized WB (more flexible/reformed) national objectives can be only pursued by fiscal policies. Reform incentives will be reduced inside the MU because the less "flexible" countries would like to keep the extra policy instrument to replace the loss of national monetary policy.

the case that ECB is as conservative as the national central banks, then the fact that it cares about area-wide developments and does not accommodate regional imbalances, reduces incentives for reform. One more disincentive arises from the fact that labor market reform in an individual country has only a small effect on aggregate equilibrium unemployment and area-wide inflation, so each member state internalizes only a small part of the benefits from reform, while bearing all the cost of the national reform effort[4].

The aim of this paper is to analyze the effect of the formation of a monetary union (MU) on governments' incentives to undertake labor market reform. It merges two strands of the literature. The first is related to the "time inconsistency" approach regarding incentives to undertake reform inside the EMU, whereas the second is related to the literature analyzing the interaction between EMU and wage bargaining. The model builds on the analysis of Calmfors (2001b), Cukierman and Lippi (2001) and Gruner and Hefeker (1999). Calmfors (2001b) aims at analyzing the effects of the formation of the monetary union on governments' incentives to undertake reform, without considering explicitly the wage bargaining process. On the other hand, Cukierman and Lippi (2001), Gruner and Hefeker (1999) analyze the effects of EMU on inflation and unemployment in the context of decentralized and centralized wage bargaining without addressing the issue of labor market deregulation[5].

Hence, distinct to the relevant previous literature, this paper analyses governments' incentives for reform in a simplified two-country monetary union where national labor markets are characterized by centralized wage bargaining, and explicitly models labor unions' behavior regarding labor market reform, as well as, its effects on governments' policies.

We assume that, before and after the MU has been formed, the labor union and the government behave as *Nash players* with respect to each other in the first stage of the game. The monetary policy has been delegated to an independent central bank. So, after the labor market institutions have been determined by the government and nominal wages have been set by the labor union, the independent CB (or ECB in the MU case), which is expected to be credible, decides on monetary policy, and hence determines the inflation rate. The model is solved by backwards induction[6]. We

[4]Similar are the results of Sibert and Sutherland (2000), labour market distortions lead policy-makers to inflate too much. The costly spillovers of uncoordinated monetary policy can be reduced by labour market reform. The authors suggest that reform is higher when there is no monetary policy cooperation, relative to the case where nations negotiate over monetary policy, which happens because cooperation reduces spillovers leading to fewer incentives for reform.

[5]Labour unions are assumed to care about inflation; this creates interdependencies between the real variables of the member states. Wage premiums above the competitive wage tend to be "strategic substitutes" leading to a moderating effect. However, in the MU more players interact, this reduces the impact of each union's wage decisions on the area wide inflation. So the MU can lead to more aggressive wage behaviour leading to higher unemployment and inflation, if unions' and CB's preferences are identical across countries before and after the MU (Cukierman & Lippi 2001, Gruner and Hefeker 1999).

[6]The solution corresponds to the notion of subgame perfect Nash equilibrium. The *sequencing of the game* is

examine two cases; the first one refers to a MU of two symmetric economies, while in the second one we allow for asymmetries with respect to labor unions' bargaining power in wage setting and their opposition to labor market reform. The solutions are evaluated by calibrating the model parameters.

The outcome of this analysis is that contrary to what the "time-inconsistency" literature on labor market reform has suggested, incentives for reform will increase in the context of a MU, when governments and labor unions move simultaneously in the first stage of the policy game. Labor unions are worse off when wages and reform are substitutes in their wage setting decisions, because higher reform worsens the wage-unemployment trade of that they face. The opposite holds when wages and reform are perceived as complements. The government in the more distorted economy is always better off inside the MU, because it can pass to the foreign government some of the losses it incurs from its "fight" against the powerful home-labor union. Consequently the government of the country with the less distorted economy is always made worse off inside the MU. Moreover, a "race to the bottom" effect regarding deregulation is possible. A cooperation among the governments in the post-MU era could address this problem; though, the governments have incentives to coordinate in deciding labor market institutions only in the symmetric case, in particular when reform is not very effective in reducing union power in wage setting. In an "asymmetric MU", the cooperative outcome does not emerges endogenously from the model.

The benchmark model was also extended to allow for an inter-labor union cooperation in setting nominal wages inside the MU. The two labor unions could be made better off by cooperating (relative to participating in a non-cooperative Nash play) in some model specifications, however only in case of an "asymmetric MU". In these specific cases area-wide reform would still be above its pre-MU levels. When labor unions play cooperatively, the national governments have no incentive to set reform in a cooperative manner, because the lower reform levels, although beneficial due to the decrease in the political cost of reform, imply much less wage moderation on the part of the unions. In some model specifications the government in country 1 can attain a higher payoff by cooperating, though the foreign government has no incentives to cooperate because it will end up in a worse position.

The paper is organized as follows: Section two presents the model, i.e. section 2.1 discusses the pre-MU case, section 2.2 the post-MU case, and section 2.3 presents the numerical evaluation of the model in the symmetric (section 2.3.2) and the asymmetric (2.3.3) case. Finally, section three concludes.

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istified as follows: monetary policy is decided at the last stage of the game since it can be changed very easily nd quite often so as to address unfavourable economic conditions. Deregulation takes place at the same time (first age) that wages are decided, and probably as often as the wage setting. The implicit assumption is that players he government and labour union) have imperfect information about each others actions.

1.2 The Model

We analyze two cases: (i) a representative country outside the MU, and (ii) a simple two-country MU. We will consider both a benchmark case of a MU composed of symmetric labor unions and countries, as well as the case of a MU composed of asymmetric labor unions and countries. Product markets are assumed to be competitive and perfectly integrated; identical firms are assumed to produce the same homogeneous good. Following Calmfors (2001) and Sibert and Sutherland (2000) we assume that the government in a representative country cares not only about inflation and unemployment, but also about labor market institutions. The labor market is characterized by the presence of a monopolistic labor union (Centralized Wage Bargaining-CWB); so the competitive outcome is not achieved (leading to unemployment and output loss), which creates an incentive for the government to inflate. This problem can be eliminated by undertaking labor market reform, which is costly, because it affects employed insiders (the electorate in terms of political economy models). The structural reform variable is assumed, in the Calmfors (2001b) and Sibert and Sutherland (2000) spirit, to be a composite index that reduces labor market rigidities (specifically we consider employment protection legislation (EPL) and union bargaining power in the wage setting process) thus increasing employment[7]. Analogous measures of composite reform indices have been used in empirical studies, such as Baker et al (2004), Van Poeck and Borghijs (2001) and were based on the OECD (1999) study on the degree to which countries complied with policy recommendations towards labor market deregulation made in the OECD's Jobs Study (1994). Moreover, they are justified by chapter IV of IMF's World Economic Outlook (2003),

[7]Although this way of modelling labour market reform is a strong simplification, nevertheless it captures the beneficial effects that labour market reform is expected to have on employment. Notice, however, that several types of reform regarding labour market institutions might have an ambiguous effect on unemployment. For example, stricter labour standards and/or employment protection legislation (EPL) is expected to lead to higher levels of long term unemployment, while it lowers short term unemployment by reducing the flows into and out of unemployment (reducing the labour turnover). This means that lower levels of EPL might not lead to the expected outcome (Nickell 1997). Though several studies like Elmeskov et al (1998), IMF's WEO (2003), Nickell et al (2003), Blanchard and Wolfers (2000) report a that stricter EPL increase unemployment. Strong labour unions are expected to raise unemployment, unless they co-ordinate with firms in the wage setting process. However, this is possible only in the case of external competitive pressure (Nickell and Layard 1999, Elmeskov at al 1998, Blanchard and Wolfers 2000, IMF's WEO 2003 etc).

Furthermore, the discussion about labour market deregulation that improves unemployment outcomes involves also other labour market institutions like labour taxes and unemployment benefits, however these are not considered in our model specification. Higher taxes on labour, that include payroll taxes, income taxes and consumption taxes increase the wedge between the real cost of a worker to an employer and the real consumption wage of the worker. Hence, lowering the tax wedge will result in lower labour costs in the long run and in lower unemployment (Belot and Van Ours (2004), Nickell et al (2003), IMF's WEO (2003) etc). Unemployment is also increasing the more generous and long-lasting the unemployment benefit entitlements are. Hence reform aiming to reduce the generosity of social security system will reduce unemployment (Nickell 1997, Elmeskov et al 1998 etc).

as well as a series of labor market studies that do not discuss each labor market institution in isolation but consider interactions among them[8]. Finally note that the CWB assumption coupled with a direct effect of institutions on unemployment assumes the presence of rigid labor contracts that allows for more aggressive wage setting on the part of the labor unions. Therefore, it is crucial to study the effect of unions' behavior on governments' incentives to undertake labor market reform.

1.2.1 Labor market institutions and monetary policy outside the MU

First we consider the case of a representative country that does not participate in the monetary union (alternatively, a representative country before joining the MU). The model is developed in two stages. In the first stage the government and the national labor union *move simultaneously*, i.e. they play Nash against each other. Union members will set nominal wages treating the actions of the government as given. The government will decide on reform taking nominal wages as given. Both the labor union and the government are Stackelberg leaders with respect to the CB, which moves in the second stage of the game and sets the rate of inflation.

In the spirit of Hefeker (2001), Sibert and Sutherland (2000) and Calmfors (2001b), we formulate the unemployment equation as:

$$u = a(w - \pi) - \delta r \tag{1.1}$$

u denotes the unemployment rate, w is the logarithm of nominal wages and π is the inflation rate which is defined as follows: $\pi = p - p_{-1}$, p is the log of the price level P, normalizing $P_{-1} = 1$, we have $p_{-1} = 0$, thus we get $\pi = p$. Hence we define $w - \pi$ as being real wages. We assume that there exists a level of reform $\bar{R}$ corresponding to the current level of labor market institutions (related to the current amount of distortions in the labor market) which is normalized to 1, so that its log is zero. Hence, $r = \ln R$, and is thought to be a *composite index* representing the degree of labor market deregulation; δ is the impact of deregulation (we assume $\delta > 0$). Thus, the unemployment rate increases with the real wage $w - \pi$ and decreases with the index r (i.e. deviation from current labor market institutions which are related to a certain amount of distortions; so if $r = 0$, no reform is undertaken, and distortions remain at the same level). The composite reform index as was mentioned before refers to employment protection legislation and union bargaining power in wage setting, implying that institutions do not act in isolation, as well as that there are complex linkages between institutions and unemployment. Notice that such institutional reforms have been proposed by several OECD's (e.g. Jobs Study 1994, Implementation of Jobs Study (1999)) and IMF's (WEO 2003) studies as a way of reducing labor market rigidities and fighting unemployment.

[8] For example, Elmeskov et al (1998), Belot and Van Ours (2002), Nickell et al (2003), Baker et al (2004).

Stage 2: The central bank's problem

The monetary authority wants to minimize the deviations of inflation and unemployment from their target levels, assumed to be zero for simplicity. So the central bank is minimizing a standard quadratic loss function of the form:

$$B = \pi^2 + \lambda u^2 \tag{1.2}$$

with respect to π and subject to eq. (1) taking as given nominal wages and reform. λ_{CB} is the unemployment aversion parameter. We assume that the central bank does not care directly about the level of labor market reform. The central bank's reaction function is obtained after the CB has equalized the marginal benefits and the marginal costs of a higher inflation rate:

$$\pi = \frac{a\lambda}{a^2\lambda + 1}(aw - \delta r) = \Phi(aw - \delta r) \tag{1.3}$$

Note that the reaction parameter of the central bank: $\Phi < 1$, thus the monetary policy is not fully accommodating union's nominal wage demands. Notice also that an increase in the level of reform lowers the inflation rate. Labor market distortions reduce output below its efficient level; this creates an incentive to the CB to raise inflation above its optimal level in order to boost real activity and reduce unemployment[9].

Stage 1: The labor union and the government play Nash

The Government The government minimizes the following loss function:

$$G = \pi^2 + \mu u^2 + \gamma r^2 \tag{1.4}$$

with respect to r, subject to (1) and (3), taking nominal wages set by the labor union as given. The government wants to minimize the deviation of r, from current labor market institutions ($r = 0$). Hence, reform has a direct negative effect through r itself (because it is opposed by its electorate, the majority of the employed insiders according to Saint-Paul, 1996), and an indirect positive effect through lower inflation and unemployment. The government is assumed to care more about unemployment relative to the central bank $\mu > \lambda$.

The minimization problem yields a reaction function of the form:

$$r = f_G(w) = \frac{aw\delta(\mu + a^2\lambda^2)}{\gamma + \mu\delta^2 + 2a^2\lambda\gamma + a^4\lambda^2\gamma + a^2\lambda^2\delta^2} \tag{1.5}$$

[9] If the natural rate of unemployment (NRU) was assumed to be higher than zero and the CB was targeting an unemployment rate below that, the model would have exhibited the Barro-Gordon inflation-bias. In that case, incorporating expected inflation and making use of the rational expectations assumption, reform would have reduced the inflation bias, and hence the incentives to generate surprise inflation.

i.e. the reform undertaken by the government is an increasing function of the wages ($f'_G(w) > 0$) set by the union. In the absence of reform, the effect of labor market distortions (e.g. increased union power and strict rules on employment protection legislation) leads to high wages and low labor demand, and thus to high unemployment. Hence, labor demand-enhancing reform should be undertaken (reduction of the union power and abolishment of strict EPL rules), in order to shift the labor demand schedule outwards (so as to reduce unemployment and inflation). Reform is an increasing function of nominal wage demands by the union members, in order to outweigh the effect that unions' wage setting behavior has on unemployment and inflation.

The labor union Employing the assumption that all labor union members are identical and that firms produce a homogeneous good we can assume the presence of only one labor union in the economy. The single labor union that represents all workers in the economy prefers a higher real wage for its members, and dislikes deviations of unemployment from its targeted level. The targeted level of unemployment (v) is affected in a negative manner by labor market reform; v can be considered as a proxy of union bargaining power in wage setting (in many empirical studies this is proxied by union density)[10]. Therefore, we assume that reform undertaken by the government affects negatively union power. Labor unions strongly averse any kind of reform that implies less strict employment protection legislation (job security rules and regulations that concern administrative procedures, like reasons for dismissal, length of notice of termination, severance payments, unfair and collective dismissals), as well as, any attempt by the government that reduces their bargaining power in the wage setting process[11]. Therefore labor unions oppose any form of deregulation that imply less rigid labor contracts and worsens the wage-unemployment trade off that they face. Nevertheless, reform has also a positive effect on union members by reducing inflation and unemployment.

The labor union is minimizing the following loss function[12]:

$$L = -\beta(w - \pi) + (u - v)^2 \tag{1.6}$$

[10] For example, Baker et al (2004), IMF's WEO (2003).

[11] This sort of reform is opposed by union members because it directly reduces their welfare, since it implies a lack of control in future periods and that the union will diminish in size and influence (the UK experience in the 1980s).

[12] A previous version of the paper assumed that the labour union is inflation averse, which is a realistic assumption for a monopolistic union that represents all workers in the economy. However, we do not consider this case here for two reasons. The first one is to keep the model simple and the second is to focus on the main concern of the paper which is labour market reform. In the current setting, inflation aversion would make unions favourable to reform undertaken by the government, the effect would be increasing on the aversion to inflation parameter assumed in the unions loss function. Furthermore, union members take already into account the real and not the nominal wages.

where

$$v = \kappa - \varepsilon r \tag{1.7}$$

with respect to nominal wages w, subject to (1) and (3) taking reform as given. β is a positive parameter representing the labor union's preferences on real wages over unemployment. κ is a positive constant not affected by labor reform, while ε represents the effectiveness of reform efforts on reducing the bargaining power of the labor union (as proxied by v) in wage setting[13].

The minimization problem yields the reaction function of the labor union:

$$w = \phi(r) = \frac{1}{2a^2}[\beta + 2a\kappa + 2ar(\delta - \varepsilon - a^2\lambda\varepsilon) + a^2\beta\lambda + 2a^3\kappa\lambda] \tag{1.8}$$

where if $\phi'(r) > 0$ nominal wages and reform are *"strategic complements"*, i.e. if $\frac{\partial w}{\partial r} = \frac{1}{a}\left(\delta - \varepsilon - a^2\lambda\varepsilon\right) > 0$, or $\delta > \varepsilon(1 + a^2\lambda)$; otherwise if $\phi'(r) < 0$ wages and reform are *"strategic substitutes"*. Notice also that: $\frac{\partial w}{\partial \kappa} = \frac{1}{a}\left(a^2\lambda + 1\right) > 0$ (and $\frac{\partial w}{\partial v} = \frac{1}{a}\left(a^2\lambda + 1\right) > 0$), which suggest that the bigger the targeted level of unemployment is (or the union power in wage setting), the higher nominal wages will be. Moreover, $\frac{\partial w}{\partial \varepsilon} = \frac{-r\left(1+a^2\lambda\right)}{a} < 0$, i.e. an increase in the effectiveness of reform efforts in reducing union bargaining power in wage setting, leads to lower nominal wage demands at a given reform level.

Therefore, the union facing the possibility of labor market reform undertaken by the government, which leads to more flexible labor contracts by reducing union's bargaining power in wage setting and by and introducing less strict EPL, decides to react "aggressively" raising nominal wage demands when $\delta > \varepsilon(1 + a^2\lambda)$, i.e. when the reduction in unemployment caused by reform is higher than the reduction in union power so that there is still room for higher wages with out affecting much unemployment among its union members. In this case more reform improves the wage-unemployment trade off faced by the labor union. In the opposite case, reform and wages are substitutes because the reduction of unemployment due to reform is smaller compared to its negative effect on the union bargaining power proxy. Hence, a bigger amount of reform worsens the wage-unemployment trade off faced by the union, i.e. the demise of unionization (the union diminish in size and influence) forces the labor union to moderate its nominal wage demands in

[13]Notice that $v \geq 0$, i.e $v = \begin{cases} \kappa - \varepsilon r & \text{if } \kappa - \varepsilon r \geq 0 \\ 0 & \text{if } \kappa - \varepsilon r < 0 \end{cases}$. We focus on the most interesting case $\kappa - \varepsilon r \geq 0$ (in fact $v > 0$), however, as will be shown in section 2.3.1 we shall allow for a high and a low value of v i.e. when the union has high and low bargaining in wage setting.

order to avoid facing higher unemployment among its members[14][15].

1.2.2 Labor market institutions and monetary policy inside the MU

We now turn to examine the effect that the establishment of a monetary union[16] might have on decisions regarding labor market reform, which are still taken by national governments in order to deal with the heterogeneous labor market structures in each country. This is a real life fact, despite the initiatives undertaken by EU member states in developing a coordinated strategy for employment (Lisbon 2000)[17]. The labor union in each country decides on nominal wages taking as given the nominal wage demanded in the other country. The common central bank (we call it for brevity European Central Bank or ECB) determines the common inflation rate for all participating countries. We analyze a two-country (1 and 2) monetary union, and we consider first the benchmark case of two identical countries having identical unions. The next step, will be introduce some asymmetries between the two economies. To focus on the direct effects of EMU we can also assume that $\lambda_{ECB} = \lambda$, although it would probably be more realistic to consider the case where the ECB cares less about unemployment relative to the national central banks.

The unemployment equation is determined as follows:

$$u_{MU} = \frac{u_1 + u_2}{2} = a(w_{MU} - \pi_{MU}) - \delta r_{MU} \tag{1.9}$$

we have defined $w_{MU} = \frac{w_1+w_2}{2}, r_{MU} = \frac{r_1+r_2}{2}$, while we have assumed that the unemployment equation in each country i is defined as follows:

$$u_i = a(w_i - \pi_{MU}) - \delta r_i \tag{1.10}$$

i.e. it is affected by the nominal wage demands in country i, the common inflation rate in the

[14]Notice that a situation where the government decides first on reform (Stackelberg leader) and then the labour union sets nominal wages implicitly assumes that the government determines unilaterally the institutional framework in the labour market, anticipating the reaction of the union to each reform level r. Moreover, all previous moves are observed before the next is chosen. So complete and perfect information are assumed. For this reason we think that the Stackelberg case can be characterized as uninteresting because the real life determination of labour market institutions and nominal wages is much more complicated allowing for imperfect information among the players. This can be captured by the simultaneous move game structure.

Furthermore, allowing the labour union to set reform unilateraly is also an unrealistic assumption, however the current setting allows it to have a strong say on the formation of labour market institutions as we will see in section 2.3.1.

[15]The Nash equilibrium solutions are presented in Appendix 1.5.1.

[16]In this benchmark case, abstracting from reality, we assume that the imposition of the MU can only be represented by the establishment of the common central bank (CB), which decides on the common inflation rate.

[17]The European Council meeting in Lisbon (2000) adopted a strategy to bring employment to all member states close to 70% of the working age population by 2010.

monetary union and the reform undertaken in country i. We assume for simplicity that δ and a are identical across countries, and that the two countries are of equal size.

The simple MU case we are considering with the common inflation rate determined by the ECB, contrary to a situation where the ECB would care about a weighted average of the inflation rates in each member state, could be thought of as the limiting case of the situation described by the "real effects" argument discussed previously. It could be described as a world with economic stability, and increased economic integration, where product market competition has led to price convergence within the MU. In this context, national labor market institutions will have very important effects on member states' economies.

Stage 2: The ECB's problem

In stage 2 the European Central Bank determines the common inflation rate taking into account u_{MU} and taking as given the nominal wages set by the unions in the two countries, as well as, the amount of reform decided by the national governments in the first stage of the game[18].

The ECB is minimizing the following loss function with respect to π_{MU}, subject to (9):

$$B_{ECB} = \pi_{MU}^2 + \lambda_{ECB} u_{MU}^2 \tag{1.11}$$

The reaction function of the ECB is defined in terms of area-wide variables:

$$\pi_{MU} = \frac{\lambda_{ECB} a}{1 + \lambda_{ECB} a^2}[a w_{MU} - \delta r_{MU}] = \Phi_{ECB}[a w_{MU} - \delta r_{MU}] \tag{1.12}$$

as in the case of national monetary policy a bigger amount of reform results in lower area-wide inflation. We can see also that since $\lambda_{ECB} = \lambda$ the ECB responds in the same way to an increase in the average nominal wages in the monetary union, as a national central bank would respond to an increase in nominal wage demands by the national labor union.

Stage 1: The Governments and the Unions play Nash

The Governments The national governments decide about the level of labor market reform in each country, subject to the ECB's reaction function, and taking as given the nominal wages set by the labor unions, as well as the amount of reform decided by the other government. Each national government in country i is minimizing the following loss function with respect to r_i:

$$G_i = \pi_{MU}^2 + \mu u_i^2 + \gamma r_i^2 \tag{1.13}$$

subject to eqs. (10) and (12), and taking as given w_i, w_j and r_j. Notice that the two governments attach the same weights μ and γ on unemployment and reform, respectively. Reform has a

[18] The ECB cares only indirectly about labour market reform.

direct negative effect on governments' decisions, as well as, an indirect positive effect through the reduction of unemployment and inflation, for the same reasons that were discussed in the case of a representative country outside the MU. The reaction function for each government will be (see Appendix 1.5.2):

$$r_i = f_{G_i}(r_j, w_i, w_j) \tag{1.14}$$

Equation (14) implies that: Reform undertaken in the home country is an increasing function of nominal wage demands by the home labor union ($\frac{\partial r_1}{\partial w_1} > 0$, for the same reasons analyzed in the pre-MU case). Notice also that the higher the wages in the foreign country, the smaller the amount of reform undertaken by the home government ($\frac{\partial r_1}{\partial w_2} < 0$), because a high w_2 will increase area wide inflation, reducing unemployment in country 1 (by reducing real wages in country 1), leading, thus, to fewer incentives for reform.

On the other hand, a bigger amount of reform in the foreign country will induce the home government to undertake more labor market reform ($\frac{\partial r_1}{\partial r_2} > 0$). This is a *"race to the bottom"* argument: a high r_2 (by increasing r_{MU}) reduces area-wide inflation, other things being equal, resulting in higher unemployment in country 1 (by increasing real wages in country 1). Thus reform has the effect of a *"beggar-thy-neighbor"* policy. So the government in country 1 decides to undertake reform in order to counterbalance this *"negative spill-over effect"*. Hence, we postulate that the level of institutional reform on each country can be thought of being *strategic complement*, an argument that has not drawn much attention in the literature and can possibly shed some more light in the workings of a monetary union and the decisions to form and/or participate in a MU.

Strategic complementarity of institutional reform in the context of the perfectly integrated MU that we are considering, implies that member states' economies will incur "real effects" by the reform decision undertaken by each national government. In real life situations labor market institutions (LMI), by affecting labor costs, would be an important determinant for firms' decisions about foreign direct investment (FDI) in an environment of intensified product market competition. Hence government action would be important in attracting FDI, generating negative side-effects to the other countries in the MU that are competing for FDI (originated from outside the MU). Additionally, other things being equal, LMI could be important factor in the relocation decisions of firms from one MU country to another, deteriorating the economy with the more "rigid" labor market.

The Labor Unions The national labor union in country i sets nominal wages minimizing the following loss function with respect to w_i:

$$L_i = -\beta(w_i - \pi_{MU}) + (u_i - v_i)^2 \quad (1.15)$$

$$v_i = \kappa - \varepsilon r_i \quad (1.16)$$

subject to eqs (10) and (12). The reaction function for each union is[19]:

$$w_i = f_{L_i}(r_j, r_i, w_j) \quad (1.17)$$

The nominal wage set by the home labor union is determined with respect to the nominal wage set by the foreign labor union, and the amount of reform decided by the home and foreign government. Two effects that hold for the pre-MU case carry over here. First, $\frac{\partial w_1}{\partial v_1} = \frac{\partial w_1}{\partial \kappa} > 0$ a higher target value of unemployment on the part of the labor union leads to higher nominal wages. Second, $\frac{\partial w_1}{\partial \varepsilon} < 0$ i.e. the more effective the reform effort is in reducing union power, the lower wages will be at a given reform level.

Examining the reaction function of the labor union in country 1 we see that: $\frac{\partial w_1}{\partial w_2} > 0$, the home union will respond in an aggressive manner to a nominal wage hike by the foreign union[20]. A bigger amount of employment enhancing reform in the home country generates an ambiguous effect on wage decisions taken by the home labor union. Specifically we have: $\frac{\partial w_1}{\partial r_1} >$ or < 0. It is positive if $\delta(2 + a^2\lambda_{ECB}) > 2\varepsilon(1 + a^2\lambda_{ECB})$ (or $\delta > \frac{2\varepsilon(1+a^2\lambda_{ECB})}{(2+a^2\lambda_{ECB})}$), i.e. if reform reduces unemployment to a greater extent than it reduces union power, the labor union will set wage in an aggressive manner. In the opposite case: $\delta < \frac{2\varepsilon(1+a^2\lambda_{ECB})}{(2+a^2\lambda_{ECB})}$, unions' bargaining power is reduced to a great extent be reform, thus it has a strong moderating effect on labor union's wage setting behavior.

Finally, a higher reform level in the foreign country induces a wage moderation on the part of the home labor union ($\frac{\partial w_1}{\partial r_2} < 0$). A bigger amount of reform in country 2 raises area-wide reform reducing area-wide inflation, which in turn increases real wages and unemployment in country 1; this sequence of events will produce a moderating effect on the wage setting decisions of the labor union in country 1[21].

A key feature is that the interaction of more labor unions inside the MU, makes them react aggressively to a nominal wage hikes in the foreign country. This will force national governments

[19] For all mathematical expression and equilibrium solutions see Appendix 1.5.2.

[20] In a previous version of the paper where unions were inflation averse this effect could even be negative ($\frac{\partial w_i}{\partial w_j} < 0$). Though this *"moderating effect"* would be possible only if unions were very inflation averse or the common CB was not very conservative (i.e. liberal having high λ_{ECB}). In that case, a high nominal wage demand in country i moderates wage demands in country j, since the union in country j realizes the positive effect of higher wage demands on area wide inflation.

[21] In a previous version of the paper when labour unions were inflation averse this effect could even be positive, assuming though the presence of a very inflation averse labour union or a liberal common central bank (high λ_{ECB}).

to react in a stronger and positive manner to nominal wage increases by the home union, as well as, to reform decisions taken in the foreign country. The home labor union, in turn, will either raise or moderate (decrease) its nominal wages demands, depending on the effect of home reform effort on its bargaining power. Furthermore, there are two more moderating effects at work: first the home labor union moderates its wage demands in the event of higher reform in the foreign country, and second the home government reduces reform when nominal wage increase in the foreign country. Therefore, there is some ambiguity with respect to how the Nash solutions in the post-MU case compare to those in the pre-MU case. To resolve this ambiguity we resort to numerical evaluation of the two cases.

1.2.3 Numerical evaluation

Calibration of parameters

We need to choose values for the parameters in the unemployment equation, a the slope of the Phillips curve, and δ the effect of labor market reform (concerning EPL and union bargaining power). In order to calibrate the parameter a we follow the analysis in Saint-Paul and Bentolila (2001). They compare real wage flexibility parameters from a series of studies and they calculate upper and lower values corresponding to "flexible" and "rigid" labor markets. Since we examine an economy with a monopolistic labor union we consider only the rigid labor market case of Saint-Paul and Bentolila (2001). In this case the real wage flexibility parameter was found to be 1.25 which in our setting translates[22] to $a = \frac{1}{1.25} = 0.8$. The parameter δ captures the effect of reform regarding EPL and labor union bargaining power on unemployment. Several studies have examined the effects of EPL and union power (as proxied by union density) on unemployment, and their estimates vary to a great extent[23]. Therefore, we have decided to consider a high and

[22] In case of a flexible economy the value for the real wage flexibility parameter was 4 in Saint-Paul and Bentolila (2001). The Saint-Paul and Bentolila paper was based among others to the Layard, Nickell and Jackman or LNJ (1991) estimations. LNJ had estimated for 19 OECD countries for the period 1969-85 the following wage equation:

$$w_t - p_t = (1 - \gamma')(w_{t-1} - p_{t-1}) + \gamma_0 - \gamma_1 u_t - \gamma_{11}\Delta u_t - \gamma_2 \Delta^2 p$$

and the real wage flexibility parameter used by Saint-Paul and Bentolila corresponded to the average value of the long-run parameter $\frac{\gamma_1}{1-\gamma'}$ in the 19 OECD countries.

[23] For example, Elmeskov et al (1998) estimated that 1 unit increase in the EPL index used would lead to an increase in unemployment by 1.43 percentage points, while union density has no effect. Nickell (1997) found no effect from EPL on unemployment, while a ten percentage point increase in the union density was found to raise unemployment by 0.96 percentage points. Blanchard and Wolfers (2000) found that an increase in the EPL index by 1 unit raises unemployment by 0.24 percentage points, while a ten percentage point increase in union density results in the unemployment increasing by 0.84 percentage points. Bertola et al (2001) report that stricter EPL will increase unemployment by 0.2 percentage points, while they found no effect from union density on unemployment rate. Simulation exercises in the IMF's WEO (2003) suggest that a reduction in EPL from Euro-Area to U.S. levels

a low value for δ, for the high value we use 1.61 (= 1.465 + 0.18 − 0.032) which is taken from the IMF's World Economic Outlook (2003), while the low value (0.2) is taken from Bertola et al (2001). These values are transformed into elasticities after being divided by 6%, which is the average unemployment rate over 1970-2002 for the OECD countries[24]. Therefore, the high value of δ is 0.268, whereas the low one is 0.033.

We also consider two values for the parameter κ (determining the targeted value of unemployment by the labor union); the low value being 5% and the high value being 10%. A high value for κ refers to a labor union that cares more about real wages, and which also has bigger influence on the wage setting process compared to a labor union with a low κ. The parameter ε represents the effectiveness of reform in reducing the union bargaining power, as proxied by v. We allow ε to take a low value 0.1 and a high value 1. In the latter case a given increase in reform reduces union power one-to-one, while in the former case it has only a minor effect on union power. Alternatively, a given decrease in union power has to be attained by a much greater amount of reform in the second case.

The parameter β, which represents the weight attached on real wages relative to unemployment in labor union's loss function, is set to 1. The targeted unemployment level ($v > 0$) indicates that the labor union is already attaching a relatively higher weight on the wage income of its union members compared to unemployment among its union members.

Table1: Parameter Values

a	δ_{low}	δ_{high}	κ_{low}	κ_{high}	ε_{low}	ε_{high}	β
0.8	0.033	0.268	5%	10%	0.1	1	1

With respect to the parameters γ, λ, μ, that represent the preferences of the central bank and the government, we know that $\lambda < \mu$ because the government attaches more weight on unemployment than the central bank (or the common CB in the post-MU era). Lippi (1998) in his study for 22 OECD countries, estimated the weight attached on inflation to be on average 71%. Saint-Paul and Bentolila (2001) consider two extreme cases for the weight attached on

will lead to a fall in the unemployment rate by about 1.65 percentage points. In addition, regression estimates presented in IMF's WEO (2003) indicate that stricter EPL increases unemployment rate by 1.465 percentage points (Table 4.3, model 3), while an increase in union density increases unemployment by 0.18 percentage points. However, their interaction produces a reduction in unemployment rate by 0.032 percentage points. As the IMF report claims EPL dampens short term unemployment, because of firing restrictions, while it increases long term unemployment due to reluctance on the part of employers to hire workers in a highly regulated labour market. As the report postulates, greater unionization (which proxies union power) makes "more effective and more widespread the implementation of the EPL measures, magnifying the first effect". Though as the report notes the "undesirable long term effect dominates in 13 out of 20 OECD countries studied, including all G7 economies".

[24] We use the OECD average unemployment rate instead of the EMU or European Union average because the above mentioned studies were based on OECD countries.

inflation in the social welfare function (parameter b in their model), a low one which is 10%, and high one which is 90%; in the latter case the economy is inflation averse, whereas in the former it is inflation prone. In the context of our paper $\lambda = \frac{1-b}{b}$ for the central bank. Furthermore, in the Saint-Paul and Bentolila (2001) framework the weights on the government's loss function would have been, for example, φ for inflation, k for reform, and $(1-\varphi-k)$ for unemployment; thus in our framework $\mu = \frac{(1-\varphi-k)}{\varphi}$ and $\gamma = \frac{k}{\varphi}$. Moreover, $b > \varphi$ i.e. the CB attaches a bigger weight on inflation compared to the government, which implies that $\lambda < \mu$. In addition, γ should be bigger or smaller but not equal to λ for $b > \varphi$ (while $\gamma < \lambda$ if $b \leq \varphi$). Therefore, we shall consider four cases: (i) $\lambda < \mu = \gamma$ (ii) $\lambda < \mu < \gamma$ (iii) $\lambda < \gamma < \mu$ (iv) $\gamma < \lambda < \mu$. In the first case the weight attached on reform is equal to the weight attached on unemployment, in the second case more weight is attached on reform. These two cases and especially the second one resemble to a situation where the political cost of reform is very high, because labor unions are strong enough to affect political developments. The political cost of reform refers to strikes and public protests on the part of the labor union members. The third case implies that the political costs of reform are important, though not so much as the cost of high unemployment. Finally, in the last case the unions do not have much "say" in the political life and cannot oppose reform in an efficient manner, this could be the case when union density is low. We will consider the following possibilities:

	Case (i) : $\lambda<\mu=\gamma$			Case (ii) : $\lambda<\mu<\gamma$		
	λ	μ	γ	λ	μ	γ
variant 1	λ=0.01	μ=0.055	γ=0.055	λ=0.01	μ=0.01	γ=0.07
variant 2	λ=0.11	μ=0.175	γ=0.175	λ=0.11	μ=0.15	γ=0.2
variant 3	λ=0.11	μ=0.5	γ=0.5	λ=0.11	μ=0.4	γ=0.6

$\lambda = 0.01$ implies that the weight on inflation by the central bank is 99% (in the framework of Saint-Paul and Bentolila, 2001), while $\lambda = 0.11$ corresponds to 90% weight on inflation, i.e. in both cases the central bank is more averse to inflation compared to the estimated aversion to inflation parameter (74 %) in Lippi (1998)[25]. $\mu = \gamma = 0.055$ corresponds to 90% weight on inflation and 5%, respectively, on reform and unemployment. $\mu = \gamma = 0.175$ implies that the weight on inflation is 74% (as reported by Lippi 1998) while the weight on reform and unemployment is 13% for each. $\mu = \gamma = 0.5$ corresponds to 50% weight on inflation (inflation prone case), and 25% respectively on reform and unemployment[26].

[25] We do not consider a case where the central bank is inflation prone, because in the run up to the EMU the central banks of all member states were independent by law, were already participating in the European Monetary System (EMS), while the member states had achieved a low and stable inflation in the run-up to the EMU.

[26] A value of μ (or γ) = 0.04 corresponds to 3.7% weight on unemployment (or reform), while a value of μ (or γ) = 0.07 corresponds to 6.3% weight on unemployment (or reform). A value of μ (or γ) = 0.15 implies weight

	Case (iii) : $\lambda<\gamma<\mu$			Case (iv) : $\gamma<\lambda<\mu$		
	λ	γ	μ	λ	γ	μ
variant 1	λ=0.01	γ=0.04	μ=0.07	λ=0.01	γ=0.005	μ=0.105
variant 2	λ=0.11	γ=0.15	μ=0.2	λ=0.11	γ=0.05	μ=0.3
variant 3	λ=0.11	γ=0.4	μ=0.6	λ=0.11	γ=0.05	μ=0.95

Notice that the first two rows in each box represent a situation where both the central bank and the government are inflation averse (with the central bank having a bigger aversion to inflation though), whereas the last row refers to a case where the central bank is inflation averse but the government is inflation prone i.e cares less for inflation (much less (50%) than the average estimated value (74%) in OECD countries as reported by Lippi, 1998)[27].

Evaluate the inside and outside the MU outcomes

The values chosen for the parameters imply that we have to examine eight different model specifications[28]. In addition, the alternative orderings of the preference parameters for the central bank and the government produce four cases to consider, with three variants on each based on how inflation-averse is the central bank and the government. However, all these different specifications can be categorized into two groups based on the conditions: $\delta > \varepsilon(1+a^2\lambda)$ and $\delta > \frac{2\varepsilon(1+a^2\lambda_{EC-B})}{(2+a^2\lambda_{EC-B})}$ that determine whether labor unions set wages as an increasing function of reform (strategic complements) pre and post-MU, respectively. Therefore, wages and reform are "strategic complements" only in models 1 and 3, where $\delta = 0.268$ and $\varepsilon = 0.1$ i.e. the labor unions face a more favorable wage-unemployment trade off, because reform reduces unemployment to a greater extent than it affects union power in wage setting. In all other cases labor unions set nominal wages as a decreasing function of labor market reform, because reform reduces their bargaining power more than it affects unemployment, i.e. wages and reform are "strategic substitutes".

Under all possible specifications reform increases inside the MU[29]. This reflects the fact that labor market institutions in each country are "strategic complements", as well as, that home

equal to 11.2% unemployment (or reform), whereas μ (or γ) = 0.2 corresponds to 14.8% weight respectively on unemployment (or reform). While μ (or γ) = 0.4 (and μ (or γ) = 0.6) imply that the weight on unemployment and reform is respectively 20 %.

The values for γ and μ in case (iv) are translated to the following weights on reform and unemployment: γ = 0.005 (0.05) corresponds to 0.45 % (3.7% when inflation weight is 74% and 2.5% when inflation weight is 50%). While when μ = 0.105 (0.3 and 0.95) the weight on unemployment is 9.55 % (22.3% and 47.5%, respectively).

[27] We do not consider the extreme case of 10% weight on inflation as in Saint-Paul and Bentolila (2001), because as already mentioned in the run-up to EMU all countries had achieved a low and stable inflation.

[28] These are: 1) κ=5, δ=0.268, ε=0.1 2) κ=5, δ=0.268, ε=1 3) κ=10, δ=0.268, ε=0.1 4) κ=10 ,δ=0.268, ε=1 5) κ=5, δ=0.033, ε=0.1 6) κ=5, δ=0.033, ε=1 7) κ=10, δ=0.033, ε=0.1 8) κ=10, δ=0.033, ε=1.

[29] The numerical solutions are presented in Appendix 1.5.3.

governments respond in an aggressive manner to wage setting by home unions. As a result, inflation and unemployment end up in a smaller level inside the MU. Moreover, nominal and real wages fall (or remain approximately the same) in all cases where wages and reform are strategic substitutes[30] (i.e. when union power is substantially reduced following the labor market reform), which generates part of the fall in unemployment and the inflation rate. Therefore, the model implies that there will be significant wage moderation (despite the fact that more agents interact inside the MU), as well as, acceleration of the reform efforts[31]. However, if wages and reform are strategic complements (model specification 1 and 3), nominal and real wages will be at a higher level inside the MU. Nevertheless, this does not inhibit inflation and unemployment from falling, because the effect of reform on unemployment is very strong. Hence, a bigger amount of reform leads to less strict EPL, which can lead to lower unemployment but does not affect much union power on wage setting, allowing labor unions to reap benefits from a "partizan" type of wage setting behavior (because a bigger amount of reform makes more favorable the wage-unemployment trade off that they face).

Welfare implications on the usefulness of reform or the decision to form of a monetary union cannot not be drawn from this framework, however, using each agent's loss function we could categorize the different outcomes[32]. In all possible specifications the common central bank's loss is lower compared to what the national central banks achieved in the pre-MU era. In case of strategic substitutability of wages and reform on unions wage setting decisions the national government ends up with lower losses inside the MU; whereas the labor unions having lost part of their strength since wage contracts have become less rigid (due to less strict EPL and reduced bargaining power in wage setting) face a less profitable outcome inside than outside the MU[33]. The outcomes achieved by labor unions and governments are in the opposite direction, when wages and reform are strategic complements on unions' wage setting decisions, i.e. labor unions are better off, while governments are worse off inside the MU (Table 2)[34][35].

[30] Model specifications 2, 4, 5, 6, 7, and 8.

[31] Bertola and Boeri (2002) document that the pace of labour market deregulation accelerated in the build up to the EMU. Taking also into account that there is a remarkable wage moderation in the Euro-area (Calmfors 2001a), we conclude that the predictions of the model are verified.

[32] Keep in mind that the benefits and costs of forming a MU are far from being analyzed in detail in the simple framework we employ, hence we are very cautious about drawing hasty conclusions about MU membership, therefore we impose it exogenously.

[33] This is attributed to the decrease in real wages which is not compensated by the fall in unemployment because its targeted level falls as well. With respect to the government, the increase in reform generates smaller losses compared to the benefits from a lower level of unemployment and inflation.

[34] Labour unions are better off because of the increase in real wages and the fall in unemployment (despite the fact that the decline in unemployment is moderated by the fall in its targeted level). Governments are worse off because the political cost of increased reform outweigh the benefits of lower unemployment and inflation. In addition, the unemployment decrease is smaller in the complementarity case because real wages increase.

[35] These alternative specifications provide us also with the following result: a reduction on the weight attached

Overall, national governments have more incentives to undertake costly reform in the context rather than outside a MU, because it can moderate the wage demands of both the home and the foreign labor union, as well as in order to counterbalance the "negative spill-over effect" of the reform undertaken in the foreign country. However, this "beggar-thy-neighbor" policy can stimulate a *"race to the bottom"* regarding labor market reform[36] inside the MU. Cooperation of the national governments in setting reform replicates the pre-MU outcome (i.e. less reform). On the other hand, cooperation on the part of the two labor unions will not change things, the solutions coincide with those under non-cooperative Nash play inside the MU[37]. Furthermore, if we consider an inter-government coalition deciding reform in each country and an inter-labor union coalition setting nominal wages the solutions obtained are similar to those prior to the MU. Therefore, the deregulation decisions taken by the national governments (and particularly the strategic complementarity of labor market institutions) are essential in determining the achieved outcome and drive the mechanics of our simple model; hence when governments internalize the effects of their actions on each others by engaging in cooperation the pre-MU outcome is achieved. Whereas, if this externality is still present a cooperation on the part of the labor unions, due to the symmetry of the problem, will lead to the same outcome as under a non-cooperative Nash play because the wage setting behavior of labor unions will still be influenced heavily by the way reform is set by the national governments

Notice though that the incentives for cooperation depend on whether wages and reform are strategic complements or supplements. More specifically, when wages and reform are strategic complements with governments being worse off and labor unions better off, the governments can improve on that outcome by cooperating and achieving the superior pre-MU outcome, though

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to reform (a lower γ) or a bigger weight on unemployment (higher μ) leads to higher level of reform and lower unemployment in all model specification. It also leads to lower nominal and real wages in the cases where wages and reform are strategic complements on the unions' wage setting decisions. In the rest of the cases (models 1 and 3) nominal and real wages increase with the reduction of γ.

[36] International coordination could deal with this problem if regulations are desirable. On the other hand if regulations are excessive this competition could be beneficial, and governments' incentives for reform will be increased (Andersen et al 2000, Bertola and Boeri 2002 etc).

[37] Governments minimize $G = \frac{1}{2}(G_1 + G_2)$ with respect to r_1 and r_2, and play Nash against the unions, while the unions play Nash against the inter-government coalition and against each other. Labour unions minimize $L = \frac{1}{2}(L_1 + L_2)$ with respect to w_1 and w_2, and play Nash against the governments, while the governments play Nash against the inter-labour union coalition and against each other. The above stated specifications of the coalitions' loss function can match the results obtained in a Nash bargaining context, because of the symmetry of the two loss functions used respectively in each case, and the fact they have a common reference point which is the loss achieved under a non-cooperative Nash play (Zervoyianni, 1997). The mathematical expressions are not reported due to space limitations, and because the symmetry of the problem (and the nature of the common loss functions used) make straight forward the equality of the pre-MU Nash and post-MU outcome under government cooperation, as well as the equality of the post-MU Nash outcome with the post-MU outcome under unions' cooperation.

in that case the labor unions will end up being worse off. When wages and reform are strategic substitutes, and governments are better off while unions are worse off inside the MU, the governments have no incentives to engage in cooperation because this will give them an inferior pay-off, whereas the labor unions cannot do anything to improve their pay-off. Hence, the governments under certain circumstances can improve their pay-off by cooperating, while this is not possible for the labor unions because what drives the mechanics of the model is the strategic complementarity of reform which is perceived as a negative externality by the governments when wages and reform are also strategic complements. In that case it serves as positive externality for the labor unions, because it eases the wage-unemployment trade off they face. When wages and reform are substitutes, the strategic complementarity of reform in the two countries serves as a positive externality for the governments (that is why the don't have incentives to cooperate) and a negative one for the labor unions because it worsens their wage-unemployment trade (Table 2).

Table 2

	(G,L)	(G,L)
Move from:	pre-MU->Nash-MU	NashMU->Govts' Coop
(w-r) substitutes	(Better off, Worse off)	(Worse off, Better off) => No incentives for cooperation
(w-r) complements	(Worse off, Better off)	(Better off, Worse off) => $\exists$ incentives for cooperation

Asymmetric Case

The next step would be to allow for asymmetries in the two countries[38]. It is expected that countries behave differently depending on whether they form a MU with countries that are more or less distorted than themselves. Abstracting from country size differences and choosing to focus on labor market differentials, we assume that country 1 is more distorted than country 2. The labor union is assumed to have bigger bargaining power in wage setting in country 1, which is modeled by setting $\kappa_1 = 10\%$, while $\kappa_2 = 5\%$. Furthermore, it is assumed that reform is much less effective in country 1 due to public discontent and strong opposition by union members. This is modeled by setting $\varepsilon_1 = 0.1$, while $\varepsilon_2 = 1$. In addition, the political cost of reform (e.g. due to strikes when unions have a strong say in the design of labor market institutions) would be higher in the country with stronger labor unions (higher union density and coverage), hence we assume that $\gamma_1 > \gamma_2$. For simplicity we allow for the same parameter $a = 0.8$, and $\delta = 0.268$, though we will examine whether the result changes when we consider a lower value of δ $(= 0.033)$[39]. Based on what we discussed above, when $\delta = 0.268$ wages and reform will

[38] The numerical solutions are presented in Appendices 1.5.4.

[39] The parameters a and δ were assumed to take the same values, since both countries are modeled as having a similar labour market structure, i.e. a monopolistic labour union. Hence, we do not allow for different a, i.e. a high (rigid) and a low (flexible) labour market, because the presence of labour unions and strict EPL generates rigid

be strategic complements on unions wage setting decisions in country 1 (distorted economy) while they will be strategic substitutes in country 2 (less distorted economy). When $\delta = 0.033$ wages and reform will be strategic substitutes on unions wage setting decisions in both countries. Therefore the combination of parameters (when $\delta = 0.268$). $\varepsilon_1 = 0.1$, $\kappa_1 = 10\%$, relative to $\varepsilon_2 = 1$, $\kappa_2 = 5\%$, implies that the union in country 1 is more powerful in wage setting and that reform reduces effectively union power in the second country. On the contrary, when we assume $\delta = 0.033$ the labor union in country 1 has still more power in wage setting, though reform is effective in reducing union power in both countries. We allow for a case where both national governments averse inflation to the same degree (high or low), as well as for a case where the government in the more distorted economy is inflation-prone, while the government in the less distorted economy is inflation-averse[40][41].

Case with: $\delta = 0.268$. We are going to examine twelve different cases, in the first eight national governments will averse inflation to the same degree, while in the last four the national government in the more distorted economy will be inflation-prone, whereas in the less distorted economy it will be inflation-averse[42]. Case 1 depicts a MU of a distorted and less distorted

labour contracts in both economies: while it is only labour unions' bargaining power in maintaining these rigid labour contracts that differs among countries. Additionally, we would not want to force any result by assuming that reform generates a bigger fall in unemployment in one country than the other (different δ). For example, unemployment might be reduced more in the economy where the labour union has more power (which also suffers from higher unemployment as suggested by several empirical studies, see footnote 6) if reform is reducing effectively labour union bargaining power. However, if labour union power is unaffected to a large extent, then reform might not manage to reduce unemployment more than in the less distorted economy.

[40] This makes uses of the presumption that inflation might be higher in an economy where unions bargaining power in wage setting is greater.

[41] In all cases the national central banks will be equally averse to inflation, because as we know they were made independent by law, participated in the EMS, while the member states were obliged to achieve a low and stable inflation rate as a prerequisite for EMU participation.

[42] In model specifications 1, 2, 5, 6 both governments are inflation averse (variant 2; see section 2.3.1). These cases correspond to a "Conservative" (inflation averse government, low influence of labour unions) versus a "Christian Democrat" regime (inflation averse and high influence of unions) according to Saint-Paul and Bentolila (2001). In specifications 3, 4, 7, 8 both governments are inflation prone (variant 3), in turn these cases correspond to a "New Labour" (π-prone government and low influence of labour unions) versus a "Socialist" regime (π-prone government and high influence of labour unions) In cases 9-12 the government in country one is inflation-averse (variant 2) and that in country two inflation prone (variant 3); i.e. we are considering a "Conservative" versus a "Socialist" regime. In models 1-4 and 9-10 the government in country 1 attaches the same weight on reform and unemployment (case i; see section 2.3.1). In specifications 5-8 and 11-12 country 1 attaches more weight to reform than unemployment (case ii). In specifications 1, 3, 5, 7, 9, 11 the government in country 2 attaches more weight on unemployment than reform (case iii), while in cases 2, 4, 6, 8, 10 and 12, it still attaches bigger weight on unemployment but cares very little about the political cost of reform (case iv where $\gamma_2 = 0.05$), or the political costs of reform are minimal due to weak labour unions.The numerical solutions are not presented due to space limitations but are available upon request.

economy with governments in both countries being equally averse to inflation. The formation of the MU leads to greater reform in both countries as in the symmetric case[43]. However, nominal wages fall in country 1 (as area-wide nominal wages) and increase in country 2, which is exactly the opposite of what we experienced in the symmetric case. Notice, though that inflation has decreased for country 1 while for country 2 its much higher than before, moreover it is lower than the average inflation in the two countries because area-wide nominal wages fall while area-wide reform increases. This implies that real wages in the "distorted" country increase slightly, despite the moderation of nominal wage demands, while in the less distorted economy real wages fall (as area wide real wages) despite the increase in the nominal wages. Unemployment decreases in both countries, in particular in the more distorted economy the higher level of reform counterbalances the small increase in real wages.

The common CB is better off compared to the average outcome attained by the two national CBs before the MU. The labor union in country 1 is better off because wages and reform are complements, hence real wages rise while actual unemployment falls more than its targeted level. On the other hand, the labor union in country 2 is worse off because wages and reform are perceived as substitutes; both real wages and unemployment rate, but so does its targeted level, moderating the beneficial effect of the decline in unemployment. Things have changed with respect to the governments' payoffs compared to the symmetric case. The government in the more distorted economy becomes better off inside the MU, since it is affronted with lower unemployment and inflation despite the higher political cost of reform. On the other hand, the government in country 2 is worse off inside the MU, because the losses incurred due to the higher inflation and the increased political cost of reform outweigh the benefits of a lower unemployment rate[44].

Case with $\delta = 0.033$ We now turn to examine what happens if $\delta = 0.033$ i.e. if reform is not reducing unemployment as much as IMF and OECD advocate. In that case wages and reform are strategic substitutes on labor unions wage setting decisions in both countries. The results

[43] As a consequence of the assumptions employed, reform, nominal and real wages, unemployment and inflation are higher in country 1. Therefore the labour union in country 1 achieves a better outcome than that in country 2, while the opposite is the case with respect to their national governments and central banks.

[44] The results described above are similar in all model specifications considered, except in case 6 where national governments attach the same weight on inflation but the government in country 2 cares much less for the political costs of reform (or cares more about unemployment). In that case reform falls inside the MU for the more distorted country (though, area-wide reform still increases because of country 2). Moreover, real wages decreases slightly because the nominal wage increase does not compensate for the inflation decline in the MU. As a result, unemployment increases marginally inside the MU for country 1. The combined effect of higher unemployment (that outweighs the increase in v) and lower real wages raises the losses (or decreases the benefits) incurred by the home labour union inside the monetary union, making it worse off.

are as follows: Reform increases inside the MU in all cases. Nominal wage demands in country 1 decrease. Though, in country 2 nominal wages are raised, because the response of the labor union to the nominal wage set in the other country outweigh the moderating effect induced by higher reform in both countries. On average reform increases and nominal wages fall reducing area-wide inflation relative to the average of the two countries before the MU. Real wages decline in both countries, in country 1 the fall in nominal wages is bigger than the fall in inflation, while in country 2 the increase in nominal wages is smaller than the increase in prices. Unemployment falls in both countries since real wages fall and reform is raised. The common CB enjoys smaller losses than the average losses of the two national CBs before the formation of the MU. Both labor unions will enjoy lower benefits inside the MU as expected in case of substitutability of wages and reform on labor unions wage setting decisions (for the same reason described in the previous section). Furthermore, the government in the distorted economy will be benefited from the formation of the MU since it will face lower unemployment and inflation, despite the increase in the political cost due to higher reform effort. Finally, the government in the second country will be worse off for the reasons discussed in the previous section[45].

Cooperation of Governments

Case with $\delta = 0.268$ Under all model specifications reform in the less distorted economy decreases below the pre-MU levels after a cooperation of two governments (keep in mind that the formation of the MU had a positive effect on reform). In the more distorted economy (country 1) reform falls short of its levels under the non-cooperative Nash play inside the MU (or all Nash play), but is still higher relative to its pre-MU levels. Therefore, the cooperation among the two governments by taking account of the negative spill over effects leads, in most cases, to moderation of reform decisions in country 1[46]. Nevertheless, the more distorted economy still ends up with more reform inside the MU, while the less distorted one, that does not "need" much reform, ends up at a lower level compared to the pre-MU outcome. In most cases area-wide

[45] However, in specifications 4 and 8 where both governments are inflation-prone, the government in the second country that cares very little about the political cost of reform, while attaches a big weight on unemployment, manages to benefit from the formation of the MU, by facing smaller losses.

[46] However, in specification 2 where both government are equally averse to inflation (and the government in country 1 attaches the same weight on reform and unemployment, while the government in country 2 cares very little about reform), cooperation among the governments raises the amount of reform in country 1.

In specification 6, where both governments are equally averse to inflation (and the government in country 1 attaches bigger weight on reform than employment unemployment, while the government in country 2 cares very little about reform), r_1 increases with respect to the case where all players were involved in a non-cooperative Nash play inside the MU, whereas it is still lower compared to the pre-MU case. In case 12 the cooperative outcome for r_1 is the same as the non-cooperative Nash play inside the MU.

reform and r_2 are lower compared to their all-Nash play levels, as well as, their pre-MU levels[47].

Next we turn to examine the implications regarding the payoffs gained by the different agents and how they compare with the non-cooperative Nash play outcomes. A more detailed discussion of the implications with respect to nominal and real wages, unemployment and inflation can be found in the Appendix 1.5.4. First of all, the common central bank will find itself in a worse position in case of cooperation by the two governments, because inflation will be higher compared to the non-cooperative Nash play inside the MU, as a consequence of an average reform decline and an average wage increase. This effect is strengthened by the increase in area-wide unemployment (because the real wage increases and reform declines), though it holds even when area-wide unemployment is at a lower level.

The labor union in country 2, the less distorted economy, will be better off after the cooperation of the two governments; although unemployment increases, real wages and the targeted level of unemployment increase as well, i.e. lower reform translates into greater union power making more favorable the wage-unemployment trade off faced by labor unions (when wages and reform are treated as substitutes on unions' wage setting decisions). When considering the labor union in country 1 we see that in most cases the outcome is worse compared to the non-cooperative Nash play[48]. A smaller amount of reform under governments' cooperation worsens the wage-unemployment trade off when wages and reform are complements.

The government is country 2 (where wages and reform are substitutes, and reform reduces effectively union power) is clearly worse off in case of cooperation, its payoff deteriorates compared to the one obtained under non-cooperative Nash play. The benefits from a lower reform level in terms of less public tension and strikes are outweighed by the losses attributed to higher unemployment and inflation. Furthermore, in the first place reform was not perceived as inducing a great political cost in country 2. Therefore, the benefits from reducing it are bound to be small, while at the same time this generates an adverse effect because reform was effectively diminishing union power in wage setting due to the substitutability of wages and reform. Absent this factor, the labor unions will raise their nominal wage demands.

In most of the cases considered, a cooperation of the two governments generates additional losses to the government of the country with the most distorted labor market with respect to its non-cooperative Nash play payoff, this is due to higher inflation, because reform decreases while unemployment can be lower or higher than before.[49] Hence, in these cases there are no incentives

[47] Though, in specification 5 reform is equal to the pre-MU level and lower than the case of an all Nash play. Nevertheless, in specifications 1, 3 and 6 area-wide reform in case of cooperation among the two governments is lower than the case of an all Nash play, but higher than the pre-MU level

[48] Though, in specifications 2 and 6 the payoff in case of cooperative play is better than under a non-cooperative one, while in specification 12 they coincide.

[49] Specifications 1-2, 5-6, 8-12.

for the government in country 1 to engage in a cooperative Nash play in a monetary union, or alternatively, if already involved in coalition with the other government it will definitely break it to achieve the non-cooperative Nash outcome. It is noteworthy that in some of the model specifications that we have examined, the cooperative outcome is the first best solution for the government in country 1, where the labor unions have greater bargaining power. These are cases 3-4 and 7; where both governments are equally inflation-prone. Nevertheless, cooperation is not going to be realized because it is not a preferable outcome for the government in country 2. If we impose it exogenously (as the MU membership), then there are some cases where the government that has to deal with the most powerful labor union could improve its pay-off by cooperating with the foreign government. This could be accomplished by making the foreign government bear some of the losses that the home government incurs from its "fight" against the powerful home labor union. Nevertheless, if we assume that some or all of the governments of the EMU countries are inflation-averse (maybe not of the same degree, but this is modeled in cases 9-12 where we consider an inflation-averse and an inflation prone government), then it appears that the national governments will have no incentives to cooperate in deciding labor market institutions, instead they will prefer a non-cooperative Nash play that will deliver them a higher pay off inside the MU.

Case with $\delta = 0.033$ In this case reform is effective in reducing labor unions' bargaining power, because it worsens the wage-unemployment trade off faced by both labor unions. Under most specifications the pattern of reform is similar to that when $\delta = 0.268$ (where reform reduces effectively union power only in the second country), i.e. reform in country 1 falls in case of cooperation relative to the non-cooperative case (while it is above the pre-MU levels in most cases)[50] In the second country reform efforts are also moderated after the cooperation of the two governments.[51] Furthermore, the average reform that affects the area-wide MU is reduced by so much that it reaches at each minimum level under cooperation[52].

The common central bank and the government of the less distorted economy are made worse off, while the labor union in country 2 is always better off when governments cooperate compared to the non-cooperative case, for the same reason discussed in the previous section[53].

[50] Excluding specifications 2, 5, and 6.

[51] The new reform level achieved is also lower with respect to its pre-MU level; however, in specifications 2, 5 and 6 it is above that level.

[52] In specifications 2, 5 and 6 average reform in case of cooperation is above the pre-MU outcome, so cooperation avoids a race to the bottom deregulation but still enhances reform efforts. Though, in this case reform in country 1 is at its lowest point, which is contrary to the fact that it has the most distorted economy and "needs" the biggest amount of reform.

[53] A more detailed discussion and comparison of the nominal and real wages, as well as the unemployment and inflation values with and without governments' cooperation can be found in the Appendix A.1.3.2.

In most model-specifications the labor union in country 1 is better off when the two governments coordinate their reform decisions compared to the non-cooperative Nash play inside the MU[54]. Like in country 2 the increase in unemployment is outweighed by the increase in real wages and the targeted level of unemployment. Whereas, when both real wages and unemployment decrease (specifications 5, 9 and 11), the decrease in unemployment is bigger increasing the benefits enjoyed by the labor union.

The government in country 1, (in most cases) is worse off under the cooperative outcome relative to the non-cooperative post-MU case. The benefits from a lower reform effort (smaller political cost) fall short of the losses generated by the increase in unemployment and inflation[55] (which are the result of more aggressive wage setting on the part of labor unions driven by the reform reduction). Nevertheless, in certain model specification (5 and 9) the cooperative outcome turns out to be the best one in terms of pay-off for the government in country 1. This happens because unemployment is reduced (which occurs because real wages are reduced more than the fall in the reform level), so that the benefits from lower unemployment and reform more than compensate for the losses generated by the increase in inflation.

Therefore, the government in country 1 in most cases will not opt for cooperation, though under certain parameter values it is possible to gain out of a cooperation. However, a cooperative outcome is difficult to realize since it does not emerge endogenously from the model. Although "race-to-the-bottom" deregulation might be a side-effect of the non-cooperative Nash play inside the MU, it cannot be dealt with cooperation; because reform is beneficial since it reduces effectively labor unions' bargaining power on wage setting. Hence a reduction in reform will bring about a more aggressive wage setting on the part of the unions (which are made better off in the cooperative relative to the non-cooperative case) that aggravates the unemployment and inflation problems.

Overall, under most specification, and for both values of δ, a cooperative outcome among the two governments is not feasible, since both of them incur greater losses (Tables 3 and 4). Hence, the race-to the-bottom is not avoided because it is consider beneficial. In some specific cases the government in country 1 is better off under cooperation, however, the government in country 2 is worse off, thus cooperation cannot be achieved endogenously. If in these specific cases cooperation was imposed exogenously (as was the case for MU membership), the "race-to-the-bottom" deregulation would be avoided, but this would not be a beneficial outcome for both governments. The cooperative outcome could be sustained in the specific cases that the government in country 1 is better off, if it makes a transfer to the government in country 2

[54]Only in case 10 the cooperative outcome is worse than the non-cooperative case.

[55]In specification 11, the government is still worse off under the cooperative outcome compared to the non-cooperative post-MU case. Because, although unemployment and reform decrease, leading to smaller losses, the inflation rise is sufficient to worsen the cooperative outcome relative to the all-Nash play.

whose position worsen after cooperation. In practice this strategy is not feasible because the extra benefits gained by the government in country 1 fall behind the extra losses incurred by the government in country 2.

Table 3

Move from:	(L_1,L_2)		(L_1,L_2)	
	pre-MU->Nash-MU		NashMU->Govts' Coop	
	$\delta = 0.268$	$\delta = 0.033$	$\delta = 0.268$	$\delta = 0.033$
(w-r) substitutes	L_2 worse off	(L_1,L_2) worse off	L_2 better off	$(L_1^{\dagger},L_2)$ better off
(w-r) complements	$L_1^{\ddagger}$ better off		L_1^{*} worse off	

‡worse off in case 6,*better off in cases 2 and 6, indifferent in 12, †worse off in case 10.

Table 4

Move from:	(G_1,G_2)		(G_1,G_2)	
	pre-MU->Nash-MU		NashMU->Govts' Coop	
	$\delta = 0.268$	$\delta = 0.033$	$\delta = 0.268$	$\delta = 0.033$
(w-r) substitutes	G_2 worse off	G_1: better off G_2: worse off	G_2 worse off	G_1: worse off† G_2: worse off
(w-r) complements	G_1 better off		G_1 worse off*	

*better of in 3, 4, and 7, †better off in 5 and 9.

Cooperation of labor unions

Although labor unions' coordination in wage setting is far from being a wide-spread phenomenon in Europe, it is interesting to examine what the model predicts in such a case. Two issues are raised in this section. First, whether the labor unions can gain a higher pay-off by cooperating relative to participating in a non-cooperative Nash play inside the MU (and how reform behaves in that case). Second, whether the governments have an incentive to cooperate in deciding reform when labor unions are cooperating already in setting nominal wages. Notice, that when an inter-labor union coalition plays Nash against an inter-government coalition, the achieved outcome coincides with the one under cooperative play on the part of the governments and non-cooperative play on the part of the labor unions. Therefore, labor unions' cooperation cannot alter the solution outcome (like in the symmetric case), because, what drives the mechanics of the model is the strategic complementarity of labor market institutions and the externality it imposes to the governments and the labor unions. If this externality is eliminated by a cooperative action on the part of national governments then the strategy of labor unions (whether they cooperate or not) is irrelevant.

Case with $\delta = 0.268$ In most cases considered reform in country 1 remains at the same level as under a non-cooperative Nash play inside the MU[56]. Moreover, in case of an inter-labor union coalition r_1 is above the levels obtained when governments are also engaging in cooperation[57]. The amount of reform in the second country is always bigger relative to that under inter-government cooperation; while, in most cases, it coincides with its levels under an all-Nash play[58]. As a results the amount of area-wide reform under unions' cooperation is always bigger relative to the one when the two governments set reform in a cooperative manner, because in the latter case they internalize the externality they impose on each other[59].

Given that labor unions cooperate, a move to a cooperative play on the part of governments worsens the position of the common central bank, because inflation and unemployment are higher due to the lower reform level[60]. However, the common central bank is also made worse off if unions diverge from an non-cooperative play and decide coordinate their wage setting. Nevertheless, this does not apply to all cases, thus in specifications 5 and 6 it attains the same losses, whereas it is better off in specifications 2, 4, 6 and 7.

The labor union in country 1 finds itself better off when it cooperates with the foreign labor union relative to a case where governments coordinate their reform decisions (real wages increase in all cases, except in specifications 1, though in that case the fall in unemployment outweigh the decrease in real wages)[61]; this is explained by the fact that governments' cooperation lowers reform and the complementarity effect leads to lower wages; alternatively, the wage-unemployment trade off worsens so the unions have to moderate their nominal wage demands. Moreover, the labor union enjoys the same benefits, with or without cooperating (all-Nash play), because real wages are raised by the same amount that unemployment increases[62].

The labor union in country 2, contrary to that in country 1 is always worse off compared to the payoff it obtains when the two governments cooperate (unemployment falls but so does its targeted level, therefore the decline in the deviation between these two is not sufficient to

[56] Except in specifications 1, 2, 6, 7, 8 where it increases above its all-Nash play levels.

[57] However, in specifications 2 and 6 reform is below, and in specification 12 it coincides with its inter-government cooperation levels.

[58] In specification 2, 4 and 8 the outcome is superior to the all-Nash play, whereas in specification 3 it is inferior.

[59] In most cases average reform in the MU equals its level under an all-Nash play, while in specifications 1, 2, 6-8 it is above, and in specifications 3 and 9 it is below its all-Nash play levels.

[60] A detailed discussion on how wages, unemployment and inflation under unions' cooperation compare to their levels under an all-Nash play and an inter-government coalition is presented in the Appendix 1.5.4.

[61] In specifications 2 and 6 the labour union is worse off, while in specification 12 it obtains the same pay-off.

[62] Though, in specifications 1, 2, 6, 7, and 8 the union is slightly better off. Because, the increase in real wages in accompanied by a reduction in the deviation of unemployment from its targeted level (case 7, where unemployment falls) or a smaller increase of the deviation of unemploymnet from its targeted level (case 1, where unemployment increases). In cases 2, 6 and 8 real wages do not change, though the deviation of unemployment from its targeted level decreases (the unemployment decreases in cases 2 and 6 and increases in case 8, though by a smaller amount than the decrease of its targeted level).

compensate for the fall in real wages). The explanation is that reform is lower when governments play cooperatively which implies that wages should be higher due to the substitutability effect, i.e. the wage-unemployment trade off becomes more favorable for the labor union. Its pay-off under an all-Nash play is equal to the one obtained when the two labor unions cooperate[63][64].

The pay-off obtained by the government in the first country is higher in most cases when unions cooperate relative to a case where governments also cooperate among themselves;[65] which is due to the fact that inflation is lower when unions cooperate, while in most cases unemployment and reform are higher. Although, higher reform implies bigger political cost, it is beneficial because it forces labor unions to moderate their nominal wage demands. However, in specifications 3, 4, 7, 8, where both governments are inflation-prone, the government in country 1 becomes worse off. Moreover, in most cases, it finds itself in a worse position compared to the non-cooperative play (because both unemployment and reform are at a higher level)[66]. Though, it is better off in specification 2, since unemployment falls more than the increase in reform (inflation does not changes).

The government in country 2 is better off when the two labor unions cooperate in setting nominal wages compared to the outcome achieved in case of inter-government coalition. The explanation is that inflation and unemployment are lower, because of the decline in real and nominal wages and the increase in reform. Notice that the losses incurred by the higher reform level are not so important, since the government in country 2 is always attaching bigger weight to unemployment than reform, which is an implication of our assumption that the labor union has less power than in country 1 in affecting labor market institutions. Comparing the all-Nash play and the unions' cooperation outcomes we do not obtain uniform results across the different cases[67].

As we saw before there are cases where the two unions gain higher payoffs when cooperating,

[63] In specifications 5, 6, 7, 9-12. In particular, in cases 5, 7, 9-10 the increase in real wages equals the increase in the deviation of unemployment from its targeted level. In cases 11-12 real wages fall by the same amount as the deviation of unemployment from its targeted level. Finally, in specification 6, unemployment and real wages are at the same level as under the all-Nash play.

[64] Notice that in specification 3 the pay-off is slightly improved because the increase in real wages out-weight the increase in the deviation of unemployment rate from its targeted value (both u_2 and τ_2 increase). However, in specifications 2, 4 and 8 the outcome is worse when the two unions cooperate, because the fall in real wages more than compensates the change in the deviation of unemployment from its targeted level, i.e. unemployment is lower but τ is also lower (since reform has a bigger value under unions' cooperations).

[65] This holds for specifications 1, 2, 5, 6, 9-12.

[66] In specifications 3, 4, and 8 the government in country 1 enjoys the same payoff as in the non-cooperative Nash play.

[67] In model specifications 1, 2, 4, 10, 11 the government in country 1 is better off when the two labour unions cooperate, it is indifferent in case 8. In all other model specifications (3, 5, 7, 8, 9, 12) the government is made worse off if the two labour unions decide to cooperate in wage setting.

though the extra benefits are small. In particular, the labor union in country 1 has incentives to cooperate with the union in country 2, because it will enjoy a slightly higher pay-off in specifications 1, 2, 6, 7, and 8; however, the labor union in country 2 is indifferent about cooperating in cases 1, 3, 6 and 7 because it enjoys the same pay-off with and without cooperation, while in cases 2 and 8 it will be worse off if it cooperates. Whereas, it is made better off if cooperating in specification 3, while in that case the labor union in country 1 is indifferent about engaging in cooperation. Therefore, the cooperative outcome is feasible because the labor union in country 1 can make a transfer to the labor union in the second country in specifications 1, 6, and 7, while the opposite would be the case in specification 3[68].

The next step is to see whether the governments have incentives or not to form a coalition when the unions are already coordinating their wage decisions. The government in country 1 obtains a higher pay-off under governments' cooperation than under unions' cooperation in model specifications 3, 4, 7 and 8. However, a cooperation of the two labor unions can be realized only in specifications 1, 3, 6 and 7, thus cases 4 and 8 are not considered, while in specifications 1 and 6 where a cooperation between the two unions is possible the government in country 1 is also in a better position and has no incentive to cooperate with the foreign government. Therefore in specification 3 and 7, the government in country 1 could improve its pay-off if the second government agrees to cooperate in deciding labor market institutions. Nevertheless, as we saw, the government in country 2 is always better off when unions cooperate among each other and has no incentive to form a coalition with the other government, because it enjoys lower inflation and unemployment, while reform is higher. However, cooperation could still be feasible if the government in country 1 was gaining so much it terms of extra pay-off that it could cover the extra losses of the government in country 2 by means of a transfer; though, this is not the case.

Case with $\delta = 0.033$ As was the case in the previous section (where reform was more effective in reducing union power in country 2), reform is higher in both countries in case of cooperation among the two unions compared to a situation where governments cooperate as well, because in the latter case the two governments internalize the negative effects of their actions, so beggar-thy-neighbor policies are absent. Moreover, r_1 in most cases coincides to its all-Nash play value[69]. In

[68]Therefore, in all model specifications, except 1, 3, 6, 7, reform will be determined in a game where governments and unions play Nash against each other. In specifications 1, 3, 6 and 7 the labour unions can form a coalition. Hence, r_1 will be above its value under the all-Nash play in cases 1, 6, and 7, whereas in case 3 its value will not change. r_2 will be equal to its all-Nash play value in specifications 1, 6, and 7 and below that in specification 3. Area-wide reform will be higher than its all-Nash play levels in models 1, 6, and 7 and below them in specification 3. In all cases reform will be above its pre-MU levels (except in case 6 for r_1).

[69]This holds in specifications 1, 3, 4, 5-7. Though, in cases 2, 9, 10 it is above, while in cases 8, 11, 12 it is below the all-Nash levels.

country 2 reform is lower or equal to its non-cooperative Nash play levels[70][71].

The common central bank is better off when unions cooperate relative to the case of an inter-government and an inter-union coalition, because both inflation and unemployment are lower. Comparing its pay-off under union cooperation with that under non-cooperative Nash play, we see that under most specifications it will be worse off in the former case,[72] since the average area-wide unemployment is higher.

Both labor unions enjoy a lower pay-off if they cooperate with respect to the case of a co-ordinated decision on reform by the two governments (for the reasons already explained when $\delta = 0.268$).[73] Moreover the labor union in country 1 is indifferent between cooperating with the foreign union and taking part in an non-cooperative Nash play; except in cases 8, 11 and 12 where it will be better off if it engages in cooperation. Similarly, in certain cases, the labor union in country 2 will enjoy a higher pay-off when cooperating relative to participating in an all-Nash play (Table 5)[74].

As in the previous section the two governments will find themselves better off when unions' cooperate relative to a case where an inter-union coalition plays Nash against an inter-government coalition, because both the unemployment rate and inflation are lower due to wage moderation on the part of the unions since reform is higher (substitutability effect). In country 1 despite the fact that the higher reform level under unions' cooperation imposes greater losses on the government, it induces also wage moderation on the unions. Though, in model-specifications 5 and 9 the government in country 1 is better off if it decides to cooperate with the other government. Moreover, in the first country the outcome under unions' cooperation is in most cases similar or worse than the one achieved in a non-cooperative Nash play.[75] The government of the second country is in most cases worse off when the unions engage in a cooperative game compared to the non-cooperative Nash play by all agents (Table 6)[76]. The way unemployment compares in case of

[70] In model specifications 2, 3, 6, 7, 10, 11 it is below, while in models 1, 4, 5, 9, 12 it coincides with the all-Nash play levels. It is above its all-Nash play value only in specification 8.

[71] A detailed discussion on how wages, unemployment and inflation under unions' cooperation compare to their levels under an all-Nash play and an inter-government coalition is presented in the Appendix A.4.4.2.

[72] The pay-off obtained is the same in both cases in specification 5, while the central bank is better off if unions cooperate in specifications 4 and 8.

[73] However in specification 9, the labour union in country 1 is better off if it cooperates with the union in country 2.

[74] The labour union is better off under cooperation compared to all-Nash play in specifications 2, 3, 6, 7, 10, 12, it enjoys the same pay-off in both cases in specifications 1, 5, 9, 11, whereas it is worse off under cooperative play in specification 4 and 8.

[75] In specifications 1, 2, 7, 9, 10, 11 the pay-off when unions cooperate is worse, while in specifications 3, 5, 6, 12 the two payoffs coincide. In specifications 4, 8, the pay-off achieved when the two labour unions cooperate is above the one under the all-Nash play.

[76] However, there are three exceptions. The government in country 2 is made better off after unions' cooperation compared to the all Nash play in specifications 4 and 8. In specification 5, the pay off obtained by the government

unions' cooperation with its level under non-cooperative Nash play, determines the governments' payoffs in these two cases.

Overall, the labor union in country 1 is marginally better off if it engages in cooperation with the foreign labor union rather than by taking part in a non-cooperative Nash play in specifications 8, 11, 12. The labor union in country 2 is willing to form a coalition with the other labor union in specifications 2, 3, 6, 7, 10, and 12. Hence, in model specification 12 both labor unions gain extra benefits by abandoning the non-cooperative Nash play and setting wages in a cooperative manner, thus cooperation will be realized. In specifications, 2, 3, 6, and 7 the labor union in country 1 is indifferent about cooperating or playing Nash, which implies that the cooperative outcome is feasible if the labor union in country 2 makes a transfer to the union in country 1. Similarly, in case 11 the union in the second country is indifferent about cooperating, thus the cooperative outcome is feasible in case the labor union in country 1 makes a transfer. In specification 8, the labor union in country 2 is worse off and its extra loss outweighs the extra benefit of the labor union in country 1, hence cooperation is not attainable. However, cooperation is possible in case 10 where the labor union in country 1 is worse off but its extra losses lag behind the extra benefits that accrue to the union in country 2.[77]

Notice that when unions' cooperation is feasible (in specifications 2, 3, 6, 7, 10, 11 and 12), the two governments have no incentives to coordinate their reform decisions because they will incur higher losses. This happens because under unions' coordination nominal wage demands are moderated as a result of the substitutability effect between wages and reform, which is stronger because reform is higher when governments play Nash against each other. The government in country 1 could improve its position in specifications 5 and 9 by cooperating with the other government, if the two labor unions have already form an inter-union coalition, though unions have no incentives to cooperate in these cases. Hence, a coordination of reform efforts does not emerge endogenously from the model, neither when $\delta = 0.268$ nor when $\delta = 0.033$.

is the same in both cases.

[77] In most specifications reform will be determined in a non-cooperative Nash play, though in cases 2, 3, 6, 7, 10, 11, 12 labour unions can cooperate in deciding nominal wages. r_1 will be above the all-Nash play levels in cases 2 and 10, while it will be below in cases 11 and 12; in cases 3, 6, and 7 it has the same value whether the unions cooperate or not. r_2 will be below its all-Nash play levels in 2, 3, 6, 7, 10 and 12, whereas in case 11 its value will be the same whether unions' cooperate or not. As a result in most cases average reform is below its non-cooperative Nash play levels, except in case 2 where it is above. Moreover, in all cases reform in both countries is above the pre-MU levels.

Table 5

Move from:	(L_1,L_2)		(L_1,L_2)	
	Nash-MU->Unions-Coop		Unions Coop->(Govts-Coop, Unions-Coop)	
	$\delta = 0.268$	$\delta = 0.033$	$\delta = 0.268$	$\delta = 0.033$
(w-r) substitutes	L_2^x indifferent	L_1^*: indifferent, L_2^-: better off	L_2 better off	L_1^+: better off L_2: better off
(w-r) complements	L_1^+ indifferent		$L_1^\dagger$ worse off*	

$^+$better off in 1, 2, 6, 7, 8 ^{x}better off in 3, worse off in 2, 4, 8, *better off in 8, 11, 12, $^-$indifferent in 1, 5, 9, 11 and worse off in 4, 8, †indifferent in 12, better off in 2, 6, ‡worse off in 9.

Table 6

Move from:	(G_1,G_2)		(G_1,G_2)	
	Nash-MU->Unions-Coop		Unions Coop->(Govts-Coop, Unions-Coop)	
	$\delta = 0.268$	$\delta = 0.033$	$\delta = 0.268$	$\delta = 0.033$
(w-r) substitutes	G_2^x worse off	$G_1^\dagger$:worse off, $G_2^\ddagger$: worse off	G_2 worse off	G_1^+: worse off G_2: worse off
(w-r) complements	G_1^+ worse off		G_1^* worse off	

$^+$indifferent in 3, 4, 6, better off in 2. ^{x}better off in 1, 2, 4, 10-11, indifferent in 6. †indifferent in 3, 5, 6, 12, and better off in 4, 8.‡better off in 4, 8, indifferent in 5.*better off in 3, 4, 7, 8, $^+$better off in 5, 9.

1.3 Conclusions

In this paper we have been able to merge the literature on the effects of a MU on labor market reform, with the literature examining the effects of a MU on inflation and unemployment under different wage bargaining structures. We have analyzed the effect of unions' behavior on governments' incentives for labor market reform before and after a monetary union has been imposed; with national labor markets characterized by centralized wage bargaining. First we examined a benchmark specification of a two-country monetary union, with symmetric countries and labor unions. Next, we allowed for asymmetric countries and labor unions. Specifically, in country 1 the labor union has greater bargaining power than the labor union in country 2, i.e country 1 is more distorted than country 2. The different solutions obtained are evaluated after calibrating the model parameters.

Under all specifications considered incentives for reform are enhanced when governments and labor unions engage in non-cooperative Nash play inside the MU. This is attributed to two factors. First, that the home government responds aggressively to higher nominal wages set by the home-labor union, and second that governments engage in a "beggar-thy-neighbour" deregulation, because labor market institutions are perceived by the two governments as being strategic

complements. Moreover, in the symmetric case there is significant wage moderation (for nominal and real wages) inside the MU when wages and reform are perceived as strategic substitutes on labor unions wage setting decisions, whereas nominal and real wages increase when wages and reform are thought of being complements, because in that case a higher level of reform improves the wage-unemployment trade off faced by the labor unions. In the asymmetric case, nominal wages are reduced in the more distorted economy and raised in the less distorted economy. Though, real wages increase when nominal wages and reform are substitutes and fall when they are substitutes (i.e. when the wage-unemployment trade off worsens).

The establishment of the MU that increased incentives for reform for the two governments, is beneficial for the labor unions when they are very powerful, and a bigger amount of reform reduces unemployment more than it affects unions power (wages and reform are complements). The results are in the opposite direction when reform is very effective in reducing the bargaining power of labor unions (i.e. when wages and reform are substitutes).

In the symmetric case governments are better off when wages and reform are considered as substitutes by labor unions because this implies lower unemployment. They are worse off when wages and reform are complements, because they have to bear greater political cost without reform being effective in avoiding an aggressive wage setting on the part of labor unions. In the asymmetric case, the government in the more distorted economy is always better off inside the MU, because it can pass part of the losses it incurs from its "fight" against the powerful home-labor union to the foreign government, thus it will enjoy higher benefits coming from the decrease in unemployment and inflation, relative to the losses generated by the greater reform effort inside the MU. Therefore, the government of the country with the less distorted economy is always worse off inside the MU, because it will have to bear greater losses coming from the higher inflation and the bigger amount of reform it undertakes due to the "race-to-the-bottom" deregulation effect.

The "race to the bottom" problem could be dealt with if the two national governments cooperate in setting reform. In the symmetric case, a cooperation among the two governments replicates the pre-MU outcome by removing all the distortions coming from the strategic complementarity of reform in the two countries. Both in the symmetric and the asymmetric case, the labor unions will be better off when wages and reform are substitutes, and worse off when they are complements. The results for the two governments point to the opposite direction in the symmetric model specification. However, the two governments will have an incentive to engage in cooperation only when wages and reform are complements in order to improve their pay-off. In an "asymmetric MU", the two governments are worse off under most model specifications independently of the substitutability or complementarity of wages and reform. Therefore, there are no incentive for cooperation and "race-to the-bottom" deregulation cannot be avoided (or could

be considered beneficial). However, there are certain cases where the government of the most distorted economy can be benefited by engaging in cooperation, both when wages and reform are strategic complements and substitutes. Nevertheless, even in these cases the cooperative outcome does not emerges endogenously, because the extra benefits gained by the government in country 1 are outweighed by the extra losses incurred by the foreign government.

The benchmark model was also extended to allow for cooperation among the two labor unions in setting nominal wages inside the MU. While in the symmetric case the labor unions have no incentives to engage in cooperation, in the "asymmetric MU", under several parameter values, labor unions are better off if they cooperate relative to participating in a non-cooperative play. In these specific cases area-wide reform would be either above or below but not equal to its all-Nash play levels. Nevertheless, it will still be above its pre-MU levels. When labor unions play cooperatively, the national governments have no incentive to set reform in cooperative manner, because this would lead to lower reform levels and much less wage moderation on the part of the unions. However, in some model specifications the government in country 1 can attain a higher payoff by cooperating with the foreign government; though, this is not feasible because the foreign government always incurs losses (which are much bigger than the extra benefits gained by the first government inhibiting the possibility of a transfer that could improve the position of both).

Based on a model specification that adopts the IMF's and OECD's belief that strict labor market institutions are related with the high unemployment problem in continental Europe, as well as the proposed solutions that involve reduction of labor market rigidities by means of structural reform, we managed to show that incentives for reform will increase inside the MU and that on average there will be moderation of real-wage demands. Moreover, these model-predictions are confirmed because studies like Bertola and Boeri (2002) report that deregulation was accelerated in the run-up to EMU[78], while real-wage moderation is a wide-spread phenomenon in the Euro-area as reported by Calmfors (2001a).

Despite the fact that the shift in the monetary regime is only captured by the establishment of the common central bank which decides on common inflation rate, without altering unions' behavior, we were able to describe real-life situation that could lead to increased incentives for labor market reform in the MU context. More elaborate arguments have been used in the literature in order to produce a similar result. Sibert (1999) argues that in the presence of coordination of monetary policy before the MU, that takes the form of *side payments* to the countries suffering from high inflation bias, incentive for reform will be higher inside the MU[79]. Moreover, Calmfors

[78] Though Van Poeck and Borghijs (2001) by evaluating the progress in labour market reform for EMU and a number of EMU countries in the recent past, conclude that "EMU countries have not been more diligent in labour market reform than countries outside the EMU, despite the worse situation in the labour market"

[79] Sibert (1999), argues, in a similar setting with Sutherland & Sibert (2000), that the negative externalities of inflation before the MU, are addressed by coordination of the monetary policy, with high regulated markets,

(1998) shows that there will be more labor market reform within a MU if national governments have a precautionary motive for reform and there is no inflation-bias problem.

Several aspects of this issue are not studied here, and are left for future research. The most important being a common evaluation of the effects of economic integration (increased product market competition) on incentives for labor market reform, which raises political economy questions regarding the advocates and opponents of labor market deregulation inside the MU.

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suffering from high inflationary bias, receiving *side payments* so as not to pursue expansionary monetary policies. However, this creates an incentive for governments not to undertake the amount of reform required so as get higher subsidies; this disincentive is absent inside the MU because the common central bank is managing the area-wide monetary policy.

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1.5 Appendix

1.5.1 Outside the MU case

The **equilibrium solutions** are as follows:

$$w = \frac{(\beta\gamma + 2a\kappa\gamma + \beta\mu\delta^2 + 2a^2\beta\lambda\gamma + 4a^3\kappa\lambda\gamma + 2a\kappa\mu\delta^2 + a^4\beta\lambda^2\gamma + 2a^5\kappa\lambda^2\gamma + a^2\beta\lambda^2\delta^2 + 2a^3\kappa\lambda^2\delta^2)}{2a^2\gamma + 2a^4\lambda\gamma + 2a^2\mu\delta\varepsilon + 2a^4\lambda^2\delta\varepsilon} \tag{1.18}$$

$$r = \frac{\beta\mu\delta + 2a\kappa\mu\delta + a^2\beta\lambda^2\delta + 2a^3\kappa\lambda^2\delta}{2a\gamma + 2a\mu\delta\varepsilon + 2a^3\lambda\gamma + 2a^3\lambda^2\delta\varepsilon} \tag{1.19}$$

$$\pi = \frac{\beta\lambda\gamma + 2a\kappa\lambda\gamma + a^2\beta\lambda^2\gamma + 2a^3\kappa\lambda^2\gamma}{2\gamma + 2\mu\delta\varepsilon + 2a^2\lambda\gamma + 2a^2\lambda^2\delta\varepsilon} \tag{1.20}$$

$$u = \frac{\beta\gamma + 2a\kappa\gamma + a^2\beta\lambda\gamma + 2a^3\kappa\lambda\gamma}{2a\gamma + 2a\mu\delta\varepsilon + 2a^3\lambda\gamma + 2a^3\lambda^2\delta\varepsilon} \tag{1.21}$$

$$w - \pi = \frac{(\beta\gamma + 2a\kappa\gamma + \beta\mu\delta^2 + a^2\beta\lambda\gamma + 2a^3\kappa\lambda\gamma + 2a\kappa\mu\delta^2 + a^2\beta\lambda^2\delta^2 + 2a^3\kappa\lambda^2\delta^2)}{2a^2\gamma + 2a^4\lambda\gamma + 2a^2\mu\delta\varepsilon + 2a^4\lambda^2\delta\varepsilon} \tag{1.22}$$

1.5.2 Inside the MU: Symmetric case

Stage 1: The Governments' problem

The governments' reaction functions are:

$$r_1 = a\delta\frac{\lambda_{ECB}^2 a^2 w_1 + \lambda_{ECB}^2 a^2 w_2 - \lambda_{ECB}^2 a\delta r_2 + 4\mu w_1 + 4\mu\lambda_{ECB} a^2 w_1}{\lambda_{ECB}^2 a^2\delta^2 + 4\mu\delta^2\lambda_{ECB} a^2 + \mu\delta^2\lambda_{ECB}^2 a^4 + 4\mu\delta^2 + 4\gamma + 8\gamma\lambda_{ECB} a^2 + 4\gamma\lambda_{ECB}^2 a^4}$$

$$+a\delta\frac{\mu\lambda_{ECB}^2a^4w_1-2\mu\lambda_{ECB}a^2w_2-\mu\lambda_{ECB}^2a^4w_2+2\mu\delta\lambda_{ECB}ar_2+\mu\delta\lambda_{ECB}^2a^3r_2}{\lambda_{ECB}^2a^2\delta^2+4\mu\delta^2\lambda_{ECB}a^2+\mu\delta^2\lambda_{ECB}^2a^4+4\mu\delta^2+4\gamma+8\gamma\lambda_{ECB}a^2+4\gamma\lambda_{ECB}^2a^4}$$

$$r_2=a\delta\frac{\lambda_{ECB}^2a^2w_1-\lambda_{ECB}^2a\delta r_1+\lambda_{ECB}^2a^2w_2+4\mu w_2+4\mu\lambda_{ECB}a^2w_2}{\lambda_{ECB}^2a^2\delta^2+4\mu\delta^2\lambda_{ECB}a^2+\mu\delta^2\lambda_{ECB}^2a^4+4\mu\delta^2+4\gamma+8\gamma\lambda_{ECB}a^2+4\gamma\lambda_{ECB}^2a^4}$$

$$+a\delta\frac{+\mu\lambda_{ECB}^2a^4w_2-2\mu\lambda_{ECB}a^2w_1-\mu\lambda_{ECB}^2a^4w_1+2\mu\delta\lambda_{ECB}ar_1+\mu\delta\lambda_{ECB}^2a^3r_1}{\lambda_{ECB}^2a^2\delta^2+4\mu\delta^2\lambda_{ECB}a^2+\mu\delta^2\lambda_{ECB}^2a^4+4\mu\delta^2+4\gamma+8\gamma\lambda_{ECB}a^2+4\gamma\lambda_{ECB}^2a^4}$$

Notice that:

$$\frac{\partial r_1}{\partial w_1}=a\delta\frac{4\mu+4a^2\lambda_{ECB}\mu+a^2\lambda_{ECB}^2+a^4\lambda_{ECB}^2\mu}{4\gamma+4\mu\delta^2+8a^2\lambda_{ECB}\gamma+4a^4\lambda_{ECB}^2\gamma+4a^2\lambda_{ECB}\mu\delta^2+a^2\lambda_{ECB}^2\delta^2+a^4\lambda_{ECB}^2\mu\delta^2}>0 \tag{1.23}$$

$$\frac{\partial r_1}{\partial w_2}=a\delta\frac{a^2\lambda_{ECB}^2-2a^2\lambda_{ECB}\mu-a^4\lambda_{ECB}^2\mu}{4\gamma+4\mu\delta^2+8a^2\lambda_{ECB}\gamma+4a^4\lambda_{ECB}^2\gamma+4a^2\lambda_{ECB}\mu\delta^2+a^2\lambda_{ECB}^2\delta^2+a^4\lambda_{ECB}^2\mu\delta^2}<0 \tag{1.24}$$

in order for $\frac{\partial r_1}{\partial w_2}>0$ we should have $\lambda_{ECB}>\mu(2+a^2\lambda_{ECB})$, but $a^2\lambda_{ECB}>0$ and $\lambda_{ECB}<\mu$ hence $\frac{\partial r_1}{\partial w_2}<0$.

$$\frac{\partial r_1}{\partial r_2}=a\delta\frac{2a\lambda_{ECB}\mu\delta-a\lambda_{ECB}^2\delta+a^3\lambda_{ECB}^2\mu\delta}{4\gamma+4\mu\delta^2+8a^2\lambda_{ECB}\gamma+4a^4\lambda_{ECB}^2\gamma+4a^2\lambda_{ECB}\mu\delta^2+a^2\lambda_{ECB}^2\delta^2+a^4\lambda_{ECB}^2\mu\delta^2}>0 \tag{1.25}$$

$\frac{\partial r_1}{\partial r_2}>0$ because $\mu(2+a^2\lambda_{ECB})>\lambda_{ECB}$. Respectively for the reaction function of the second government.

Stage 1: The Labor Unions' problem

The labor unions' reaction functions are:

$$w_1=\frac{\beta+3\lambda_{ECB}a^2+\lambda_{ECB}a^3\delta r_1+\lambda_{ECB}a^4w_2-\lambda_{ECB}a^3\delta r_2+2a\delta r_1+2a\kappa+2\kappa\lambda_{ECB}a^3-2a\varepsilon r_1-2\varepsilon r_1\lambda_{ECB}a^3}{a^2(2+\lambda_{ECB}a^2)}$$

$$w_2=\frac{\beta+3\lambda a^2+\lambda_{ECB}a^4w_1-\lambda_{ECB}a^3\delta r_1+\lambda_{ECB}a^3\delta r_2+2a\delta r_2+2a\kappa+2\kappa\lambda_{ECB}a^3-2a\varepsilon r_2-2\varepsilon r_2\lambda_{ECB}a^3}{a^2(2+\lambda_{ECB}a^2)}$$

Notice that:

$$\frac{\partial w_1}{\partial r_1}=\frac{\partial w_1}{\partial\kappa}=\frac{2}{a}\frac{a^2\lambda_{ECB}+1}{a^2\lambda_{ECB}+2} \tag{1.26}$$

$$\frac{\partial w_1}{\partial r_2}=\frac{-a\lambda_{ECB}\delta}{a^2\lambda_{ECB}+2} \tag{1.27}$$

$$\frac{\partial w_1}{\partial w_2}=\frac{a^2\lambda_{ECB}}{a^2\lambda_{ECB}+2}>0 \tag{1.28}$$

$$\frac{\partial w_1}{\partial r_1}=\frac{\left(-2a\varepsilon+2a\delta+a^3\lambda_{ECB}\delta-2a^3\lambda_{ECB}\varepsilon\right)}{a^2\left(a^2\lambda_{ECB}+2\right)} \tag{1.29}$$

$$\frac{\partial w_1}{\partial\varepsilon}=\frac{-\left(2ar_1+2a^3\lambda_{ECB}r_1\right)}{a^2\left(a^2\lambda_{ECB}+2\right)} \tag{1.30}$$

The **equilibrium solutions** are:

$$r^{MU} = \frac{\left(2\lambda_{ECB}^2 a^3\kappa + \lambda_{ECB}^2 a^2\beta + 2\mu\kappa\lambda_{ECB}a^3 + \mu\beta\lambda_{ECB}a^2 + 4\mu a\kappa + 2\mu\beta\right)\delta}{2\left(2\gamma\lambda_{ECB}a^2 + 2\gamma + \delta\lambda_{ECB}^2 a^2\varepsilon + \delta\mu\varepsilon\lambda_{ECB}a^2 + 2\delta\mu\varepsilon\right)a} \tag{1.31}$$

$$\begin{aligned} w^{MU} = {} & \frac{4a\kappa\gamma + 2\delta^2\mu\beta + 4\kappa\lambda_{ECB}^2 a^5\gamma + 8\kappa\lambda_{ECB}a^3\gamma + 2\beta\lambda_{ECB}^2 a^4\gamma + 4\beta\lambda_{ECB}a^2\gamma}{2a^2\left(2\gamma\lambda_{ECB}a^2 + 2\gamma + \delta\lambda_{ECB}^2 a^2\varepsilon + \delta\mu\varepsilon\lambda_{ECB}a^2 + 2\delta\mu\varepsilon\right)} \\ & + \frac{2\delta^2\lambda_{ECB}^2 a^3\kappa + \delta^2\lambda_{ECB}^2 a^2\beta + 4\delta^2\mu a\kappa + 2\beta\gamma + 2\delta^2\mu\kappa\lambda_{ECB}a^3 + \delta^2\mu\beta\lambda_{ECB}a^2}{2a^2\left(2\gamma\lambda_{ECB}a^2 + 2\gamma + \delta\lambda_{ECB}^2 a^2\varepsilon + \delta\mu\varepsilon\lambda_{ECB}a^2 + 2\delta\mu\varepsilon\right)} \end{aligned} \tag{1.32}$$

$$\pi^{MU} = \frac{\lambda_{ECB}\gamma\left(\beta + 2a\kappa\right)\left(a^2\lambda_{ECB} + 1\right)}{2\gamma + 2\mu\delta\varepsilon + 2a^2\lambda_{ECB}\gamma + a^2\lambda_{ECB}\mu\delta\varepsilon + a^2\lambda_{ECB}^2\delta\varepsilon} \tag{1.33}$$

$$w^{MU} - \pi^{MU} = \frac{1}{a^2}\frac{\left(\frac{1}{2}\beta + a\kappa\right)\left(2\gamma + 2\mu\delta^2 + 2a^2\lambda_{ECB}\gamma + a^2\lambda_{ECB}\mu\delta^2 + a^2\lambda_{ECB}^2\delta^2\right)}{2\gamma + 2\mu\delta\varepsilon + 2a^2\lambda_{ECB}\gamma + a^2\lambda_{ECB}\mu\delta\varepsilon + a^2\lambda_{ECB}^2\delta\varepsilon} \tag{1.34}$$

$$u^{MU} = \frac{\gamma\left(\beta + 2a\kappa\right)\left(a^2\lambda_{ECB} + 1\right)}{2\gamma + 2\mu\delta\varepsilon + 2a^2\lambda_{ECB}\gamma + a^2\lambda_{ECB}\mu\delta\varepsilon + a^2\lambda_{ECB}^2\delta\varepsilon} \tag{1.35}$$

1.5.3 Numerical solutions: Symmetric case

The numerical solutions presented in this section correspond to section 2.3.2 of the paper[80].

Model 1: $\kappa = 5$, $\delta = 0.268$, $\varepsilon = 0.1$

Case (i):$\lambda<\mu=\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.4644	7.3826	0.04382	5.4786	7.3388	4.8536	0.30207	-6.9482	1.7707
variant 2	1.4507	7.8181	0.48223	5.4799	7.3359	4.8549	3.5358	-6.9453	5.856
variant 3	1.4315	7.8143	0.4824	5.4819	7.3319	4.8569	3.5383	-6.9412	16.283

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.4607	7.3818	0.04383	5.4789	7.3380	4.8539	0.30211	-6.9474	1.7703
variant 2	1.4332	7.8146	0.48239	5.4817	7.3322	4.8567	3.5381	-6.9416	5.8507
variant 3	1.3947	7.8069	0.48273	5.4855	7.3241	4.8605	3.543	-6.9335	16.251

Case (ii):$\lambda<\mu<\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.84644	7.2533	0.044323	5.5404	7.209	4.9154	0.30892	-6.8184	1.2799
variant 2	1.0988	7.7473	0.48533	5.5151	7.262	4.901	3.5814	-6.8714	5.0395
variant 3	1.4315	7.8143	0.4824	5.4819	7.3319	4.8569	3.5383	-6.9412	16.283

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.84445	7.2529	0.044324	5.5406	7.2086	4.9156	0.30894	-6.8180	1.2798
variant 2	1.0893	7.7454	0.48541	5.5161	7.2600	4.8911	3.5826	-6.8694	5.0370
variant 3	0.94107	7.7156	0.48672	5.5309	7.2289	4.9059	3.6019	-6.8382	13.005

[80]The calculations were done in Scientific workplace 5.0 (Maple).

Case (iii):$\lambda<\gamma<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	2.5131	7.602	0.042989	5.3737	7.5591	4.7487	0.29061	-7.1684	2.2759
variant 2	1.9129	7.9111	0.47817	5.4337	7.4330	4.8087	3.4764	-7.0423	6.6826
variant 3	2.1177	7.9523	0.47636	5.4132	7.4760	4.7882	3.4503	-7.0853	19.603

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	2.5068	7.6007	0.042995	5.3743	7.5577	4.7493	0.29068	-7.1671	2.275
variant 2	1.8851	7.9055	0.47841	5.4365	7.4271	4.8115	3.4800	-7.0365	6.673
variant 3	2.0614	7.9410	0.47686	5.4189	7.4641	4.7939	3.4574	-7.0735	19.546

Case (iv):$\gamma<\lambda<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	20.220	11.306	0.02882	3.603	11.277	2.978	0.1306	-10.887	3.4081
variant 2	7.6518	9.0658	0.42766	4.8598	8.6381	4.2348	2.7809	-8.2475	10.196
variant 3	18.609	11.27	0.33121	3.7641	10.939	3.1391	1.6682	-10.549	30.885

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	20.182	11.298	0.02885	3.6068	11.270	2.9818	0.1309	-10.879	3.4034
variant 2	7.5108	9.0374	0.4289	4.8739	8.6085	4.2489	2.797	-8.2179	10.131
variant 3	18.233	11.195	0.33455	3.8017	10.86	3.1767	1.7018	-10.469	30.164

Model 2: $\kappa = 5$, $\delta = 0.268$, $\varepsilon = 1$

Case (i):$\lambda<\mu=\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.1864	5.9812	0.035508	4.4386	5.9457	3.8136	0.19827	-5.555	1.1622
variant 2	1.1774	6.3453	0.39139	4.4476	5.9539	3.8226	2.3291	-5.5633	3.8575
variant 3	1.1617	6.3581	0.39251	4.4603	5.9656	3.8353	2.3424	-5.5749	10.779

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.1840	5.9834	0.035528	4.441	5.9479	3.816	0.19849	-5.5573	1.1631
variant 2	1.1659	6.3569	0.3924	4.4591	5.9645	3.8341	2.3412	-5.5739	3.8715
variant 3	1.1403	6.3826	0.39166	4.4847	5.9879	3.8597	2.3682	-5.5973	10.862

Case (ii):$\lambda<\mu<\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.74548	6.3882	0.039036	4.8795	6.3491	4.2545	0.23962	-5.9585	0.9928
variant 2	0.93452	6.5889	0.41276	4.6905	6.1762	4.0655	2.5904	-5.7855	3.6451
variant 3	0.83535	6.6884	0.42149	4.7897	6.2669	4.1647	2.7011	-5.8763	9.7726

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.74394	6.3896	0.039049	4.8811	6.3505	4.2561	0.23977	-5.9599	0.9932
variant 2	0.92761	6.5959	0.41337	4.6974	6.1825	4.0724	2.5981	-5.7919	3.6528
variant 3	0.81791	6.7059	0.42302	4.8071	6.2829	4.1821	2.7208	-5.8922	9.8236

Case (iii):$\lambda<\gamma<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.7925	5.4217	0.030660	3.8325	5.3911	3.2075	0.14782	-5.0005	1.1576
variant 2	1.4646	6.0572	0.36611	4.1604	5.6911	3.5354	2.0380	-5.3005	3.9175
variant 3	1.5817	5.9398	0.35581	4.0433	5.5840	3.4183	1.9249	-5.933	10.936

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.7892	5.4248	0.030686	3.8358	5.3941	3.2108	0.14808	-5.0035	1.1589
variant 2	1.4483	6.0736	0.36755	4.1767	5.7061	3.5517	2.054	-5.3154	3.9387
variant 3	1.5501	5.9715	0.35859	4.0749	5.6129	3.4499	1.9551	-5.2223	11.053

Case (iv):$\gamma<\lambda<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
SCU2dc1	4.7742	2.6696	0.0680	0.85075	2.6628	0.22575	0.0728	-2.272	0.1900
SCU2dc2	3.4401	4.0758	0.1922	2.1849	3.8835	1.5599	0.5620	-3.492	2.060
SCU2dL1	4.6787	2.8336	0.0832	0.94634	2.7503	0.32134	0.1054	-2.359	1.952

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	4.7722	2.6715	0.0682	0.85284	2.6647	0.22784	0.0731	-2.274	0.1902
variant 2	3.4113	4.1047	0.1948	2.2137	3.9099	1.5887	0.5769	-3.519	2.089
variant 3	4.6545	2.8578	0.0854	0.97052	2.7724	0.34552	0.1109	-2.381	1.985

Model 3: $\kappa = 10$, $\delta = 0.268$, $\varepsilon = 0.1$

Case (i) :$\lambda<\mu=\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	2.7662	13.945	0.082787	10.348	13.862	9.7234	1.0777	-13.472	6.3176
variant 2	2.7402	14.768	0.91089	10.351	13.857	9.7260	12.615	-13.466	20.894
variant 3	2.7039	14.76	0.91121	10.355	13.849	9.7296	12.624	-13.458	58.095

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	2.7591	13.943	0.082793	10.349	13.861	9.7241	1.0779	-13.47	6.3163
variant 2	2.7072	14.761	0.91118	10.354	13.8498	9.7293	12.623	-13.459	20.875
variant 3	2.6344	14.746	0.91182	10.362	13.834	9.7366	12.641	-13.444	57.982

Case (ii):$\lambda<\mu<\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.5988	13.701	0.083721	10.4653	13.617	9.8401	1.1022	-13.2264	4.5667
variant 2	2.0755	14.634	0.91674	10.417	13.717	9.7924	12.778	-13.326	17.98
variant 3	1.8213	14.583	0.91897	10.443	13.664	9.8179	12.84	-13.273	46.456

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.5951	13.700	0.083724	10.4655	13.616	9.8405	1.1023	-13.2254	4.5662
variant 2	2.0575	14.63	0.91689	10.419	13.713	9.7942	12.782	-13.323	17.971
variant 3	1.7776	14.574	0.91936	10.447	13.655	9.8222	12.851	-13.264	46.399

Case (iii):$\lambda<\gamma<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	4.7475	14.359	0.081202	10.1499	14.278	9.5253	1.0369	-13.888	8.1201
variant 2	3.6133	14.943	0.9032	10.264	14.01	9.6387	12.404	-13.649	23.843
variant 3	4.0001	15.021	0.89980	10.225	14.121	9.6000	12.31	-13.731	69.94

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	4.7351	14.357	0.081212	10.1516	14.276	9.5265	1.0371	-13.885	8.1171
variant 2	3.5608	14.933	0.90366	10.269	14.029	9.6439	12.416	-13.638	23.809
variant 3	3.8937	15.000	0.90074	10.236	14.099	9.6106	12.336	-13.708	69.737

Case (iv):$\gamma<\lambda<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	38.193	21.356	0.054446	6.8057	21.302	6.1807	0.46615	-20.911	12.160
variant 2	14.453	17.124	0.80781	9.1797	16.316	8.5547	9.9218	-15.926	36.377
variant 3	35.151	21.289	0.62567	7.1099	20.663	6.4849	5.952	-20.272	110.19

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	38.122	21.341	0.054502	6.8128	21.287	6.1878	0.46711	-20.896	12.143
variant 2	14.187	17.071	0.81015	9.2063	16.261	8.5813	9.9795	-15.870	36.147
variant 3	34.439	21.145	0.63193	7.1811	20.514	6.5561	6.0718	-20.123	108.69

Model 4: $\kappa = 10$, $\delta = 0.268$, $\varepsilon = 1$

Case (i):$\lambda<\mu=\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	2.2411	11.298	0.067072	8.3839	11.231	7.7589	0.7074	-10.840	4.146
variant 2	2.2240	11.986	0.73929	8.401	11.246	7.776	8.31	-10.856	13.763
variant 3	2.2000	12.010	0.7414	8.425	11.268	7.8	8.3576	-10.878	38.46

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	2.2364	11.302	0.067108	8.3886	11.235	7.7636	0.70818	-10.841	4.149
variant 2	2.2022	12.007	0.74121	8.4228	11.266	7.7978	8.3532	-10.876	13.813
variant 3	2.1538	12.056	0.74546	8.4712	11.311	7.8462	8.4494	-10.920	38.756

Case (ii):$\lambda<\mu<\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.4081	12.067	0.073735	9.2169	11.993	8.5919	0.85494	-11.602	3.5423
variant 2	1.7652	12.446	0.77966	8.8598	11.666	8.2348	9.2424	-11.275	13.005
variant 3	1.5779	12.634	0.79615	9.0471	11.837	8.4221	9.6374	-11.447	34.868

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	1.4052	12.069	0.073758	9.2198	11.995	8.5948	0.85549	-11.605	3.5438
variant 2	1.7522	12.459	0.78081	8.8728	11.678	8.2478	9.2697	-11.287	13.033
variant 3	1.5449	12.667	0.79901	9.0801	11.868	8.4551	9.7077	-11.477	35.050

Case (iii):$\lambda<\gamma<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	3.3859	10.241	0.057913	7.2391	10.183	6.6141	0.5274	-9.7925	4.1303
variant 2	2.7665	11.441	0.69154	7.8585	10.750	7.2335	7.2713	-10.359	13.977
variant 3	2.9877	11.220	0.67208	7.6373	10.547	7.0123	6.8678	-10.157	39.019

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	3.3796	10.247	0.05796	7.2454	10.189	6.6204	0.52832	-9.7983	4.1350
variant 2	2.7357	11.472	0.69426	7.8893	10.778	7.2643	7.3285	-10.387	14.053
variant 3	2.9280	11.279	0.67734	7.697	10.602	7.072	6.9756	-10.212	39.434

Case (iv):$\gamma<\lambda<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	9.018	5.0426	0.01285	1.6070	5.0298	0.98197	0.025989	-1.6391	0.6779
variant 2	6.498	7.6988	0.36318	4.1270	7.3356	3.5020	2.0054	-6.9450	7.3527
variant 3	8.8375	5.3523	0.1573	1.7875	5.1950	1.1625	0.37623	-1.8043	6.9653

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	9.0141	5.0463	0.01288	1.6109	5.0334	0.98592	0.026117	-1.6427	0.6789
variant 2	6.4436	7.7533	0.36796	4.1814	7.3853	3.5564	2.0586	-6.9947	7.4566
variant 3	8.7918	5.3981	0.16132	1.8332	5.2368	1.2082	0.39569	-1.8461	7.0834

Model 5: $\kappa = 5$, $\delta = 0.033$, $\varepsilon = 0.1$

Case (i):$\lambda<\mu=\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.18453	7.0606	0.044852	5.6065	7.0157	4.9815	0.31631	-6.62517	1.73269
variant 2	0.18276	7.5093	0.49339	5.6067	7.0159	4.9817	3.7013	-6.6253	5.7505
variant 3	0.18028	7.5096	0.49341	5.6070	7.0162	4.9820	3.7017	-6.6255	15.979

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.18405	7.0607	0.044853	5.6066	7.0158	4.9816	0.31635	-6.62525	1.73274
variant 2	0.18051	7.5095	0.49341	5.6069	7.0161	4.9819	3.7016	-6.6255	5.7508
variant 3	0.17555	7.51	0.49346	5.6074	7.0165	4.9824	3.7023	-6.6259	15.981

Case (ii):$\lambda<\mu<\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.10562	7.06729	0.04491	5.61443	7.0223	4.9894	0.317236	-6.6317	1.263671
variant 2	0.13766	7.5135	0.49379	5.6112	7.0197	4.9862	3.7073	-6.6291	4.9705
variant 3	0.12054	7.5151	0.49394	5.6129	7.0212	4.9879	3.7095	-6.6305	12.855

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.10537	7.06730	0.04491	5.61444	7.0224	4.9895	0.317237	-6.6318	1.263675
variant 2	0.13645	7.5136	0.49380	5.6114	7.0198	4.9864	3.7074	-6.6292	4.9707
variant 3	0.1176	7.5154	0.49397	5.6132	7.0214	4.9882	3.7099	-6.6308	12.856

Case (iii):$\lambda<\gamma<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.3221	7.049	0.044742	5.5928	7.0042	4.9678	0.31479	-6.6136	2.19569
variant 2	0.24278	7.5038	0.49286	5.6007	7.0109	4.9757	3.6934	-6.6203	6.5251
variant 3	0.26966	7.5013	0.49263	5.598	7.0087	4.973	3.6899	-6.618	19.075

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.32123	7.0491	0.044743	5.5929	7.0043	4.9679	0.3148	-6.6137	2.19575
variant 2	0.23915	7.5041	0.49290	5.6011	7.0112	4.9761	3.6939	-6.6206	6.5260
variant 3	0.26225	7.5020	0.49269	5.5988	7.0093	4.9738	3.6908	-6.6187	19.078

Case (iv):$\gamma<\lambda<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	3.6357	6.7689	0.042091	5.2614	6.7268	4.6364	0.27860	-6.3361	2.9745
variant 2	1.0698	7.4272	0.48559	5.518	6.9417	4.893	3.5851	-6.551	9.4276
variant 3	3.2278	7.2275	0.46660	5.3022	6.7609	4.6772	3.3102	-6.3703	27.446

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	3.6259	6.7697	0.042099	5.2624	6.7276	4.6374	0.2787	-6.3370	2.9753
variant 2	1.0475	7.4293	0.48578	5.5203	6.9435	4.8953	3.588	-6.5529	9.4328
variant 3	3.1365	7.2360	0.46740	5.3113	6.7686	4.6863	3.3216	-6.3779	27.51

Model 6: $\kappa = 5$, $\delta = 0.033$, $\varepsilon = 1$

Case (i):$\lambda<\mu=\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.17921	6.8582	0.043566	5.4458	6.8146	4.8208	0.29846	-6.4240	1.6348
variant 2	0.17757	7.2960	0.47937	5.4474	6.8166	4.8221	3.4940	-6.4260	5.4284
variant 3	0.17523	7.299	0.47958	5.4498	6.8194	4.8248	3.4970	-6.4288	15.095

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.17879	6.8587	0.043570	5.4462	6.8151	4.8212	0.29851	-6.4215	1.635
variant 2	0.17544	7.2987	0.47956	5.4496	6.8192	4.8246	3.4967	-6.4286	5.4325
variant 3	0.17076	7.3048	0.47997	5.4542	6.8248	4.8292	3.5027	-6.4312	15.119

Case (ii):$\lambda<\mu<\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.10386	6.9499	0.044169	5.5211	6.9057	4.8961	0.30678	-6.5151	1.22203
variant 2	0.13469	7.3516	0.48315	5.4903	6.8684	4.8653	3.5492	-6.4778	4.7586
variant 3	0.11826	7.3729	0.48459	5.5067	6.888	4.8817	3.5705	-6.4977	12.373

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.10362	6.9502	0.044171	5.5214	6.9060	4.8964	0.30681	-6.5154	1.22213
variant 2	0.13353	7.3531	0.483 25	5.4915	6.8698	4.8665	3.5507	-6.4792	4.7605
variant 3	0.11543	7.3766	0.484 84	5.5096	6.8917	4.8846	3.5742	-6.5011	12.385

Case (iii):$\lambda<\gamma<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.30632	6.7035	0.042549	5.3187	6.6610	4.6937	0.28469	-6.2701	1.9858
variant 2	0.23371	7.2232	0.47443	5.3913	6.7488	4.7663	3.4221	-6.3581	6.0465
variant 3	0.258 51	7.191	0.47225	5.3665	6.7188	4.7415	3.3909	-6.3282	17.529

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.305 53	6.7045	0.042556	5.3195	6.6619	4.6945	0.28478	-6.2713	1.9863
variant 2	0.23034	7.2276	0.47473	5.3947	6.7528	4.7697	3.4266	-6.3622	6.0538
variant 3	0.25169	7.1999	0.47285	5.3733	6.727	4.7483	3.3996	-6.3361	17.572

Case (iv):$\gamma<\lambda<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	2.2986	4.2795	0.026611	3.3264	4.2528	2.7014	0.11136	-3.8622	1.1890
variant 2	0.91346	6.3417	0.41462	4.7115	5.9271	4.0865	2.6138	-5.5365	6.8732
variant 3	2.1285	4.7661	0.30769	3.4965	4.4584	2.8715	1.4395	-4.0678	11.935

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	2.2947	4.2842	0.026643	3.3303	4.2576	2.7053	0.11162	-3.8670	1.1916
variant 2	0.89713	6.3629	0.41605	4.7279	5.9468	4.1029	2.6319	-5.5562	6.9192
variant 3	2.0885	4.818	0.31122	3.5365	4.5068	2.9115	1.4726	-4.1162	12.197

Model 7: $\kappa = 10$, $\delta = 0.033$, $\varepsilon = 0.1$

Case (i):$\lambda<\mu=\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.34857	13.3369	0.084721	10.5902	13.2521	9.9651	1.12871	-12.8614	6.1822
variant 2	0.34522	14.184	0.93196	10.5902	13.252	9.9655	13.206	-12.8617	20.517
variant 3	0.34054	14.185	0.932	10.591	13.253	9.9659	13.07	-12.862	57.012

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.34766	13.337	0.084722	10.5903	13.2522	9.9652	1.12873	-12.8615	6.1823
variant 2	0.34096	14.185	0.93200	10.5911	13.253	9.9659	13.207	-12.8620	20.519
variant 3	0.33160	14.186	0.93208	10.592	13.2539	9.9668	13.209	-12.863	57.021

Case (ii):$\lambda<\mu<\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.1995	13.3489	0.08484	10.6046	13.2640	9.98	1.1317	-12.8739	4.5083
variant 2	0.26002	14.1917	0.93271	10.5986	13.259	9.9740	13.227	-12.8688	17.734
variant 3	0.22769	14.195	0.93300	10.602	13.262	9.9772	13.235	-12.8716	45.865

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.19903	13.349	0.084841	10.6047	13.2641	9.9801	1.1318	-12.874	4.5084
variant 2	0.25773	14.1927	0.93273	10.5989	13.260	9.9742	13.228	-12.869	17.735
variant 3	0.2224	14.196	0.9335	10.603	13.263	9.9778	13.237	-12.872	45.868

Case (iii):$\lambda<\gamma<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.60842	13.3151	0.084513	10.5643	13.2305	9.9392	1.12320	-12.8397	7.8343
variant 2	0.45859	14.1741	0.93096	10.5793	13.24314	9.9541	13.1782	-12.8522	23.282
variant 3	0.50936	14.169	0.93052	10.574	13.239	9.9491	13.165	-12.848	68.056

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.60676	13.3152	0.084515	10.5645	13.2306	9.9393	1.12323	-12.8398	7.8345
variant 2	0.45173	14.1742	0.93102	10.5796	13.24318	9.9548	13.1789	-12.8528	23.283
variant 3	0.49537	14.17	0.93064	10.575	13.240	9.9505	13.169	-12.849	68.069

Case (iv):$\gamma<\lambda<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	6.8674	12.786	0.079506	9.9383	12.706	9.3133	0.99401	-12.315	10.613
variant 2	2.0208	14.029	0.91722	10.423	13.112	9.7979	12.791	-12.721	33.637
variant 3	6.097	13.652	0.88135	10.015	12.771	9.3903	11.81	-12.38	97.926

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	6.8489	12.787	0.079521	9.9401	12.708	9.3151	0.99438	-12.317	10.615
variant 2	1.9786	14.033	0.91759	10.427	13.116	9.8021	12.802	-12.725	33.655
variant 3	5.9246	13.668	0.88286	10.033	12.785	9.4075	11.851	-12.394	98.151

Model 8: $\kappa = 10$, $\delta = 0.033$, $\varepsilon = 1$

Case (i):$\lambda<\mu=\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.3385	12.954	0.0822	10.286	12.872	9.661	1.0649	-12.481	5.8327
variant 2	0.3354	13.781	0.9054	10.290	12.876	9.664	12.466	-12.485	19.368
variant 3	0.3309	13.787	0.9058	10.294	12.881	9.669	12.477	-12.491	53.859

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.33771	12.955	0.082298	10.287	12.873	9.6623	1.0651	-12.482	5.8336
variant 2	0.33139	13.787	0.90584	10.294	12.881	9.6686	12.476	-12.49	19.382
variant 3	0.32254	13.798	0.90662	10.302	12.891	9.6775	12.497	-12.501	53.914

Case (ii) :$\lambda<\mu<\gamma$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.19619	13.1274	0.08343	10.4287	13.044	9.8038	1.0946	-12.653	4.3601
variant 2	0.25442	13.886	0.91261	10.371	12.974	9.7456	12.663	-12.583	16.978
variant 3	0.22338	13.927	0.91534	10.402	13.011	9.7766	12.739	-12.621	44.145

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.19573	13.1284	0.083434	10.4295	13.045	9.8043	1.0917	-12.654	4.3604
variant 2	0.25222	13.889	0.9128	10.373	12.976	9.7478	12.669	-12.586	16.985
variant 3	0.21804	13.934	0.91581	10.407	13.018	9.7820	12.752	-12.627	44.189

Case (iii) :$\lambda<\gamma<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.57860	12.662	0.080371	10.046	12.582	9.4214	1.0158	-12.191	7.0850
variant 2	0.44145	13.644	0.89615	10.184	12.748	9.5586	12.211	-12.357	21.573
variant 3	0.48829	13.583	0.89203	10.137	12.691	9.5117	12.099	-12.3	62.543

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	0.5771	12.664	0.080383	10.048	12.584	9.4229	1.0161	-12.193	7.0870
variant 2	0.43509	13.652	0.89671	10.190	12.755	9.5649	12.226	-12.365	21.599
variant 3	0.47542	13.600	0.89316	10.150	12.707	9.5246	12.129	-12.316	62.697

Case (iv) :$\gamma<\lambda<\mu$

Inside MU	r	w	π	u	w-π	v	B	L	G
variant 1	4.3418	8.0834	0.050266	6.2832	8.0331	5.6582	0.39732	-7.6425	4.2421
variant 2	1.7254	11.979	0.78316	8.8996	11.196	8.2746	9.3256	-10.805	24.523
variant 3	4.0206	9.0026	0.58119	6.6044	8.4214	5.9794	5.1358	-8.0308	42.584

Outside MU	r	w	π	u	w-π	v	B	L	G
variant 1	4.3343	8.0924	0.050325	6.2907	8.0421	5.6657	0.39826	-7.6515	4.2516
variant 2	1.6946	12.019	0.78588	8.9304	11.233	8.3054	9.3904	-10.842	24.687
variant 3	3.9449	9.1007	0.58785	6.6801	8.5129	6.0551	5.2542	-8.1223	43.517

1.5.4 Asymmetric Case

Numerical solutions when $\delta = 0.268$

The numerical solutions displayed in the current section correspond to sections 2.3.3.1, 2.3.4.1, and 2.3.5.1 of the paper.

Case 1: Distorted (M3C1v2) versus Less Distorted (M2C3v2) M3c1v2 corresponds to model 3, case 1, variant 2 and refers to the model specification in the previous section[81]. Similarly for the cases presented below. In this case, both governments have the same inflation aversion parameter. While the government in country one attaches the same weight to costs from reform and unemployment; moreover it attaches bigger weight on reform than country two, the opposite holds for unemployment. More specifically we have γ_1=0.175, γ_2=0.15, μ_1=0.175, μ_2=0.2.

In the tables below L-C stands for cooperation of the two labor unions inside the MU, G-C stands for cooperation among the two governments inside the MU, Nash-MU means non-cooperative Nash play inside the MU, finally pre-MU stands for the outside the MU outcomes.

C1	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	2.7234	1.4795	2.1015	14.491	6.3155	10.4032	10.35259	4.14555	7.24907
G-C	2.7217	1.4354	2.0785	14.493	6.3577	10.425	10.35308	4.18957	7.27133
Nash-MU	2.7233	1.4795	2.1014	14.49	6.3155	10.4027	10.35184	4.14558	7.24871
pre-MU	2.7072	1.4183	2.0778	14.761	6.0736	10.417	10.35432	4.17669	7.26551

C1	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.85308	5.67758	9.76533	0.63792			9.72766	3.5205
G-C	13.85313	5.71783	9.78548	0.63987			9.72783	3.5646
Nash-MU	13.85211	5.67761	9.76486	0.63789			9.72767	3.5205
pre-MU	13.84982	5.70605	9.77793	0.63937	0.91118	0.36755	9.72928	3.5517

C1	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.18734			-13.462539	-5.286882	20.46073	4.172410
G-C	6.22538			-13.462181	-5.327233	20.46339	4.229000
Nash-MU	6.18672			-13.462517	-5.286882	20.45788	4.172411
pre-MU	7.33879	12.623	2.054	-13.459137	-5.315430	20.87492	3.938686

[81] The numerical solutions for the asymmetric cases where evaluated up to the sixth decimal point. The calculations were done in Scientific Workplace 5.0 (Maple) and Excel (when more precision was required). Small differences between the pre-MU values in this section and those of the symmetric case are attributed to the rounding up done in Maple (SWP 5.0). This, of course, does not affect the comparisons of the different model specifications in each section.

Case 2: Distorted (M3c1v2) versus Less Distorted (M2c4v2) Both governments have the same inflation aversion parameter. While the government in country one attaches the same weight to costs from reform and unemployment, as well as, it attaches bigger weight on reform than country two, the opposite holds for unemployment. Country two in this case attaches a very small weight on political costs of reform, i.e. we have γ_2=0.05, μ_2=0.3 and $\gamma_1 = 0.175$ and $\mu_1 = 0.175$.

C2	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	2.7181	3.471	3.09455	14.402	4.4056	9.4038	10.35289	2.15399	6.25344
G-C	2.7194	3.394	3.0567	14.406	4.4794	9.4427	10.35304	2.23096	6.29200
Nash-MU	2.7179	3.4709	3.0944	14.402	4.4057	9.4039	10.35294	2.15410	6.25352
pre-MU	2.7072	3.4113	3.0593	14.761	4.1047	9.4329	10.35432	2.21369	6.28400

C2	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.8516	3.8552	8.8534	0.55032			9.72819	1.529
G-C	13.8523	3.9257	8.889	0.55370			9.72806	1.606
Nash-MU	13.8516	3.8553	8.8535	0.55032			9.72821	1.5291
pre-MU	13.8498	3.9099	8.8798	0.55299	0.91118	0.1948	9.72928	1.5887

C2	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	4.60446			-13.461425	-3.46466	20.352683	2.297153
G-C	4.66140			-13.461699	-3.53511	20.358186	2.375710
Nash-MU	4.60457			-13.461383	-3.46475	20.352687	2.297257
pre-MU	6.60028	12.623	0.576	-13.459137	-3.51928	20.874925	2.089924

Case 3: Distorted (M3c1v3) versus Less Distorted (M2c3v3) Both governments have the same inflation aversion parameter, though now they case less about inflation (inflation-prone). The government in country one attaches the same weight to costs from reform and unemployment, as well as it attaches bigger weight on reform than country two, the opposite holds for unemployment, i.e. we have γ_2=0.4, μ_2=0.6, γ_1=0.5, μ_1=0.5.

C3	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	2.6979	1.5872	2.14255	14.481	6.2122	10.346	10.3551	4.03775	7.1964
G-C	2.6693	1.5178	2.0935	14.478	6.2790	10.379	10.3578	4.10725	7.2325
Nash-MU	2.6979	1.5873	2.1426	14.481	6.2121	10.347	10.3551	4.03765	7.1963
pre-MU	2.6344	1.5501	2.0923	14.746	5.9715	10.359	10.3613	4.07490	7.2181

C3	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.8477	5.5789	9.71331	0.63329			9.73021	3.4128
G-C	13.8415	5.6425	9.74203	0.63647			9.73307	3.4822
Nash-MU	13.8477	5.5788	9.71326	0.63329			9.73021	3.4127
pre-MU	13.8341	5.6129	9.72354	0.63521	0.91182	0.35859	9.73656	3.4499

C3	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.097825			-13.457183	-5.188336	57.6547	11.1908
G-C	6.159173			-13.451177	-5.251837	57.6102	11.4483
Nash-MU	6.097741			-13.457183	-5.188245	57.6547	11.1901
pre-MU	7.297904	12.640	1.955	-13.443848	-5.222283	57.9799	11.0526

Case 4: Distorted (M3c1v3) versus Less Distorted (M2c4v3) Both governments have the same inflation aversion parameter, though they case less about inflation (inflation-prone). The government in country one attaches the same weight to costs from reform and unemployment, as well as it attaches bigger weight on reform than country two, the opposite holds for unemployment. In addition country two attaches a very small weight on political costs of reform, i.e. we have γ_2=0.05, μ_2=0.95, γ_1=0.5, μ_1=0.5.

C4	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	2.695	4.694	3.6945	14.341	3.2328	8.7884	10.35566	0.93096	5.64331
G-C	2.6885	4.5589	3.6237	14.348	3.3621	8.8554	10.35581	1.06607	5.7109
Nash-MU	2.695	4.6939	3.6945	14.344	3.2330	8.7885	10.35564	0.93113	5.64339
pre-MU	2.6344	4.6545	3.6445	14.746	2.8578	8.8019	10.36132	0.97050	5.66591

C4	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.8474	2.7362	8.2918	0.4966			9.7305	0.306
G-C	13.81542	2.85982	8.35262	0.50258			9.73115	0.4111
Nash-MU	13.84738	2.73638	8.29188	0.49662			9.7305	0.3061
pre-MU	13.83418	2.772394	8.303287	0.49861	0.91182	8.5406×10^{-2}	9.73656	0.3455

C4	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	3.749780			-13.456574	-2.345614	57.4979	2.1716
G-C	3.840224			-13.455209	-2.469231	57.4880	2.3714
Nash-MU	3.749896			-13.456574	-2.345706	57.4978	2.1719
pre-MU	6.375796	12.640	0.110	-13.443848	-2.381757	57.9799	1.9853

Case 5: Distorted (M3c2v2) versus Less Distorted (M2c3v2) Both governments have the same inflation aversion parameter. The government in country one attaches more weight on

reform than unemployment, the opposite in country two, i.e. we have γ_1=0.2, γ_2=0.15, μ_1=0.15, μ_2=0.2.

C5	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	2.0606	1.4796	1.7701	14.355	6.3182	10.336	10.419095	4.14536	7.282229
G-C	2.0593	1.4465	1.7529	14.356	6.3500	10.353	10.419075	4.17850	7.298791
Nash-MU	2.0606	1.4796	1.7701	14.355	6.3182	10.336	10.419087	4.14535	7.282221
pre-MU	2.0575	1.4483	1.7529	14.63	6.0736	10.352	10.419078	4.17669	7.297887

C5	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.71417	5.67737	9.69577	0.64083			9.79394	3.5204
G-C	13.71371	5.70771	9.71071	0.64229			9.79407	3.5535
Nash-MU	13.71416	5.67736	9.69576	0.64084			9.79394	3.5204
pre-MU	13.71311	5.70605	9.70958	0.64222	0.91689	0.36755	9.79425	3.5517

C5	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.2440			-13.323350	-5.286790	17.5435	4.1758527
G-C	6.2724			-13.323078	-5.317077	17.5442	4.2183732
Nash-MU	6.2440			-13.323350	-5.286790	17.5434	4.1758522
pre-MU	7.4179	12.781	2.0540	-13.322699	-5.315430	17.9709	3.9386861

Case 6: Distorted (M3c2v3) versus Less Distorted (M2c3v3) Both governments have the same inflation aversion parameter. The government in country one attaches more weight on reform than unemployment. The opposite in country two, where the government cares little about the political cost of reform, i.e. we have γ_1=0.2, γ_2=0.05, μ_1=0.15, μ_2=0.3.

C6	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	2.0559	3.4712	2.76355	14.266	4.4083	9.33715	10.41924	2.15378	2.15378
G-C	2.0574	3.4116	2.7345	14.269	4.4655	9.3673	10.41914	2.21341	6.31628
Nash-MU	2.0558	3.4712	2.7635	14.266	4.4083	9.3315	10.41926	2.15378	6.28652
pre-MU	2.0575	3.4113	2.7344	14.63	4.1047	9.364	10.41907	2.21369	6.31638

C6	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.71278	3.8550	8.78393	0.55322			9.79441	1.5288
G-C	13.71316	3.9096	8.81141	0.5558			9.79426	1.5884
Nash-MU	13.71278	3.8550	8.78393	0.5532			9.79442	1.5288
pre-MU	13.71311	3.9099	8.811505	0.5558	0.91689	0.1948	9.79425	1.5887

C6	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	4.65327			-13.322363	-3.464477	17.4354	2.3001
G-C	4.69745			-13.322678	-3.519011	17.4393	2.3606
Nash-MU	4.65329			-13.322342	-3.464477	17.4354	2.3001
pre-MU	6.67948	12.781	0.576	-13.322699	-3.519285	17.9709	2.0899

Case 7: Distorted (M3c2v3) versus Less Distorted (M2c4v3) Both governments have the same inflation aversion parameter, though they care less about inflation than before (inflation-prone). The government in country one attaches more weight on reform than unemployment, the opposite in country two γ_1=0.6, γ_2=0.4, μ_1=0.4, μ_2=0.6.

C7	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	1.8162	1.5873	1.70175	14.3	6.216	10.258	10.44352	4.03766	7.24059
G-C	1.7924	1.5338	1.6631	14.297	6.2675	10.282	10.44553	4.09123	7.26838
Nash-MU	1.8161	1.5873	1.7017	14.300	6.216	10.258	10.44354	4.03765	7.24060
pre-MU	1.7776	1.5501	1.6639	14.574	5.9715	10.273	10.44731	4.07490	7.26110

C7	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.66283	5.57883	9.62083	0.63717			9.81838	3.4127
G-C	13.65737	5.62787	9.64262	0.639 63			9.82076	3.4662
Nash-MU	13.66282	5.57882	9.62082	0.637 18			9.81839	3.4127
pre-MU	13.65464	5.61291	9.633775	0.638 98	0.919 36	0.358 59	9.82224	3.4499

C7	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.17286			-13.272026	-5.188245	46.01199	11.19544
G-C	6.22036			-13.267028	-5.237197	45.98040	11.39307
Nash-MU	6.17289			-13.272005	-5.188245	46.01195	11.19542
pre-MU	7.40322	12.851	1.955	-13.263920	-5.222283	46.39969	11.05260

Case 8: Distorted (M3c2v3) versus Less Distorted (M2c4v3) Both governments have the same inflation aversion parameter, though they care less about inflation (inflation-prone). The government in country one attaches more weight on reform than unemployment, the opposite in country two where the government care little about reform, i.e.γ_1=0.6, γ_2=0.05, μ_1=0.4, μ_2=0.95.

C8	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	1.8138	4.6942	3.251	14.163	3.2366	8.6998	10.44392	0.930	5.6873
G-C	1.8087	4.588	3.1988	14.166	3.337	8.751	10.44396	1.036	5.7400
Nash-MU	1.8137	4.691	3.2539	14.162	3.236	8.699	10.44315	0.931	5.6871
pre-MU	1.7776	4.654	3.2161	14.574	2.857	8.715	10.44732	0.970	5.7089

C8	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.66252	2.73612	8.19932	0.50048			9.81862	0.3058
G-C	13.66087	2.83247	8.24667	0.505 13			9.81913	0.4112
Nash-MU	13.66153	2.73633	8.19893	0.500 47			9.81863	0.306
pre-MU	13.65464	2.772394	8.21351	0.502 38	0.919 36	0.08540 6	9.82224	0.3455

C8	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	3.8085			-13.271522	-2.3454	45.854	2.1754
G-C	3.8794			-13.270451	-2.4418	45.848	2.3279
Nash-MU	3.8082			-13.271501	-2.3456	45.847	2.1757
pre-MU	6.4811	12.851	0.110	-13.263920	-2.3817	46.399	1.9853

Case 9: Distorted and $\pi-$prone (M3c1v3) versus Less Distorted and $\pi-$averse (M2c3v2) The government in country one is inflation-prone while that in country two inflation averse. Moreover, the government in country one cares more both about reform and unemployment (attaches the same weight on r and u), i.e. γ_1=0.5, γ_2=0.15, μ_1=0.5, μ_2=0.2.

C9	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	2.698	1.4795	2.08875	14.486	6.3156	10.4008	10.35531	4.1455	7.2504
G-C	2.697 2	1.289 1	1.993 1	14.494	6.498 1	10.496	10.35522	4.3358	7.3455
Nash-MU	2.698	1.479 5	2.0888	14.486	6.315 5	10.401	10.35530	4.1454	7.2503
pre-MU	2.6314	1.4183	2.0114	14.746	6.073 6	10.410	10.36132	4.1766	7.2690

C9	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.84797	5.67757	9.76277	0.63803			9.7302	3.5205
G-C	13.84759	5.85169	9.84964	0.646 41			9.73028	3.7109
Nash-MU	13.84796	5.67746	9.76271	0.638 04			9.7302	3.5205
pre-MU	13.83418	5.70605	9.770115	0.639 69	0.911 82	0.367 55	9.73656	3.5517

C9	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.1896			-13.457204	-5.286882	57.6629	4.1725
G-C	6.3531			-13.457037	-5.461098	57.6706	4.4270
Nash-MU	6.1895			-13.457204	-5.286882	57.6628	4.1724
pre-MU	7.3473	12.640	2.051	-13.443848	-5.315430	57.9799	3.9386

Case 10: Distorted and $\pi-$prone (M3c1v3) versus Less Distorted and $\pi-$averse (M2c4v2) The government in country one is inflation-prone while that in country two inflation averse. Moreover, the government in country one cares more both about reform and unemployment (attaches the same weight in r and u), in addition the government in country two attaches

minimum weight on political costs from reform i.e. γ_1=0.5, γ_2=0.05, μ_1=0.5, μ_2=0.3

C10	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	2.6961	3.471	3.0836	14.398	4.4057	9.4019	10.35551	2.1540	6.25476
G-C	2.6958	3.1636	2.9297	14.411	4.7005	9.5559	10.35517	2.4614	6.40828
Nash-MU	2.6961	3.471	3.0836	14.398	4.4057	9.4019	10.35550	2.1539	6.25475
pre-MU	2.6344	3.4113	3.0229	14.746	4.1047	9.4254	10.36132	2.2136	6.28750

C10	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.81759	3.85529	8.85144	0.55041			9.73039	1.529
G-C	13.81706	4.13656	8.99181	0.56394			9.73042	1.8364
Nash-MU	13.81758	3.85528	8.85143	0.55042			9.73039	1.529
pre-MU	13.83418	3.9099	8.87204	0.55331	0.91182	0.1918	9.73656	1.5887

C10	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	4.60637			-13.456805	-3.46466	57.55579	2.2972631
G-C	4.83530			-13.456742	-3.745931	57.56650	2.6359982
Nash-MU	4.60637			-13.456805	-3.46466	57.55572	2.2972638
pre-MU	6.60884	12.640	0.576	-13.443848	-3.519285	57.97997	2.0899245

Case 11: Distorted and π−prone (M3c2v3) versus Less Distorted and π−averse (M2c3v2) The government in country one is inflation-prone while that in country two inflation averse. Moreover, the government in country one cares more both about reform and unemployment, though it attaches more weight to reform than unemployment: γ_1=0.6, γ_2=0.15, μ_1=0.4, μ_2=0.2.

C11	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	1.8163	1.4797	1.648	14.305	6.3192	10.3121	10.4137	4.145280	7.2941
G-C	1.8157	1.333	1.5744	14.311	6.4599	10.385	10.4135	4.291988	7.3677
Nash-MU	1.8163	1.4797	1.648	14.301	6.3192	10.312	10.4129	4.145288	7.2941
pre-MU	1.7776	1.4483	1.6130	14.571	6.0736	10.321	10.4173	4.176695	7.3120

C11	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.6631	5.6773	9.6702	0.6119			9.81837	3.5203
G-C	13.6626	5.8115	9.7370	0.64836			9.81843	3.667
Nash-MU	13.6621	5.6773	9.6697	0.64189			9.81837	3.5203
pre-MU	13.6546	5.7060	9.6803	0.64346	0.91936	0.36755	9.82224	3.5517

C11	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.265			-13.272047	-5.286699	46.019	4.1771323
G-C	6.391			-13.271921	-5.42093	46.025	4.3711362
Nash-MU	6.264			-13.272047	-5.286699	46.013	4.1771327
pre-MU	7.452	12.851	2.054	-13.263920	-5.315430	46.399	3.9386861

Case 12: Distorted and $\pi-$prone (M3c2v3) versus Less Distorted and $\pi-$averse (M2c4v2) The government in country one is inflation-prone while that in country two inflation averse. Moreover, the government in country one cares more both about reform and unemployment, though it attaches more weight to reform than unemployment. Furthermore, the government of country two cares little about the political cost of reform, i.e. γ_1=0.6, γ_2=0.05, μ_1=0.4, μ_2=0.3.

C12	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	1.8147	3.4713	2.643	14.217	4.4093	9.3131	10.4438	2.15370	6.2987
G-C	1.8147	3.2328	2.5238	14.227	4.638	9.4326	10.4431	2.39219	6.4178
Nash-MU	1.8147	3.4713	2.643	14.216	4.4093	9.3127	10.4430	2.15372	6.2983
pre-MU	1.7776	3.4113	2.5945	14.574	4.1047	9.3394	10.4473	2.21369	6.3305

C12	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.6627	3.85502	8.75887	0.55428			9.81853	1.5287
G-C	13.6622	4.07323	8.86773	0.56477			9.81853	1.7672
Nash-MU	13.6617	3.85504	8.75839	0.55426			9.81853	1.5287
pre-MU	13.6546	3.9099	8.78227	0.55708	0.91936	0.1948	9.82224	1.5887

C12	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	4.671			-13.271711	-3.464385	45.9125	2.301259
G-C	4.849			-13.271711	-3.682613	45.9210	2.558292
Nash-MU	4.670			-13.271711	-3.464385	45.9060	2.301257
pre-MU	6.714	12.851	0.576	-13.263920	-3.519285	46.3996	2.089924

Numerical solutions when $\delta = 0.033$

The numerical solutions displayed in the current section correspond to sections 2.3.3.2, 2.3.4.2 and 2.3.5.2 of the main paper.

C1: Distorted (M7c1v2) versus Less Distorted (M6c3v2) The preference parameter values for the governments in country 1 and 2 are : $\gamma_1 = 0.175$, $\gamma_2 = 0.15$, $\mu_1 = 0.175$, $\mu_2 = 0.2$.

C1	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.34345	0.23569	0.28957	13.956	7.4495	10.7027	10.591	5.3893	7.990
G-C	0.34222	0.22893	0.28557	13.956	7.4579	10.7069	10.5907	5.3960	7.993
Nash-MU	0.34345	0.23569	0.28957	13.955	7.4494	10.7022	10.5901	5.3892	7.989
pre-MU	0.34096	0.23034	0.28565	14.185	7.2276	10.7063	10.5911	5.3947	7.992

C1	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.2528	6.74638	9.9996	0.70312			9.9656	4.764
G-C	13.2525	6.75448	10.003	0.70342			9.9657	4.771
Nash-MU	13.2519	6.7463	9.9991	0.70310			9.9656	4.764
pre-MU	13.253	6.75287	10.002	0.7033	0.932	0.474	9.9659	4.769

C1	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	7.517			-12.861860	-6.355734	20.1445	6.3116
G-C	7.523			-12.861964	-6.363905	20.1440	6.3260
Nash-MU	7.516			-12.861860	-6.355734	20.1415	6.3115
pre-MU	8.317	13.207	3.426	-12.862069	-6.362201	20.5191	6.0538

C2: Distorted (M7c1v2) versus Less Distorted (M6c4v2) The preference parameter values for the governments in country 1 and 2 are: $\gamma_1 = 0.175$, $\mu_1 = 0.175$, $\gamma_2 = 0.05$, $\mu_2 = 0.3$.

C2	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.34322	0.91934	0.63128	13.926	6.593	10.2595	10.5910	4.7056	7.648
G-C	0.33967	0.90094	0.62031	13.927	6.6161	10.271	10.5913	4.2406	7.657
Nash-MU	0.34321	0.91939	0.6313	13.925	6.5929	10.2589	10.5902	4.7055	7.647
pre-MU	0.34096	0.89713	0.61905	14.185	6.3629	10.274	10.5911	4.7278	7.659

C2	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.2529	5.9199	9.586	0.67304			9.965678	4.08066
G-C	13.2531	5.9422	9.597	0.67386			9.96603	4.09906
Nash-MU	13.2519	5.9198	9.585	0.67303			9.965679	4.08061
pre-MU	13.253	5.9468	9.599	0.67403	0.932	0.416	9.96590	4.10287

C2	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.887			-12.861880	-5.529372	20.103	7.138
G-C	6.901			-12.862177	-5.551614	20.105	7.189
Nash-MU	6.886			-12.861880	-5.529312	20.100	7.137
pre-MU	7.919	13.207	2.631	-12.862069	-5.556219	20.519	6.919

C3: Distorted (M7c1v3) versus Less Distorted (M6c3v3) The preference parameter values for the governments in country 1 and 2 are: $\gamma_2 = 0.4$, $\mu_2 = 0.6$, $\gamma_1 = 0.5$, $\mu_1 = 0.5$.

C3	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.33991	0.25925	0.29958	13.955	7.42	10.6875	10.5911	5.3657	7.9784
G-C	0.33484	0.24782	0.29133	13.956	7.4343	10.695	10.5916	5.3771	7.9844
Nash-MU	0.33991	0.25926	0.29959	13.955	7.4199	10.6874	10.5911	5.3656	7.9783
pre-MU	0.33160	0.25169	0.29165	14.186	7.1999	10.693	10.5921	5.3733	7.9827

C3	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.2529	6.7179	9.9854	0.7021			9.9660	4.74075
G-C	13.2533	6.731	9.9925	0.7026			9.9665	4.75218
Nash-MU	13.2529	6.717	9.9853	0.7021			9.9660	4.74074
pre-MU	13.2539	6.727	9.9904	0.7021	0.932	0.472	9.9668	4.74831

C3	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	7.495			-12.862157	-6.327256	56.636	17.7946
G-C	7.506			-12.862582	-6.341072	56.641	17.8665
Nash-MU	7.494			-12.862157	-6.327244	56.636	17.7941
pre-MU	8.301	13.210	3.399	-12.862853	-6.336394	57.021	17.5725

C4: Distorted (M7c1v3) versus Less Distorted (M6c4v3) The preference parameter values for the governments in country 1 and 2 are: $\gamma_2 = 0.05$, $\mu_2 = 0.95$, $\gamma_1 = 0.5$, $\mu_1 = 0.5$.

C4	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.33969	2.1338	1.2367	13.872	5.0716	9.4718	10.5906	3.49118	7.04093
G-C	0.33408	2.0728	1.2034	13.876	5.1481	9.5118	10.5919	3.55221	7.07206
Nash-MU	0.33969	2.1337	1.2367	13.872	5.0716	9.4718	10.5907	3.49116	7.04094
pre-MU	0.33160	2.0885	1.2101	14.86	4.818	9.502	10.5921	3.53650	7.06134

C4	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.25238	4.45198	8.85218	0.61962			9.9660	2.8662
G-C	13.25367	4.52577	8.88972	0.62233			9.9665	2.9272
Nash-MU	13.25239	4.45199	8.85219	0.61961			9.9660	2.8663
pre-MU	13.25392	4.50678	8.88035	0.62165	0.932	0.311	9.9668	2.9115

C4	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	5.83714			-12.862175	-4.061394	56.5230	12.19043
G-C	5.88884			-12.862645	-4.135128	56.5373	12.58943
Nash-MU	5.83715			-12.862175	-4.061515	56.5231	12.19047
pre-MU	7.34139	13.210	1.472	-12.862853	-4.116150	57.0210	12.19646

C5: Distorted (M7c2v2) versus Less Distorted (M6c3v2) The preference parameter values for the governments in country 1 and 2 are: $\gamma_1 = 0.2$, $\gamma_2 = 0.15$, $\mu_1 = 0.15$, $\mu_2 = 0.2$.

C5	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.25847	0.23569	0.24708	13.963	7.4498	10.706	10.59907	5.3892	7.9941
G-C	0.25740	0.23077	0.24408	13.963	7.456	10.710	10.59893	5.3942	7.9965
Nash-MU	0.25847	0.23569	0.24708	13.963	7.4498	10.706	10.59907	5.3892	7.9941
pre-MU	0.25773	0.23034	0.24404	14.192	7.2276	10.710	10.59891	5.3946	7.9968

C5	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.25951	6.7463	10.002	0.70349			9.97415	4.7643
G-C	13.25929	6.7522	10.005	0.70371			9.97426	4.7692
Nash-MU	13.25951	6.7463	10.002	0.70349			9.97415	4.7643
pre-MU	13.25927	6.7528	10.006	0.70373	0.932	0.474	9.97422	4.7696

C5	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	7.5246			-12.868978	-6.355734	17.3593	6.3120
G-C	7.5291			-12.869067	-6.361681	17.3590	6.3227
Nash-MU	7.5246			-12.868978	-6.355734	17.3593	6.3120
pre-MU	8.3268	13.227	3.426	-12.869040	-6.362201	17.7338	6.0538

C6: Distorted (M7c2v2) versus Less Distorted (M6c4v2) The preference parameter values for the governments in country 1 and 2 are: $\gamma_1 = 0.2$, $\gamma_2 = 0.05$, $\mu_1 = 0.15$, $\mu_2 = 0.3$.

C6	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.25827	0.91935	0.58881	13.933	6.5934	10.2632	10.5991	4.7056	7.6521
G-C	0.25517	0.90575	0.58046	13.934	6.6105	10.272	10.5995	4.7192	7.6591
Nash-MU	0.25827	0.91939	0.58883	13.933	6.5933	10.2631	10.5991	4.7055	7.6523
pre-MU	0.25773	0.89713	0.57743	14.192	6.3629	10.277	10.5989	4.7278	7.6633

C6	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.2595	5.9199	9.58979	0.67341			9.9741	4.08065
G-C	13.2599	5.9364	9.59823	0.67402			9.9744	4.09425
Nash-MU	13.2595	5.9198	9.58974	0.67341			9.9741	4.08061
pre-MU	13.2592	5.9465	9.60306	0.67439	0.932	0.416	9.9742	4.10287

C6	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.89499			-12.868994	-5.529360	17.3181	7.1386
G-C	6.90765			-12.869254	-5.545799	17.3199	7.1768
Nash-MU	6.89493			-12.868994	-5.529312	17.3181	7.1381
pre-MU	7.92947	13.227	2.631	-12.869040	-5.556219	17.7338	6.9191

C7: Distorted (M7c2v3) versus Less Distorted (M6c3v3) The preference parameter values for the governments in country 1 and 2 are: $\gamma_1 = 0.6$, $\gamma_2 = 0.4$, $\mu_1 = 0.4$, $\mu_2 = 0.6$.

C7	τ_1	τ_2	τ	w_1	w_2	w	u_1	u_2	u
L-C	0.22717	0.25925	0.24321	13.965	7.4205	10.692	10.60243	5.3657	7.9841
G-C	0.22294	0.25055	0.23674	13.966	7.4314	10.698	10.60305	5.3744	7.9887
Nash-MU	0.22717	0.25926	0.24322	13.965	7.4204	10.693	10.60242	5.3656	7.9840
pre-MU	0.22214	0.25169	0.23692	14.196	7.1999	10.698	10.60302	5.3733	7.9881

C7	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.26241	6.7179	9.99016	0.70259			9.97728	4.74075
G-C	13.26301	6.7284	9.99571	0.70299			9.97770	4.74945
Nash-MU	13.2624	6.7178	9.9901	0.70260			9.97728	4.74074
pre-MU	13.26295	6.7275	9.995	0.70295	0.933	0.472	9.97778	4.74831

C7	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	7.50568			-12.871599	-6.327256	45.48922	17.79543
G-C	7.51441			-12.871953	-6.337772	45.49389	17.8502
Nash-MU	7.50561			-12.871599	-6.327241	45.48916	17.79487
pre-MU	8.31841	13.237	3.399	-12.872020	-6.336391	45.86988	17.57256

C8: Distorted (M7c2v3) versus Less Distorted (M6c4v3) The preference parameter values for the governments in country 1 and 2 are: $\gamma_1 = 0.6$, $\gamma_2 = 0.05$, $\mu_1 = 0.4$, $\mu_2 = 0.95$.

C8	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.22698	2.1338	1.18039	13.882	5.0721	9.4771	10.602021	3.49117	7.0465
G-C	0.22232	2.0871	1.1547	13.885	5.1307	9.5078	10.602911	3.53793	7.0701
Nash-MU	0.22699	2.1337	1.18034	13.882	5.0721	9.4771	10.602029	3.49118	7.0466
pre-MU	0.22214	2.0885	1.553	14.196	4.818	9.507	10.603029	3.53650	7.0697

C8	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.2618	4.451	8.85694	0.62011			9.977302	2.8662
G-C	13.2628	4.508	8.88566	0.62219			9.977768	2.9129
Nash-MU	13.2619	4.452	8.85695	0.6201			9.977301	2.8663
pre-MU	13.2629	4.506	8.88465	0.62214	0.933	0.31	9.977786	2.9115

C8	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	5.84653			-12.871615	-4.061394	45.3765	12.1910
G-C	5.88611			-12.872005	-4.117842	45.3854	12.4960
Nash-MU	5.84654			-12.871614	-4.061515	45.3766	12.1911
pre-MU	7.35493	13.237	1.472	-12.872020	-4.116150	45.8698	12.1964

C9: Distorted and π-prone (M7c1v3) versus Less Distorted and π-averse (M6c3v2)

The preference parameter values for the governments in country 1 and 2 are: $\gamma_1 = 0.5, \gamma_2 = 0.15$, $\mu_1 = 0.5, \mu_2 = 0.2$.

C9	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.33092	0.23569	0.287805	13.956	7.4495	10.702	10.591078	5.3893	7.99019
G-C	0.33948	0.20507	0.27227	13.957	7.4879	10.723	10.590813	5.4199	8.00539
Nash-MU	0.33991	0.23569	0.2878	13.956	7.4494	10.703	10.591070	5.3892	7.99015
pre-MU	0.33160	0.23034	0.28097	14.186	7.2276	10.707	10.592193	5.3946	7.99344

C9	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.25287	6.7463	9.9996	0.70313			9.966008	4.76431
G-C	13.25252	6.7834	10.017	0.70448			9.96605	4.794
Nash-MU	13.25286	6.7462	9.9995	0.70314			9.966009	4.764
pre-MU	13.25392	6.7528	10.003	0.70341	0.932	0.474	9.96684	4.769

C9	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	7.5171			-12.862156	-6.355734	56.6376	6.3116
G-C	7.5457			-12.862193	-6.392746	56.6365	6.3778
Nash-MU	7.5170			-12.862157	-6.355734	56.6375	6.3114
pre-MU	8.3184	13.210	3.426	-12.862853	-6.362201	57.0210	6.0538

C10: Distorted and π-prone (M7c1v3) versus Less Distorted and π-averse (M6c4v2)

The preference parameter values for the governments in country 1 and 2 are: $\gamma_1 = 0.5$, $\gamma_2 = 0.05$, $\mu_1 = 0.5$, $\mu_2 = 0.3$.

C10	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.33984	0.91934	0.62959	13.926	6.5931	10.2595	10.59114	4.7057	7.6484
G-C	0.33857	0.83837	0.58847	13.930	6.6945	10.312	10.59153	4.7866	7.689
Nash-MU	0.33983	0.91939	0.62961	13.926	6.5929	10.2594	10.59113	4.7055	7.648
pre-MU	0.33160	0.89713	0.61437	14.186	6.3629	10.274	10.59219	4.7278	7.660

C10	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.25295	5.920	9.5865	0.67305			9.966016	4.08066
G-C	13.25338	6.017	9.6356	0.67662			9.966143	4.16163
Nash-MU	13.25294	5.919	9.5864	0.67306			9.966017	4.08061
pre-MU	13.25392	5.946	9.6004	0.67407	0.932	0.416	9.96684	4.10287

C10	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.8878			-12.862163	-5.529372	56.596921	7.138344
G-C	6.9612			-12.862269	-5.627245	56.605395	7.366528
Nash-MU	6.8876			-12.862164	-5.529312	56.596849	7.137883
pre-MU	7.9210	13.210	2.631	-12.862853	-5.556219	57.021030	6.919179

C11: Distorted and π-prone (M7c2v3) versus Less Distorted and π-averse (M6c3v2)

The preference parameter values for the governments in country 1 and 2 are: p-prone vs p-averse $\gamma_1 = 0.6$, $\gamma_2 = 0.15$, $\mu_1 = 0.4$, $\mu_2 = 0.2$

C11	r_1	r_2	r	w_1	w_2	w	u_1	u_2	u
L-C	0.22717	0.23569	0.23143	13.966	7.45	10.708	10.60239	5.3893	7.99585
G-C	0.22681	0.21239	0.21960	13.967	7.4792	10.723	10.60238	5.4126	8.00750
Nash-MU	0.22718	0.23569	0.23144	13.966	7.4199	10.707	10.60239	5.3892	7.995851
pre-MU	0.22214	0.23034	0.22624	14.196	7.2276	10.712	10.60302	5.3946	7.99886

C11	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.26237	6.74637	10.00437	0.70363			9.977283	4.76431
G-C	13.26234	6.77454	10.01844	0.70166			9.977319	4.78761
Nash-MU	13.26237	6.74627	10.00432	0.70363			9.977282	4.76431
pre-MU	13.26295	6.75287	10.00791	0.70389	0.933	0.474	9.977786	4.76966

C11	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	7.5278			-12.871599	-6.355734	45.490408	6.312377
G-C	7.5497			-12.871629	-6.383898	45.491657	6.362609
Nash-MU	7.5277			-12.871598	-6.355731	45.490407	6.312205
pre-MU	8.3319	13.237	3.426	-12.872020	-6.362201	45.869882	6.053873

C12: Distorted and π-prone (M7c2v3) versus Less Distorted and π-averse (M6c4v2) The preference parameter values for the governments in country 1 and 2 are: $\gamma_1 = 0.6$, $\gamma_2 = 0.05$, $\mu_1 = 0.4$, $\mu_2 = 0.3$.

C12	τ_1	τ_2	τ	w_1	w_2	w	u_1	u_2	u
L-C	0.2271	0.91935	0.57322	13.936	6.5935	10.26475	10.602465	4.7056	7.65401
G-C	0.22605	0.85756	0.541 81	13.939	6.6709	10.305	10.602724	4.7671	7.68506
Nash-MU	0.22711	0.91940	0.57326	13.936	6.5934	10.2647	10.602465	4.7055	7.65400
pre-MU	0.22214	0.89713	0.55964	14.196	6.3629	10.2794	10.603029	4.7278	7.66545

C12	$w_1-\pi$	$w_2-\pi$	$w-\pi$	π	π_1	π_2	v_1	v_2
L-C	13.26245	5.91995	9.5912	0.67355			9.97729	4.08065
G-C	13.26273	5.99463	9.6286	0.67627			9.97738	4.14241
Nash-MU	13.26245	5.91985	9.5911	0.67355			9.97728	4.0806
pre-MU	13.26295	5.94685	9.6049	0.67455	0.933	0.416	9.97778	4.10287

C12	B	B_1	B_2	L_1	L_2	G_1	G_2
L-C	6.8979			-12.871605	-5.529360	45.449525	7.138791
G-C	6.9539			-12.871693	-5.604049	45.455105	7.312555
Nash-MU	6.8978			-12.871604	-5.529300	45.449525	7.138565
pre-MU	7.9345	13.237	2.631	-12.872020	-5.556219	45.869882	6.919179

Cooperation of governments

Here we discuss the implications for nominal, real wages, unemployment and inflation when the two governments engage in cooperation and how they compare with their levels under a non-cooperative Nash play (or all-Nash play).

Case with $\delta = 0.268$ The nominal wage in country 2 increases above its level in case of a non-cooperative Nash play inside the MU. The reduction in home-country reform following governments' cooperation is the driving force for this result since wages and reform are perceived as being strategic substitutes on the wage setting decisions of the labor union in the second

country[82]. Furthermore, in most cases considered nominal wages in country 1 increase above their value under non-cooperative Nash play (but are still below their pre-MU levels). The driving forces are the lower level of reform (τ_2) and the higher level of wages (w_2); there is also a moderating effect coming into play in the cooperative case, i.e. the lower value of τ_1, because wages and reform are strategic complements in the wage-setting decisions of the home labor union[83]. Overall, average wage in the MU are at their highest levels under the cooperative play (with its value being above the pre-MU case)[84].

Under all different specifications inflation is at its highest value inside the MU in the case of cooperation, because average reform decreases and average nominal wages increase relative to the all-Nash play. Real wages in country 2 end up in a higher level after the cooperation of the two governments, in particular they are above the case of an all-Nash play (as well as above their before the MU levels),[85] i.e. the increase in nominal wages outweighs the higher inflation level. Real wages in country 1 are bigger compared to the pre-MU outcome under all specifications examined. Though in some cases they can be above or below their non-cooperative Nash play levels.[86]

Unemployment in country 2 reaches its maximum level in the case of cooperative play inside the MU, because real wages in country 2 attain their maximum value in that case, while home reform is at its minimum level in the cooperative case[87]. In most cases unemployment in country 1 is higher under cooperative play than under non-cooperative Nash play (while it is below the pre-MU outcome)[88]. On the one hand, reform is slightly lower (compared to the all-Nash play) because national governments internalize the effects of the "beggar-thy-neighbor", while on the other hand, real wages (which are bigger compared to their pre-MU levels) either increase compared to the all-Nash play raising further unemployment or when they fall, their decline is

[82] In addition, the reduction in τ_1 compared to the Nash play inside the MU will raise w_2; moreover, positive will also be the impact of a higher w_1.

[83] Actually this moderating effect is stronger and makes nominal wages attain their lowest value in the cooperative case in the first country in specification 3 and 7, where both governments are inflation prone and the government in country one attaches the less or equal weight on reform compared to inflation ($\gamma_1 \leq \mu_1$) while still $\gamma_1 < \gamma_2$.

[84] Though in case 6, the area wide nominal wages although bigger than in the case of Nash play inside the MU, they lag behind those obtained outside the MU, hence the strategic complementarity effect on the wage setting decisions of the labour union in country 1 is quite strong.

[85] Not in case 6, where the cooperation outcome under cooperation is below its pre-MU levels.

[86] In specifications 1, 2, 11 and 12, real wages end up in a higher level compared to Nash play inside the MU, similarly for the case 6, though in that case real wages end up in a lower level inside the MU compared to their levels outside the MU. In all the rest cases real wages are lower in the cooperative compared to the non-cooperative case.

[87] The only exception is specification 6 where unemployment following the pattern of real wages is above the case of an all-Nash play inside the MU, but below the outcome achieved prior to MU.

[88] This holds for cases 1-4, 7-8 and 11-12.

not sufficient to improve the unemployment outcome[89].

Case with $\delta = 0.033$ Nominal wages in country 2 reach their maximum value after cooperation: wages and reform are perceived as substitutes, hence when reform is reduced and union bargaining power is raised, nominal wage demands are raised as well. Similarly, the nominal wages in country 1 increase above the levels achieved under non-cooperative Nash play inside the MU (though they are still below their pre-MU levels). Area-wide nominal wages increase above the levels under Nash play by all agents inside the MU, as well as their pre-MU levels[90].

The inflation rate under cooperation increases above its all-Nash play and pre-MU levels, because average reform reaches its lowest level under cooperation, while nominal wages increase compared to the all-Nash play case[91]. Real wages in country 2 increase after cooperation (i.e. the nominal wage increase more than compensates the inflation rise), and in most cases (excluding 2, 5 and 6) they are above their pre-MU values. Real wages in country 1 increase above their non-cooperative Nash play inside the MU when governments cooperate, though they can be above or below their pre-MU levels[92]. Overall, in most cases area-wide real wages reach their maximum value in the cooperative case[93].

Unemployment in country 2 reaches its maximum value in the cooperative case for the reasons described in the previous section.[94] As we saw above, reform is lower in the cooperative case, while real wages in most cases increase compared to their non-cooperative levels, these developments lead to higher unemployment in country 1 when the two governments engage in cooperation. Though in the cases (5, 9 and 11) where real wages fall compared to the non-cooperative post-MU case, unemployment in country 1 falls as well, because the decrease in real wages out-weights the decrease in reform.

[89] In some of the cases unemployment decreases with respect to the non-cooperative Nash outcome, but is still above its pre-MU level. This is attributed to the decline in real wages inside the MU that outweighs the fall in reform effort (case 5) or to the increase in real wages that lags behind the fall in reform (case 6).

[90] In specification 2, 3, 4, 5, and 6 nominal wages in the cooperative outcome are below or equal their pre-MU levels.

[91] However, in cases 2, 5 and 6 the inflation rate under cooperation is below its pre-MU levels, because average reform and nominal wages are, respectively, above and below their pre-MU levels.

[92] In specification 5, 9 and 11 real wages in the more distorted economy fall when governments cooperate compared to the all-Nash play case.

[93] Except in cases 2, 5 and 6 where they are at a lower level compared to the pre-MU case.

[94] Though, in specifications 2, and 6 the unemployment outcome is lower than the pre-MU case, because real wages and reform are, respectively, at a lower and higher value compared to the prior to MU model.

Cooperation of labor unions

Case with $\delta = 0.268$ In case of inter-union cooperation w_1 is lower relative to its value under governments' cooperation (with the exception of specifications 3 and 5). Furthermore, wages are at the same level as under the all-Nash play[95]. Therefore, the cooperation of the two labor unions implies that when reform is at the same or higher levels relative those under the all-Nash play, w_1 will also be at the same or higher levels compared to its all-Nash play value[96]. Notice that when unions cooperate relative to a case where governments also cooperate, reform is higher in most cases while wages are lower; which occurs because reform is moderated when governments cooperate, instead wages are moderated when unions cooperate.

Under all specification w_2 is at a lower level when unions cooperate rather than when governments cooperate as well (notice that there is substitutability effect at work because reform has increased). Comparing the inter-union cooperation with the all-Nash play game, we see that the wage levels coincide in most cases (as reform does)[97]. Area-wide nominal wages are lower when unions cooperate relative to an inter-government coalition (while reform is higher). In most cases unions' coalition results in higher average wages than the all-Nash play[98].

Given that labor unions cooperate, a cooperation on the part of the governments in deciding labor market institutions will lead to higher inflation rate, because wages will be increased and reform will be reduced. Comparing the unions' coalition outcome with that of an all-Nash play, we see that the inflation outcome is not uniform across the different specifications[99].

Real wages in country 1 are in most cases above the governments' coalition outcome, because the fall in nominal wages is more than compensated by the fall in inflation (exactly the opposite holds is specifications 1, 2 and 6). Moreover, they are above their all-Nash play levels due to the fall in inflation while nominal wages are unchanged[100]. Hence, in most cases, the union in country 1 (that treats wages and reform as complements) is benefited, both with respect to the all-Nash play and governments' cooperation case[101]. Contrary to country 1, real wages in country 2 are always above their levels under government cooperation[102].

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[95] Except in specifications 1, 8, 11-12 where w_1 is above its all-Nash play levels.

[96] In specifications 1 and 8 an increase in reform implies higher wages, i.e. a complementarity effect is at work.

[97] However, wages are at a lower level when unions form a coalition in specifications 2, 4, and 8, because reform increases (the substitutability effect), whereas in specifications 3 and 9 wages are at a higher level.

[98] Though, in specifications 2 and 4 the opposite is true, while in specification 5-7 and 10 the wage levels coincide.

[99] In some cases (1, 8, 11-12) inflation increases when unions cooperate, while in specifications 4, 5, 7, 9, 10 inflation decreases. In model specifications 2, 3 and 6 inflation coincides in the two cases.

[100] In model specifications 2, 3 and 6 the real wages under unions' cooperation coincide with those under all-Nash play.

[101] In specifications 2 and 6 real wages are below their levels under governments' cooperation, while they coincide with those under an all-Nash play.

[102] In addition, real wages in country 2 when unions form a coalition are in some cases (1-3, 8, 11,12) below their levels under all-Nash play, while in others (specification 3, 5, 7, 9 and 10) they are above (in specification 6 their

If the labor unions cooperate in setting nominal wages, the unemployment rate in country 1 (in most cases) increases above its all-Nash play levels, because real wages rise while reform either does not change or is raised by a smaller amount[103]. Moreover, in specifications 5, 6, 9-12 unemployment is higher relative to the case where two governments cooperate, while it is below that level in specifications 1-4 and 7-8. If the two national governments engage in cooperation, when the labor unions already set wage in a cooperative manner, then the unemployment rate in country 2 will increase because reform and real wages will be at a lower and higher level, respectively[104].

Case with $\delta = 0.033$ Like in the previous section nominal wages in both countries are lower when unions cooperate relative to the case where governments also decide to coordinate their reform efforts[105]. Comparing the wages when unions cooperate with those under non-cooperative Nash play (in country 1) we see that they are practically unchanged[106]. In country 2 nominal wages increase in most cases,[107] as a result average wages increases as well (except in specification 4 and 5).

The inflation rate is at a lower level when unions cooperate relative to a case where the two governments are also setting reform in cooperative manner; as discussed previously the bigger amount of reform will lead to a higher nominal wage decline in case of unions' cooperation due to the substitutability effect. The comparison of the all-Nash play and the unions cooperation outcomes gives more ambiguous results[108].

Real wages and consequently unemployment in country 1 have a lower value when unions cooperate relative to a case where governments cooperate as well[109]. Real wages and unemployment in case of an inter-union coalition are at the same levels with those under non-cooperative Nash play in specification 3, 5, 6, 11 and 12; while they are at a bigger level when unions cooperate in specification 1, 2, 7, 9 and 10[110]. Real wages and unemployment in country 2 are lower under unions' cooperation relative to the case where an inter-union coalition plays Nash against an inter-government coalition (because the fall in wages is bigger than the decline in the

values coincide).

[103] In specification 3, unemployment does not change; whereas in specifications 2, 6 and 7 it is at a lower level, because reform increases while real wages either don't changes or increase by a smaller amount.

[104] Notice that the way unemployment compares under unions' cooperation with respect to the all-Nash play case, corresponds exactly to the way real wages compare under unions' cooperation relative to the all-Nash play case.

[105] In country 1, in specifications 1 and 5, wages coincide when unions or governments cooperate.

[106] In models 1 and 2 they increase above their non-cooperative Nash values.

[107] However, in specifications 4, 5, 8, nominal wages do not change.

[108] Inflation is not altered in specifications 3, 5, 6, 7, 11, 12. It is higher in the cooperative case in specifications 1, 2, 4, 8 while it is lower in model specifications 9 and 10.

[109] Though in specifications 1, 5, 9 and 11 real wages and unemployment are higher in the case of inter-union cooperation.

[110] The opposite is the case in specification 4 and 8.

inflation rate, therefore real wages decrease; combining this with the bigger amount of reform generates a fall in unemployment). When unions cooperate, in most cases real wages, as well as unemployment are above their non-cooperative Nash play levels[111].

[111] Except in case 5, that are equal, and cases 4 and 8 that are below their all-Nash play levels.

Chapter 2

The Effects of Macroeconomic Policy Shocks on the UK Labor Market

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2.1 Introduction

This paper examines the effects of various macroeconomic policy shocks on the UK labor market. In particular it analyzes the pattern of dynamic responses of employment, average hours per worker, and real wages to government spending, net taxes and monetary policy shocks. Furthermore, it considers the effects that different government spending components have on labor market outcomes. The motivation for this study comes from the fact that the UK labor market is characterized by different outcomes both over time and compared to the US and major Euro-area countries. This is attributed to the series of labor market reforms that it underwent in the 1980s that led to an improvement of its flexibility and performance. Therefore we shall investigate how the responsiveness of labor market variables has evolved over time, whether their dynamic responses are in line with what the economic theory would suggest and whether they resemble with previous empirical findings for the UK, the US and the Euro-area.

The structural reforms in the 1980s and beginning of 1990s have affected in a significant manner the performance of the UK labor market over time. Specifically, the measures that were

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taken aimed at reducing hiring costs (the Employment Act of 1988 and 1989) and made easier the dismissal of workers by reducing firing costs (the Unfair Dismissal Variation of Qualifying Period Order of 1979 and 1985).[2] Whereas, a series of legislative actions aimed at improving wage flexibility (especially earlier legislative actions that abolished Wage Councils, which were setting minimum wages) and weakening the power of labor unions.[3] As a result the proportion of workers covered by collective agreement fell from 71 percent in 1984 to 54 percent in 1990. Aggregate union membership fell from 13.2 million in 1980 to 9.9 million by 1990, and union density declined from 54 percent in 1980 to 38 percent in 1990.[4]

As a consequence, the cyclical components of employment, total hours, real wages and average hours have become much more volatile but less persistent (see Appendix, tables 1 and 2) since the beginning of the 1990s. The volatility of real wages increased above that of employment, while the volatility of average hours came much closer to the volatility of the cyclical component of employment. The persistence of the cyclical component of average hours became larger than the one for employment. Hence, since the beginning of the 1990s, while all labor market variables became more volatile to cyclical fluctuations, there has been an increased role for real wage adjustment relative to employment adjustment following cyclical fluctuations. Despite the fact that cyclical fluctuations became less persistent for all variables due to increased labor market flexibility, average hours became relatively more persistent than employment over the cycle, strengthening the labor input adjustment along the extensive margin.

When comparing employment, average hours per worker, total hours and real wages in the UK with those in the US, and the three major Euro-area economies (i.e. Germany, France and Italy) we see that overall the above mentioned variables are more volatile in the UK, adjusting in a flexible manner to cyclical variations in economic activity (see Appendix, figure 17). Moreover, in the UK there is an adjustment of the labor input, following cyclical fluctuations, both with respect to the intensive (average hours) and the extensive margin (employment) as is revealed by the volatility measures, while in the other countries this is not the case. Employment appears to

[2]See for example Millard (2000), Disney et al (1995), Mason and Bain (1993), Millward et al (1992), Gregg and Yates (1991), Green (1992).

[3]For example, the Wages Act of 1986, the Employment Act and Social Security Act of 1980, the Employment Act of 1982, 1988, 1990, the Trade Union Act of 1984 and the Trade Union Reform and Employment Rights of 1993, as well as, the Collective Redundancies and Transfer of Undertaking (Amendment) Regulations of 1995.

The specific measures were including, for example, deduction of strike pay from the benefit entitlement of striking workers. Moreover, any industrial action without a secret ballot was considered illegal, closed shop arrangements were also made illegal (i.e. to hire workers only if they are union or non-union members). Furthermore, any industrial action that was taken in order to enforce union membership was deemed illegal.

[4]Moreover, the proportion of enterprises which recognized labour unions for collective bargaining with respect to wages and conditions of work fell from 67 percent in 1980 to 54 percent in 1990. For a more detailed discussion see e.g. Millward et al (1992) and Disney et al (1995).

be slightly more persistent (see Appendix, figure 18) than average hours over the business cycle in the UK, whereas in the rest of the countries considered average hours are equally persistent as employment (US and France) or more persistent (Germany and Italy).

Thus at first glance, empirical evidence suggests that the UK labor market has become more flexible both over-time and with respect to the other countries considered due to the reforms that were introduced in the 1980s. Whereas, the labor input adjustment was found to take both the form of employment and average hours adjustment. Hence, the decomposition of total labor input to employment and average hours is crucial in understanding the effects and propagation of macroeconomic policy shocks in the UK economy. The analysis is carried out by means of a semi-structural VAR in the spirit of Blanchard and Perotti (2002), combining elements of Christiano, Eichenbaum and Evans (1999), Mojon and Peersman (2001) and Peersman and Smetts (2001).

Relevant studies using U.S. data (e.g. Christiano, Eichenbaum and Evans, 1996, 1999) and Euro-area data (e.g. Mojon and Peersman, 2001) suggest that aggregate output and employment decline following a hump-shaped pattern in response to a contractionary monetary policy shock. Economic theory (Hammermesh 1993, Ch. 6) suggests that following a shock the response of hours and employment will depend on two factors. First, the economic agents' perception of the permanence of the demand change caused by the shock, and second the relative cost of adjusting hours or employment. When the demand change induced by the shock is perceived as temporary and there exist adjustment costs to labor, economic agents will adjust along the intensive margin; while when the effects of the shock are perceived as permanent profit maximization on the part of the firms implies adjustment along the extensive margin. We will test whether the UK data are in line with these points.

The typical Real Business Cycle model analyzing the effects of fiscal policy implies that a positive government spending shock in the present period that is to be matched by higher labor taxes in the current and future periods, generates a wealth effect that decreases consumption and increases labour supply. Both the intertemporal substitution effect (individuals prefer to supply more labor when labor taxes are low) and the intratemporal substitution effect (individuals prefer to supply more labor when the cost of work relative to leisure is low) reduce labor supply, while the intertemporal effect decreases consumption. In this case the effect on labour supply and real wages is ambiguous. If the elasticity of labour supply is big enough, labour could decrease while real wages increase. Introducing price stickiness and monopolistic competition (New Keynesian features) implies that firms meet the higher demand for their products by increasing their labour demand. The implications for employment and real wages, consumption and consequently output and investment will depend on the strength of the intertemporal and intratermporal substitution effects relative to the wealth effect and the severity of price rigidities, as well as the persistence of the government spending shock and the timing of taxation. Several papers using U.S. data on

the effects of a fiscal policy shock (e.g Blanchard and Perotti (2002), Fatas and Mihov (2001), Burnside, Eichenbaum and Fisher (2003), Gali, Lopez-Salido and Valles (2004)) find that a government spending shock increases output, as well as, employment and total hours, with their responses having a hump-shaped pattern.[5] Perotti (2004), finds that the effect of a government spending shock on output in the UK, Canada and Germany is much smaller (even negative) and not persistent over the last twenty years. In addition, several studies (e.g. Finn 1998, Ardagna 2001, Alesina et al 2002, Lane and Perotti 2003) have shown that the composition of the government spending shock matters, with the wage and non-wage components having much different effects on labor market variables and output. Our analysis builds on these papers and examines whether the responses of the UK labour market variables are in line with theory and previous empirical evidence.

The main implication of our analysis is that the response of employment and hours to a monetary policy shock is negative and follows a hump-shaped pattern generating an analogous response for output. The adjustment of labor input is primarily along the extensive margin, although there is also significant adjustment along the intensive margin one year after the shock, contrary to the results reported by relevant U.S. studies. When considering the smaller sample 1970 Q1-1990 Q4, that covers the period where the legislative change took place, average hours are found to respond faster and in a more pronounced way compared to employment. Therefore, once the favorable legislative actions that improved labor market flexibility were in place, firms took advantage of them adjusting primarily along the extensive margin and to a lesser extent along the intensive margin following a shock, as we see from the whole sample case. Labor market reform that was pursued during the 1980s in the UK brought down the adjustment costs of labor input incurred by firms. The response of real wages to a monetary shock is negative (as expected) but insignificantly estimated.

A government spending shock leads to a negative response for employment, hours, output and its components; real wages are affected positively for more than one and a half years following the shock. However, composition matters with respect to the effects of a government spending shock. Specifically, a "labor market channel" of fiscal policy as defined in Alesina et al (2002) is present; i.e. the wage bill component of government spending increases the wages in the private sector, reducing profits, which leads to a decrease in employment and business investment. This, in turn, contracts output, income and private expenditure. Changes in the non-wage component of government consumption or the government investment do not generate an increase in labor cost, thus they do not deteriorate the competitive position of UK businesses, however, they also fail to boost private demand in a significant manner, so employment in the business sector

[5] Basu and Kimball (2003) show that an increase in government spending may even reduce output in the absence of adjustment costs to investment.

is unaffected or increases only on impact. Nevertheless, average hours increase in a persistent manner generating a significant increase in total hours.

It appears that when the labour input declines, (i.e. mainly in cases of a wage government consumption), both employment and average hours decline. However, when the labour input increases, like in the case of a non-wage government consumption shock or a government investment shock, the adjustment takes place in the form of an increase in average hours per worker, with employment changes being insignificant over the five year horizon considered. Thus, when real wages increase and the competitive position of UK firms deteriorates, profit maximization (or cost minimization) induces them to reduce the number of workers they employ; while when the spending boost is not affecting their labour costs, firms adjust their labour input only along their intensive margin because they anticipate that the shock will have only temporary effects on private demand.

Notice that in an RBC model with distortionary taxation, a tax hike in the current period, when government spending is unchanged, will be matched by lower taxes in the future. In this case it generates an intertemporal and an intratemporal substitution effect that induce individuals to reduce labour supply and consumption in the current period. Moreover, an increased tax burden on the part of the firms (and consumers that decreases income and total demand) can lead them to cut back employment (reduction in the demand for labor), depending on the adjustment cost of labor and their perception about the permanence of the shock. Nevertheless, this will also depend on the extent of price rigidities. However, the net impact effect on employment and real wages might not be clear. The results obtained here indicate that the effect of a net taxes shock on employment, hours and real wages is negative on impact but it switches to positive one to two years after the shock. Whereas, output responds positively with a delay of two quarters. Similar output responses are presented in Perotti (2004) with respect to the UK, the US and Canada, for the period 1980 Q1-2001 Q2.

Section 2 discusses the identification conditions of the monetary (section 2.1.1) and fiscal policy shocks (section 2.1.2). Section 3 presents the results on the monetary (section 3.1), spending (sections 3.2) and net taxes shocks (sections 3.3). Finally, section 4 concludes.

2.2 VAR Analysis

The benchmark estimated VAR includes in the following order: the log of real total government purchases (consumption and investment), the log of real net taxes (total revenues minus transfers), the log of real GDP, the log of the GDP deflator, the log of dependent employment in the business sector (excluding self-employed and government employment), the log of average hours per worker (on dependent employment), the log of real effective exchange rate and the short-

term nominal interest rate which is considered to be the monetary policy instrument[6]. The real effective exchange rate is included in the analysis to take into account the openness effects on the UK economy. Moreover, we use as exogenous variables the log of agricultural raw materials to deal with the so-called price puzzle. Both an intercept and a trend are included, whereas the lag length was set to two[7]. The estimation period is 1970:Q1-2003:Q1. The VAR we estimated is of the form:

$$x_t = A_1 x_{t-1} + A_2 x_{t-2} ... + A_p x_{t-p} + CD_t + Bz_t + u_t \tag{2.1}$$

where $x_t = [g, t, y, p, E, H, reer, i]$ is the vector of endogenous variables included in the analysis, D_t contains all regressors associated with deterministic terms, whereas z_t are the exogenous variables included in the analysis.

Notice that according to Dolado and Lutkepohl (1996) and Toda and Yamamoto (1995) if all variables in an unrestricted VAR are I(1) and/or I(0) and the lag order is greater or equal to 2 then the usual tests (t, Chi-square, F) have their standard asymptotic properties. Moreover, by carrying out the analysis in levels we allow for implicit cointegrating relationships in the data (Hamilton 1994, ch18).

2.2.1 Identifying monetary and fiscal policy shocks

Monetary policy shock

In order to identify a monetary policy shock we assume following Christiano, Einchebaum and Evans (CEE, 1999) that the monetary authority responds in systematic way to economic developments by setting a policy instrument (nominal interest rate). Hence, it follows a feedback rule of the form[8]:

$$r_t = \Phi(I_t) + \varepsilon_t^m \tag{2.2}$$

that relates policy-makers' actions to the state of the economy. I_t stands for the information set, Φ is a *linear function*, and ε_t^m is the monetary policy shock. The first crucial assumption that is made towards identification of the monetary policy shock is the linearity of the feedback rule, combined with the variables included in I_t i.e the variables that the monetary authority

[6] All variables used in the analysis are from the OECD Economic Outlook and the IMF International Financial Statistics.

[7] Lag length was chosen, in all cases, based on no autocorrelation and after the evaluation of the relevant information criteria (Hannan-Quinn).

[8] We do not consider the possibility of equating the policy instrument to monetary aggregates like the base (M0), M1 and M2. On the one hand, the demand for broad monetary aggregates is unstable in a very deregulated banking system. On the other hand, narrow money aggregates that are not affected by deregulation, have been strongly affected by technological innovation of the banking and financial system.

is assumed to look at when it undertakes a policy action. Following these assumptions, we impose the so-called *recursiveness assumption*, i.e. the monetary policy shock is orthogonal to the information set of the monetary authority. As CEE (1999) point out, "the recursiveness and linearity assumptions, allow us to estimate a policy shock by the fitted residuals in the ordinary least squares regression of the monetary authority's policy instrument on the variables included in its information set". This implies that at time t there is no contemporaneous response of the variables in I_t to the monetary policy shock. Notice that I_t can contain values of current and past variables; e.g. if the current value of GDP is included, then it is assumed that this does not respond contemporaneously to the shock at time t, but that it responds at time t+1.

The ordering of the variables adopted implies that: the monetary policy authority is assumed to see the fiscal variables, real output, prices and employment and average hours when deciding on the value of the policy instrument. In addition, we assume that the fiscal authority decides first on spending and taxation and then follows the monetary authority, which is realistic because the bulk of the spending and tax decisions are set by relevant legislative action once a year, whereas monetary policy is adjusted more frequently. As CEE (1999) point out, even if quarterly data, as we use in our analysis, are known with a delay, the monetary authority has at its disposal monthly data on aggregate real economic activity and the price level. Alternatively, as CEE (1996) say, any contemporaneous correlation between the shock and the indicators of aggregate production activity reflects causation from the production side to the policy instrument, and not the other way around, i.e. output, prices and labor market variables are not affected in the impact period of a monetary policy shock.

In allowing the real effective exchange rate to be ordered before the policy instrument we assume that the monetary policy instrument responds contemporaneously to movements of the real exchange rate as is likely to be the case for a small open economy like the UK. On the other hand, ordering the real effective exchange rate last, would imply that the monetary policy shock affects the exchange rate immediately, though, in that case the monetary policy instrument does not respond to contemporaneous changes in the effective exchange rate. However, this assumption might be more appropriate for big closed economies like the US.

We include as exogenous variable a proxy for the world commodity prices, which is the log of agricultural raw materials[9] This way we attempt to control for changes in world inflation and deal with the "price puzzle". By treating this variable as exogenous we assume that it has a contemporaneous effect on all endogenous variables but it is not influenced by them.

[9]Alternatively we used an index of food and average crude oil price, but the results obtained were similar.

Fiscal policy shock

The next step in our analysis will be to examine the effects of unanticipated fiscal policy shocks. But what exactly are supposed to be the unanticipated fiscal policy shocks? According to Blanchard and Perotti (2002), they correspond to mid-year legislation and executive decisions, so "decision lags in policy making (more than a quarter) help identify the policy shocks, while, implementation lags make them predictable." It usually takes more than a quarter for policy makers and legislators to identify and understand the effects of a shock on the economy and to decide on discretionary fiscal policy action. However, it is possible that decisions on fiscal policy actions are implemented with a delay of more than one quarter. This implies that what we measure as a policy shock is already known and people have already adjusted their behavior anticipating the implementation of the relevant policy measure.

To achieve identification we follow relevant work by Blanchard and Perotti (2002) and Perotti (2004) in assuming that fiscal policy variables are predetermined with respect to the other variables included in the VAR and by using institutional information about the elasticities of spending and net taxes to economic activity (which reflect the automatic response of fiscal variables to economic activity)[10]. Hence, any changes in fiscal policy variables are not considered to be a contemporaneous (within the quarter) discretionary response to the changing economic environment, but are considered to be exogenous. Blanchard and Perotti (2002) assume that there is *no automatic feedback* from economic activity to government spending within the quarter. In addition *any discretionary change* to fiscal policy in response to changing economic conditions within the quarter *can be eliminated* by the use of quarterly data. This is based on the assumption that within a quarter, policy makers cannot learn about a GDP shock and respond to it by implementing fiscal policy actions. However, there is automatic feedback from economic activity with respect to net taxes; therefore by constructing elasticities of net taxes with respect to various economic variables we try to identify the net tax shock clean of any contemporaneous responses to economic activity.

The reduced form residuals u_t are assumed to be related to the mutually uncorrelated economic shocks ε_t in the following manner:

$$\begin{aligned} u_t^g &= a_{gy}u_t^y + a_{gp}u_t^p + a_{gE}u_t^E + a_{gH}u_t^H + a_{greer}u_t^{reer} + a_{gi}u_t^i \\ &\quad + \beta_{gt}\varepsilon_t^t + \beta_{gg}\varepsilon_t^g \end{aligned} \tag{2.3}$$

$$\begin{aligned} u_t^t &= a_{ty}u_t^y + a_{tp}u_t^p + a_{tE}u_t^E + a_{tH}u_t^H + a_{treer}u_t^{reer} + a_{ti}u_t^i \\ &\quad + \beta_{tt}\varepsilon_t^t + \beta_{tg}\varepsilon_t^g \end{aligned} \tag{2.4}$$

[10] See discussion in Perotti (2004) on comparison with other identification schemes, as well as for a detailed discussion on the interpretation of fiscal shocks.

Following Blanchard and Perotti (2002) we construct the cyclically adjusted fiscal shock:

$$\begin{aligned} u_t^{g,CA} &= u_t^g - (a_{gy}u_t^y + a_{gp}u_t^p + a_{gE}u_t^E + a_{gH}u_t^H + a_{greer}u_t^{reer} + a_{gi}u_t^i) \\ &= \beta_{gt}\varepsilon_t^t + \beta_{gg}\varepsilon_t^g \qquad (2.5) \\ u_t^{t,CA} &= u_t^t - (a_{ty}u_t^y + a_{tp}u_t^p + a_{tE}u_t^E + a_{tH}u_t^H + a_{treer}u_t^{reer} + a_{ti}u_t^i) \\ &= \beta_{tt}\varepsilon_t^t + \beta_{tg}\varepsilon_t^g \qquad (2.6) \end{aligned}$$

We consider both orderings, with spending first and assuming $\beta_{gt} = 0$, as well as having net taxes first and $\beta_{tg} = 0$. The results are invariant to the ordering used because the correlation between the shocks is low enough and insignificant. As in Perotti (2004) the two fiscal shocks are used as instruments in the third equation for output $u_t^y = \gamma_{yg}u_t^g + \gamma_{yt}u_t^t + \beta_{yy}\varepsilon_t^y$ and so on for the rest of the equations. The construction of the elasticities $a'_{jk}s$ is discussed in the Appendix.

2.3 Estimation Results

2.3.1 Monetary policy shock

First we consider the benchmark VAR specification with employment and average hours[11]. Figures 1 and 2 present the effects of a monetary policy shock[12]. The responses of real government purchases and real net taxes are insignificantly estimated as can be seen[13]. The rest of the results are in accordance with relevant literature for the US (e.g CEE (1996, 1999), Trigari (2003)) and other European countries (e.g. Mojon and Peersman (2001) and Peersman and Smets (2001)); they indicate that after a contractionary monetary policy shock the short term interest rate (treasury bill rate) declines at a slow pace until the first quarter after the shock, thereafter it declines in an accelerating pace returning back to trend seven quarters after the shock. Second, after a delay of one-two quarters real GDP persistently declines in a hump-shaped pattern, reaching its maximal decline after four to five quarters; it returns back to trend after nine quarters. Third, the GDP deflator is relatively flat for about six quarters after the shock, thereafter it declines, though

[11] In this case $a_{gp} = -0.5$, $a_{gy} = a_{greer} = 0$, $a_{treer} = 0$, $a_{ty} = 0.9977$, $a_{tp} = 1.2996$, $a_{tE} = 1.5069$, $a_{tH} = 1.1029$.

[12] The graph legends correspond to the following variables: SIR_UK: nominal interest rate, LRGP_UK: real government purchases, LRNT_UK: real net taxes, LrGDP_UK: real GDP, LGDPD_UK: GDP deflator, LDEB_UK: employment, LHRS_UK: average hours, LREER_UK: real effective exchange rate, LTH_UK: total hours, LRTCE_UK: real wages, LRGC_UK: real government consumption LRGI_UK: real government investment LRWGC_UK: real wage government consumption LRNWGC_UK: real non-wage government consumption, LPCV_UK: real private consumption, LPFIV_UK: real private investment, LIBV_UK: real business investment LIHV_UK: real residential investment, LRIGS_UK: real imports LREGS_UK: real exports.

[13] The dark grey dashed lines display the point estimates of the coefficients, whereas the light grey dashed lines represent the 95 % Hall percentile confidence intervals and have been generated by means of bootstrap analysis (1500 number of bootstrap replication).

the response is not statistically significant, except after the 18th quarter following the shock[14]. The real effective exchange rate, as we see from figure 2, appreciates affecting in a contractionary manner real GDP; its maximum response is about two quarters after the shock. It remains above trend for about seven quarters, like the impulse response of the nominal interest rate.

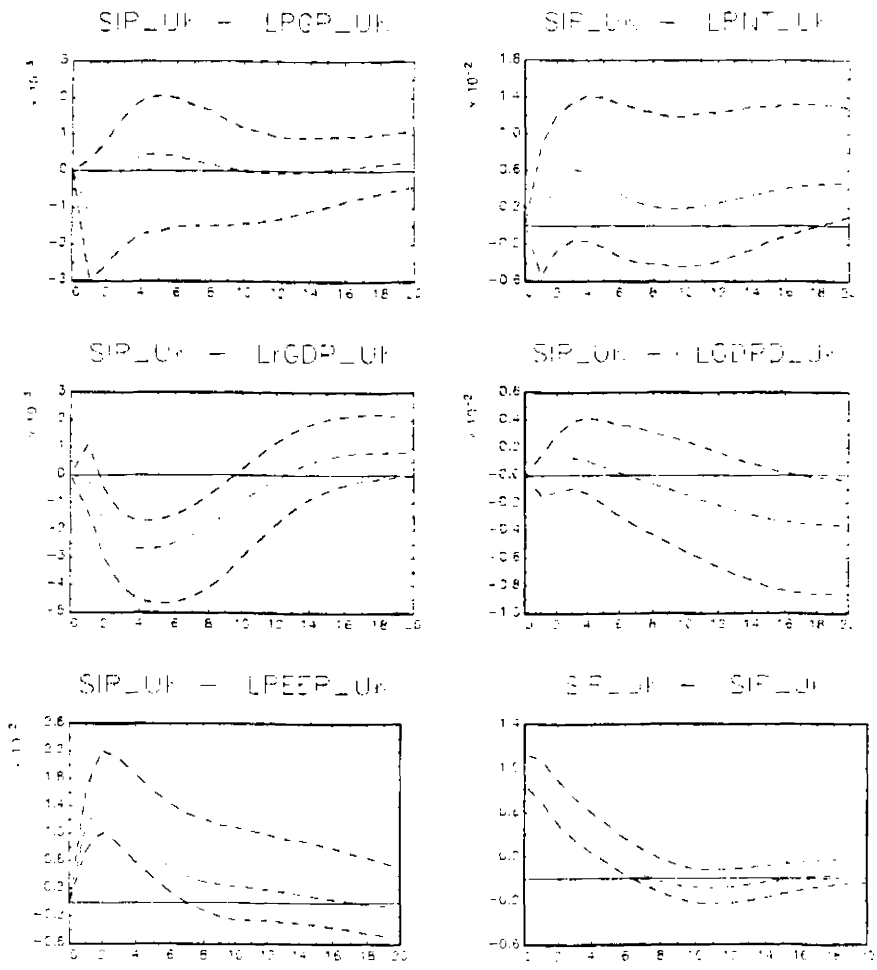

Figure 1: g, t, y, p, reer, i, - responses to a contractionary monetary policy shock

Following a contractionary monetary policy shock, employment declines in a significant manner two to three quarters after the shock, and returns back to its previous value around twelve

[14]The slow response of price is in line with the so-called 'price-puzzle'. The standard IS-LM model suggests that prices should decrease following a contractionary monetary policy shock, however, many empirical studies found that the GDP deflator, after an inertia of about 2-3 quarters, increases following a shock. According to Sims (1992) the price-puzzle' reflects the fact that the monetary authority's reaction function incorporates some indicator of inflation, other than GDP deflator, which is absent from the VAR specification and is sensitive to the changing economic environment. This can be dealt with by introducing in the VAR a commodity price index that is sensitive to monetary policy changes. In several cases, even the introduction of a commodity price index generates a delayed decline in prices, for example in the US as CEE (1999) show the deflator declines after 8-9 quarters, whereas in Germany it declines after about 4-5 quarters as is shown by Mojon and Peersman (2001). In addition it should be noted that the sluggishness in the reaction of prices is in line with the sticky price literature, where firms in adjusting their prices have to incur a cost.

quarters after the shock, reaching its maximal response seven quarters after the shock. Whereas, average hours start to decline three and a half quarters after the shock and reach their minimum value eight quarters after the shock, while they return back to trend at around the thirteenth quarter. Moreover, their response is more muted compared to that of employment: notice that the value attained at the point of their maximum decline is attained by employment one year after the shock.

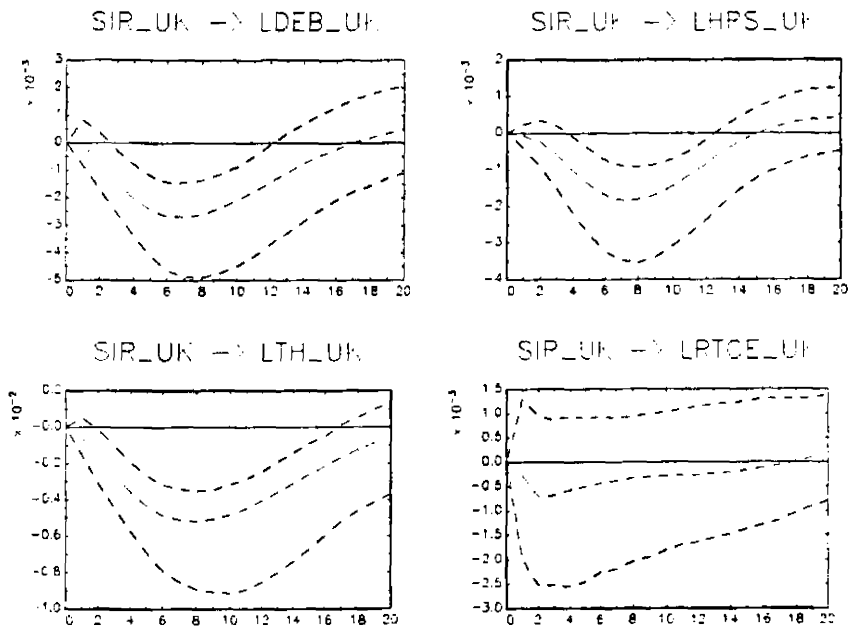

Figure 2: E, H, TH, RW, - responses to a contractionary monetary policy shock

In order to evaluate whether the responsiveness of the variables of interest have changed over time, due to the introduction of reforms in the UK labor market we estimated the benchmark VAR specification over the period 1970:Q1-1990:Q4. The results are displayed in figure 3 (see also Appendix, figure 19).[15] Output declines immediately and its response is significant after one and a half quarters, moreover it returns to trend two and a half years after the shock, while in the whole sample case this happens one quarter earlier. Employment responds negatively more than two quarters after the shock, while average hours respond immediately following the shock (its response becomes significant one period after the shock). Furthermore, employment goes back to trend three and a half years after the shock, it takes one more semester compared

[15] The analysis is conducted with different elasticities this time, using institutional information and conducting regression analysis when needed up to 1990:Q4. Hence we have used: $a_{ty} = 0.9414$, i.e. the output elasticity of net taxes has increased over time (for the whole sample it was 0.9977). $a_{tp} = 1.3772$ on the contrary the price elasticity of net taxes has fallen over time (before it was 1.2995). $a_{tE} = 1.3154$, and $a_{tH} = 1.0742$ i.e. the employment and average hours elasticities of net taxes have increased over time in line with a_{ty} (they were 1.5069 and 1.1029, respectively). Hence, it appears that the automatic response of real variables to net taxes has increased slightly over time, while that of prices has decreased. Therefore, we should take this into account when comparing how the responses of employment and hours to a monetary policy shock change over time.

to the whole sample case. Though, average hours respond in a less persistent manner in the small sample, i.e they are back to trend at the tenth quarter (previously, this was happening at the twelfth quarter. Hence the labor market reform efforts that were initiated in the 1980s did not immediately reduce the adjustment costs of labor input. Therefore adjustment along the intensive margin was the first response of firms in the light of demand shock that was perceived to be temporary. Furthermore, notice that the initial fall in government spending is statistically significant in this smaller sample, moreover, the average size of the shock has declined slightly since the impact effect on the interest rate is closer to one in the smaller than the bigger sample (as for the Euro Area study by Peersman and Smetts, 2001)[16]. In addition, after the impact period the response of the interest rate declined faster in the smaller sample going back to trend after the fifth quarter; in the whole sample case it declines at a slower pace (crossing the zero line at the seventh quarter). Hence, this is an indication that interest rates adjust in a more sluggish fashion to own shocks over time (i.e. the monetary policy shock has become more persistent over time).

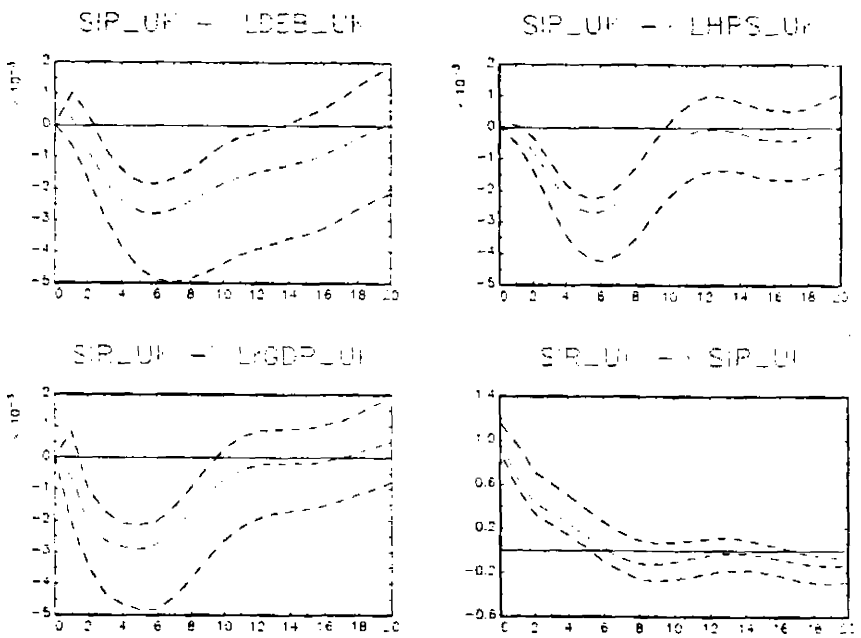

Figure 3: y, E, H, i - responses to a contractionary MP shock (1970:Q1-1990:Q4)

Next, we turn to examine an alternative VAR specification including total hours and real wages instead of employment and average hours.[17] We focus on the effect on total hours and real wages (figure 1, second row). The response for total hours follows a similar pattern as employment and average hours. They start declining immediately after the shock; however, their response is statistically significant only after the first two quarters following the shock, in addition their response is more persistent (returns to trend after about sixteen and a half quarters and

[16] We use a one standard deviation shock.

[17] In this case $a_{gp} = -0.5$, $a_{greer} = 0$, $a_{gw} = 0$, $a_{ty} = 1.0023$, $a_{tw} = 1.8532$, $a_{tTH} = 1.4159$, and $a_{tp} = 1.2996$.

reaches its maximum after eight quarters) and of a bigger magnitude. Real wages appear to be affected negatively by the monetary policy shock (as reported for the US economy in CEE (2001)), however their response is statistically insignificant. When considering the smaller sample 1970:Q1-1990:Q4 we still obtain an negative but insignificant response for real wages, while the response of total hours is similar to the one when using the whole sample, the only difference is that it is slightly less persistent this time, returning to trend after about fifteen and a half quarters.[18]

Overall, after the contractionary monetary policy shock takes place the real effective exchange rate appreciates; both forces generate a negative and delayed response to output; employment and average hours are affected in a negative manner, with an extra delay of one more and two more quarters for employment and average hours, respectively[19]. It seems that either economic agents perceive this shock as having permanent effects so they respond by firstly adjusting their labor input with respect to the extensive margin (employment) rather than the intensive margin (average hours), or that firms face smaller costs of adjusting employment relative to the costs of adjusting average hours (overtime wage) or a combination of these two. The results obtained in the smaller sample 1970:Q1-1990:Q4 indicate that the restructuring of the UK labor market in the 1980s improved flexibility and reduced the adjustment costs of labor input; so that while using the smaller sample, average hours respond faster than employment for about two quarters, when using the whole sample this result is overturned and employment's response is faster and more pronounced. Notice, that the response of total hours, employment and output is in line with relevant studies for the US (CEE 1999, Campbell 1997, Trigari 2003 etc) and Europe (Peersman and Smets, Mojon and Peersman (2001)). While with respect to average hours the results obtained for the US by Trigari (2003) are similar in that average hours' fall is smaller compared to employment, they differ significantly, though, in that the decline in average hours in the US is found to be transitory (it lasts about 5 quarters),with the adjustment one-two years following a shock being mainly in employment rather than in hours per worker[20]. In the UK, as we have

[18]Due to space limitations these results are not reported here, but are available upon request. Notice, that in this case we have re-calculated the elasticities using information concerning only this period, i.e. $a_{ty} = 0.9414$, $a_{tp} = 1.3772$, $a_{tTH} = 1.2514$, $a_{tw} = 1.9572$. As before the automatic response of output and total hours to net taxes has increased over time, while that of prices and real wages has decreased. Therefore, a change in the wage bill due to the total hours component, over time, generates a bigger increase on net taxes; whereas, a change in the wage component of the wage bill generates a smaller effect on net taxes over time. Alternatively, the contemporaneous effect on net taxes from the increase in the number of wage earners relative to the one coming from employers passing to a higher earnings bracket (due to higher wages) has increased over time.

[19]This pattern of response reflects also the increased significance of part-time employment in the UK, especially in the 1980's. Part-time employees having "weaker" contracts are the ones to be "sacked" with no or limited costs by firms in periods of bad economic conditions.

[20]The response of employment is explained by the transitory decrease in job creation and the larger and persistent increase in job destruction. Hence, these imply the presence of small firing costs, that can rationalize the smaller

seen, there is significant adjustment of average hours until the twelfth quarter after the monetary policy shock, and comparing to the small sample response its persistence increased by more than a semester (while employment returns to trend a semester faster). This implies that compared to the US, the labor input in the UK adjusts in a significant manner both with respect to the extensive and the intensive margin over the medium term (2-3 years), a result that is in line with the stylized facts regarding cyclical fluctuations presented at the Introduction, which might be also attributed to factors other than the adjustment costs of labor.

2.3.2 Spending shock

Figures 4 and 5 display the results for the case of a government spending shock in the benchmark VAR specification with employment and average hours. Total government purchases rise significantly and persistently following the shock, they return back to trend after about eleven quarters. Real net taxes increase marginally on impact (similarly to Fatas and Mihov (2001) and Gali Lopez-Salido and Valles or GLSV (2004)), however, their effect is not significant, thereafter they decline in a significant and persistent manner (after the third quarter), reaching their lowest value ten quarters after the shock. The response of government purchases and real net taxes suggest that a government purchases shock generates a persistent increase in primary budget deficit. Real GDP reacts positively but insignificantly on impact, next it become negative and significant after the second quarter. Its profile is very persistent, returning to trend seventeen quarters after the shock, whereas its maximal decline occurs eight quarters after the shock. Prices jump on impact and follow a hump-shaped pattern returning to trend after 15 quarters. The responses of prices and output are analogous to those reported in Perotti (2004) for the period 1963:Q1-2001:Q2 (and in particular those for the period 1980:Q1-2001:Q2).[21] The nominal interest rate responds in a negative and significant manner only after the fifth quarter[22]. Moreover, the combined effect of the nominal interest rate and inflation implies that the real interest rate will decrease on impact (and thereafter as the ex-post and ex-ante real interest rates in Perotti, 2004), which implies that the return on holding UK bonds will fall increasing their price, which will reduce the demand for UK bonds and consequently the demand for local currency (or it will increase the demand for foreign currency) generating a statistically significant real depreciation

and transitory response of hours per worker.

[21] When considering $a_{gp} = -1$, the impact effect on prices is much bigger, it follows a similar pattern as before but it returns to trend four and a half years following the spending shock. Additionally, output's impact effect is negative. In case where $a_{gp} = 0$, prices' impact response is negative and turns positive thereafter, however, it is insignificantly estimated. Moreover, output's impact response is positive and significant, thereafter it becomes negative as before (see Appendix, figures 20 and 21).

[22] This pattern of reaction while it seems puzzling is in line with the results obtained in Perotti (2004) for the UK (in the post 1980 period) and the US.

of the sterling on impact, that will turn out to be very persistent[23][24]. Notice that the real depreciation has a beneficial effect on domestic demand by fostering exports relative to imports, therefore it should have muted the negative effect that we observe on real GDP following the government spending shock.

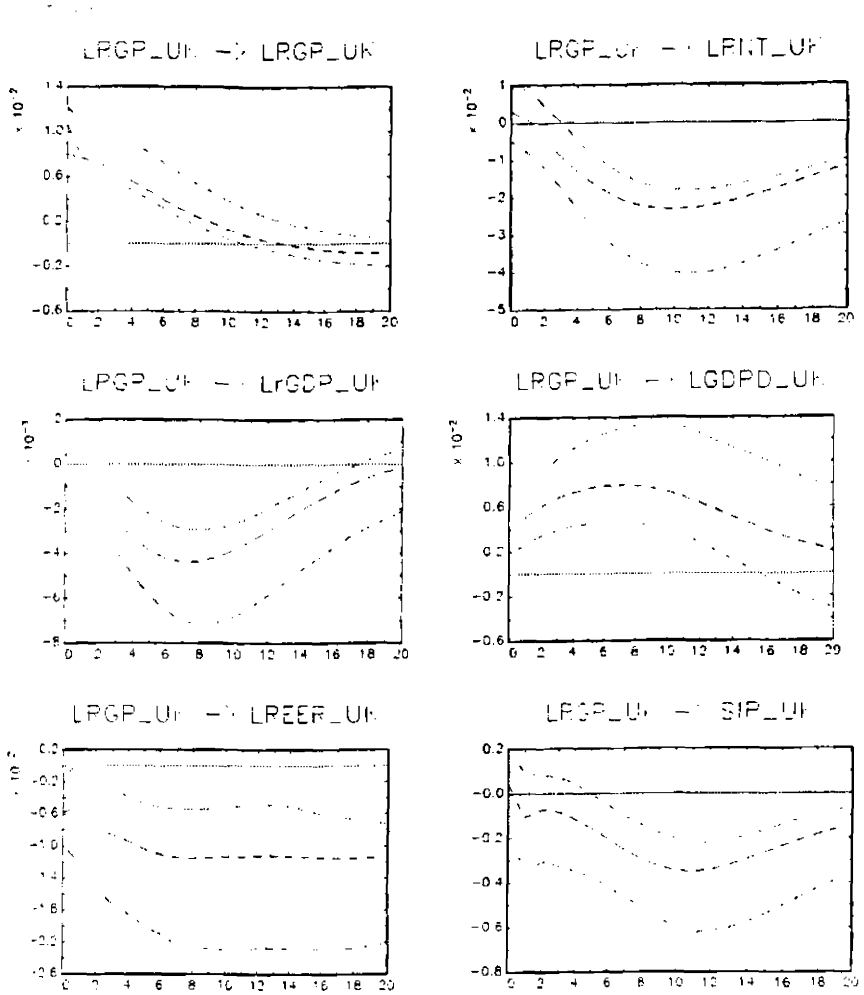

Figure 4: g, t, y, p, reer, i - an expansionary g shock

Employment responds with a delay of one quarter but then it declines in an accelerating pace, reaching its minimum value at the 9th quarter, while it returns to trend after about 5 years. This response, is in stark contrast with the results of Fatas and Mihov (2001) using US data, where employment increases in a hump-shaped pattern, furthermore, it appears that the negative response of employment generates a negative output response after the first quarter. Average hours respond in an insignificant manner to the government spending shock, however they seem to have a marginally significant negative effect between the 7th and 10th quarter.

[23] When considering the case with $a_{greer} = -0.06556$, the real effective exchange rate does react immediately as before but to a smaller extent and not significantly, whereas output falls immediately (see Appendix, figure 22).

[24] Alternatively, if the import content of government purchases is high enough, then it will lead to an immediate deterioration of the trade balance which would lead to a depreciation of sterling.

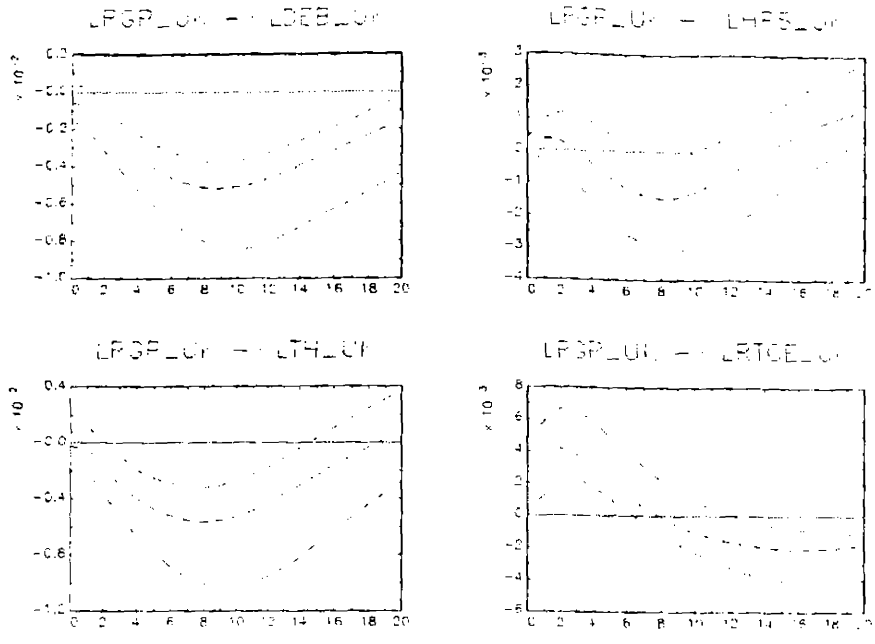

Figure 5: E, H, TH, RW - an expansionary g shock

When considering the smaller sample 1970:Q1-1990:Q4, in order to evaluate whether there is any significant change in the responsiveness of the labor market variables and output over time, we see that the response of employment is less persistent returning to trend around the 17th quarter, while average hours have the same response profile as before with the exception that they are significant for a bigger period (between 6th and 10th quarter). The output response is much less persistent reaching its maximum two quarters after the shock and return to trend three years after the shock[25]. Overall, the variables' responses appear qualitatively the same, being slightly less persistent, except for average hours that are a bit more persistent. The fact that the responses of employment and average hours are no different in this smaller sample (contrary to the case of a monetary policy shock) could be attributed to the fact that firms perceive government spending changes as being more persistent, adjusting in a profit maximizing way (mainly along the extensive margin) their labor input decisions. It is noteworthy that the size of the spending shock was smaller in the sample 1970:Q1-1990:Q4, as judged by the value of the impulse response of spending on impact[26]. Moreover, it is less persistent crossing the zero line around the 10th quarter while in the whole sample case this happens only at the 12th quarter.

Next, we examine the effects of a spending shock on total hours and real wages (figure 5, second row). The response of total hours is a mixture of the responses of employment and average hours. After a delay of one to two quarters total hours decline fast reaching their lowest value after eight to nine quarters, thereafter they return faster to trend (after 15 quarters) compared to employment. In the smaller sample case 1970:Q1-1990:Q4 (figure 6) the effect comes along a

[25] See Appendix, figures 23 and 24.

[26] Keep in mind that we are consider a one standard deviation shock.

quarter faster but is less persistent, i.e. it returns to trend two quarters earlier (at the thirteenth quarter). These results are in contrast with the results of similar studies for the US economy. Fatas and Mihov (2001) find that employment increase in a hump-shaped pattern following a government spending shock, whereas, total hours do not deviate significantly from trend. GLSV (2003), as well as, and Burnside, Eichenbaum and Fisher (2003) report a positive hump-shaped pattern for total hours. On the other hand, the response of real wages is analogous to results obtained for the US economy (Fatas and Mihov 2001 and GLSV 2003) i.e. it is positive on impact and follows a hump-shaped pattern. In addition, it crosses the zero line at about the seventh quarter and becomes negative and statistically significant after the 12th quarter, approaching back to trend after five years from the impact period.[27] In the small sample case, the response of real wages follows the same pattern but is more pronounced on impact and less persistent, crossing the zero line after the fifth quarter. Therefore, it appears that in the smaller sample the spending shock had a larger impact effect on the labor market variables, particularly real wages, despite the fact that it had a slightly smaller size. Moreover, the responses of the labor market variables were less persistent, because the spending response was also less persistent.

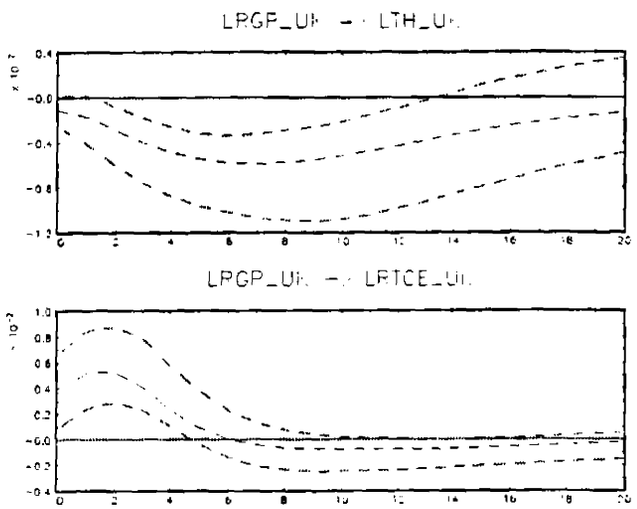

Figure 6: TH, RW - expansionary g shock 1970:Q1-90:Q4

Overall, we observe that on impact employment and consequently total hours do not respond for about one-two quarters, whereas real wages jump following the shock. Furthermore, at first glance, the response of the employment variables are perfectly consistent with the response of output, which is driven by them. To verify this we exclude the labor input and real wages variables from the VAR; still we get the same pattern of reaction for real GDP[28]. This is in line with the

[27] If we allow for $a_{gw} = 0.1757$ real wages' impact response to the spending shock is still positive, though of a smaller magnitude and not significant on impact, thereafter it behaves as before except that it crosses the zero line a half a quarter earlier than before. Total hours follow a similar pattern as before, though their response returns back to trend on the 14th instead of the 15th quarter (Appendix, figure 25).

[28] The results are not presented here, but are available upon request.

work by Perotti (2004) where he finds that the effect of government spending on output in the UK has been much lower compared to the US in terms of magnitude of impact effect, persistence and statistical significance, in particular in the period 1980:Q1-2001:Q2. This works through the employment channel, because in all previous empirical U.S. studies the response of employment or total hours has been positive and hump-shaped, i.e. persistent, generating an analogous output response. Therefore it seems that government spending in the UK has not been able to generate a positive and persistent response of employment and output.

GDP components

These results are quite puzzling, so further investigation is required in order to understand what hinges behind the responses of real wages, labor input and output. Therefore we will discuss how the GDP components are affected by a spending shock. We will consider real private consumption expenditure, real private investment (residential and non-residential), real import and real exports[29]. Each component is added before the real effective exchange rate i.e. assuming that each GDP component belongs to the information set of the monetary authority (while it can also affect the real effective exchange rate within the quarter). An increase in spending reduces the real private consumption expenditure in a statistically significant manner after the third quarter (figure 7); its pattern of response is analogous to the response of output. This resembles the result of Perotti (2004) for UK in his 1980:Q1-2001:Q2 sub-sample, but is contrary to the positive consumption response in relevant US studies, like Blanchard and Perotti (2002), Fatas and Mihov (2001). Furthermore, real non-residential investment respond in a negative and quite persistent manner following a spending shock (though on impact they increase but not significantly). In the Fatas and Mihov (2001) study for the US economy, the response of business investment is positive but not significant, while in GLSV (2003) they have a negative but insignificant response. In a panel of OECD countries Alesina et al (2002) show that business investment are reduced following an increase in government spending, which is due to the government wage bill component, because a higher government wage spending puts upward pressure on private sector wages increasing labor cost and reducing profits, reducing thus investment (this would be examined in more detail in the following section where composition effects of government spending will be taken into account). Residential investment fall on impact and remain below trend until the 15th quarter, while the non-residential investment decline in a more persistent manner returning to trend around the 20th quarter. In Fatas and Mihov (2003), residential investment fall until the 8th quarter, though their response is not significant. Interestingly, both the nominal interest rate and the net taxes do not increase on impact in a significant manner, whereas the real interest rate falls on impact (providing an incentive for an increase in borrowing), however residential invest-

[29] Each GDP component is deflated by its respective deflator.

ment decline to a large extent attaining their minimum value. Overall, total private investment are crowed out by government spending, with their responses following a hump-shaped pattern as those of output and consumption, though their value on impact is negative and insignificant. A similar response is reported in Perotti (2004) for the UK in the period 1980:Q1-2001:Q2, while in Blanchard and Perotti (2002) private investment is crowed out following a spending shock in the US economy.

The response pattern of real imports is similar to that of output, i.e. the decrease in output and income leads to lower demand for imported goods. Real exports decrease as well, but to a smaller extend and their response is much less persistent compared to that for imports[30]. The combined effect of these two variables generates an increase in net exports, i.e. the trade balance of the economy improves in a horizon of five years after the shock which is in line with the real depreciation of sterling over the same horizon as a consequence of an increase in government spending. Though, the depreciation makes economic agents in the UK to substitute imported goods for locally produced, but it does not bolster export demand as a consequence local demand and output is not fostered[31].

[30] An earlier version (2002) of Perotti (2004) presents analogous evidence for imports, whereas exports decline on impact but turn positive when considering the last twenty years.

[31] When considering the smaller sample 1970:Q1-1990:Q4 the responses of all variables are less persistent because the spending response to own shock is also less persistent (these results are not presented here but are available on request). Specifically, the response profile for consumption is analogous though it returns earlier to trend, i.e. four years after the shock. The response profile of private investment and its components is similar but less persistent crossing the zero line after 3 years. Business investment increase on impact in a significant manner, but thereafter they decline but their response is insignificant. Residential investments are crowed out following the spending shock; they return to trend around the 11th quarter. Exports' response is insignificant. Whereas imports have a bigger impact effect, though insignificant, and they return to trend much earlier (12th quarter) relative to the whole sample case because the spending shock itself is less persistent and the response of the real effective exchange rate is insignificant (i.e. there is no expenditure switching effect in favor of the domestic relative to the imported goods).

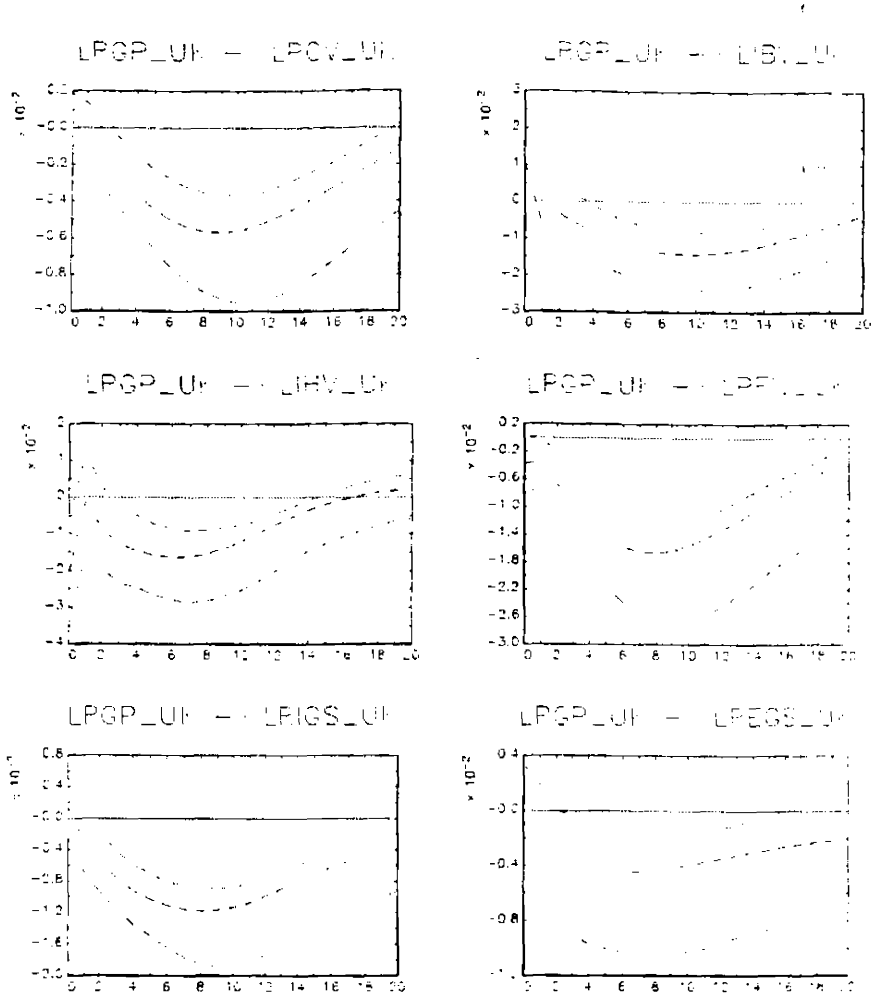

Figure 7: response of GDP components to an expansionary g shock

It appears that there is a "labor market channel" (as is cited in Alesina et al (2002), while in Lane and Perotti (2003) it is reported as the "cost channel" of fiscal policy) through which fiscal policy affects economic activity. More specifically, an unanticipated government spending shock by raising real wages in the private sector increases labor costs, this reduces profits as well as expectation about future profits, due to an decrease in the competitiveness of the business sector. The implications are a cut back in hiring and an acceleration in firing, thus employment is reduced, moreover, investment projects are aborted due to a decrease in profitability as a result of higher labor cost. Hence, output and income are reduced, as a result consumption and investment are both crowed out by an increase in government spending. Moreover, the reduction in private demand discourages the demand for imports, while export activity is also diminished due to higher labor costs. Notice, that the real depreciation of sterling, through the increase in net exports, must have muted the negative output response which is attributed to the deterioration of the competitiveness of UK firms as a consequence of the higher labor costs. The workings of this "cost or labor market channel" of fiscal policy will be further investigated by considering the effects of the different spending components.

Composition effects of government spending

The next step will be to examine the implications of decomposing real total government purchases into real government consumption and real government investment. Over the period 1970:Q1-2003:Q1 real government consumption constitutes on average 92.4 percent of real government purchases, while the remaining 7.6 percent is the government investment share. Therefore, the implications of a unanticipated increase in real government consumption are of a great importance in understanding how government spending affects employment, hours and real wages, as well as output and its components. To this end we will further decompose real government consumption into real wage government consumption and real non-wage government consumption. Real wage government consumption constitutes on average 52.4 percent of real government purchases, while real non-wage government consumption's share is about 40 percent. However, while the ratio of government consumption to total government purchases is relatively stable over the sample, e.g. it was 87.9 percent on the first quarter of 1970 and 91.8 percent on the first quarter of 2003, the share of the wage government consumption has declined substantially i.e. from around 67.8 percent during the first quarter of 1970 to 34 percent over the first quarter of 2003. The opposite is the case for the non-wage government consumption which was 20.1 percent of total government purchases when considering the first observation of the sample and became 57.8 percent over the first quarter of 2003.

Government consumption The response of government consumption to own shocks is more persistent relative to the case of government spending[32], consequently both the labor market variables and the output respond in a more persistent manner to the shock (see Appendix, figure 26).[33]. Employment drops immediately after the shock and declines in a persistent manner (figure 8). Average hours decline with a delay of two quarters, thereafter its response follows a hump-shaped pattern, with its maximal decline being around the 7th quarter, while it returns to trend after nineteen quarters. As a result total hours respond in a more persistent manner. Furthermore, the response of real wages is more pronounced and more persistent, returning to trend after the tenth than after the sixth quarter. Prices, real GDP and its components respond in a similar manner as before, with the exception of residential investment and exports (as well as the interest rate and the real effective exchange rate) that are insignificant (Appendix, figures

[32] It goes back to trend three and a half years after the shock, instead of eleven quarters.

[33] The results correspond to the benchmark specification with $a_{gp} = -0.5$, $a_{gy} = a_{greer} = 0$, $a_{treer} = 0$, $a_{ty} = 0.9977$, $a_{tp} = 1.2996$, $a_{tE} = 1.5069$, $a_{tH} = 1.1029$.

26 and 27).[34][35]

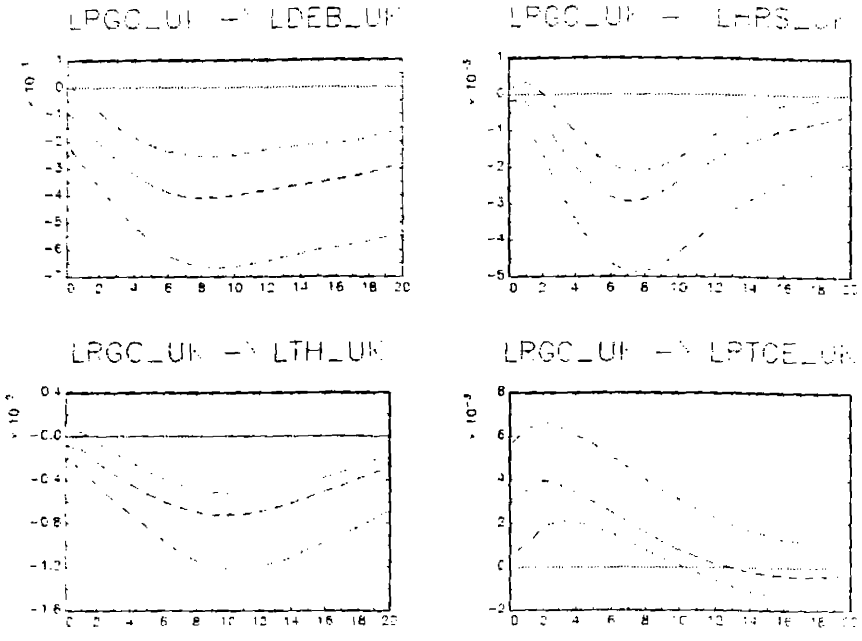

Figure 8: E, H, TH, RW - an expansionary government consumption shock

Wage government consumption When examining the responses of labor market variables to an innovation on the wage government consumption component we see that employment, average hours and total hours respond in a negative and significant manner, while real wages increase substantially on impact and thereafter (figure 9).[36][37] As a result the output response is negative and very persistent. The response of consumption is similar to that of output while private investment does not respond in a significant manner. Though the response of its components is significant (Appendix, figures 33, 34), i.e. business investment decreases three quarters after the shock, while residential investment responds positively only after two and a half years following the shock; notice that a bigger government wage bill implies a higher disposable income for a group of people which can serve as an explanation of the boost in residential investment. Both imports and exports fall, with the export decline being more pronounced two and a half years after the shock, i.e. net exports decrease and the real effective exchange rate appreciates. Notice,

[34] When allowing $a_{rgc,w} = 0.2255$, the real wages impact response is of smaller magnitude and insignificant; moreover, the response becomes significant only after the second quarter, and it returns to trend earlier i.e. in the 9th rather than the 10th quarter. The total hours' response is also half quarter delayed (Appendix, figure 28).

[35] When considering the smaller sample (where the government consumption response to own shock is less persistent) we find similar results, but the responses of all labour market variables are more pronounced but less persistent. The same applies for output and its components. The only difference is that the nominal interest rate increases in a significant manner between the second and the fourth quarter following the government consumption shock (Appendix, figures 29-31).

[36] Pappa (2003) reports analogous results for employment and real wages in about 12 out of 41 US states.

[37] Allowing for $a_{rgc,w} = 0.2538$ generates a zero impact effect of real wage; its response is equally persistent as before but significant only after the fourth quarter (Appendix, figure 32).

that when considering the smaller sample (1970:Q1-1990:Q4), we see that the response of wage government consumption to own shocks is of a lower magnitude and less persistent. Nevertheless, both employment and output respond negatively and in a more pronounced way one semester after the shock takes place; while for total hours this happens three semesters after the shock (figure 10 and figures 35, 36 in Appendix).[38] On the contrary the response of real wages is bigger until the first five quarters, however it is much less persistent returning to trend after seven quarters. This could imply that when the share of wage government consumption was bigger (from 67.8 percent in 1970:Q1, to 47 percent in 1990:Q4, and finally to 34 percent in 2003:Q1) the negative effects on employment and output and the positive on real wages were bigger, whereas when its share in total government purchases started to decline these effects became more muted but remained equally persistent (except of the effect on real wages that became more persistent, in line with the response of wage government consumption to own shocks).

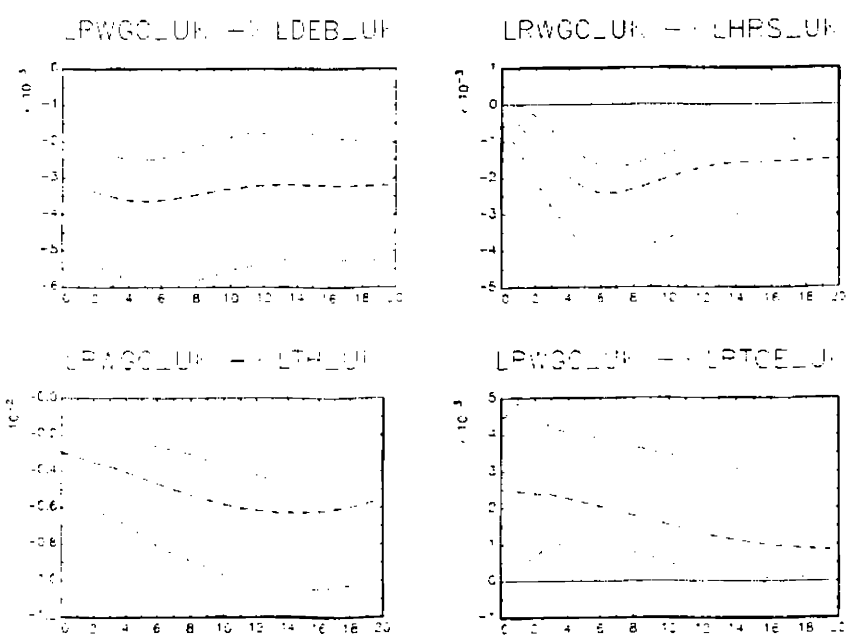

Figure 9: E, H, TH, RW - an expansionary wage consumption shock

[38] Similarly for consumption and imports.

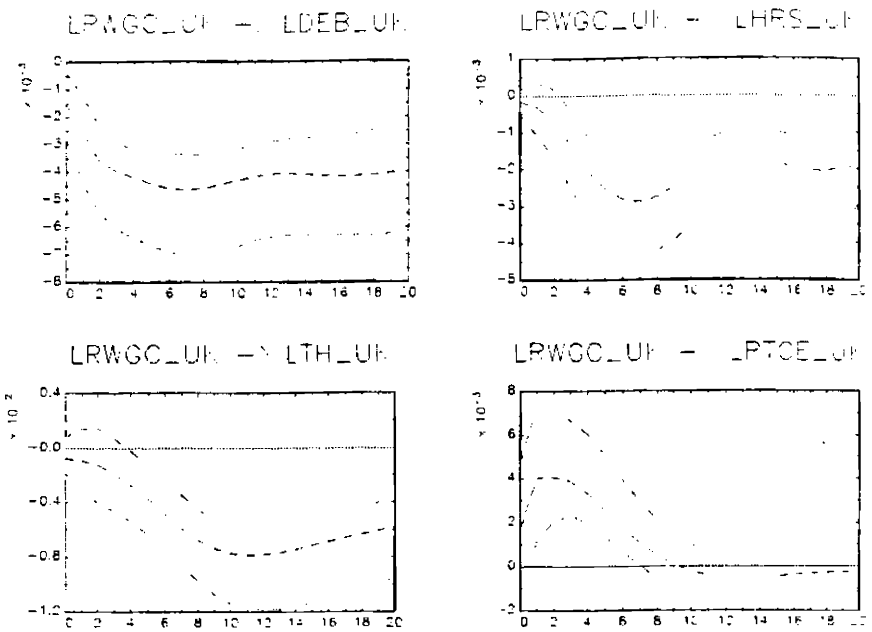

Figure 10 : E, H, TH, RW - an expansionary wage consumption shock (1970:Q1-1990:Q4)

Non-wage government consumption A non-wage government consumption shock generates a positive and significant impact effect on employment, however, thereof its response is insignificant (figure 11). On the contrary, the effect on average hours is more persistent and significant, following a hump-shaped pattern reaching its maximum four quarters after the shock; note that five years after the shock it is still above trend. Total hours respond in a positive manner, however their response is significant only during the first year following the shock, as well as, around the end of the five year horizon. Real wages respond in an insignificant manner, but two years after the shock occurs their decline is significant and persistent.[39] Like employment, output responds in a positive and significant way on impact, but thereafter it return to trend (Appendix, figures 38 and 39). Analogous is the response pattern of private consumption, though it declines significantly between the tenth and twelfth quarter. Private investment also decreases significantly, but only after the seventh quarter, however contrary to the case of a shock on the government wage bill component of spending, business investment are not affected while residential investment decline significantly (between the fifth and the sixteenth quarter). Notice that in this case the nominal interest rate increases on impact (it is significant between the second and fifth quarter). Furthermore, exports appear to be unaffected, while imports decline is statistically significant two years after the shock, which implies that net exports are positively affected (this is generated by the depreciation of the real effective exchange rate).

In the smaller sample case (1970:Q1-1990:Q4), the response of the non-wage government

[39] This response profile is similar when considering also $a_{nwgc,w} = 0.3596$, the only difference is that in this case the impact effect is smaller, but still not significant (Appendix, figure 37).

consumption component to own shocks is bigger on impact but less persistent, returning to trend after one and a half years. Nevertheless, the response of employment (total hours and output) looks as in the case of a shock on wage government consumption, i.e. it is negative until the eleventh quarter (7th quarter, respectively) but thereafter it goes back to trend; whereas real wages increase significantly and in a hump-shaped pattern the first year after the shock (figure 12 and figures 40 and 41 in Appendix). Consequently, the responses of private consumption, private investment (still residential investment determine its response profile) and imports[40] are similar to the output response. Notice that the wage and non-wage components of government consumption are substitutes as relevant VAR analysis has indicated for the whole sample case. Though in the smaller sample, while an increase in wage government consumption generates a negative response on the non-wage government consumption component, in the reverse case the response is positive but significant only between the first and third quarter. Therefore, an unanticipated increase of the non-wage government consumption component the time that its share was small (20.1 percent in 1970:Q1, 45.22 percent in 1990:Q4, and finally 57.8 percent of total government spending in 2003:Q1) was accompanied by an increase of the wage government consumption component that probably generated the real wage increase.[41] Hence, the nature of the relationship between the different spending components has changed over time. This implies that when the share of the non-wage government consumption increased, its effects on employment, average hours and output switched to being positive and significant (only on impact, though, for employment and output), while the effect on the wage component of spending became negative. Therefore, the composition effects of spending and their evolution over time are very crucial elements for determining the responses of real wages, labor input and output.

[40] In this case *rer* does not react in a statistically significantly manner.

[41] The responses are not shown here but are available upon request. The wage and non-wage components were introduced together in the benchmark VAR. Both orderings were considered, allowing interactions between the economic shocks of the two spending components, as well as taxes. The price elasticities was -0.5 for the non-wage component and -1 for the wage component of government consumption.

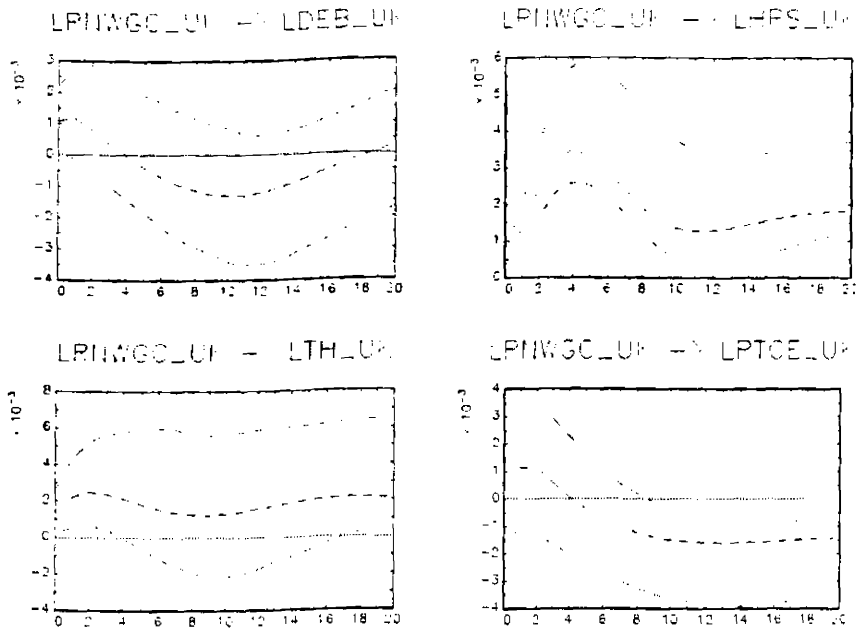

Figure 11: E, H, TH, RW - non wage government consumption shock

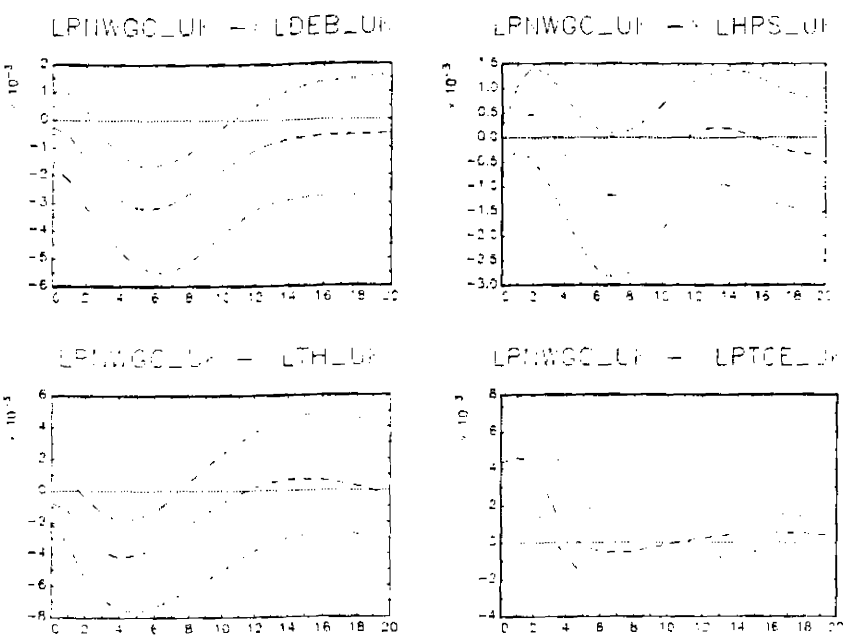

Figure 12: E, H, TH, RW - expansionary non-wage government consumption shock (1970:Q1-1990:Q4)

Government Investment The effects of a government investment innovation on employment, average hours, total hours and real wages are displayed on figure 13. Employment responds in a negative but insignificant manner. The response of average hours is positive and quite persistent, it follows a hump-shaped pattern reaching its maximum one and a half years after the shock, thereafter it declines without returning to trend over the five year horizon studied. Total hours respond positively but quite insignificantly, whereas the response of real wages is insignificant over the first eleven-twelve quarters, thereof it turns negative and significant.

The response of prices, output and consumption is not significant (see Appendix, figures 42 and 43). Private investment is crowed out by government investment projects. Although business investment increases on impact, thereafter it returns back to trend; while residential investment declines significantly up to three years after the shock. However, the interest rate falls in a persistent manner. Both imports and exports fall, but their relative changes leads to an increase in net exports (the depreciation of local currency has generated a expenditure switch effect from imported to locally produced goods, which however did not lead to an increase in output).[42]

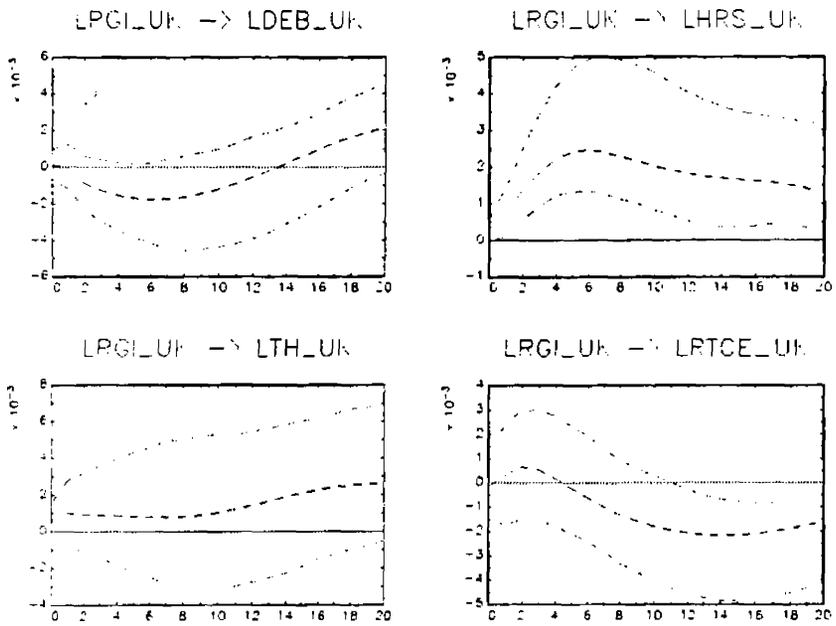

Figure 13: E, H, TH, RW - an expansionary government investment shock

Findings: Overall, after having examined the effects of different spending components on labor input, real wages, output and its components we conclude that there is a "cost or labor market channel" of fiscal policy as defined, by Lane and Perotti (2003) and Alesina et al (2002), respectively. Specifically, we have found that an increase in government purchases, and particularly in the wage bill component of government spending, increases the wages in the private sector, reducing firms profits, which leads to a decrease in employment and business investment in the current and future periods. As a result, output, income and private consumption expenditure

[42] When considering the smaller sample case (1970:Q1-1990:Q4) the government investment shock is more persistent, but of a smaller magnitude compared to the whole sample case. Furthermore, all labour market variables respond in an insignificant manner (Appendix, figures 44, 45, 46). The only significant difference is that around the end of the horizon considered (17-18th quarter) total hours respond positively (due to average hours) and this generates an analogous response by output, consumption and private investment. Though, as for the whole sample private investment decrease for two and a half years after the shock (although business investment increase on impact, residential investment fall until about the 10th quarter). Moreover, the increase in output fosters import demand; while exports are affected positively between the 2nd and 10th quarter, as well as around the end of the horizon considered.

contract. Notice, that in case of an unanticipated increase in wage government consumption the nominal interest rate does not change in a statistically significant manner, while prices increase, so the real interest rate decreases in a significant manner, nevertheless business investment fall. However, residential investment is unaffected in the short run and increases significantly two years after the shock.

Increases in the non-wage component of government consumption or the government investment do not generate an increase in private sector wages (though in the smaller sample real wages were raised after a shock on the non-wage government consumption component, probably because the same shock prompt as well the wage-bill component of government consumption), as a result employment in the business sector is unaffected or increases on impact; though average hours increase in a persistent manner generating a significant increase in total hours (particularly in the whole sample case and mostly for non-wage government consumption). Furthermore, when the nominal interest rate increases on impact (non-wage government consumption) business investment are unaffected, whereas residential investment decline in a significant manner but only one year after the shock. An innovation in government investment boosts business investment, only on impact though, and decreases residential investment. However, in both cases private consumption and consequently demand is not enhanced, except on impact. Moreover, the depreciation of the real effective exchange rate implies that import demand is discouraged, while exports decline to a smaller extent or are unaffected.

It is noteworthy that when the labor input declines, i.e. in the cases of a wage government consumption shock (both for the whole and smaller samples) and a non-wage government consumption in the smaller sample, both employment and average hours decline. However, when the labor input increases, like in the case of a non-wage government consumption shock (whole sample case) or a government investment shock (not significantly in the whole sample case, while it is significant in the small sample but only at the end of the horizon), the adjustment takes the form of an increase in average hours per worker, with employment changes being insignificant over the five year horizon considered. Thus, an increase in real wages deteriorates the competitive position of UK firms inducing them, through profit maximization (or cost minimization), to reduce the number workers they employ; whereas when the spending boost is not affecting their labor costs, firms adjust their labor input only along the intensive margin because they anticipate that the shock will have temporary effects on private demand.

Are these findings in accord with the theory? Several papers have study the effects of government wage bill. Finn (1998), in an environment of competitive labour markets and lump-sum taxation, suggests that an increase in government employment can lead to lower employment (if the wealth effect is small) and higher real wages, as well as lower private hours, output and investment. In Ardagna (2001) where labour market is unionized the increase in government

wage bill raises the outside option of workers, leading to higher real wages in the private sector. Therefore, labor costs increase in both cases and can affect firms decisions on employment and investment ("cost or labor market channel" of fiscal policy). Pappa (2003) reports that an increase in government employment (in an RBC model) that leads through factor relocation to a reduction in private employment can reduce output, consumption and investment and raise real wages if government employment is unproductive for the private sector. Similarly, Cavallo (2003) finds that a government employment shock decreases private hours, output and investment.

When considering the non-wage government consumption and government investment a Real Business Cycle model with distortionary taxation could deliver some of the results. Specifically, the increase in spending that is to be financed by current and future taxes generates a wealth effect that decreases consumption and increases labor supply. Both the intertemporal substitution effect (individual prefer to supply more labor in the period where the labor taxes are low) and the intratemporal substitution effect (individual prefer to supply more labor when the cost of work relative to leisure is low) reduce labor supply while the intertemporal effect decreases also consumption. In this case the effect on labor supply and real wages is ambiguous, if the elasticity of labor is big enough labor supply could even decrease and real wages increase. Introducing price stickiness and monopolistic competition we can generate an increase in labor demand. The implications for employment and real wages, consumption and consequently output and investment will depend on the strength of the intertemporal and intratermporal substitution effects relative to the wealth effect and the severity of price rigidities, as well as the persistence of the spending shock and the timing of taxation.

An alternative explanation could be based on the notions of job creation and job destruction. Specifically, the wage pressure caused by an increase on the government wage bill could reduce substantially job creation, as well as, raise job destruction, while the boost in private demand by the increase on the wage and non-wage components of government spending might generate only a temporary reduction in job destruction leaving unaffected job creation. In this case employment could be reduced.

2.3.3 Tax shock

The correlation between the cyclically adjusted spending and tax shocks is low and insignificant, therefore the ordering of spending and taxation does not have an effect on the responses generated. In figures 14, 15 and 16 we present the responses following a net tax shock, when net taxes are ordered first in the benchmark VAR with employment and average hours. Net taxes respond in a positive and persistent manner to an own shock, i.e they return to trend much after the 20th quarter. The response of government spending is not significant, oscillating around the zero line over the whole horizon considered. The profile of responses of the fiscal variables indicates that following a shock on net taxes, the primary budget deficit declines in a persistent manner; alternatively starting from a balanced budget an increase in net taxes will generate a primary surplus.[43] The impact effect on prices is negative, it remains so until the eighth to ninth quarter, thereafter it becomes positive. However, prices' response is significant only on impact and after the eighteenth quarter.[44] The net tax shock has a negative but insignificant effect on the nominal interest rate until the seventh quarter, thereof it is positive and significant and stays so until the twentieth quarter.

Employment decreases on impact following an unanticipated increase in net taxes However, it increases in a significant and hump-shaped pattern after the fourth quarter reaching its maximum value around the eighth quarter, finally it returns to trend four years after the shock. Average hours oscillate around zero for about fifteen quarters, afterwards they decrease significantly. Therefore, it appears that a net taxes shock affects mostly employment than average hours for the first three and a half years, thereafter the effect on average hours is more pronounced and thus more persistent. However, the response of total hours is mostly determined by the response profile of employment (it is significant between the fifth and fifteenth quarter). Real wages decrease on impact, and remain negative the first two quarters. After the eighth quarter their response becomes positive and remains so until the end of the horizon considered.

The impulse response of output is quite similar to the responses of employment and total

[43] As displayed in figure 47 in the Appendix, government consumption will increase, though its response is significant only on impact, as well as after the 13th quarter. The wage government consumption component will increase substantially following a net taxes shock, but the non-wage government consumption component will decrease in a statistically significant manner. Government investment decline on impact, but thereafter their response profile is insignificant. Hence, after an unanticipated increase on net taxes the government substitutes the spending in goods (government investment and non-wage government consumption) with higher spending on the government wage bill. In total, the extra revenues generate surpluses, because the government spending is unchanged, i.e. there are no "voracity" effects in the UK.

[44] An analogous pattern of response is presented in Perotti (2002) especially with respect to results that refer to his second sub-sample 1980:Q1-2001:Q2, notice that the price elasticity of net taxes is 1.32 in this sub-sample (and 1.21 over the whole sample 1963:Q1-2001:Q2), while we have calculated it to be 1.2996. Moreover, as is shown in the previously mentioned paper reducing by 0.5 the relevant elasticities the results remain qualitatively the same.

hours. Specifically, it responds positively with a delay of one semester and has a hump-shaped profile reaching its maximum value after six to seven quarters, finally it returns back to trend around the thirteenth quarter. Analogous results are reported by Perotti (2004),[45] where he also claims that the positive effect of output on taxes might be due to the low output elasticity of net taxes (it is below unity, while in the US and Canada where net taxes have a negative effect on output it approaches two, because there are no lags in the tax collection of direct taxes to businesses). Increasing the output elasticity of net taxes by one he shows that this can generate a negative impact effect in the UK, however the impact effect remains positive and significant when considering only the period 1980:Q1-2001:Q2. Turning now to the GDP components, we see that the response profile of private consumption and private investment are qualitatively similar to the response of output, with the response of private consumption being more pronounced. Moreover, both residential and non-residential investment respond in a similar manner, however residential investment respond faster, i.e. one quarter after the shock, while the non-residential component responds three quarters after the shock. Similar responses for consumption and investment in the UK are reported in Perotti (2004), in particular for the sample 1980:Q1-2001:Q2. Both imports and exports are affected positively by an unanticipated tax hike, they both respond in the same hump-shaped pattern as output, with the export response being faster (one quarter after the shock) but less persistent than the corresponding import response. Hence until about the fourth quarter net exports were positive but thereafter they turned negative, which is in line with an appreciation of the real effective exchange rate (after the fifth quarter). Notice, that in Blanchard and Perotti (2002), net taxes were found to have negative or insignificant effects in the US economy[46].

How could these findings be justified by theory? In principle, a tax hike in the current period, when government spending is unchanged, will be matched by lower taxes in the future in an RBC model with distortionary taxation. In this case it generates an intertemporal substitution effect making individuals more willing to work and consume in the future periods when taxation is smaller than in the current period, in addition it creates an intratemporal substitution effect

[45] For the US in the period 1980:Q1-2001:Q2, and for UK and Australia in the periods (1963:Q1-2001:Q2) and (1960:Q1-2001:Q2), respectively, as well as for the smaller sample starting in 1980:Q1. Moreover, notice that Perotti (2004) considers a tax cut instead of a tax hike.

[46] In the smaller sample case the response of all variable are qualitatively the same (figures 48-51 in Appendix). The only difference is that average hours increase significantly from the 8th until the twelfth quarter, reinforcing the increase in total hours driven by the increase in employment. The fall in real wages lasts until the sixth quarter, thereafter they return to trend. Output, consumption and investment respond as before. However, the nominal interest rate declines in significant manner between the first and tenth quarter. The response of imports is not significant, while exports decline between the 4rth and 6th quarter and increase between the 10th and 17th. The real effective exchange rate is depreciated, but is response is significantly estimated only between the fourth and 8th quarter.

(the increase in the cost of work relative to leisure), that also affects negatively the supply of labor in the current period. Moreover, an increased tax burden on the part of firms (and consumers that lowers income and total demand) can make them reduce employment (reduction in the demand for labor); if the adjustment cost of labor is small and shocks are perceived to be permanent. Nevertheless this will also depend on the extent of price rigidities. However, the net impact effect on employment and real wages might not be clear. Hence, according to the obtained dynamic response profile of real wages, the fall in labor supply should be smaller compared to the fall in labor demand right after the shock occurs, decreasing real wages; while the opposite appears to be the case one year after the net tax shock takes place. Furthermore, a strong intertemporal elasticity of labor can generate an increase in private demand in the future periods.[47] Alternatively, the relative movements of labor demand and labor supply that decrease employment and real wage on impact lower labor costs faced by firms, improving their competitive position in the medium term, fostering exports and boosting business investment and employment, which in turn will increase output and private demand.

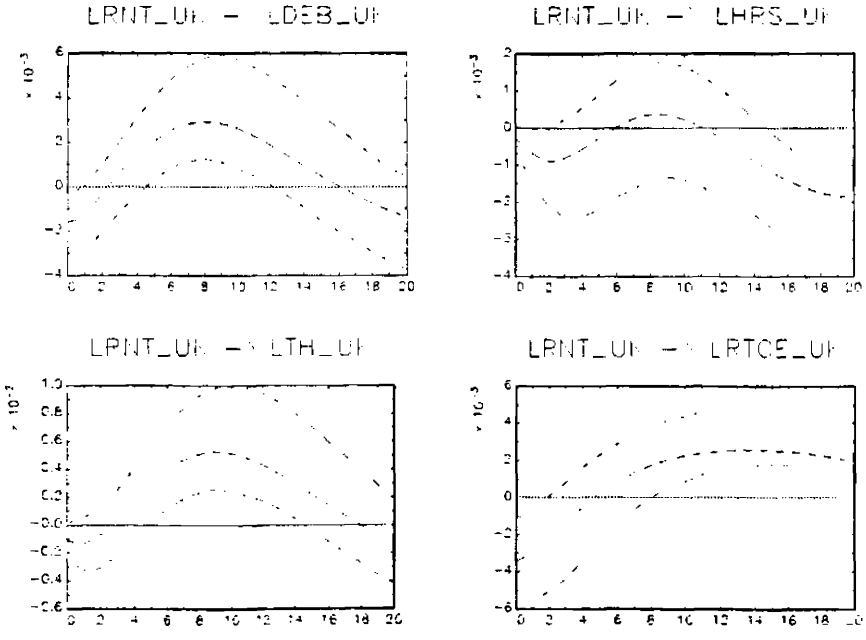

Figure 14: E, H, TH, RW - a contractionary net tax shock

[47]The private sector perceives the tax hike as having long lasting effects, while the intertemporal elasticity of labor supply is low, so that labor demand falls more than labor supply.

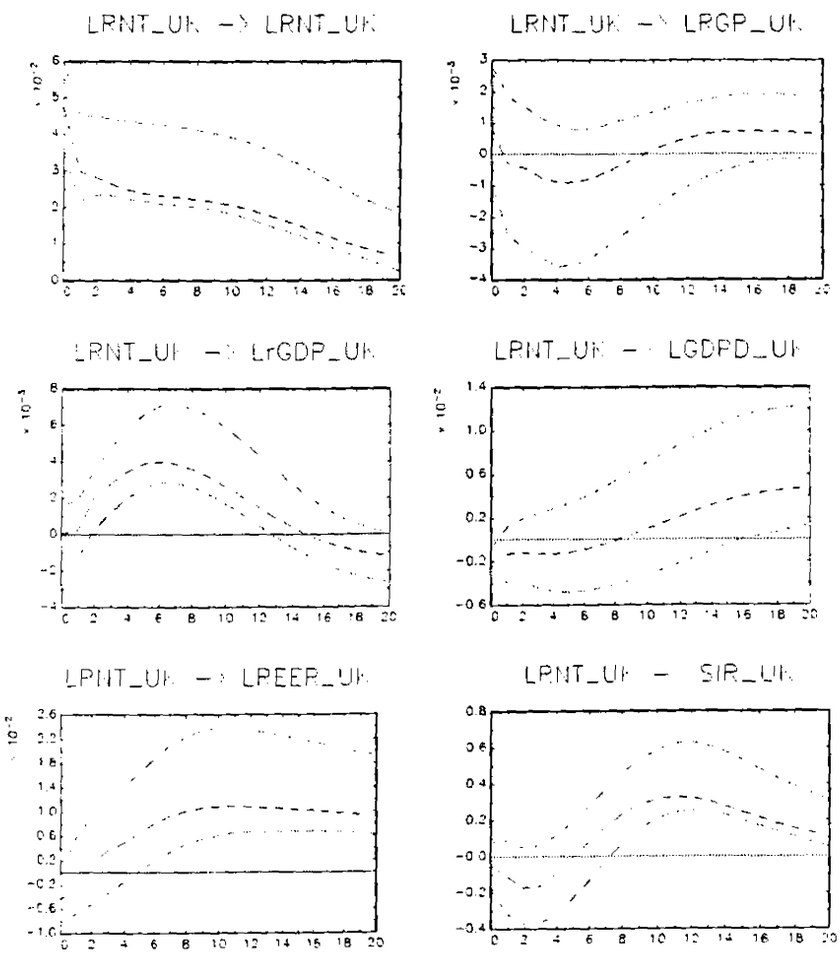

Figure 15: g, t, y, p, reer, i - a contractionary net tax shock

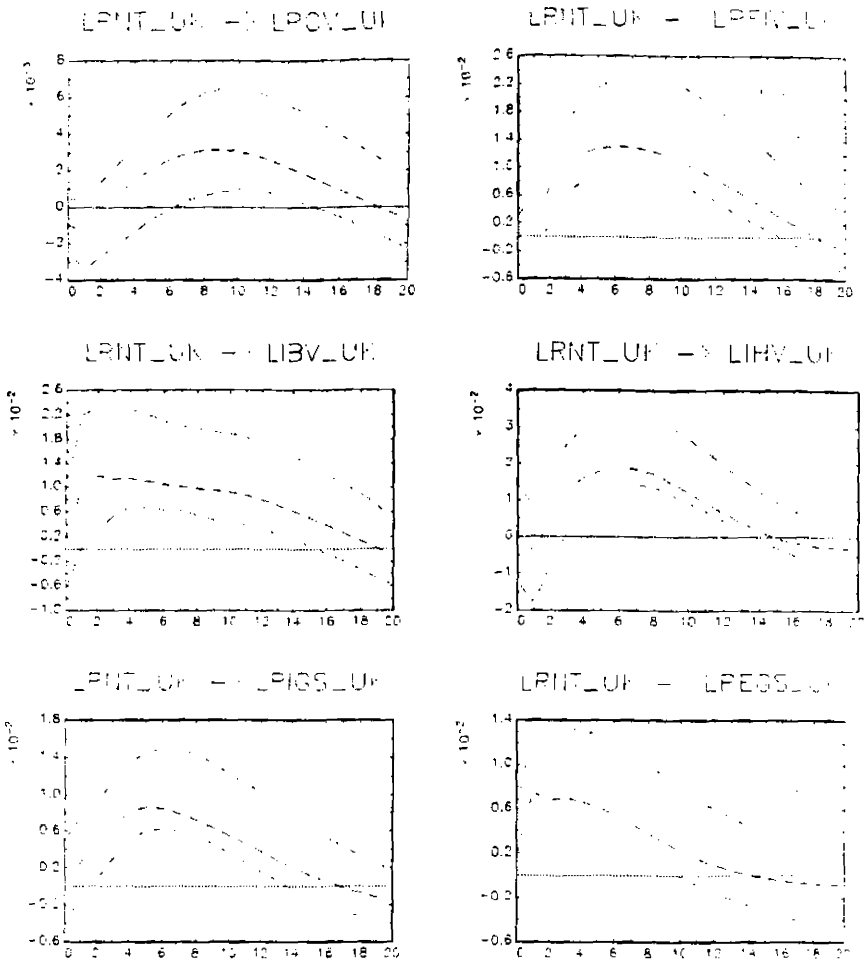

Figure 16: GDP components - a contractionary net tax shock

2.4 Conclusion

This paper has investigated the dynamic response of employment, average hours per worker, total hours and real wages to monetary, government spending and net taxes shocks in the UK. We considered the effects of a government consumption and a government investment shock separately. Government consumption is further decomposed into its wage and non-wage components. The main findings with respect to the *monetary policy shock* are as follows: the responses of employment and hours are negative and follow a hump-shaped pattern generating an analogous response for output. The adjustment of labor input is primarily along the extensive margin, however there is also significant adjustment along the intensive margin one year after the shock (contrary to the previous findings for the US economy where the fall in average hours is transitory). When considering the smaller sample 1970 Q1-1990 Q4 that covers the period of legislative change, average hours were found to respond faster and in a more pronounced way compared to employment, which implies that once the favorable legislative actions that improved labor market flexibility were in place, firms took advantage of them adjusting primarily along the extensive margin and

to a lesser extent along the intensive margin following a shock, as we see from the whole sample case. Hence, the labor market reform that was pursued during the 1980s in the UK brought down the adjustment costs of labor input incurred by firms. Real wages are found to respond in a negative (as for the US economy) but insignificant manner.

Both the spending and net tax shocks have similar effect on output with those reported in Perotti (2004) for the UK economy (particularly in the period 1980 Q1-2001 Q2). A *spending shock* leads to negative employment, hours and output responses; real wages are affected positively for one and a half year following the shock. The responses of the labor market variables and output are mainly attributed to the real government consumption expenditure and particularly to its wage government consumption component. Hence, a "cost or labor market channel" of fiscal policy as defined by Lane and Perotti (2003) and Alesina et al (2002), respectively, is present with respect to the government wage bill, i.e. the wage bill component of government spending increases the wages in the private sector, reducing profits in the business sector, this in turn leads to a decrease in employment and business investment. As a consequence output, income and private expenditure contract. The non-wage government consumption component has a positive but small and transitory effect on employment and output, while the effect is positive and more persistent with respect to average hours and to a lesser extent for total hours. In addition, government investment have a positive, significant and quite persistent effect on average hours, while its effect on total hours is positive but insignificant, due to its insignificant effect on employment. Therefore, increases in the non-wage component of government consumption or the government investment do not generate an increase in labor cost, thus they do not deteriorate the competitive position of UK businesses. On the other hand, they also fail to boost private demand and employment. Furthermore, a *net tax* shock has negative effects on employment, hours and real wages on impact, though they switch to positive one to two years after the shock. Whereas, output responds positively with a delay of two quarters.

The response of employment and hours to fiscal policy shocks point to the absence of big adjustment costs of labor input. What instead affects their decisions heavily is their perception about the permanence of the fiscal shock. In particular when the labour input declines, i.e. in the cases of a wage government consumption (both for the whole and smaller samples) and a non-wage government consumption shock (in the smaller sample), both employment and average hours decline. However, when the labour input increases, like in case of a non-wage government consumption shock (whole sample case) or a government investment shock (not significantly in the whole sample case, while it is significant in the small sample case but only at the end of the horizon considered), the adjustment takes place in the form of an increase in average hours per worker, with employment changes being insignificant over the five year horizon. Thus, when real wages increase and the competitive position of the UK firms deteriorates, profit maximization

(or cost minimization) induces them to reduce the number workers they employ; while when the spending boost is not affecting their labour costs, firms adjust their labour input only along the intensive margin because they anticipate that the shock will have only temporary effects on private demand. Hence, when the implications of the shock are negative, they are perceived as long lasting, instead when they are positive they are perceived as temporary. Moreover, the permanence of the shock, the value of the intertemporal elasticity of labor supply, as well as the extent to which prices are rigid determine also the implications of a net tax shock on employment, wages and output.

Overall, the responses of employment, hours, real wages, output and its components to macroeconomic policy shocks point to the absence of big adjustment costs of labor input, to the relevance of the elasticity of labour supply, as well as to the importance of composition effects of the unanticipated government spending changes, which in turn appear to generate different expectations on the private sector with respect to the permanence of the shocks. The responses to the government spending shock highlight the importance of exactly determining the fiscal policy action that is undertaken because different spending components have different effects on labour market variables and output components. Therefore, future research should be directed towards a theoretical investigation of the relationship between different spending components, labour market variables and output, focusing especially on the role played by the intertemporal elasticity of labor supply, the adjustment costs of labor input (hiring and firing costs, and in particular the flows in and out of unemployment), the persistence of government spending shocks and the timing of the taxes. Furthermore, it is worth examining the effects that different spending components could have on the job creation and the job destruction decisions of firms. Notice that job creation and job destruction could explain the movements of employment. Specifically, the wage pressure caused by an increase on the government wage bill could reduce substantially job creation, as well as, raise job destruction while the boost in private demand due to the increase on the wage and non-wage components of government consumption might generate only a temporary reduction in job destruction, without affecting job creation. Consequently, employment will fall.

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2.6 Appendix

2.6.1 Stylized facts of the UK labor market

The volatility measures displayed in figure 17 and table 2 are the standard deviations of the cyclical components of the labor market variables, divided by the standard deviation of the cyclical component of real GDP;[48][49] the period examined is 1970:Q1-2003:Q1. As we see the labor market variables are more volatile in the UK than in the rest of the countries (employment is more volatile in UK than in Germany if we exclude the reunification year 1991). While the persistence measure displayed in figure 18 and table 3 is the first order autocorrelation of the cyclical component of each labor market variable divided by the first order autocorrelation of the cyclical component of real GDP (Hess and Shin 1997 and 1998). Employment is slightly more persistent in UK than average hours over the business cycle, while in France and Germany they are equally persistent. In Germany and Italy average hours are more persistent that employment (especially in Germany), this implies that there is not much adjustment along the intensive margin.

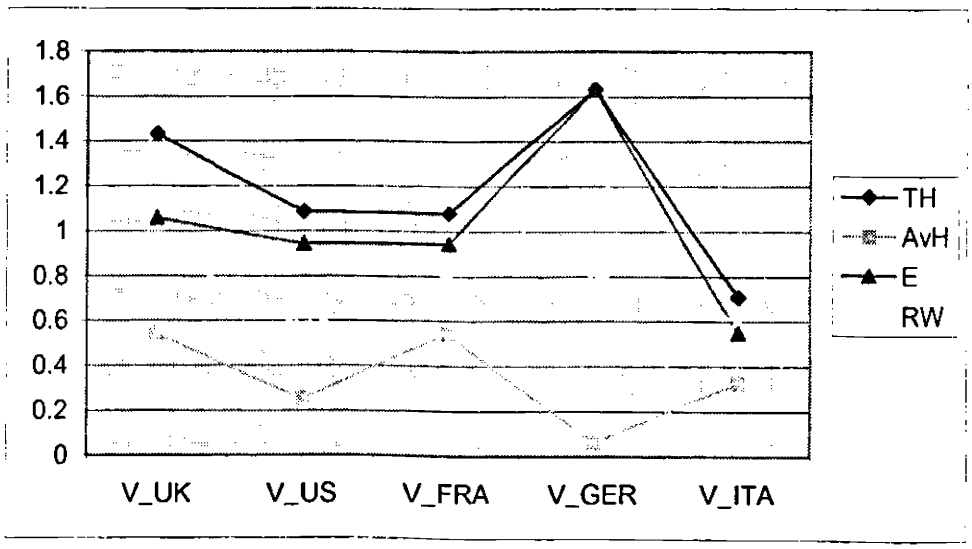

Figure 17: Volatility Measures

[48]The standard deviations obtained for the UK are for employment 0.016234, for average hours 0.008363, for total hours 0.021969, for real wages 0.014341, 0.160243 for unemployment, and finally for real GDP 0.015337.

[49]The cyclical components were extracted by means of the Hodrick-Prescott filter (λ=1600).

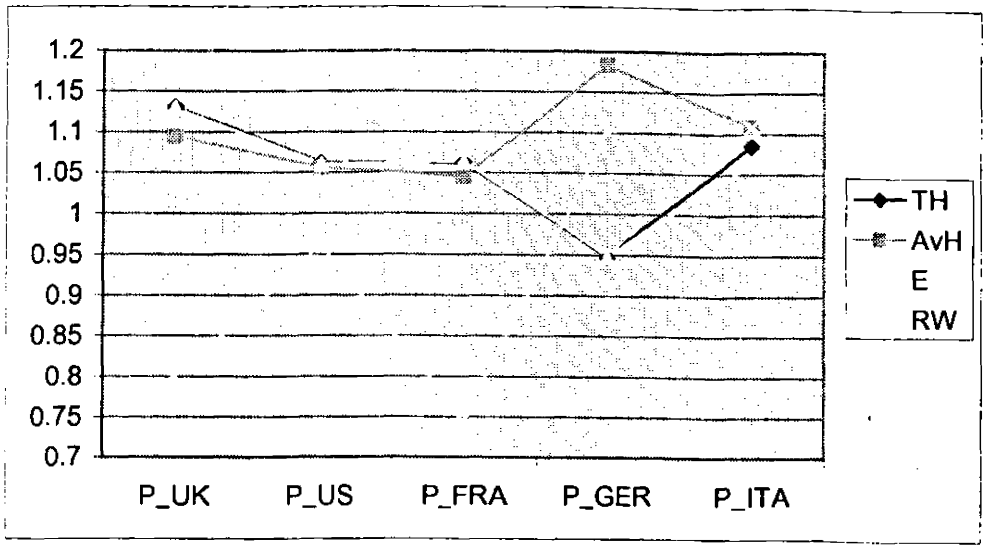

Figure 18: Persistence measures

TABLE 1: UK variables

variable	volatility	1970:Q1-1990:Q4	1991:Q1-2003:Q1
Total Hours	1.4324	1.42568	1.54851
Average hours	0.54528	0.54705	0.95095
Employment	1.0585	1.05485	1.09297
Real Wages	0.93506	0.89923	1.18478

As table 2 displays all UK variables became more volatile with respect to real GDP over the last part of the sample[50], on top of that during the second sub-sample the volatility of average hours came much closer to the volatility measure of employment, whereas real wages' volatility became bigger that the one for employment. In addition as table 3 shows all UK variables became less persistent with respect to real GDP over the cycle during the last twelve years[51]. Notice also that average hours' cyclical fluctuations became more persistent than those of employment over

[50] However, in absolute terms all variables became less volatile over the cycle over the last part of the sample. The actual standard deviations for each variable are as follows for 1991:Q1-2003:Q1: employment (0.10274), total hours (0.014556), average hours (0.008939), real wages (0.011137) , real GDP (0.0094). Whereas for the 1970:Q1-1990:Q4 period we have:employment (0.018729), total hours (0.025313), average hours (0.009713), real wages (0.015966) , real GDP (0.017755).

[51] Nevertheless, in absolute terms the cyclical components of average hours and real GDP became more persistent over the sample. The actual correlation values for the periods 1970:Q1-2003:Q1, 1970:Q1-1990:Q4 and 1991:Q1-2003:Q1, are for gdp(0.805, 0.781, 0.925) for employment (0.909, 0.924, 0.783), average hours (0.881, 0.874, 0.911), total hours (0.910, 0.913,0.858), real wages (0.643, 0.648, 0.626).

the second part of the sample.

TABLE 2: UK variables

variable	persistence ratios	1970:Q1-1990:Q4	1991:Q1-2003:Q1
Total Hours	1.1304	1.16901	0.92756
Average hours	1.0944	1.11907	0.98486
Employment	1.1292	1.18309	0.84648
Real Wages	0.79876	0.82970	0.67675

2.6.2 Construction of the elasticities $a'_{jk}s$

The construction of $a'_{jk}s$ resembles the analysis of Blanchard and Perotti (2002), Perotti (2002) as well as Van den Noord (2002), and Giorno et al (1995). The interest rate semi elasticities of government purchases and net taxes are assumed to be zero $a_{gi} = a_{ti} = 0$, as in Perotti (2004). The output elasticity of net taxes is constructed as the weighted average of each component of net taxes (direct taxes on households, direct taxes on business, indirect taxes, social security contributions by households and total transfers)[52]. Each revenue component is decomposed into a tax rate and tax base, for example:

$$R = S(W_t P_t) W_t(H_t, E_t) E(Y_t) H(Y_t) \tag{2.7}$$

i.e. we assume that real revenues (R) are decomposed into tax rate S which is affected by real wages W_t and prices P_t, and the tax base $W_t(H_t, E_t)E(Y_t)H(Y_t)$, with H_t being average hours and E_t employment (EH being total hours), with those two being affected by output Y_t. Taking logs (lower-case letters) and totally differentiating we can write:

$$\begin{aligned} dr &= \{[(\frac{\partial s_t}{\partial w_t} + 1)\frac{\partial w_t}{\partial e_t} + 1]\frac{\partial e_t}{\partial y_{t\,t}} \\ &\quad + [(\frac{\partial s_t}{\partial w_t} + 1)\frac{\partial w_t}{\partial h_t} + 1]\frac{\partial h_t}{\partial y_t}\}dy_t + \frac{\partial s_t}{\partial p_t}dp_t \qquad (2.8) \\ a_{ty} &= \{[(\frac{\partial s_t}{\partial w_t} + 1)\frac{\partial w_t}{\partial e_t} + 1]\frac{\partial e_t}{\partial y_{t\,t}} + [(\frac{\partial s_t}{\partial w_t} + 1)\frac{\partial w_t}{\partial h_t} + 1]\frac{\partial h_t}{\partial y_t}\} \qquad (2.9) \\ a_{tp} &= \frac{\partial s_t}{\partial p_t} \qquad (2.10) \end{aligned}$$

we construct a_{ty} in the way described above for *direct taxes on households* and *social security contributions paid by households*. In order to do that we get $(\frac{\partial s_t}{\partial w_t} + 1)$, the elasticity of tax revenues per person to average real earnings, from Giorno et al (1995) until 1992 and Van den Noord (2002) thereof, whereas we estimate the contemporaneous elasticity of real wages to employment $(\frac{\partial w_t}{\partial e_t})$ and to average hours $(\frac{\partial w_t}{\partial h_t})$ and the contemporaneous elasticity of employment $(\frac{\partial e_t}{\partial y_t})$ [average hours $(\frac{\partial h_t}{\partial y_t})$] to output in the way that is described in Perotti and Blanchard (2002).[53]

[52] The definitions used are taken form the OECD Economic Outlook 2003.

[53] We regress:

$$\Delta w_t = c_1 + c_2\Delta e_{t-1} + c_3\Delta e_t + c_4\Delta e_{t-1} + c_5\Delta e_{t-2} + c_6\Delta e_{t-3} + c_7\Delta e_{t-4}$$

The output elasticity of *direct taxes to businesses* in constructed in the way described in Blanchard and Perotti (2002) and Perotti (2004), though it is set to zero because in the UK there are lags of more than a quarter in tax collection[54]. We assume that the tax base for *indirect taxes* fluctuates in proportion with private consumption, so we approximate the output elasticity of indirect taxes with the output elasticity of consumption, as in van den Noord (2002). To obtain the last elasticity we regress the log difference of real private consumption on the log difference of real output (on lead 1 and lags 0 to 4). Notice that the elasticity obtained is less than 1 (the average value is 0.7215 up to 2003:Q1)[55] which is assumed by Blanchard and Perotti (2002)[56]. The output elasticity of *transfers* is set to -0.1 until 1992 and afterwards is set to -0.2 as in van den Noord(2002)[57]. Therefore, the average output elasticity of net taxes that is constructed as a weighted average of the net tax components is: $a_{ty} = 0.9977$, (in Perotti (2002) this was set to 0.76). The price elasticity of net taxes is calculated to be $a_{tp} = 1.2996$[58].

Following relevant literature we set the output elasticity of government purchases at zero ($a_{gy} = 0$), so that there are no automatic responses of government purchases to contemporaneous economic developments within a quarter. In addition we set the price elasticity of real government purchases at ($a_{gp} = -0.5$), in the benchmark model, following the discussion in Perotti (2004) about the presence of indexation lags (more than one quarter) on wage and non-wage components of government spending[59]. The employment elasticity of government spending and the average hours elasticity of government spending are both set to zero ($a_{gE} = a_{gH} = 0$) following the same reasoning as for a_{gy}. The employment elasticity of net taxes is: $a_{tE} = 1.5069$, it is constructed assuming a change in employment holding constant average hours and output. Therefore, its value for direct taxes to households and social security contributions paid by households is given by: $a_{tE} = [(\frac{\partial s_t}{\partial w_t} + 1)\frac{\partial w_t}{\partial e_t} + 1]$. Transfers are expected to be affected within the quarter by movements in employment given output, therefore the relevant elasticity is obtained by means of regression

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the coefficient c_3 represents the contemporaneous elasticity of real wage to employment (similarly for the other cases). As in Perotti (2004) when the estimate of c_3 is negative or very insignificant we set it at zero.

[54] We regress the change in log profits on the first lead and 0 to 4 lags of change in the log of real GDP. The coefficient on the zero lag is the output elasticity of profits. The elasticity of direct taxes on businesses to the tax base is set to one, given the proportionality of direct taxes on businesses.

[55] Whereas it is 0.7253 up to 1990:Q4.

[56] The output elasticity on non-tax revenues (like property income taxes) is set to zero.

[57] Transfers include social security contributions paid by government, other current transfers paid by government, capital tax and transfers paid and subsidies.

[58] The price elasticity of real direct taxes to businesses, indirect taxes and non-tax revenues is set to zero. The price elasticity of direct taxes to households and of social security contributions can be obtained from Van den Noord (2002) by subtracting 1 from the elasticity of tax revenues per person to average earnings i.e. from $(\frac{\partial s_t}{\partial w_t} + 1)$. While the price elasticity of transfers was set to -1.

[59] We also consider $a_{gp} = 0$ and -1. Notice, that when we consider the wage bill component of government consumption we set $a_{gp} = -1$, since indexation of government wages occurs with a lag above one quarter. While for the non-wage component of government spending and government investment we consider $a_{gp} = -0.5$.

analysis in a similar mode as above and its value is -0.2742[60]. As before the employment elasticity of direct taxes to businesses is set to zero due to collection lags. The employment elasticity of indirect taxes is set to 0.3143 by means of regression analysis (which is analogous to the analysis described above though this time we regress real private consumption on employment). The average hours elasticity of net taxes is: $a_{tH} = 1.1029$, given employment and output, and is constructed in a similar manner as a_{tE}.[61]

To obtain a_{greer} and a_{treer}, lacking any institutional information we resort to regression analysis. We regress the log difference of government purchases on the log difference of *reer* (with leads 1 and lags 0 to 4), the contemporaneous elasticity was found to be $a_{greer} = -0.065565$ and it was significantly estimated (t-stat=-2.1519)[62]. This implies that an appreciation of the real effective exchange rate generates contemporaneously a negative effect on real government purchases. An analogous analysis for each component of real net taxes produced highly insignificant effects, therefore we have set $a_{treer} = 0$. Notice that both with respect to net taxes and spending any effects of a change in the real effective exchange rate that comes through inflation have already been accounted for. So the benchmark specification will include $a_{greer} = a_{treer} = 0$, since the automatic response of real government purchases on *reer* changes within the quarter is not clear and deserves further examination.

An alternative VAR specification that we have estimated includes total hours instead of employment and average hours, as well as real wages. In this case we follow a similar procedure as above to obtain the relevant elasticities. a_{ty} is calculated to be 1.0023, while the total hours elasticity of net taxes a_{tth} is found to be 1.4159[63]. Regression analysis analogous to the ones described above was followed to get the real wage elasticity of real government purchases $a_{gw} = 0.1757$.

[60] The log difference of each component of transfers is regressed on log difference of employment (on lead 1 and lags 0 to 4) and we obtain the employment elasticity of transfers as weighted average of the relevant elasticity of each component. Only the elasticity of social benefits is set at a value different than zero, since for all the rest components of transfers the t-statistics are below one in absolute terms.

[61] Though in this case only the direct taxes to households and the social security contributions received by the government have a non-negative elasticity, which equals to 1 for both of them as for a_{tE} (because the employment and hours elasticity of wages is set to zero since the estimation gave us a negative value). The elasticities of transfers, indirect taxes and business taxes is set to zero.

[62] When controlling for inflation (by including leads and lags of current inflation) the value of the elasticity remain approximately the same being always statistically significant.

[63] The calculation of output elasticity of net taxes when total hours are used is similar to the one described when we used employment, the only exception is that we use: $[(\frac{\partial s_t}{\partial w_t} - 1)\frac{\partial w_t}{\partial TH_t} - 1]\frac{\partial TH_t}{\partial y_t}$ for direct taxes on households and social security contributions paid by households.

a_{tTH} is calculated in a similar manner as the one for employment. Though in this case the total hours elasticity of transfers is set to -0.1678, and the total hours elasticity of indirect taxes is calculated to be 0.2885. The total hours elasticity of direct taxes on businesses is set to zero, while the total hours elasticity of direct taxes to households and social security contributions paid by households is calculated (as for employment and average hours) taking as given output.

this implies that an increase in real wages will generate an increase in real government purchases within the quarter. Notice that for the years under consideration (1970:Q1-2003:Q1) the real wage government consumption constituted on average the 56.87% of real government consumption and the 52.24% of real total government purchases in the UK. Therefore, any increase in wages will probably show up in government spending, within the quarter. However, wages could be fixed to a certain level for a certain period due to contractual arrangements, which implies that we should consider $a_{gw} = 0$ as benchmark case.[64] The real wage elasticity of net taxes is constructed as a weighted average of the individual tax and transfer components and is found to be $a_{tw} = 1.8532$.[65][66]

TABLE 3: Elasticities of net taxes

	output	prices	employment	average hours	total hours	real wages
VAR with E and H	0.9977	1.2996	1.5069	1.1029	-	-
VAR with TH and RW	1.0023	1.2996	-	-	1.4159	1.8532
Perotti (2004): 1963:1-2001:2	0.76	1.21	-	-	-	-
Perotti (2001): 1980:1-2001:2	0.82	1.32	-	-	-	-

[64] We also consider the decomposition of total government purchases into government consumption and government investment: moreover, we have further decomposed government consumption into its wage and non-wage components. The real wage elasticity of each spending component is constructed by means of regression analysis. Specifically we have $a_{gc,w} = 0.2255$, $a_{gi,w} = 0$, $a_{wgc,w} = 0.2538$, $a_{nwgc,w} = 0.3596$, respectively for government consumption, investment, wage government consumption and the non-wage component of government consumption.

[65] Holding constant total hours and output, we calculate the real wage elasticity of direct taxes to households and social security contributions to households as being equal to $(\frac{\partial s_t}{\partial w_t} - 1)$ which can be obtained from Giorno et al (1995) and van den Noord (2002) for several years. The real wage elasticity of direct taxes to businesses is set to zero due to collection lags. The real wage elasticity of indirect taxes is calculated as the real wage elasticity of private consumption (0.2746) as described before. While the real wage elasticity of transfers is set to -0.1 until 1992 and -0.2 thereafter as for the output elasticity of transfers.

[66] Notice, that these elasticities vary over time, though as the previously mentioned studies we consider the average values in the VAR analysis.

2.6.3 Monetary policy shock - Figures

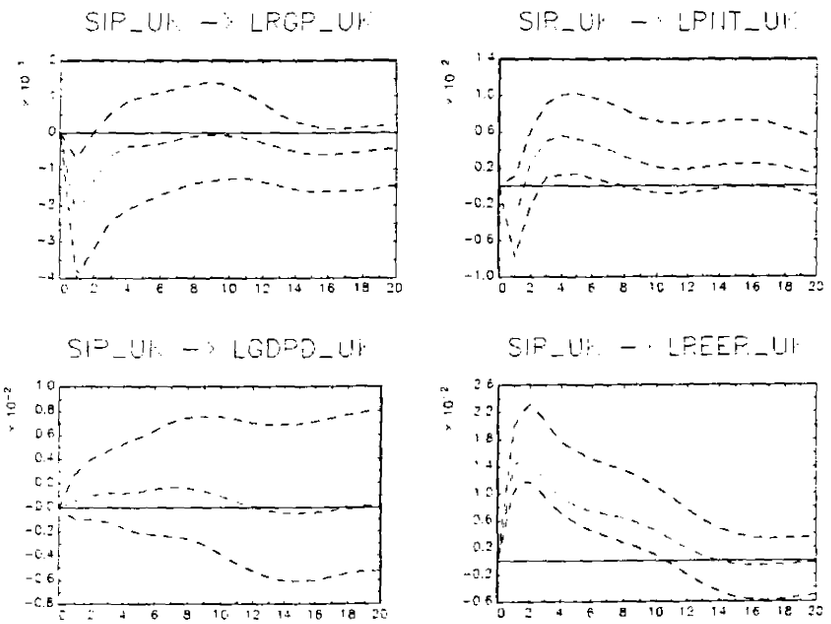

Figure 19: g, t, p, reer - responses to a contractionary MP shock (1970:Q1-1990:Q4)

2.6.4 Government Spending Shock - Figures

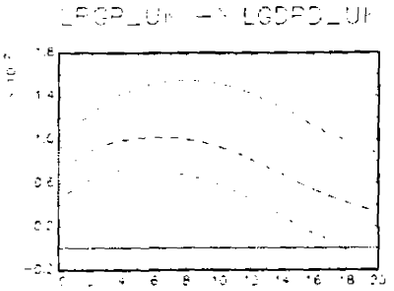

Figure 20: g shock on p with a_{gp}=−1

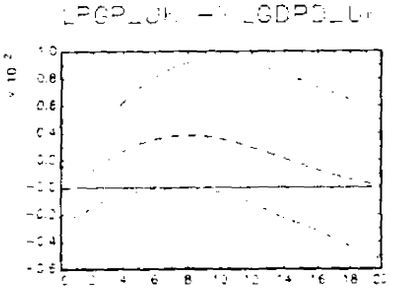

Figure 21: g shock on p with a_{gp}=0

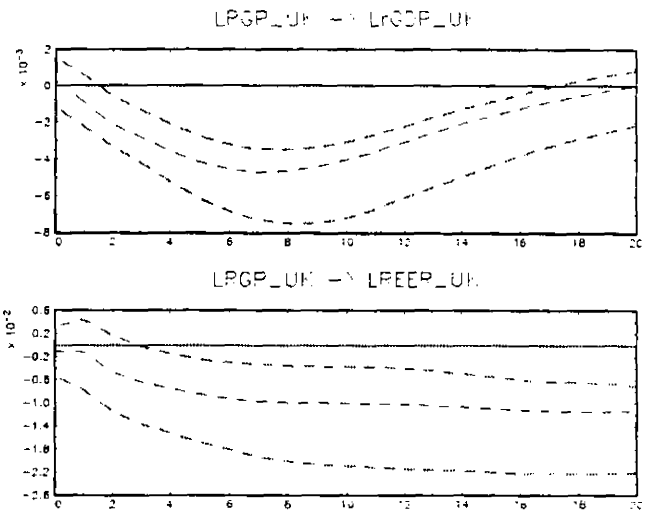

Figure 22: g shock on y and reer with $a_{greer} = -0.065565$

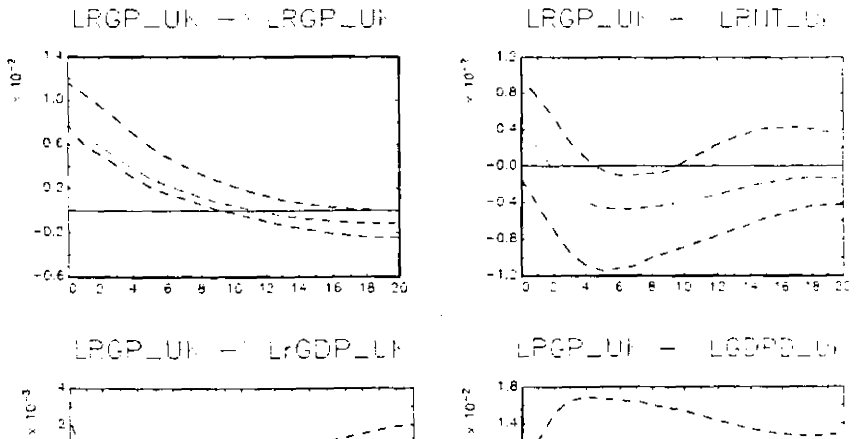

Figure 23: g, t, y, p - g shock (1970:Q1-00:Q4)

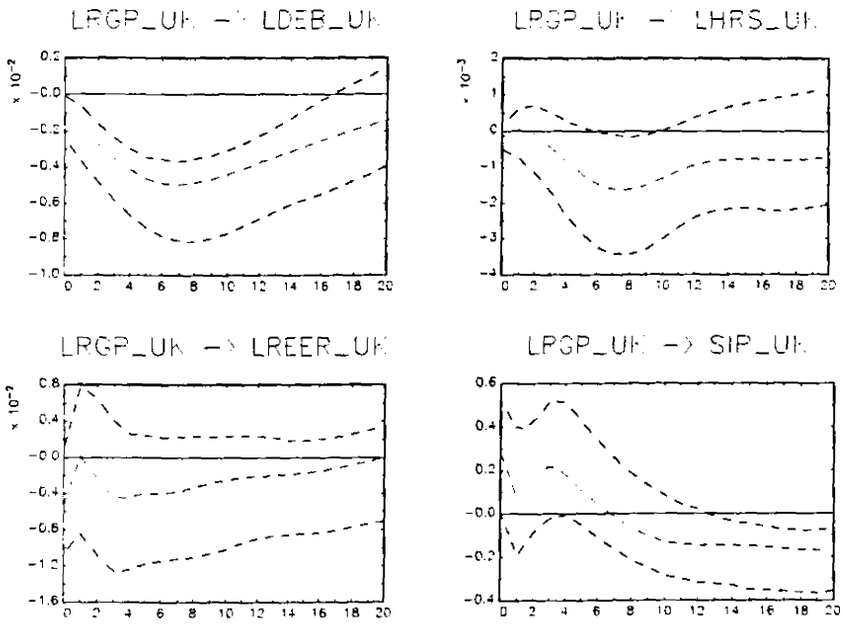

Figure 24: E, H, reer, i - g shock (1970:Q1-90:Q4)

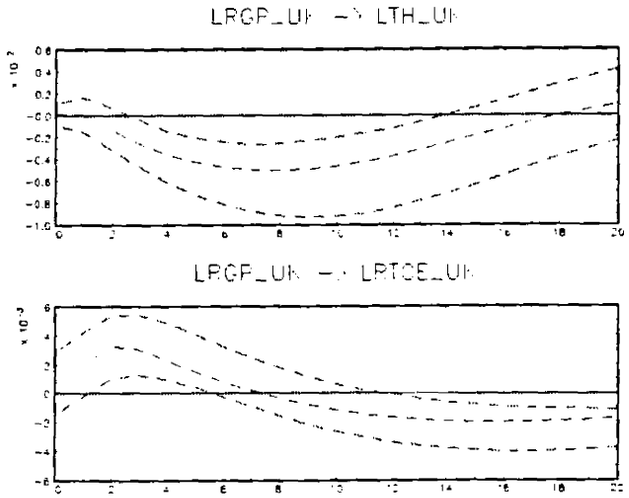

Figure 25: g shock on TH and RW with: a_{gw}=0.1757

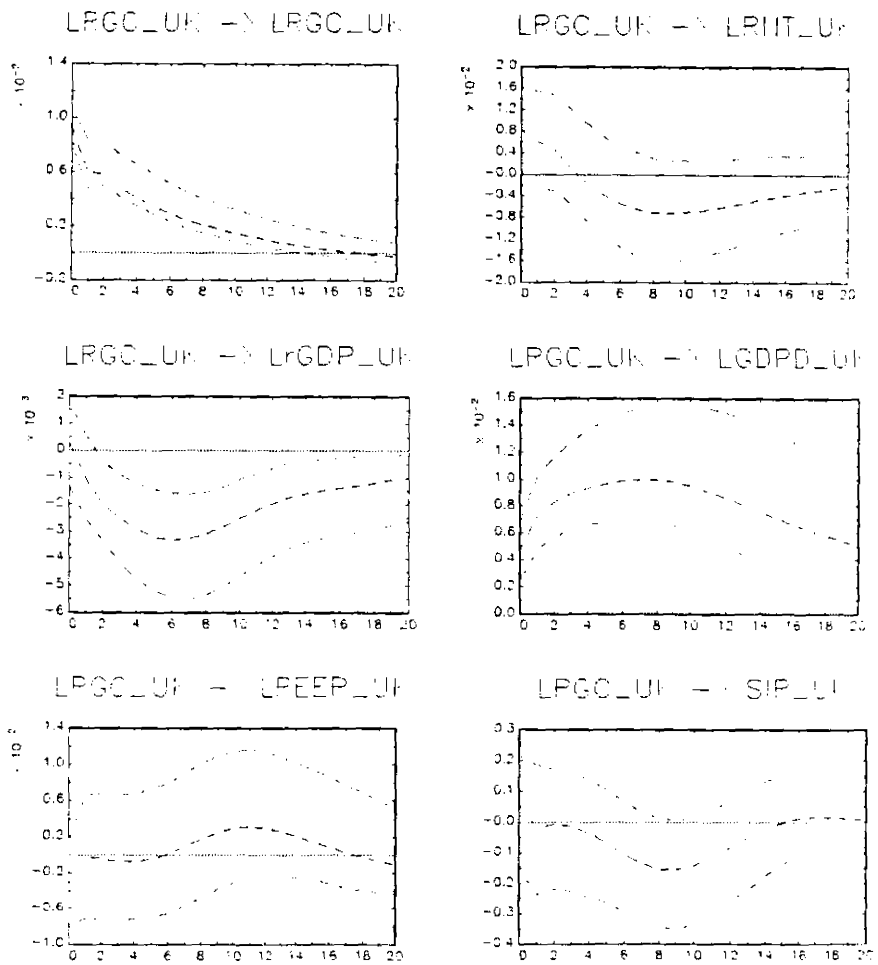

Figure 26: gc, t, y, p, reer, i, - government consumption (gc) shock

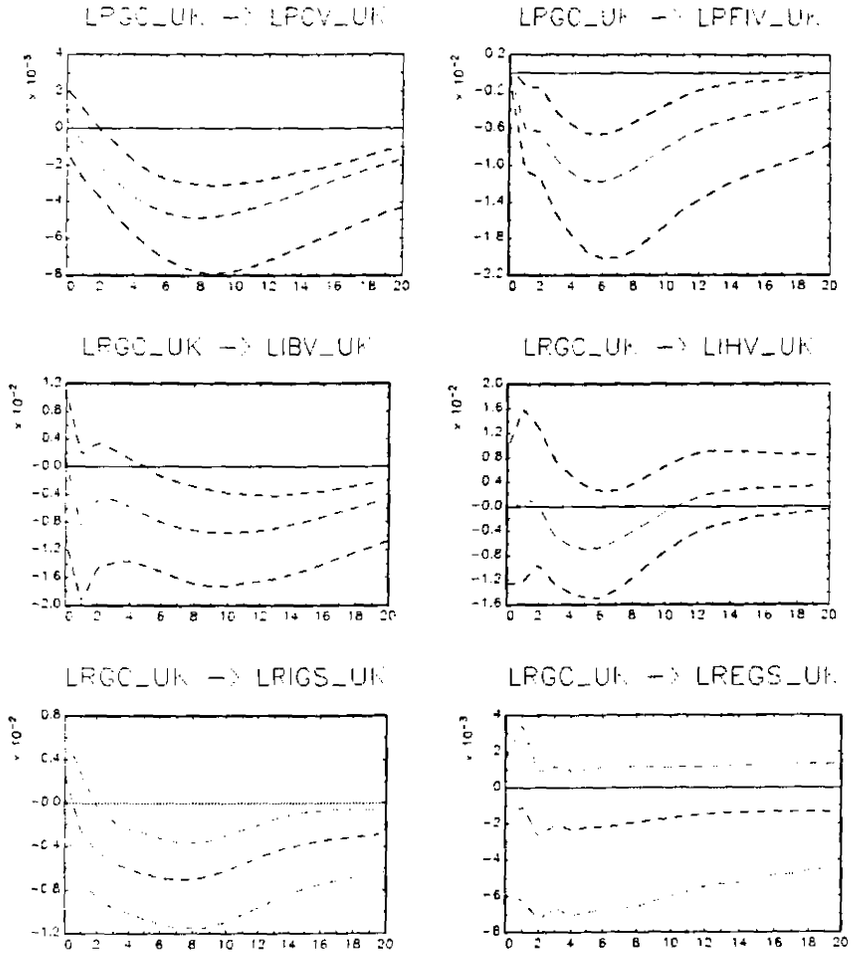

Figure 27: GDP components - government consumption (gc) shock

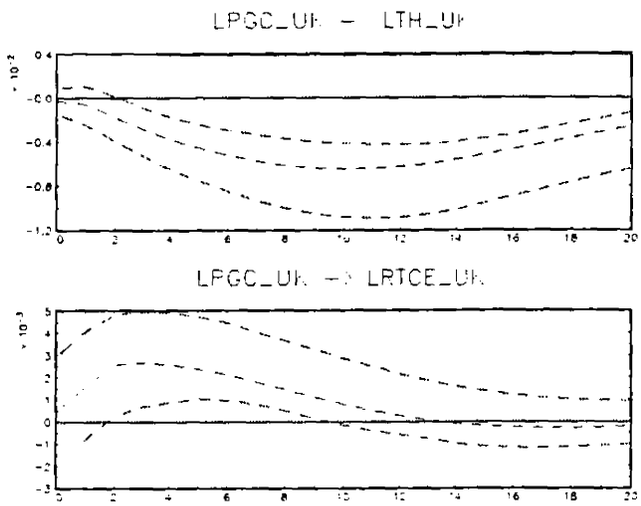

Figure 28: gc shock on TH and RW with $a_{gc,w}$=0.2255

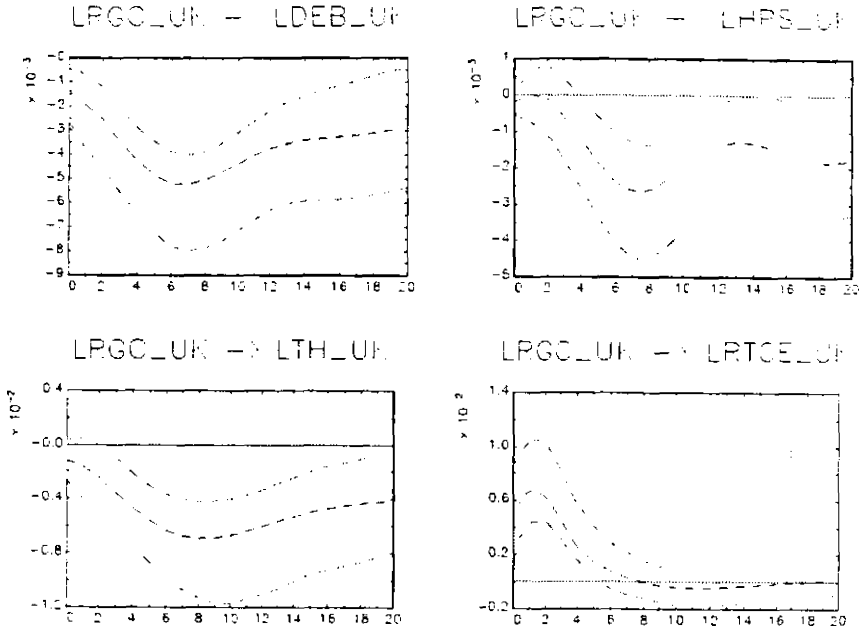

Figure 29: E, H, TH, RW - gc shock (1970:Q1-1990:Q4)

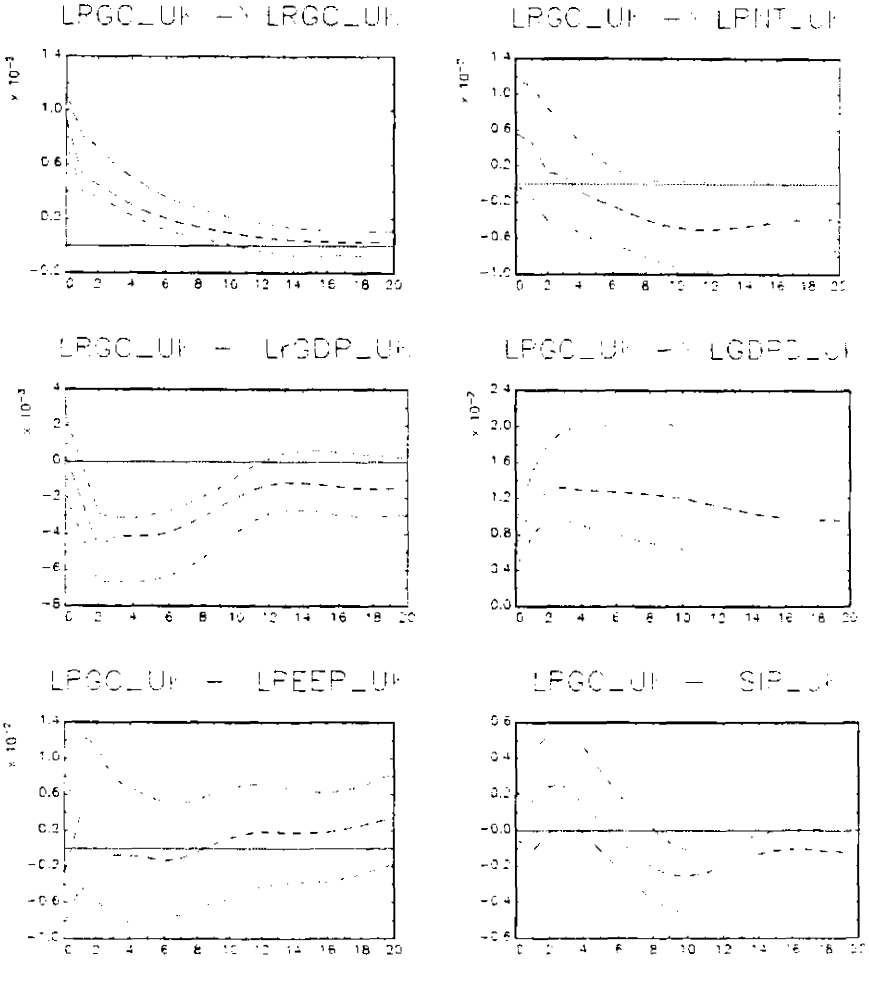

Figure 30: gc, t, y, p, reer, i - gc shock (1970:Q1-1990:Q4)

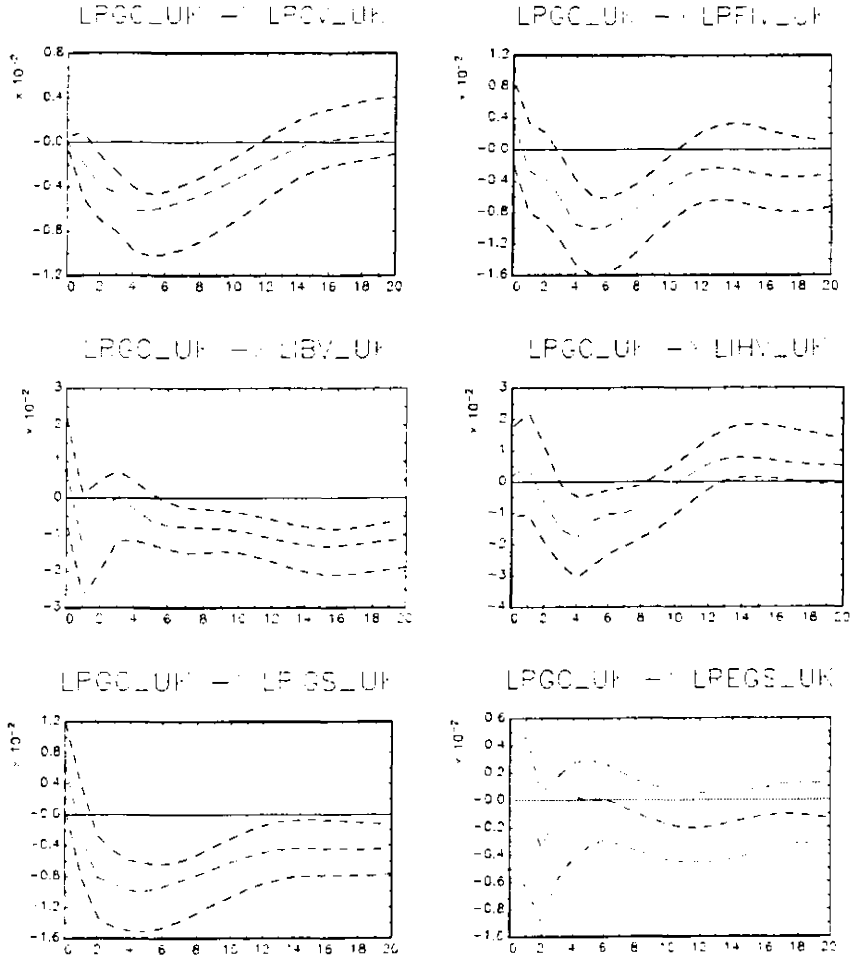

Figure 31: GDP components- gc shock (1970:Q1-1990:Q4)

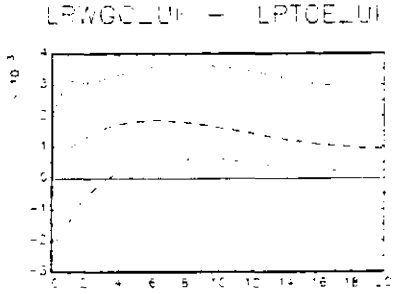

Figure 32 : wgc shock on RW with $a_{wgc,w}$=0.2538

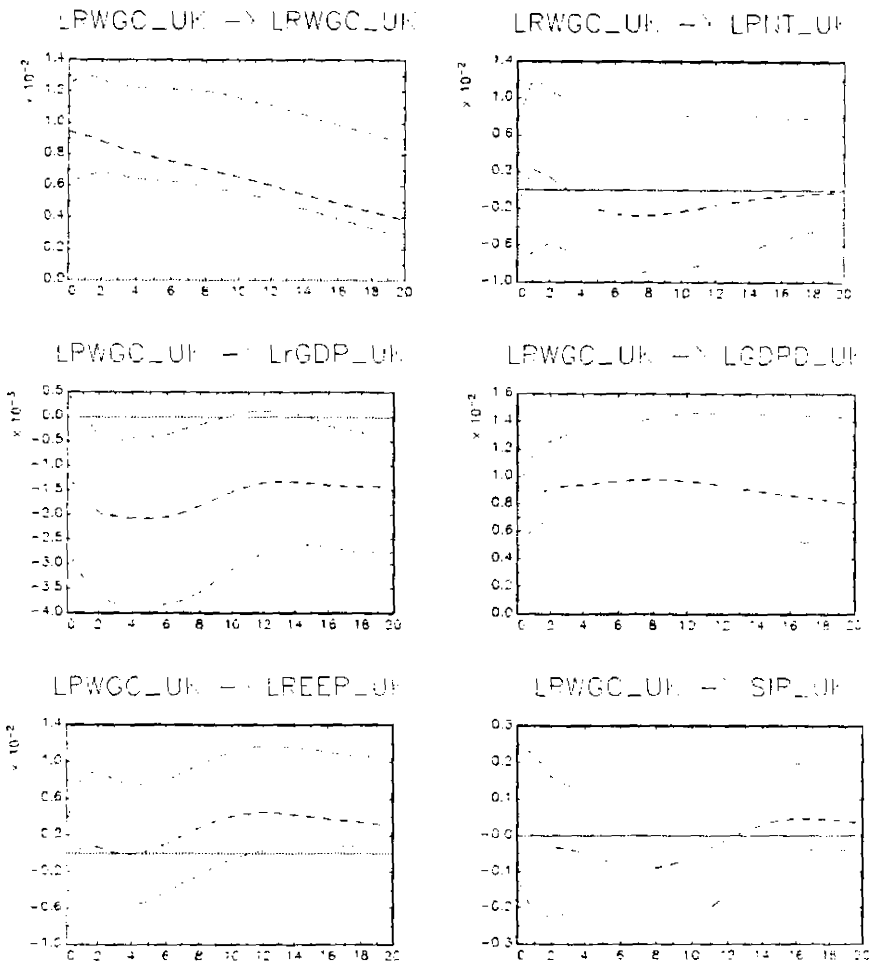

Figure 33: wgc, t, y, p, reer, i - wage government consumption (wgc) shock

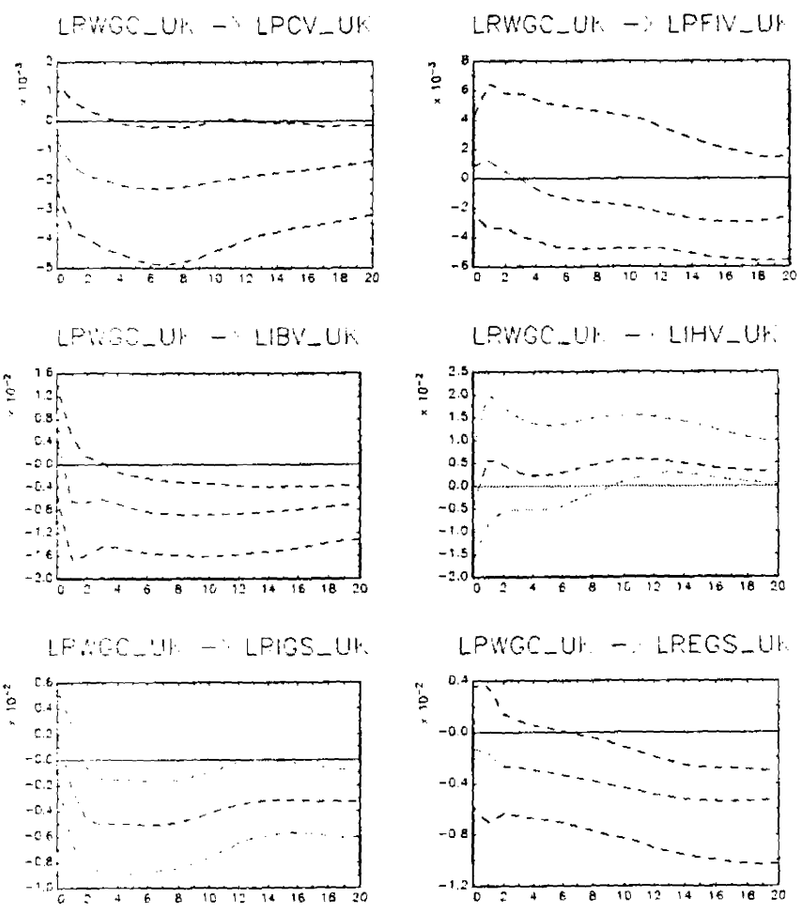

Figure 34: GDP components -wage government consumption (wgc) shock

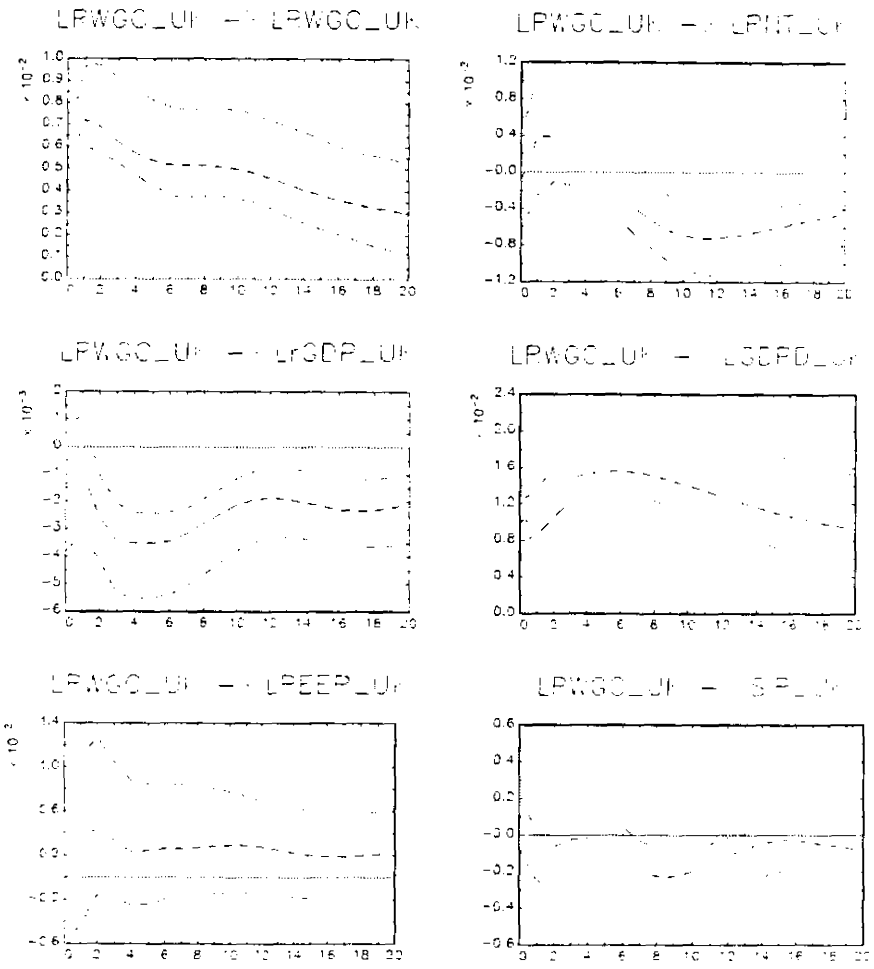

Figure 35: wgc, t, y, p, reer, i - wgc shock (1970:Q1–1990:Q4)

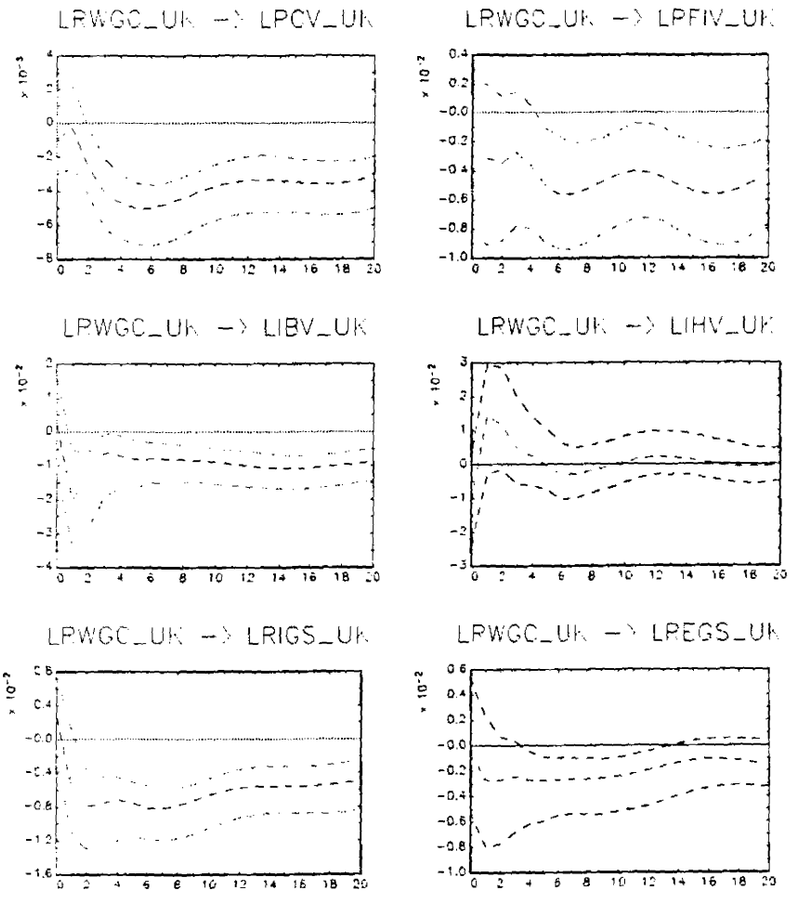

Figure 36: GDP components - wgc shock (1970:Q1-1990:Q4)

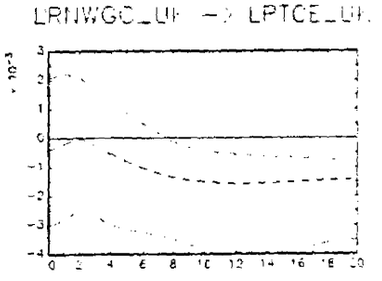

Figure 37 : nwgc shock on RW with $a_{nwgc,w}$=0.3596

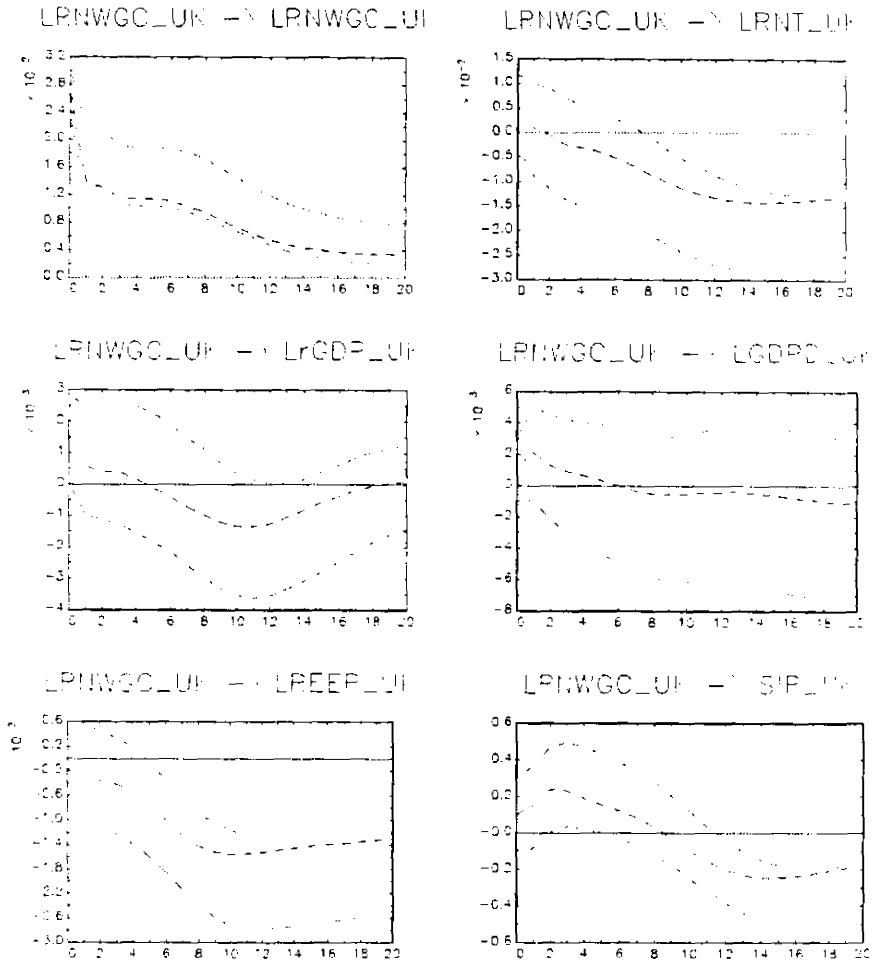

Figure 38: nwgc, t, y, p, reer, i - non-wage government consumption (nwgc) shock

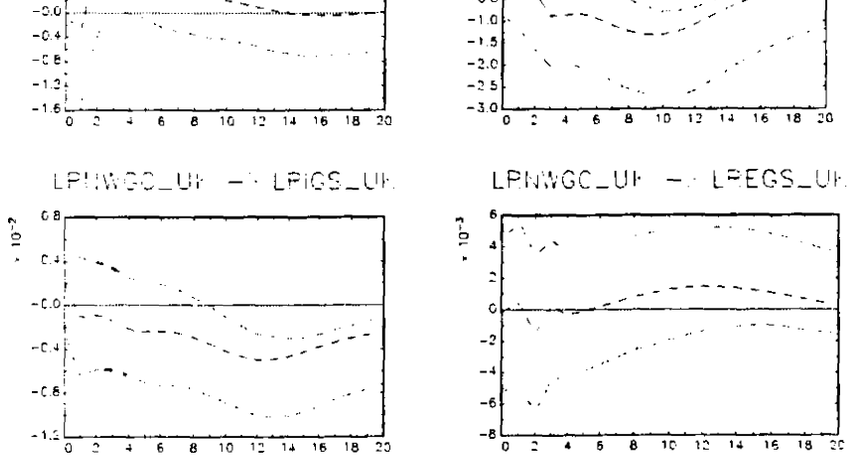

Figure 39: GDP components - nwgc shock

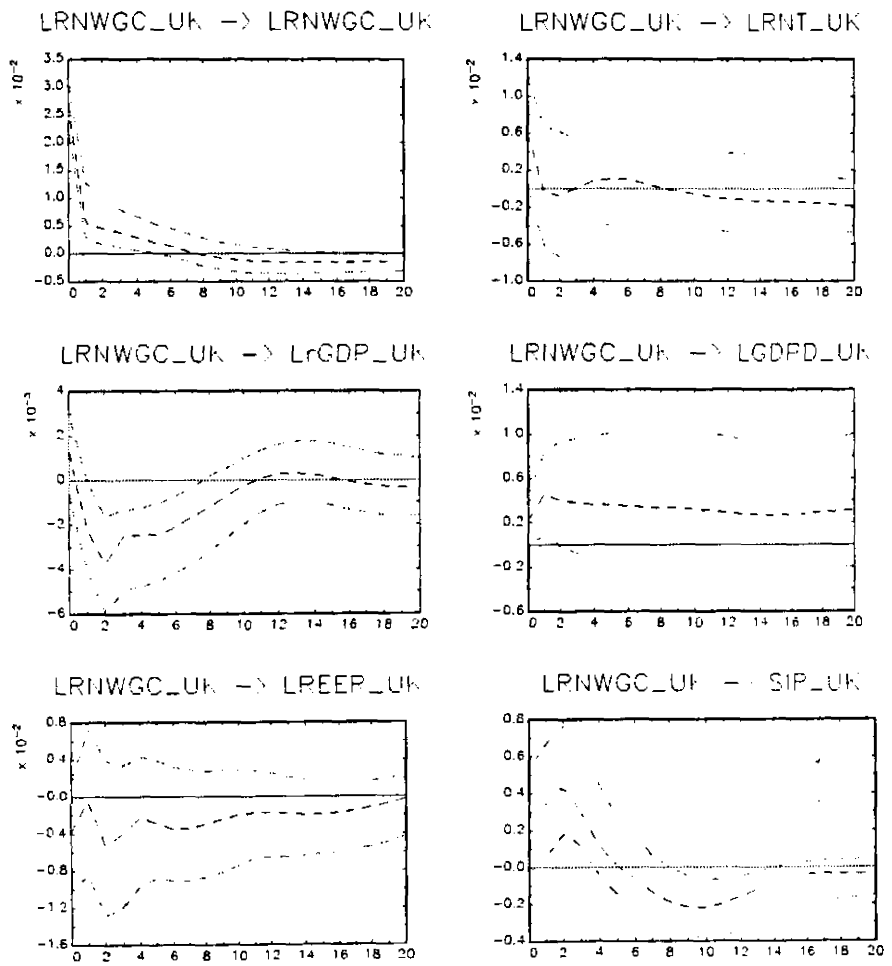

Figure 40: nwgc, t, y, p, reer, i - nwgc shock (1970:Q1-1990:Q4)

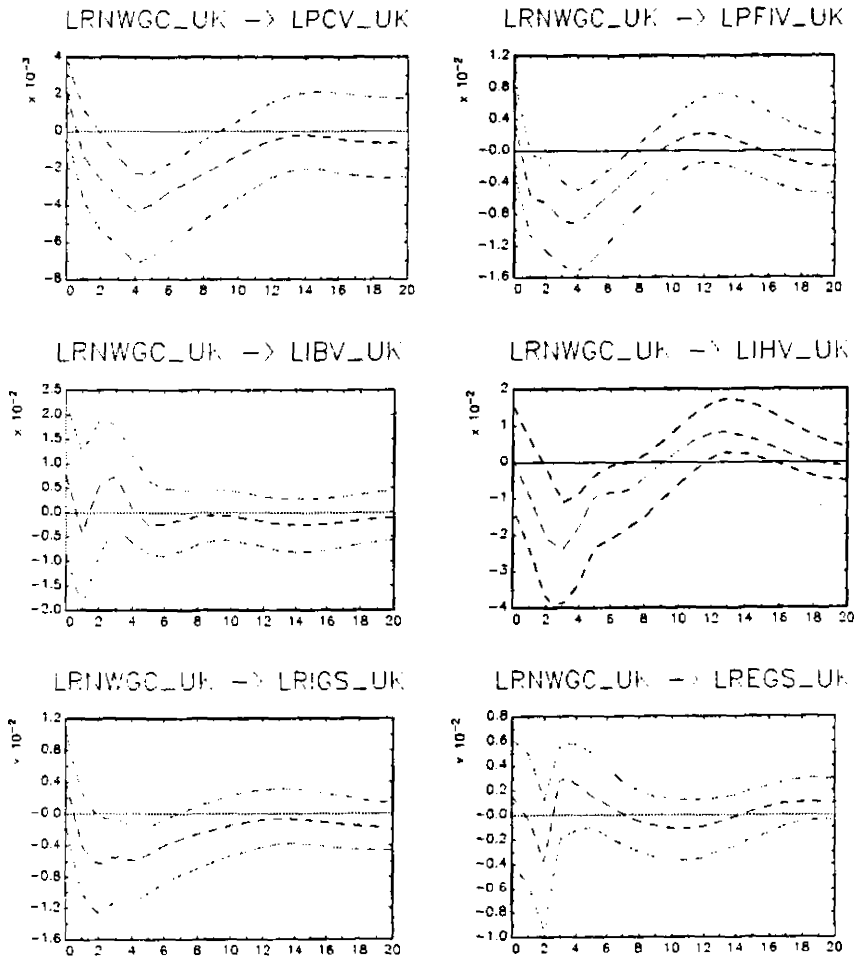

Figure 41: GDP components - nwgc shock (1970:Q1-1990:Q4)

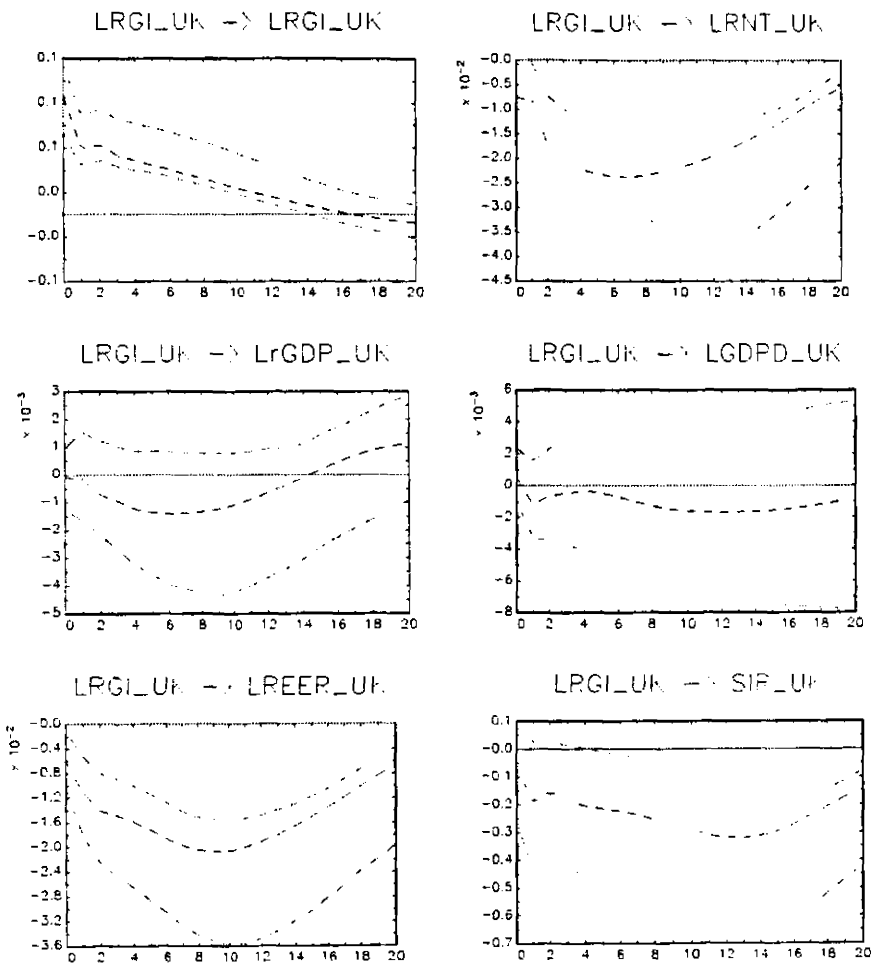

Figure 42: gi, t, y, p, reer, i - government investment (gi) shock

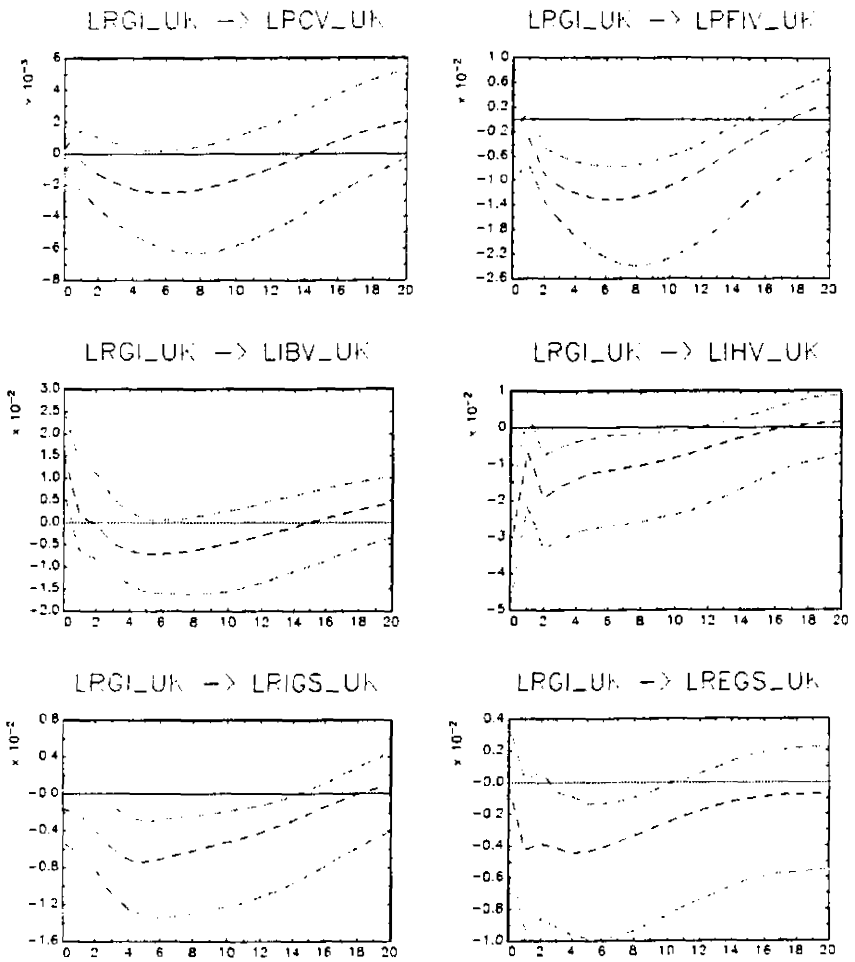

Figure 43: GDP components - gi shock

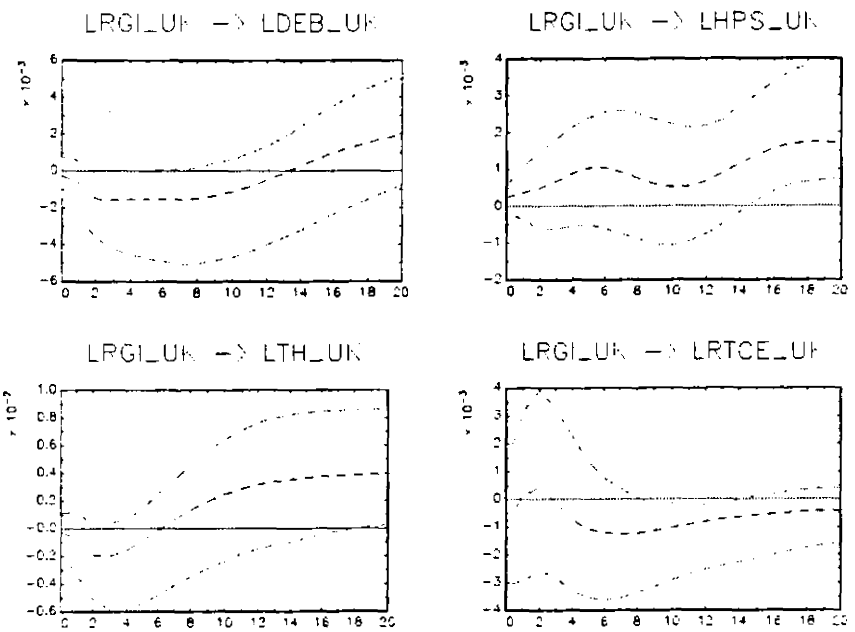

Figure 44: E, H, TH, RW - gi shock (1970:Q1-1990:Q4)

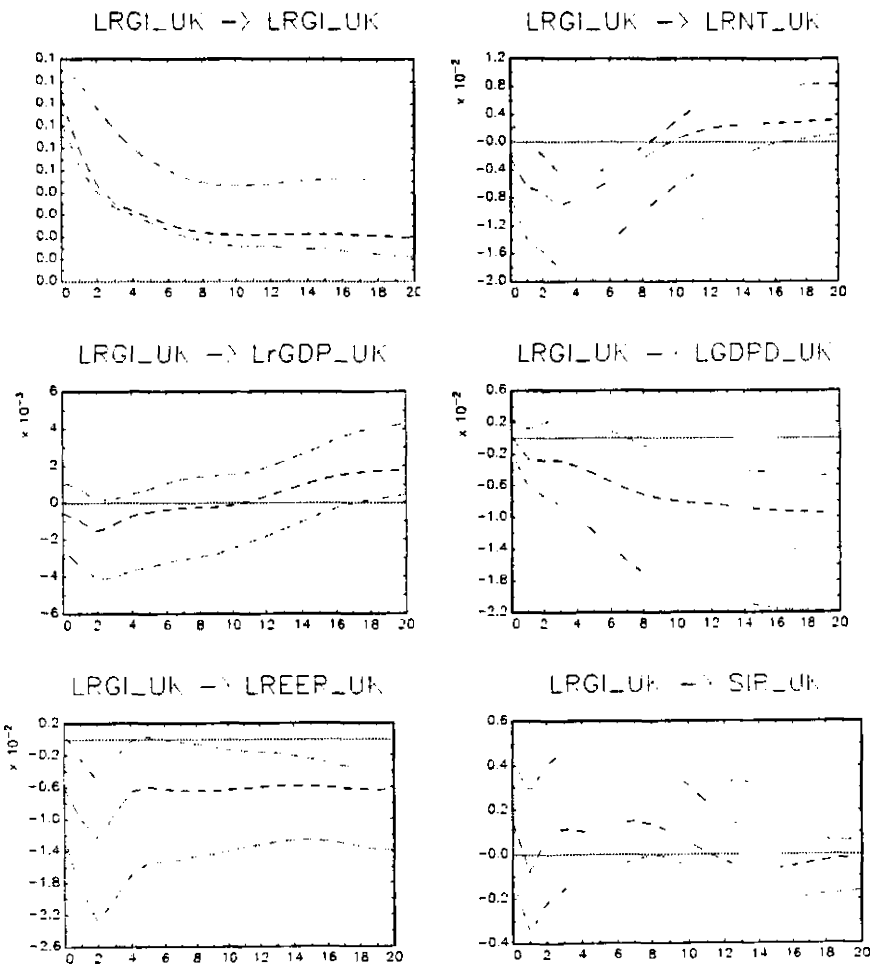

Figure 45: gi, t, y, p, reer, i - gi shock (1970:Q1–1990:Q4)

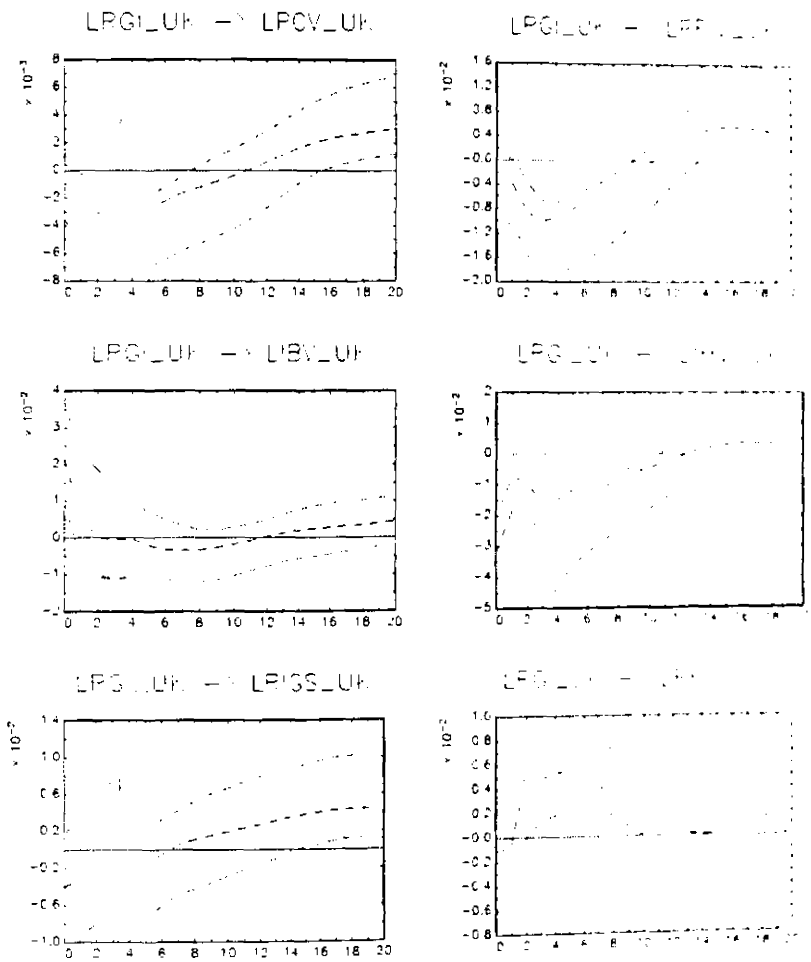

Figure 46: GDP components - gi shock (1970Q1-1990Q4)

2.6.5 Net tax shock - Figures

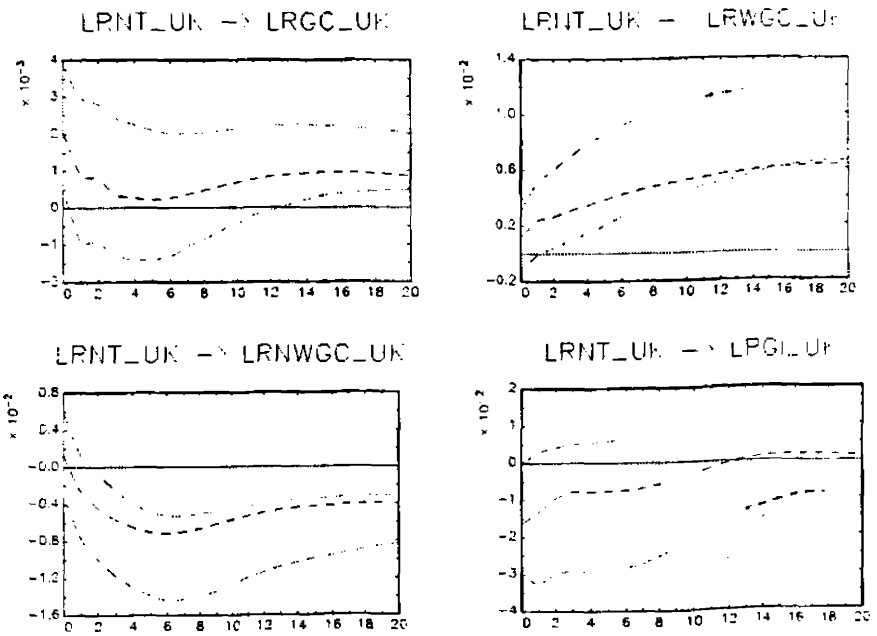

Figure 47: Spending components - a contractionary net tax shock

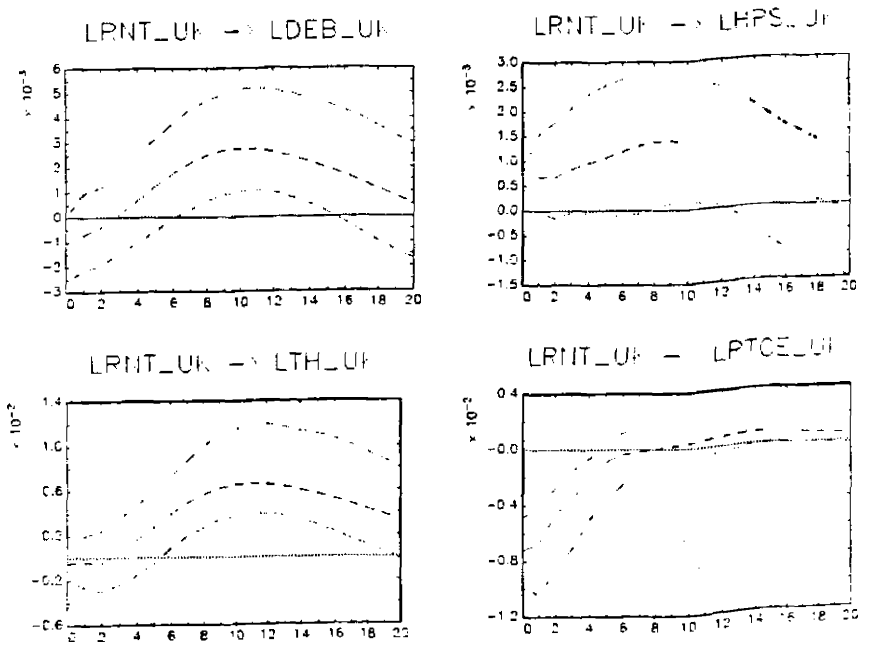

Figure 48: E, H, TH, RW - net tax shock (1970:Q1-1990:Q4)

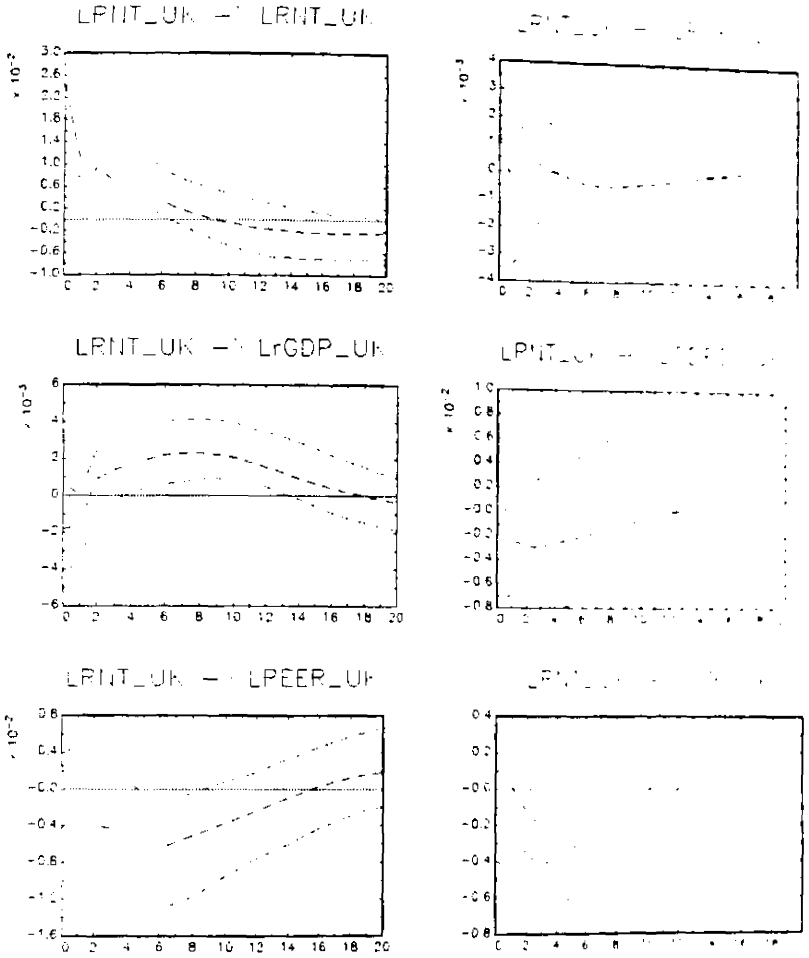

Figure 49: g, t, y, p, reer, i - net tax shock (1970Q1-1999Q4)

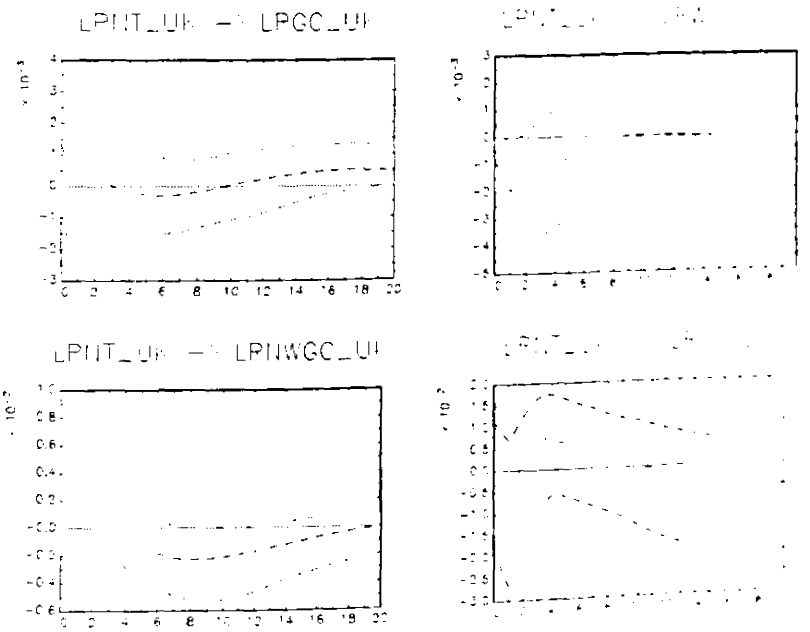

Figure 50: Spending components - net tax shock (1970Q1-1999Q4)

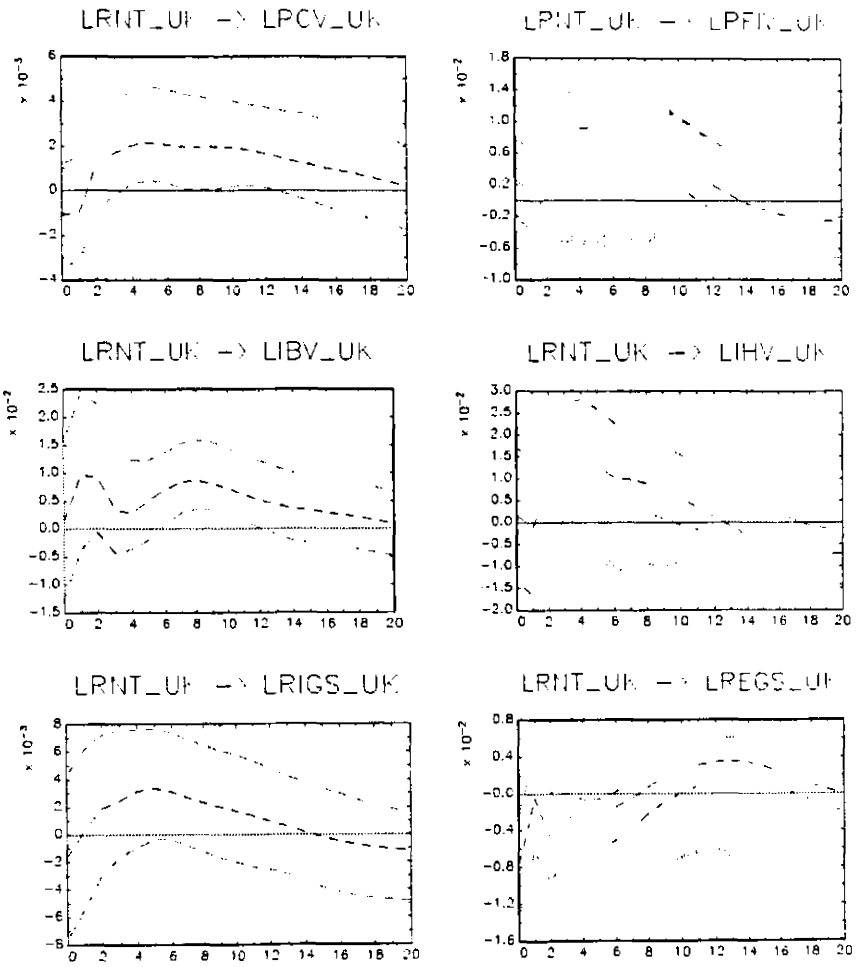

Figure 51: GDP components - net tax shock (1970:Q1-1990:Q4)

Chapter 3

The Asymmetric Effects of Fiscal Policy on Private Consumption over the Business Cycle

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3.1 Introduction

Several recent studies[2] have examined the effects that fiscal policy has on private consumption and investment, identifying the government spending multiplier on output. However, what is not accounted for by this literature is the possibility that fiscal policy can have different effects over the business cycle. It can be less or more effective as a policy instrument depending on the state of the economy. For example, fiscal policy might be more effective in mitigating economic slumps than in muting booms, alternatively it might be less effective at lengthening expansions than at shortening recessions. Liquidity constraints can explain the asymmetric effects of fiscal policy over the business cycle[3]. In recessions liquidity constraints become binding across a wider range

[1] I am grateful to Roberto Perotti and Michael J. Artis for their helpful comments and constant support. I also thank Omar Licadro, Emmanuel C. Mamatzakis and Miltiadis Makris as well as seminar participants at the Bank of England, at the Macroeconomics Working Group (EUI), and conference participants at the 8th International Conference on Macroeconomic Analysis and International Finance (University of Crete) for their useful suggestions and comments.

[2] For example, Blanchard and Perotti (2002), Fatas and Mihov (2001), Perotti (2004), Mountford and Uhlig (2000).

[3] Sorensen and Yosha (2001) study whether state fiscal policy in the U.S. is asymmetric over the business cycle. Their findings indicate that tax revenue increases more than spending in booms: whereas in slowdowns both revenue and spending decline, but revenue remain at low levels for a longer time. The implication of their analysis is that

of households and firms (the opposite in booms). This will affect fiscal policy actions, and their propagation and transmission in the economy.

As Gali, Lopez-Salido and Valles (2004) point out there is a consensus in the empirical literature that government purchases have positive effects on aggregate output; what has not been dealt with is the size of the fiscal multiplier, i.e. whether it is above or below unity. To determine this, it is the effect of fiscal policy on private consumption (the bigger component of aggregate demand) that has to be examined. Private consumption behaves in a quite different manner depending on whether or not liquidity constraints bind.

The typical Real Business Cycle model with lump-sum taxation predicts that the wealth effect of fiscal policy generates adverse effects on private consumption[4]. The presence of binding liquidity constraints alters the implications of fiscal policy actions on private consumption. The wealth effect of fiscal policy weakens, because fewer people have access to credit markets. Thus, it is likely that private consumption is increased after a fiscal expansion, amplifying the effects of government spending on output. This effect is strengthened further in recessions when liquidity constraints affect a larger fraction of the population. Hence, fiscal policy could have Keynesian effects (Gali et al (2004)), particularly in downturns of economic activity[5] In periods of expansion, liquidity constraints are less likely to bind or bind for a smaller fraction of the population. Households prefer to save if they are uncertain about their future income. Hence, a fiscal contraction, to avoid inflationary pressure in the economy, could lead to stronger positive reaction of private consumption (because of the stronger positive wealth effect of lower future taxation, or because income uncertainty is reduced as in Barsky et al (1986)), cancelling the contractionary effects of fiscal policy on aggregate demand[6].

After presenting our motivation and a short discussion of relevant literature, we present a stylized two period theoretical framework, where three types of individuals coexist. Neoclassical consumers that can "borrow and save", Keynesian consumers that can only save and rule-of-

state fiscal policy (procyclical budget surpluses) mutes economic expansions to the same extent as it mitigates downturns.

[4]An increase in government spending, that has to be financed by current and future taxes, will decrease private consumption (and increase labor supply) because the present discounted value of disposable income will be reduced by the higher taxation (negative wealth effect of taxation). Allowing for distortion taxation, the intertemporal and the intratemporal effects come into play. The first one implies that individuals prefer to supply more labor, as well as, consume more in the period where taxes are low; while the second one induces individuals to supply more labor when the cost of work relative to leisure is low.

[5]Moreover, as long as a fiscal expansions lead to higher interest rates and lower asset prices, and people have access to a whole range of interest bearing assets, then the wealth effect could be even weaker in recessions (the opposite in booms).

[6]In Barsky et al (1986) a decrease in distortionary taxation in the present period to be financed by higher taxes in the future will lead to an increase in consumption if future income is uncertain and individuals have a precautionary saving motive.

thumb (ROT) consumers. We employ the assumption that government spending has a positive effect on disposable income. This is the case when government spending has a positive impact on output in the presence of nominal or real rigidities. We study the effect of fiscal policy in two cases. In the first, liquidity constraints do not bind in the first period; we refer to this as "Good times". Whereas, in the second, liquidity constraints bind, and this case is characterized as "Bad times". The main implication of the simple theoretical framework is that, under certain assumptions, a fiscal expansion will generate a stronger response of private consumption in Bad times compared to Good times. This effect will be bigger, the larger the fraction of liquidity constrained individuals

Turning to the empirical estimations, we use an unbalanced yearly panel data set (1970-2001) of nineteen OECD countries. Periods of recession (Bad times) are characterized for each of the countries. Following work by Jappelli and Pagano (1994) and Perotti (1999), we use as a proxy of the degree of credit constraints, the maximum ratio of loan to the value of house in housing mortgages (LTV ratio), and we assign pairs of country-decades into high and low LTV groups. The next step is to extract the spending and tax shocks that are affecting private consumption in each state of nature and to categorize them into expansionary and contractionary.

The empirical evidence confirms the theoretical predictions suggesting that both a government spending and a tax shock have stronger positive effects on private consumption in recessions than in expansions. The effect is more pronounced in countries characterized by less developed consumer credit markets that are more likely to have a larger group of liquidity constrained individuals. Furthermore, in countries with less developed consumer credit markets consumption is affected the most by expansionary spending shock and contractionary tax shocks in Bad times, while in the more financially developed economies the effects on private consumption are driven by contractionary spending and tax shocks in Bad times, and solely by expansionary tax shocks in Good times.

3.2 Motivation and Related Literature

The motivation for this paper comes from two adjacent fields of research. The first is related to the theoretical and empirical literature on the assessment of fiscal policy shocks, and its effects on private spending. The second investigates the conditions under which fiscal policy can have Non-Keynesian effects, and implicitly or explicitly introduces a role for liquidity constraints in the analysis.

As discussed above, following a government spending shock that is financed by future lump-sum taxes the typical RBC model predicts, through the negative wealth effect, a decline in consumption and an increase in employment that raises the return to capital and boosts invest-

ment. On the other hand, the Keynesian analysis predicts that private consumption will increase after a government spending shock financed by future lump-sum taxes, because disposable income increases. Investment may be crowded out because the increase in consumption could raise the interest rate; but this depends on monetary policy[7]. The prediction of both models could be in line with a fiscal multiplier bigger or smaller than one. Nevertheless most of the empirical studies seem to confirm the traditional Keynesian view, finding a non-negative or positive response of private consumption to government spending (e.g. Blanchard and Perotti (2002), Perotti (2004). Fatas and Mihov (2001)).[8]

In a recent contribution to the literature, Gali et al (2004), very elegantly, bring the above approaches together by developing a dynamic general equilibrium model with sticky prices and infinite horizon optimizing, as well as, rule-of-thumb consumers (ROT)[9]. Conditional on having a large fraction of ROT consumers (around fifty percent of the population), and a high degree of price stickiness (average price duration of about four quarters) they conclude that a government spending shock generates an increase in aggregate consumption only if it is not very persistent: otherwise the negative wealth effect of higher taxation dominates. However, Gali et al (2004) do not consider the possibility of having asymmetric effects over the business cycle; which as we claim will be driven by the presence of (binding) liquidity constraints.

The second field of research relates fiscal policy outcomes to borrowing constraints. Several papers (e.g. Perotti (1999), Giavazzi and Pagano (1990, 1996)) implicitly or explicitly add the assumption that there exist credit market imperfections; hence both constrained and unconstrained individuals coexist in the economy[10]. This implies that the wealth effect of fiscal policy will be stronger when the fraction of unconstrained individuals is high enough, so that fiscal consolidations (by reducing tax burden[11] and boosting private consumption) can be expansionary. On the contrary, if the fraction of constrained agents is large enough, the wealth effect weakens and fiscal policy has Keynesian effects (this effect is stronger especially when the present discounted value of future taxation is quite high, i.e. in the presence of convex tax distortions). These

[7] However, investment could also decrease for other reasons as well. As is shown by Alesina et al (2002) and Lane and Perotti (2003) there is a "cost or labor market channel" through which higher government consumption (in particular its wage bill component) could lead to upward wage pressure on the private sector that could reduce profits and private investment.

[8] However, Burnside, Eichenbaum and Fisher (2003) extending the standard RBC model with habit formation and investment adjustment costs confirm its predictions.

[9] Keynesian effects of fiscal policy are possible when some individuals are not optimizing fully over long horizons when choosing consumption, but follow "rules of thumb" that place a lot of weight on current income. It that case, e.g. a bond-financed tax cut will make them increase their consumption despite the fact that their lifetime budget constraint is not affected.

[10] Studies of consumption behavior have suggested that the excess sensitivity of consumption growth to labor income is an indication of liquidity constraints (Attanasio 1999).

[11] Conditional on having a small expected increase in future taxes.

Non-Keynesian effects of fiscal policy are more likely in cases of bad initial conditions[12] i.e. high or growing debt-to-GDP-ratio (Perotti 1999), when the fiscal correction is large and persistent (Giavazzi and Pagano 1990, 1996). Crucial also is the composition of fiscal consolidation (Alesina and Perotti 1995, 1997); an expenditure cut has higher probability of success than a consolidation based on tax increases[13]. Nevertheless, so far there has not been established a link between borrowing constraints that bind depending on the state of the economy and fiscal policy actions that generate Keynesian or non-Keynesian effects.

3.3 Theoretical framework

Consider a simple two period theoretical framework (t=1, 2). Suppose that there exist three types of individuals. Rule-of-thumb (ROT) consumers that consume their disposable income in each period, LC type (Keynesian individuals) who are liquidity constrained (can save, but cannot borrow) and the U type (neoclassical individual) who are unconstrained (can borrow and save). Following Perotti (1999) we assume the presence of nominal or real rigidities so that fiscal policy has a positive effect on output. With respect to *timing* we assume that production takes place at the beginning of each period, while consumption and investment decisions take place at the end.

We examine two cases. In the first case, if the economy is in a Good state (expansion) in t=1, it will pass to a Bad state in period t=2. In the second case if the economy is in a Bad state (recession) in t=1, it will switch to a Good state in period t=2. The transition probabilities are assumed to be 1, and are known by all individuals at the beginning of period t=1. During an expansion all individuals (except of ROT consumers) want to save, while during a recession all (except of ROT consumers) want to borrow, though this is not possible for the LC type of individuals. Incorporating both ROT and LC type consumers in the analysis we can replicate some of the real life phenomena, because even in Good times a fraction of the population will not have access to financial markets, while in Bad times this fraction will increase. Moreover, this will be relevant both for more and less financially developed economies.

3.3.1 Individuals

There exists a continuum of individuals indexed by $i \in [0, 1]$. A fraction λ_1 of them is of the ROT type, λ_2 are LC type individuals, whereas the rest $(1 - \lambda_1 + \lambda_2)$ are of the U type[14]. The U type

[12] Crucial is the assumption that politicians discount the future more than consumers, so that consumers perceive the future tax burden as higher.

[13] Giavazzi, Jappelli and Pagano (2000) find that non-Keynesian effects are more likely when taxes and transfers change (however they focus on national savings). Moreover non-Keynesian responses appear asymmetric and stronger for fiscal contractions rather than expansion. Tax increases have no effect on saving during periods of large fiscal contractions.

[14] We assume that total population is $L = \bar{L} = 1$, i.e. there is no population growth.

individuals have full access (can save and borrow) to credit markets under all states of nature at the going interest rate r. When savings are positive (in Good times), both U and LC types invest in government securities and earn gross return equal to $(1+r)$. In Bad times, only the U type individuals can borrow, and they repay in the second period. The LC types are constrained to consume their disposable income. The ROT individuals at all times consume their disposable income.

Both types of individuals own one unit of labor which they supply inelastically. In the first period individuals receive a real wage w_1^G or w_1^B depending on whether they are in a Good or Bad state, moreover $w^G > w^B$; this assumption is considered to be a real life phenomenon since wages are mildly procyclical. If in Good state at time t=1, then next period they receive w_2^B. Analogously, if in Bad state at time t=1 then next period they receive w_2^G.

Each U type individual maximizes expected utility

$$EU(C_1, C_2) \tag{3.1}$$

where C_1 and C_2 are first and second period consumption respectively and E denotes expectations conditional on information available at the beginning of period 1. $U(.)$ is a von Neumann-Morgenstern utility function. The government imposes lump-sum taxes (T) on all individuals, except of the ROT consumers, in both periods.

The intertemporal budget constraint of the U type individuals when moving from Good to Bad times can be written as:

$$c_1^U + Rc_2^U = w_1^G + Rw_2^B - T_1 - RT_2 \tag{3.2}$$

$R = \frac{1}{1+r}$ where $(1+r)$ is the real rate of return on savings.[15]

When switching from Bad to Good times the intertemporal budget constraint for the U type of individuals is:

$$c_1^U + Rc_2^U = w_1^B + Rw_2^G - T_1 - RT_2 \tag{3.3}$$

When moving from Good to Bad times, the LC type individuals maximize a function like (1) with respect to the following intertemporal budget constraint:

$$c_1^{LC} + Rc_2^{LC} = w_1^G + Rw_2^B - T_1 - RT_2 \tag{3.4}$$

whereas they face a analogous problem with the U types when considering the switch from Bad to Good times. Furthermore, the LC type individuals face the following complementary slackness condition:

$$\begin{aligned} \mu_1 S_1^{LC} &= \mu_1(w_1 - T_1 - c_1^{LC}) = 0 \\ \mu_1 &\geq 0 \end{aligned}$$

[15] For simplicity we assume that the rate of time preference (ρ) equals the market rate of return.

so when $\mu_1 = 0$ then $S_1^{LC} > 0$; the liquidity constraints[16] do not bind and people want to save i.e. we are in a situation of Good times; whereas when $\mu_1 > 0$, then $S_1^{LC} = 0$. so the liquidity constraints bind, people would like to borrow but they cannot, i.e we are in a situation of Bad Times.

The ROT consumers each period maximize[17]

$$U(C_t) \tag{3.5}$$

with respect to the zero saving constraint $c_t^{ROT} = w_t$, for $t = 1, 2$.

Finally aggregate consumption for $t = 1, 2$ is given by:

$$c_t = \lambda_1 c_t^{ROT} + \lambda_2 c_t^{LC} + (1 - \lambda_1 - \lambda_2) c_t^{U} \tag{3.6}$$

Fiscal Policy

We assume that the government "consumes" a quantity G_t, $t = 1, 2$ of the goods produced in the private sector of the economy. Implicitly we assume that the economy is characterized by real or nominal rigidities, so that government spending on goods and services has positive effects on labor demand and output[18]. It finances its spending by imposing lump sum taxes on the U and LC type individuals in each time period. In the first period the government budget constraint is $G_1 + B_1 = T_1$, whereas in the second $G_2 = T_2 + (1 + r)B_1$. B_1 is the stock of debt at the end of period 1 and is defined in real terms.

Next we discuss the type of discretionary fiscal policy action undertaken by the government. First keep in mind the *timing of events:* following the realization of the productivity shock (we call it A) that pushes the economy into a recession (A^{LOW}) or an expansion (A^{HIGH}), fiscal policy actions are taken, then production takes place, at the end of each period comes consumption and investment decisions. Before the government's fiscal policy decision, individuals form expectations of the government's action in light of the productivity shock. Therefore the government sets the public spending equal to

$$G_1 = \bar{G}_1 + \rho u_{1/A1}^{G} + \varepsilon_1^{G} \tag{3.7}$$

[16]There have been several ways of introducing liquidity constraints in the literature: (i) there is a wedge between the borrowing and lending rates, (ii) the interest rate varies continuously with amount borrowed or saved, (iii) there is an exogenous limit (could be zero) to the amount that they can borrow, (iv) there can also be a "natural" debt limit which is the maximum amount that the individuals can repay, and is obtained if the consumer budget constraint is solved with respect to the asset holdings and then is iterated forward; in this case the individuals can borrow only a fraction of their natural debt limit.

[17]Alternatively, we could have assumed that the fraction λ_1 of the population is very impatient so they always prefer to consume more in the first period, i.e. their rate of time preference exceeds the market rate of return ($\rho > r$).

[18]Nominal rigidities (e.g. sticky prices) faced by firms arise in an environment of monopolistic competition with downward sloping demand curves and constant elasticity of substitution among firms' products.

and the taxes equal to

$$T_1 = \bar{T}_1 + \phi u^T_{1/A1} + \varepsilon^T_1 \tag{3.8}$$

Where $\bar{G}_1 = \eta G_0$ and $\bar{T}_1 = \chi T_0$, with G_0, and T_0 representing the beginning of period values before the productivity shock takes place (while η and χ display the adjustment that takes place from the beginning of period values G_0 and T_0). Moreover $E(G_1) = \bar{G}_1 + \rho u^G_{1/A1}$ and $E(T_1) = \bar{T}_1 + \phi u^T_{1/A1}$, i.e. the individuals knowing the state of the economy correctly anticipate that the government will respond setting spending and taxation to the above stated values (which are composed of a fixed part ($\bar{G}_1$ and $\bar{T}_1$) and a part ($u^G_{1/A1}$and $u^T_{1/A1}$) that is set according to the realization of the productivity shock A). However they do not foresee ε^G_1 and ε^T_1 which represent the unanticipated component of fiscal policy actions. *This is the component which is unanticipated as of the information available to individuals following the realization of the productivity shock at the beginning of period t=1.* We employ this assumption because we want to *analyze how individuals respond to fiscal shocks when already in a recession or an expansion.*

Analogously in the second period we have

$$G_2 = \bar{G}_2 + \rho u^G_{2/A2} + \varepsilon^G_2 \tag{3.9}$$

$$T_2 = \bar{T}_2 + \phi u^T_{2/A2} + \varepsilon^T_2 \tag{3.10}$$

with $\bar{G}_2 = \eta G_1$ and $\bar{T}_2 = \chi T_1$. Moreover $E_1(G_2) = \bar{G}_2 + \rho u^G_{2/A2}$ and $E_1(T_2) = \bar{T}_2 + \rho u^T_{2/A2}$, i.e. the individuals knowing the value of the productivity shock in the second period anticipate (in period 1) part of the government's actions that will be undertaken in the second period.

Higher government spending affects positively real wages in both periods depending on the severity and the type of the rigidities assumed, while by assuming the presence of lump-sum taxation we exclude any effects of taxation on real wages[19].

3.3.2 Implications for Private Consumption

In this section we discuss what are the implications of these unexpected government shocks on the private consumption of the three types of individuals. Keep in mind that we are examining changes in consumption in period t=1 after the fiscal policy shock has occurred, compared to what would have been the case hadn't the fiscal shock occurred, conditional on knowing the realization of the productivity shock. The changes in disposable income are driven by the effects

[19] We employ the assumption that the economy is characterized by an upward sloping labor supply function. As Lane and Perotti (2003) argue, an upward sloping labor supply curve arises as the equilibrium of a unionized labor market, where each union defines a sector; that is the mass of firms for which the union sets the wage (Alesina and Perotti (1999)). Furthermore, empirical evidence by Alesina et al (2002), Lane and Perotti (2003), Fatas and Mihov (2001) and Burnside, Eichenbaum and Fischer (2003) reports positive effects on real wages when government spending increases.

of the fiscal policy changes on real wages and taxation. The disposable income (Y) is given by[20]:

$$Y_1 = a_1 w_1 - a_2 T_1 \tag{3.11}$$

with $a_1, a_2 > 0$ (using lump-sum taxes can have $a_2 = 1$), while real wages are approximated by:

$$w_1 = b_1 G_1 + b_2 A_1 + b_3 \Phi_1 \tag{3.12}$$

we assume that $b_1 > 0$. A_1 is the productivity shock and takes a low value in Bad times and a high value in Good times, its coefficient ($b_2 > 0$) captures all the effect a productivity shock could have on wages and wage setting. $\Phi_1 = \xi\Phi_0 + v_1$ is a process that summarizes all remaining factors that affect wage setting, v_1 is a stochastic disturbance (uncorrelated with the productivity shock and the fiscal shocks and not anticipated by individuals), Φ_0 indicates beginning of period value, prior to the realization of the productivity shock ($b_3 >< 0$). Using equations (7)-(8) and (11)-(12) we can write the end-of-period t=1 disposable income as follows:

$$Y_1 = a_1 b_1(\eta G_0 + \rho u^G_{1/A1} + \varepsilon^G_1) + a_1 b_2 A_1 + a_1 b_3 \Phi_1 - a_2(\chi T_0 + \omega u^T_{1/A1} + \varepsilon^T_1) \tag{3.13}$$

Notice that what we want to compare is the disposable income after all fiscal policy actions have taken place, with the disposable income after the realization of the productivity shock but prior to any fiscal policy action. This change in disposable income in period t=1 can be separated into an anticipated and an unanticipated component. The anticipated component is $\Delta Y_{1/anticipated} = Y_{1/anticipated} - Y_{1/A1}$; where $Y_{1/anticipated}$ represents the disposable income following the anticipated fiscal policy action, whereas $Y_{1/A1}$ represents the realization of disposable income following the productivity shock but before the fiscal policy action is taken. The unanticipated component is $Y_1 - Y_{1/anticipated} = \Delta Y_{1/\varepsilon_1}$, i.e. the value of disposable income at the end of period t=1 minus the value of disposable income following the anticipated fiscal policy change, this effect is due only to the fiscal shocks ε^G_1 and ε^T_1 and the stochastic disturbance v_1. Hence we can write:

$$\Delta Y_{1/\varepsilon_1} = Y_1 - Y_{1/anticipated} = a_1 b_1 \varepsilon^G_1 - a_2 \varepsilon^T_1 + a_1 b_3 v_1 \tag{3.14}$$

$$\Delta Y_{1/antic} = Y_{1/anticipated} - Y_{1/A1} = a_1 b_1 \rho u^G_{1/A1} - a_2 \omega u^T_{1/A1} + a_1 b_3 \xi \Phi_0 \tag{3.15}$$

In the second period we have:

$$Y_2 = a_1 w_2 - a_2 T_2 \tag{3.16}$$

$$w_2 = b_1 G_2 + b_2 A_2 + b_3 \Phi_2 \tag{3.17}$$

A_2 is the value of the productivity shock in the second period. $\Phi_2 = \xi\Phi_1 + v_2$ is a process that summarizes all remaining factors that affect wage setting, v_2 is a stochastic disturbance (uncorrelated with the productivity shock and the fiscal shocks and not anticipated by individuals),

[20] We assume that the lump-sum taxation does not affect real wages.

Φ_1 is the end of period one value prior to the adjustment of the productivity shock to its new value in the second period. What is relevant for the analysis is *not* the end of period two value of disposable income i.e. Y_2, *but the expectation in period 1 of the value in disposable income in period 2*, i.e. $E_1(Y_2) = Y_{2/1}$. This implies that the fiscal shocks ε_2^G and ε_2^T and the stochastic disturbance v_2 are not included since they are unanticipated as of the information available to individuals in period one. Keep in mind that A_2 is included (as well as the fiscal policy actions implied by the new value of the A parameter) because we have assume that the individuals know with certainty at t=1 the value of the productivity shock in period t=2 (i.e. if it will be a Bad or Good period). Therefore combining (9)-(10) and (16)-(17) we find that:

$$E_1(Y_2) = Y_{2/1} = a_1 b_1(\eta G_1 + \rho u^G_{2/A2}) + a_1 b_2 A_1 + a_1 b_3 \xi \Phi_1 - a_2(T + \chi T_1 + \phi u^T_{2/A2}) \tag{3.18}$$

substituting (7) and (8) we have:

$$\begin{aligned} E_1(Y_2) \;=\; Y_{2/1} &= a_1 b_1 \eta(\bar{G}_1 + \rho u^G_{1/A1} + \varepsilon^G_1) + a_1 b_1 \rho u^G_{2/A2} + a_1 b_2 A_1 + a_1 b_3 \xi \Phi_1 \\ &\quad - a_2 \chi(\bar{T}_1 + \phi u^T_{1/A1} + \varepsilon^T_1) - a_2 \phi u^T_{2/A2} \end{aligned} \tag{3.19}$$

Similarly the change in the second period's disposable income following the shock can be separated into anticipated and unanticipated components as of the information available to individuals following the productivity shock at the beginning of the first period. So the anticipated component is $Y_{2/1antic} - Y_{2/A1} = \Delta Y_{2/1antic}$ and the unanticipated component is $Y_{2/1} - Y_{2/1anticipated} = \Delta Y_{2/\varepsilon_1}$. Therefore:

$$\Delta Y_{2/\varepsilon_1} \;=\; Y_{2/1} - Y_{2/1anticipated} = a_1 b_1 \eta \varepsilon^G_1 - a_2 \chi \varepsilon^T_1 + a_1 b_3 \xi v_1 \tag{3.20}$$

$$\begin{aligned} \Delta Y_{2/antic} \;=\; & Y_{2/1antic} - Y_{2/A1} = \\ & a_1 b_1 \eta \rho u^G_{1/A1} - a_2 \chi \phi u^T_{1/A1} + a_1 b_1 \rho u^G_{2/A2} - a_2 \phi u^T_{2/A2} + a_1 b_3 \xi^2 \Phi_0 \end{aligned} \tag{3.21}$$

Turning now to examine the changes in consumption we know that when moving from Good to Bad times the U and LC types can save and thus smooth their consumption between the two periods; hence under a quadratic utility function:[21] $\Delta C_1 = \frac{\Delta Y_{1/\varepsilon_1} + R\Delta Y_{2/\varepsilon_1}}{1+R}$, i.e. the individuals respond only to the innovations in the present discounted value of their disposable income. The same holds for the U type individuals when moving from Bad to Good times because they can

[21] This way we abstract from precautionary saving because marginal utility is assumed to linear. However allowing for convex marginal ($U''' > 0$) utility of consumption will induce people who want to save to save more and people who want to borrow to borrow less. The simplest form of utility function assumed could be: $c_1^2 - \beta c_2^2$, where $\beta = \frac{1}{1-\rho}$, where ρ is the rate of time preference and is assumed to be equal to r, so that $R = \beta$. Note that if $\beta > R$ all individuals prefer to accumulate and consume at the very last period, since they are very patient ($\rho < r$). If $\beta < R$ ($\rho > r$) the individuals are very impatient and are dissaving.

smooth consumption. However, this is not the case for the LC type of individuals because of the binding liquidity constraints. Therefore the change in consumption in period t=1 due to the fiscal policy change equals the change in their disposable income in the same period: $\Delta C_1 = \Delta Y_1 = Y_1 - Y_{1/A1} = (Y_1 - Y_{1/antic}) + (Y_{1/antic} - Y_{1/A1}) = \Delta Y_{1/\varepsilon_1} + \Delta Y_{1/antic}$ i.e. it incorporates both the anticipated and unanticipated components. The ROT consumers under both states of nature will consume their disposable income in each period, therefore their change in consumption in period one will be equal to their disposable income change (following the fiscal policy action) in the same period (as for the LC types in Bad times).

Hence the simple theoretical framework employed implies that fiscal policy actions will have a positive effect on ROT individuals' consumption as long as the effect on real wages is positive. In addition they will have a positive effect on the LC and U types' consumption, if the positive effect on real wages outweighs the negative effect of higher taxation, leading to higher disposable income. In addition the effect on the LC types' consumption will be bigger in Bad times because they will face binding liquidity constraints and hence they will consume all their disposable income change.

Unanticipated fiscal policy changes are expected to have stronger effects on private consumption in Bad times when individuals face binding liquidity constraints (LC types) and consume all their disposable income change at t=1 without smoothing consumption over the two periods. This would be the case as long as, $\Delta Y_{1/\varepsilon_1} > \Delta Y_{2/\varepsilon_1}$ i.e. the disposable income change in the first period due to the unanticipated components of the fiscal shocks is bigger than the corresponding disposable income change in the second period. The condition for this to hold depends on the parameters, η, χ and ξ. Abstracting from parameter ξ by setting it equal to one, what matters is the weight that is attached on previous period's taxes (χ) relative to the weight that is attached on previous period's government spending (η). If $\chi > \eta$ future taxation matters more for the financing of current spending decisions.[22] Hence, the bigger the fraction of the liquidity constrained and ROT individuals in an economy (that do not perceive the tax burdens to be born in the future out of a current spending expansion), the more likely it is that fiscal policy will be effective in recessions.[23] In addition, if a fraction of the population faces binding constraints under both states of nature (like the ROT consumers that have no access to financial markets) then fiscal policy would be always more effective in the countries having a bigger fraction of liquidity

[22] Allowing for $0 \leq \xi < 1$, we could obtain $\Delta Y_{1/\varepsilon_1} > \Delta Y_{2/\varepsilon_1}$ even without $\chi > \eta$, which would also depend on the sign and magnitude of the fiscal shocks and the stochastic disturbance v_1. Focusing on $\xi = 1$ is equivalent to abstracting from income and consumption changes that are not driven by the fiscal shocks. All the remaining factors affecting consumption change will be picked up by the error terms of the estimated equations in the empirical analysis to follow.

[23] Alternatively, the more likely to have a smaller negative effect if overall the effect of fiscal policy actions on consumption are negative.

constraint agents.

Disposable income changes induced by the anticipated component of fiscal policy actions will be of a positive nature if the positive effect on real wages is bigger than the negative effect of taxation. In addition, they are expected to be more important in Bad times, and more pronounced in countries with less developed consumer credit markets where a bigger fraction of the population is expected to face binding credit constraints and follow a rule of thumb consumer behavior.

3.4 Data and Empirical Strategy

The implications of the theoretical discussion are tested using an unbalanced panel of yearly data from nineteen OECD countries[24] from 1970 to 2001. The first step in our empirical strategy is to characterize the periods of recession (Bad times) for each country in the data set. The next step is to consider the role played by credit constraints. It is expected that fiscal policy is more effective in economies with less developed consumer credit markets, with the effects being much stronger in periods of economic recession. Hence, crucial to the results obtained will be the use of the right measure of the severity of liquidity constraints.

With respect to the effects of fiscal policy in Bad and Good times, there have been several recent empirical studies that have contributed to the literature.[25] The studies by Perotti (1999) and Gavin and Perotti (1997) are those most related to the current study. Perotti (1999) analyzes the effects of fiscal shocks on private consumption; however, it considers as Bad times the periods with high or growing deficit or debt to GDP ratio and not the periods of low economic activity.

[24] All variables are from the OECD's Economic Outlook. Our data run from 1970 to 2001 for Australia, 1970-2001 for Austria, 1970-2001 for Belgium, 1970-2002 for Canada, 1970-2001 for Germany, 1981-2001 for Denmark, 1970-2001 for Spain, 1970-2001 for Finland, 1970-2001 for France, 1970-2001 for the UK, 1970-2001 for Greece, 1970-2001 for Ireland, 1970-2001 for Italy, 1970-2001 for Japan, 1971-2001 for Netherlands, 1970-2001 for Norway, 1970-2001 for Portugal, 1970-2001 for Sweden, and 1970-2001 for the US.

[25] Gali and Perotti (2003) are examining the cyclical relation between budget variables and economic activity; to this end they estimate fiscal rules using output gap as well as squared output gap in order to test for the presence of any non-linearity on the sign and intensity of discretionary fiscal policy response. They argue that, so far, there has not been any significant change in the discretionary fiscal policy actions of the EMU members following the imposition of the Stability and Growth Pact. Lane (2003), as well, discusses the role of fiscal policy over the cycle, focusing on the limitations for fiscal policy to act in a countercyclical manner in less developed economies. Perotti and Kontopoulos (2002) analyze the implication of fragmentation in the political process in determining fiscal outcomes in difficult times. To attain this they interact the political variables (number of parties, number of ministers and ideology) that determine fragmentation of the political process with the change in unemployment. This way they capture the implications of a bad economic environment for the effects of political variables on fiscal variables. In addition they interact the above mentioned variables with a dummy variable that determines the state of public finances (as in Perotti (1999) in order to determine the implications of bad initial conditions in terms of the debt/GDP ratio). The results indicate that in periods of bad times,"when unemployment increases by 1%, the deficit increases by 0.08% of potential GDP more for every extra party or spending minister".

Gavin and Perotti (1997) analyze the behavior of fiscal balance and government revenue and expenditure in recessions and expansions in Latin American countries. They use two definitions of recessions. Firstly, they characterize as recessions the years during which a country's growth rate is less than the average rate of growth minus one standard deviation of the growth rate series for each country. Secondly, they characterize as deep recession episodes for the OECD countries the periods where output growth is below -1.

We consider two definitions of Bad times. The first measure of Bad times used is based on the cyclical component of real GDP and has been extracted by applying the Hodrick-Prescott filter where the lambda coefficient was set to 6. The dummy variable DY takes the value 1 when the cyclical component is negative, while it is zero otherwise. According to DY there are (261) cases of Bad times, and (274) cases of Good times. This is a measure of the "output gap". The second measure of Bad times used is based on the cyclical component of unemployment rate, extracted as before by using the Hodrick-Prescott filter (the lambda coefficient was set to 6). The dummy variable DU takes the value 1 when the cyclical component is positive while it is 0 otherwise; this definition generates (270) cases of Bad and (265) cases of Good times. The last definition being related to the unemployment rate can be characterized as a milder definition of the cyclical economic conditions, since unemployment might be high and or increasing not only during periods with low or declining output growth.[26]

Being constrained to used yearly data since non-interpolated fiscal variables are not available on quarterly frequency for most countries, we prefer to use the above described definitions of Bad times so as to generate enough Bad time data points.[27] Using definitions analogous to Gavin and

[26] In a previous version of the paper we have considered two more definitions. The first of them corresponds to the change in the cyclical component of real GDP; the dummy variable $D\Delta Y$ takes the value 1 when the change of the cyclical component of real GDP is negative and 0 otherwise. According to $D\Delta Y$ there are (285) cases of Good and (251) cases of Bad times. The other definition corresponds to the change of the cyclical component of unemployment rate, so $D\Delta U$ takes value 1 when the cyclical component is positive and zero when it is negative; this generates (245) cases of Bad times and (290) cases of Good times.

These definitions captures the relative change compared to the last period's state of nature; i.e. when our output gap indicator (the first definition of Bad times DY) implies that we are in a recession for two consecutive periods, despite an improvement in the output gap measure from one period to the other, $D\Delta Y$, evaluating the relative change of the output gap measure, will classify the current period as Good times. Analogously when in Good times according to the output gap measure, with the performance of the output gap deteriorating between two consecutive periods, $D\Delta Y$ will classify the current state as Bad times. Therefore the estimates under this definition capture the effects of fiscal policy actions on private consumption when the state of the economy improves or deteriorates without actually being in a recession or economic expansion according to the output gap measure used. Similarly for the relation between DU and $D\Delta U$.

The results that correspond to these alternative definitions are qualitatively similar to those reported below, however they are not reported in order not to clutter the exposition.

[27] The use of interpolated fiscal data of a quarterly frequency would deteriorate the quality of the information born by the estimated fiscal shocks, which will be crucial for the analysis that will be carried out in the next

Perotti (1997) produces insufficient data points to carry out the analysis in Bad times. Moreover, when output growth is negative, i.e. we are in a deep recession episode, all governments whether in a more or less financially developed economy are expected to provide a fiscal stimulus to the economy. This implies that the effect of fiscal shocks on private consumption in Bad times will be biased upwards by the fact that the fiscal impulse will be of a bigger magnitude.

The definitions used capture relatively well the economic downturns that many countries have experienced in the early 1980s, 1990s and 2000s.

TABLE 1: DEFINITIONS OF BAD TIMES

Dummy	Definition	1	0	Total
DY	Cyclical component of real GDP growth>0	261	274	535
DU	Cyclical component of UnRate>0	270	265	535

With respect to the role of credit constraints on the effects of fiscal policy actions on private consumption, we follow previous work by Jappelli and Pagano (1994) and Perotti (1999). We use as a proxy for credit constraints the maximum ratio of the loan to the value of the house in housing mortgages for first time buyers (LTV ratio). Jappelli and Pagano (1994) that have constructed this measure provide an extensive discussion of why this measure is appropriate as a proxy for liquidity constraints faced by consumers, even in countries where the credit to the private sector as a share of GDP is relatively high[28]. Following, Perotti (1999) we assign each country-decade pair in high or low LTV group, using a cutoff value of 80 % for the LTV ratio. The countries already in a high LTV group before 1994 are retained in the same group for the period from 1995 onwards, assuming (as Perotti (1999)) that the LTV ratio does not decrease over time. The countries belonging to a low LTV ratio before 1995 are either reassigned in the high LTV ratio group or remain in the low LTV group[29].

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sections.

[28]As Jappelli and Pagano (1994) argue, this is the case "because there is no necessary connection between the degree to which credit is available to firms and the degree to which it is available to consumers". Some useful comparison of the LTV ratio and credit to the private sector as a fraction of GDP, which is an index of financial intermediation for the economy as a whole, are shown in the Appendix (Table 8).

[29]Loan-to-Value Ratio: ratio of loan to value of house in average mortgage contract, from Jappelli and Pagano (1994) and Perott(1999). The country decade characterization reported in Perotti (1999) is: (High-LTV countries-decades) Australia 1980-1994, Canada 1980-1994, Germany 1980-1994, Denmark 1970-1994, Spain 1980-1994, Finland and France 1965-1994, UK 1970-1994, Ireland 1965-1994, Norway 1980-1994, Sweden, US (1965-1994). Country-decades with LTV less than 80 percent: (low LTV): Australia 1965-1980, Austria, Belgium 1965-1994, Canada 1965-1980, Germany 1965-1980, Denmark 1965-1970, Spain 1965-1980, Greece, Italy and Japan 1965-1994, Netherlands 1965-1994, Norway 1965-1980, Portugal 1965-1994. These high and low LTV groups for the sample used in the current study are presented at the Appendix (Table 9).

3.4.1 Model Specification and Estimations

As we have discussed above the U and LC types of individuals respond to the unanticipated fiscal policy shocks. The LC type individuals will respond also to anticipated changes in their disposable income when they face binding liquidity constraints, while the ROT consumers will respond both to unanticipated and anticipated disposable income changes under both states of nature. Therefore, we should include a proxy of the "anticipated" disposable income changes ($\Delta\tilde{Y}_{1/antic}$) that are induced by the anticipated component of fiscal policy actions. We expect that this proxy will have more important effects in Bad times than in Good times; because in Bad times it is related both to ROT and LC type consumers, while in Good times it concerns only the ROT consumers. Notice that even if we do not distinguish between Bad and Good times, and we consider only a categorization of more and less financially developed economies both the disposable income proxy and the unanticipated components of the fiscal variables should have more pronounced effects in the less financially developed economies because it is more likely that a bigger fraction of their population faces binding liquidity constraints in both recessions and expansions, or that a bigger fraction of their population behaves as rule-of-thumb consumers.

As discussed above we study how individuals' consumption responds to fiscal shocks when already in a recession or an expansion. The simple theoretical framework implies that the *U-type individuals* always smooth their consumption (reacting only to the unanticipated component of the fiscal policy change): $\Delta C_1^U = \frac{\Delta Y_{1/\varepsilon_1} + R\Delta Y_{2/\varepsilon_1}}{1+R}$, *this is true for the LC types only in Good times.* While *in Bad times* their consumption change equals the change in their disposable income (including both the anticipated and unanticipated component): $\Delta C_1^{LC} = \Delta Y_{1/\varepsilon_1} + \Delta Y_{1/antic}$. The *same applies for the ROT consumers under both states of nature.* Hence, the equation to be estimated would be composed of two components, an unanticipated component which is determined by the fiscal shocks ε_1^G, ε_1^T and the stochastic disturbance v_1, and an anticipated component of the disposable income changes which is proxied by $\Delta\tilde{Y}_{1/antic}$. Therefore, we will estimate the following specification for the high and low LTV groups:

$$\Delta C_1 = \alpha_1(1-D_1)\varepsilon_1^G + \alpha_2(1-D_1)\varepsilon_1^T + \alpha_3(1-D_1)\Delta\tilde{Y}_{1/antic} + \alpha_4 D_1\varepsilon_1^G + \alpha_5 D_1\varepsilon_1^T + \alpha_6 D_1\Delta\tilde{Y}_{1/antic} + v_1 \tag{3.22}$$

D_1 is a dummy variable taking the value 1 in Bad times and 0 in Good times. ε_1^T is the spending shock and α_1 gives us its effect on consumption in Good times, while α_4 gives us its effect in Bad times. ε_1^T is the tax shock and α_2, α_5 are its effects in Good and Bad times, respectively. α_3 and α_6 are, respectively, the Good and Bad time effects of the disposable income proxy. While v_1 is a stochastic disturbance that is uncorrelated with the fiscal shocks. Notice that the coefficients of fiscal policy variables in Good and Bad times capture the effect on private consumption for the U, LC and ROT type individuals. Whereas, the coefficient of the disposable income proxy

in Good times captures the change in consumption for the ROT individuals; in Bad times the coefficient of the disposable income proxy incorporates the effect of anticipated income changes on the private consumption of the LC and ROT consumers. This setting captures in a simple way the real life fact that some people face binding constraints both in recessions and expansions, with the liquidity constraints binding for a bigger fraction of the population in recessions.

In order to construct the proxy $\Delta\tilde{Y}_{1/antic}$, and to deal with the *endogeneity* of current income changes with the fiscal variables, we predict the "anticipated" disposable income change using only lagged information. Notice that the disposable income proxy according to equation (15) should capture the anticipated fiscal policy effects on disposable income conditional on the realization of the productivity shock (i.e. knowing the state of the economy at the beginning of period one). Therefore we predict $\Delta\tilde{Y}_{1/antic}$ with the fitted values ($\Delta\ddot{Y}_t$) from the regression[30]:

$$\begin{aligned}\Delta Y_t &= \Delta Y_{t-1} + \Delta Y_{t-2} + \Delta Y_{t-3} + \Delta TL_{t-1} + \Delta TL_{t-2} \\ &\quad + \Delta G_{t-1} + \Delta G_{t-2} + \Delta C_{t-2} + \Delta C_{t-2} * cdum + cdum + tdum \qquad (3.23)\end{aligned}$$

i.e. we regress the change in households disposable income (ΔY_t) on the first, second and third lagged values of ΔY_t, on first and second lagged values of changes of government spending and cyclically adjusted labor taxation (direct taxes and social security contributions paid by households), and on the second lagged value of the change in consumption and its interaction with country specific dummies (*cdum*) (see Perotti, 1999) in order to capture country specific consumption dynamics. Finally, *tdum* are year dummies that control for global economic developments. The lagged values of the change in taxation and expenditure can be thought of capturing the anticipated effects of fiscal policy changes on disposable income, while the lagged values of the disposable income change control for the state of the economy.[31]

Fiscal shocks

Next we discuss the estimation of the fiscal shocks. To get consistent estimates of the coefficients of (22) we need to exclude any feedback on fiscal policy variables due to economic activity. Therefore, we should not consider the component of fiscal policy changes which is driven by

[30]The fiscal variables used are G_t: government consumption, T_t: total tax revenues (total direct taxes, social security contributions received by the government and total indirect taxes). TL_t: income and social security taxes paid by employees. All variables are expressed in real per capita terms, for the fiscal variables we have used the GDP deflator, whereas for private consumption and household disposable income we have used the deflator of private consumption. Moreover, following Perotti (1999) we scale each variable by the lagged value of real per capita disposable income (the argument for that is that a fiscal policy change will have different effects on private consumption when government consumption or taxation is 10 percent or 40 percent of GDP).

[31]Alternative specifications were also considered, using unadjusted instead of cyclically adjusted measures of ΔTL. The preferred one had a better fit.

cyclical movements in economic activity. The focus should be on discretionary policy changes of an unanticipated nature. Discretionary policy changes, as is discussed Gali and Perotti (2003), can be decomposed into a systematic or endogenous component (systematic responses to changes in actual or expected cyclical economic conditions) and an exogenous component (random changes in budget variables (e.g. war spending etc). Perotti (1999) provides a discussion of whether it is appropriate to talk about discretionary changes in taxation and spending with no feedback from GDP when using yearly data. He claims that the assumption that policy makers do not respond much to economic environment within a year is not unreasonable with respect to several government spending components. However, it is quite likely that such kind of feedback will exist with respect to taxation. Nevertheless, Perotti (1999) argues that "*even if the estimated surprises are not truly exogenous, this is likely to bias...the coefficients of tax surprises upwards, both in Good and Bad times,... but it is not clear why it should seriously bias their difference*". However, Bad and Good times in Perotti (1999) correspond to periods of high debt and/or deficit, not recessions and expansions as in our analysis. In our case it is likely that fiscal policy might be conducted in a countercyclical manner, being stronger in Bad times because an economic downturn is more costly to policy-makers so they will choose to respond in a more decisive manner to adverse economic conditions. This would imply that the difference between the coefficients of fiscal variables in recessions and expansions might be biased. Moreover, there might be strong monetary and fiscal policy interactions. This would also affect the coefficients of the fiscal variables, especially in downturns of economic activity where the fiscal and monetary authorities might coordinate to get the economy out of the recession.

To extract $\varepsilon_t^G, \varepsilon_t^T$,the fiscal policy shocks, we perform OLS on the following system of equations,[32] where we are dealing with the above mentioned problems by adding two lagged values of the change in real GDP (Q), as well as, including the lagged change in short term interest rate (IRS):[33]

$$\begin{aligned}
\Delta G_t &= a_{11} + a_{12}\Delta G_{t-1} + a_{13}\Delta T_{t-1} + a_{14}\Delta Q_{t-1} + a_{15}\Delta Q_{t-2} + a_{16}\Delta IRS_{t-1} + \varepsilon_t^G \\
\Delta TL_t &= a_{21} + a_{22}\Delta G_{t-1} + a_{23}\Delta TL_{t-1} + a_{24}\Delta Q_{t-1} + a_{25}\Delta Q_{t-2} + a_{26}\Delta IRS_{t-1} + \varepsilon_t^T \quad (3.24) \\
\Delta Q_t &= a_{31} + a_{32}\Delta G_{t-1} + a_{33}\Delta T_{t-1} + a_{34}\Delta Q_{t-1} + a_{35}\Delta Q_{t-2} + a_{36}\Delta IRS_{t-1} + \varepsilon_t^Q
\end{aligned}$$

[32] As in Perotti (1999) in each regression the constant is allowed to change in 1975. Moreover, we allow for a post-Maastricht effect on EU countries by allowing a different mean after 1992; this captures more cooperative and possibly more coordinated policies as well as a trend towards fiscal consolidation in the run up to the EMU. The countries considered are: Austria, Belgium, Germany, Denmark, Spain, Finland, France, UK, Greece, Ireland, Italy, Netherlands, Portugal and Sweden.

[33] Data for real GDP and short-term interest rate are from OECD, Economic Outlook and International Financial Statistics of the IMF.

The government spending shock will be $\ddot{\varepsilon}_1^G$ as estimated above, whereas the cyclically adjusted tax shock is constructed as proposed by Blanchard (1993), and it is $\ddot{\varepsilon}_1^{TCA} = \ddot{\varepsilon}_1^T - \phi_t \ddot{\varepsilon}_t^Q TL_t$. ϕ_t is a weighted average of the GDP elasticities of direct taxes to households and social security contributions paid by employees, i.e. the components of TL. These elasticities are taken from OECD's Economic Outlook (2003), Giorno et al (1995), and Van den Noord (2002).[34]

Notice that in order to capture the effect of credit or liquidity constrained consumers we should estimate equation (22) for the two LTV groups that represent different degrees of development of consumer credit and mortgage markets. The larger the fraction of liquidity constrained individuals, the stronger the effect of fiscal policy on private consumption. Particularly in Bad times when liquidity constraints bind for more people (or when they are stricter) and consumption smoothing is not possible. Hence, we expect that a government spending shock, will have positive and stronger effects on private consumption in Bad times compared to Good times in countries characterized by less developed consumer credit and mortgage markets. This happens because the liquidity constrained individuals being at a "corner" solution will consume their income increase that results as a consequence of the spending shock. In more financially developed economies, where the fraction of liquidity constraint individuals and rule-of-thumb consumers is much smaller, we would expect that a government spending shock has smaller effects on private consumption compared to the less financially developed economies. Though, even for them fiscal policy might be more effective in Bad times if the fraction of population affected by liquidity constraints increases in Bad times.

Similarly a tax shock (tax hike) is expected to have a stronger negative effect on consumption in periods of economic slowdown compared to economic expansions, in less financially developed countries. The other side of the coin would be that a tax cut could boost private demand by much more in downturns relative to upturns, in countries where access to consumer credit is limited. In countries with more developed consumer credit markets the effects should be of a smaller magnitude, still though it is possible that a tax shock might have stronger effects in a recession relative to an expansion, as long as the fraction of the population that cannot smooth consumption increases in Bad times.

Moreover, we expect that the disposable income proxy will have more pronounced effects on consumption in the low LTV rather than in the high LTV group, whereas it will be of a bigger magnitude for both of them in Bad times. The first result holds, as long as, a bigger fraction of the population does not have access to financial markets in the low LTV than in the high LTV group. In addition the second result holds if the constraints bind for more people in both LTV groups during Bad times.

[34] Following work by Perotti (2001) we are assuming interest rate semi elasticities for taxes and spending equal to zero.

3.4.2 Estimation Results

The analysis will be conducted in four steps. *First*, we will examine the implications of fiscal shocks on private consumption in the whole OECD sample without using the LTV categorization or the Bad-Good times definitions. This way we will get a better idea of what the results are for the *benchmark* model using the whole OECD sample, and whether the categorizations that we shall use next make sense. As a *second* step we will analyze what are the implications if we consider the two LTV groups separately (high and low), without considering the Bad times definitions. If there exist consumers that have limited access to consumer credit under all states of nature then fiscal policy will be more effective in the low LTV group. The *third* step will be to consider the fiscal policy actions taken in Bad and Good times for the whole OECD sample, without making use of the LTV index. The conclusions drawn will be related to the effectiveness of the exogenous component of discretionary fiscal policy on affecting private demand over the business cycle, a useful benchmark for the final step of the analysis. The *fourth* and last step will be to investigate the role of liquidity constraints (as proxied by the LTV indexed) in the transmission of fiscal shocks in recessions and expansions. In all the above cases we will consider also the decomposition of fiscal innovations into their expansionary (when spending shocks are positive and tax shocks negative) and contractionary (when spending shocks are negative and tax shocks positive) components.[35]

Fiscal policy in OECD countries

First we present the benchmark model which is estimated by the Prais-Winsten estimation procedure allowing for a panel-level heteroskedastic AR(1) error structure[36] with country and year dummy variables. Table 2 displays that a government spending shock has a very strong positive effect on private consumption, while the tax shock has a negative effect of a smaller magnitude though. Moreover, the disposable income enters with a positive and significant coefficient, according to the theoretical discussion this should indicate the presence of liquidity constrained individuals. Overall, the effects are of a Keynesian nature. After using the categorization of fiscal shocks into expansionary and contractionary components (see table 10, Appendix) we find that an expansionary spending shock has a positive and quite strong effect on private consumption,

[35] The coefficient estimate of an expansionary spending shock displays the effect on consumption from a spending increase, when fiscal policy is set in an expansionary manner. The negative of a coefficient estimate of a contractionary spending shock gives the effect in consumption following a decrease in government spending (or alternatively the effect on an increase in spending, when fiscal policy is set in a contractionary way). Similarly, the (negative of the) coefficient of an expansionary tax shock represents the effect of a tax cut on private consumption, while the coefficient of a contractionary tax shock represents the effect on private consumption following a tax hike.

[36] Alternatively, we estimated the model by pooled OLS allowing for heteroskedastic and autocorrelated of order one error structure (Newey-West standard errors). The results obtained are qualitatively similar.

while a contractionary spending shock still has a positive but very small and insignificant effect on private consumption. These results are confirmed by relevant Chi-square tests (table 10, Appendix). Both expansionary and contractionary tax shocks generate similar (negative) effects on private consumption, though the contractionary tax shock has a slightly bigger and much more significant coefficient, though the Chi-square test performed does not reject the null of a common effect in both cases.[37] Overall, spending shocks' effects present significant asymmetry, with the expansionary spending shocks having the most important effects.[38]

Table 2

Variables	OECD	HLTV	LLTV
ε_t^g	2.2940(3.32)***	0.1662(1.34)	3.4199(3.63)***
ε_t^t	-0.4101(-3.14)***	-0.2070(-3.52)***	-0.5396(-3.49)***
ΔY_t	0.7586(2.24)**	0.4077(4.75)***	0.7475(2.07)**
Nobs	535	302	233
R^2	0.321	0.5147	0.4043
Adj R^2 1st regr.	0.873	0.873	0.873
Nobs 1st regr.	544	544	544

t-statistics in parenthesis. ***, **,* statistical significance at 1%, 5% and 10% level of significance, respectively.

The next step is to introduce the high and low LTV categorization and see whether the results change in a significant manner. The results are shown in the last two columns of Table 2 for each LTV group. The estimates after pooling the two groups are reported in Table 3. As expected spending, taxation and the disposable income proxy have bigger coefficient estimates in the case of the low LTV group. However, only the spending shock has statistically different results between the two groups. The tax shock produces different effects in the two LTV groups, though the difference between the two groups is statistically different from zero only at the 20% level of significance. Therefore, fiscal policy shocks and particularly government spending shocks have asymmetric effects in the two LTV groups, suggesting that liquidity constraints are important.

[37] The results are to be read as follows: an decrease in tax burden by 1% will increase consumption by 0.528%, while an increase in tax burden will decrease consumption by 0.638%.

[38] Considering the two hypotheses together, we are able to reject the null of common effects when fiscal policy is contractionary and expansionary (Table 10).

Table 3

Variables	
$\varepsilon_t^g LLTV$	3.4863(3.44)***
$\varepsilon_t^g(HLTV - LLTV)$	-3.3630(-3.30)***
$\varepsilon_t^t LLTV$	-0.5264(-3.20)***
$\epsilon_t^t(HLTV - LLTV)$	0.2431(1.34)
$\Delta\tilde{Y}_t LLTV$	0.7626(2.14)**
$\Delta\tilde{Y}_t(HLTV - LLTV)$	-0.0837(-0.33)
Nobs	535
R^2	0.3755
Nobs & R^2 in the 1st regr.	544 (0.873)

t-statistics in parenthesis. ***, **,* statistical significance at 1%, 5% and 10% level of significance, respectively.

In the high LTV group (table 10, Appendix), contractionary and expansionary spending shocks have a positive effect of a similar magnitude, but they are statistically insignificant. The expansionary tax shock seems to have a much bigger impact on private consumption than the contractionary tax shock, i.e. a decrease in taxation increases consumption by about the double of the absolute value of a private consumption decrease following an increase in taxation. However, relevant Chi-square tests do not confirm this result.

Both spending and tax shocks of expansionary and contractionary nature are of a bigger magnitude in the low-LTV group. Expansionary spending shocks have a much more pronounced, positive and significant effect on private consumption, compared to contractionary spending shocks. While it is contractionary tax shocks that appear to have a significant impact on consumption. Though, the Chi-square tests reported support only the case of different spending effects and not tax effects. Considering both hypotheses together we are able to reject the null of common effects when fiscal policy is expansionary and contractionary. After pooling all observations (table 11, Appendix) expansionary spending shocks in the low-LTV group are the driving force of the asymmetry between the effects of spending shocks in OECD countries (the expansionary spending shocks are of a much bigger magnitude in the low-LTV group). In addition, there is significant asymmetry in the effects of a contractionary tax shock between the two LTV groups, with the effect being almost three times bigger in absolute value in the case of the low-LTV group. Hence, an increase in spending and an increase in taxation are translated into much bigger consumption changes in the low-LTV group, that is characterized by less developed consumer credit markets, than in the high LTV group.

Before turning to examine the role of liquidity constraints in the transmission of fiscal shocks in recessions and expansions, we analyze how tax and spending shocks affect private consumption in recessions and expansions in all the nineteen OECD countries considered. The results will be

suggestive of the effectiveness of fiscal policy over the business cycle and will serve as a useful benchmark in order to evaluate the effect that the interaction of the degree of development of consumer credit markets (as described by the LTV ratio) with fiscal policy shocks has on private consumption in upturns and downturns of economic activity.

We estimate two versions of the model. In the first one, according to our simple theoretical framework, the proxy $\Delta\ddot{Y}_t$ captures the effects of anticipated income changes on private consumption of liquidity constrained individuals. While in the second $\Delta\ddot{Y}_t$ is allowed to have a different effect in Bad and Good times, i.e. allow for liquidity constraints to bind both in Good and Bad times; we expect though the result to be stronger in Bad times. In both cases we include a full set of country and year dummy variables. Tables 4 and 5 present the estimates that correspond to the four definitions of Bad times.

When examining DY, we see that spending shocks have a positive effect on private consumption which much more pronounced in Bad times. Tax shocks, have a negative effect in both states of nature with their effect being stronger and more significant in Bad times. The disposable income proxy has a bigger effect in economic recessions. Though, Chi-square tests indicate that only the effect of the spending shock has statistically different effects in Good and Bad times.

After decomposing the fiscal shocks into expansionary and contractionary categories, in the case of definition DY, we see (table 12 Appendix) that an expansionary spending shock generates a bigger (positive) impact effect on private consumption than a contractionary spending shock when in Bad times. So an increase in spending affects consumption (positively) by much more than a corresponding decrease when in Bad times; this appears is not the case in Good times as can be seen by the reported Chi-square tests. Moreover, there is a statistically significant and much bigger (positive) effect on private consumption following an expansionary spending shock in Bad than in Good times.

A contractionary tax shock in Bad times appears to affect consumption to a greater extent than an expansionary tax shock in Bad times, though the Chi-square tests reported in Table 12.1 do not confirm this result. In Good times there is an indication of asymmetric effects, with bigger coefficient (in absolute values) for the case of an expansionary tax shock, though the relevant test performed does not reject the null of a common coefficient for expansionary and contractionary tax shocks. While, contractionary tax shocks have a bigger (negative) and more significant impact effect on private consumption in Bad times, than in Good times. Whereas, for expansionary tax shocks we cannot reject the null of a common effect both in Bad and Good times.

TABLE 4

Variables	DY	DY
$\varepsilon_t^g Bad$	3.6949(3.62)***	3.8225(3.82)***
$\varepsilon_t^g Good$	0.7130(0.88)	0.3064(0.41)
$\varepsilon_t^t Bad$	-0.5711(-3.61)***	-0.6199(-3.90)***
$\varepsilon_t^t Good$	-0.3422(-1.00)	-0.2012(-0.62)
$\Delta\ddot{Y}_t$	0.7467(2.27)**	-
$\Delta\ddot{Y}_t Bad$	-	0.8351(2.48)**
$\Delta\ddot{Y}_t Good$	-	0.6000(1.74)*
Nobs	535	535
NofBad Times	261	261
R^2	0.368	0.386
X^2(and p-values):bg=gg	5.22(0.0224)	7.88(0.0050)
X^2 :bt=gt	0.36(0.5477)	1.32(0.2505)
$X^2 : b\Delta\ddot{Y}_t = g\Delta\ddot{Y}_t$	-	1.18(0.2779)
Adj.R^2 & Nobs 1st regr.	0.873 (544)	

t-statistics in parenthesis (in X^2 tests we report p-values).*

**, **,* statistical significance at 1%, 5% and 10% level of signif., respectively.

TABLE 5

Variables	DU	DU
$\varepsilon_t^g Bad$	1.8343(1.83)*	2.2484(2.38)**
$\varepsilon_t^g Good$	0.5958(0.73)	0.1963(0.26)
$\varepsilon_t^t Bad$	-0.5305(-3.77)***	-0.6185(-4.53)***
$\varepsilon_t^t Good$	0.0426(0.22)	0.1368(0.74)
$\Delta\hat{Y}_t$	0.6529(2.01)**	-
$\Delta\hat{Y}_t Bad$	-	0.8300(2.48)**
$\Delta\hat{Y}_t Good$	-	0.5270(1.62)
Nobs	535	535
NofBad Times	270	270
R^2	0.437	0.475
X^2(and p-values):bg=gg	0.89(0.3456)	2.79(0.0950)
X^2 :bt=gt	6.13(0.0133)	10.95(0.0009)
$X^2 : b\Delta\hat{Y}_t = g\Delta\hat{Y}_t$	-	2.08(0.1488)
Adj.R^2 & Nobs 1st regr.	0.873 (544)	

t-statistics in parenthesis (in X^2 tests we report p-values).

***, **,* statistical significance at 1%, 5% and 10% level of signif., respectively.

The DU definition that is based on the unemployment rate and describes milder recession episodes produces analogous results for the spending and tax variables. However the estimates are of a smaller magnitude and not as significant as before, in particular those refering to the fiscal shocks.The disposable income proxy, as above, produces positive and more significant effects in Bad times. Moreover, we see (tables 13 and 13.1) that expansionary fiscal shock produce a strong and significant positive effect in Bad times, which is of a bigger magnitude and statistically different than in Good times but it is not statistically different from the effects of contractionary spending shock in Bad times. As far as taxation is concerned, both contractionary and expansionary tax shocks generate similar magnitude effects in Bad times, while the contractionary tax shock (a decrease in taxation; the negative of the coefficient) increases consumption and generates a statistically different effect compared to Good times. Notice that in this case tax shocks have insignificant effect in Good times.

Overall, fiscal policy appears to have Keynesian effects on private consumption in Bad times for the whole OECD sample. A tax cut in downturns increases private consumption more than a tax cut in upturns of economic activity, whereas a spending shock generates much more pronounced effects in periods of reduced economic activity. Furthermore, the results obtained point to the following: Expansionary spending shocks in Bad times are more important in generating

positive effects in consumption and differ significantly both with respect to the corresponding effects in Good times and the effects of a contractionary spending shock in Bad times. With respect to taxation, expansionary tax shocks in Good times (a decrease in taxation, i.e. the negative of the coefficient estimate) raise significantly consumption, mainly for DY (though the magnitude of the effect does not differ significantly from the effect in consumption caused by a tax hike as part of a contractionary tax policy in Good times); while a contractionary tax shock in Bad times generates a significant reduction in private consumption, which is statistically different from the corresponding effect in Good times, but not statistically different from the magnitude effect of a expansionary tax shock (a tax cut) in Bad times.

Hence fiscal policy (particularly an expansionary spending shock) is more effective in mitigating economic slumps rather than in muting booms, with respect to its effect on private consumption. As far as taxation is concerned, we see that tax effects on consumption are stronger in Bad times particularly because tax shocks, contractionary or expansionary, are equally important in Bad times, while at the same time contractionary shocks in Bad times affect private consumption to a greater extent relative to their corresponding effect in Good times. Alternatively we could say that government spending is a more effective mechanism in shortening recession episodes than lengthening expansions in OECD countries. Tax policy has very negative effects on private economic activity if pursued in a contractionary manner in particular in Bad times than in Good times; whereas there are no significant indications that its contractionary (tax hike) and expansionary (tax cut) components produce asymmetric effects (in terms of the magnitude of the coefficient) in Bad times.[39]

A possible justification for these results is the presence of liquidity constraints that bind for a fraction of the population in all OECD countries during Bad times, so that unanticipated fiscal policy actions that increase or decrease disposable income will induce them to consume more or less, respectively.[40] Next, we will evaluate the implications of credit constraints.

The effects of credit constraints in recessions and expansions In this section we will examine the effects of consumer credit availability on the way that fiscal policy affects consumption behavior. Consumer credit availability is determined by the LTV ratio[41].

[39] In case of a tax hike consumption decreases, the opposite in case of a tax cut, but the result is of a symmetric nature.

[40] Alternatively, the fiscal policy shocks might be countercyclical, with their effect being inherently stronger in recessions because. Though, even in that case liquidity constraints should bind, otherwise individuals should be able to smooth their consumption.

[41] As before we estimate two versions of equation (22). The first one imposes a common $\Delta\tilde{Y}_t$ in Good and Bad times, while in the second $\Delta\tilde{Y}_t$ is allowed to have a different effect in upturns and downturns. A full set of country and year dummy variables have been included, and the estimation is conducted for a high and a low LTV country-year groups. The Prais-Winsten estimation procedure that allows for panel-level heteroskedastic AR(1)

The results presented on Table 6 make use of the DY definition of Bad times and refer to the high and low LTV groups. A government spending shock affects in a positive and significant manner private consumption in Bad times with respect to the high LTV group; though in Good times its effect is not statistically significant, and the coefficient has a negative sign. The tax variable has a negative and significant effect which appears to be of a similar magnitude in both Good and Bad times. The disposable income proxy enters with a positive and significant coefficient both in Good and Bad times, though its effect is bigger in Good times.

Fiscal policy is more effective for the low LTV group. A government spending shock has a much bigger and statistically significant coefficient in Bad times, on top of that the tax shocks have a bigger effect and are statistically significant only in Bad times. The disposable income proxy has a bigger effect on private consumption in the low LTV group, with its effect being more pronounced, as expected, in Bad times. However, it is only the spending shock that appears to have statistically different effects (at conventional levels of statistical significance) on private consumption in Bad and Good times.

Therefore, spending shocks have more pronounced effects in Bad times for both LTV groups, though the magnitude of the coefficients is much bigger when considering the low LTV group. Tax shocks have a bigger coefficient for the low LTV group rather than the high LTV group, however, in both cases we cannot reject the null of a similar effect in Good and Bad times. Analogously, the effect of the disposable income proxy is bigger in the low LTV group. In addition, the disposable income proxy has a stronger effect in Good times for the high LTV group, whereas its effect is bigger in Bad times for the low LTV group (though only at the 20% percent level of significance).

error structure was used. Qualitatively similar results were obtained when we estimated the model with pooled OLS with Newey-West standards errors.

TABLE 6: DY

Variables	1	2	3	4
-	H-LTV	H-LTV	L-LTV	L-LTV
$\varepsilon_t^g Bad$	0.5255(2.73)***	0.4932(2.60)***	4.7018(3.89)***	4.9059(4.12)***
$\varepsilon_t^g Good$	-0.0641(-0.040)	-0.0690(-0.44)	1.3697(1.05)	0.5108(0.39)
$\varepsilon_t^t Bad$	-0.2185(-2.47)**	-0.2327(-2.70)***	-0.7016(-3.97)***	-0.7611(-4.28)***
$\varepsilon_t^t Good$	-0.1868(-2.52)**	-0.2013(-2.78)***	-0.5507(-0.67)	-0.2401(-0.30)
$\Delta\ddot{Y}_t$	0.4139(4.84)***	-	0.7589(2.15)**	-
$\Delta\ddot{Y}_t Bad$	-	0.2750(2.77)**	-	0.8475(2.40)**
$\Delta\ddot{Y}_t Good$	-	0.4841(5.38)***	-	0.5599(1.50)
Nobs	302	302	233	233
NofBad Times	149	149	112	112
R^2	0.528	0.535	0.443	0.465
X^2 (and p-values) for bg=gg	5.49(0.0191)	5.15(0.0232)	3.61(0.0574)	6.16(0.0131)
X^2 :bt=gt	0.08(0.7765)	0.08(0.7723)	0.03(0.8565)	0.42(0.5192)
$X^2 : b\Delta\ddot{Y}_t = g\Delta\ddot{Y}_t$	-	6.45(0.0111)	-	1.73(0.1883)

t-statistics in parenthesis (in X^2 tests we report p-values).***, **,* statistical significance at 1%, 5% and 10% level of signif., respectively

Decomposing the fiscal shocks into their expansionary and contractionary components we see that with respect to the high-LTV group the contractionary spending shock produces bigger and significant effects on private consumption in Bad times, and moreover that its effect is statistically different from the corresponding effect in Good times, as well as the effect of the expansionary spending shock during Bad times (tables 14 and 14.1, Appendix). We can interpret this result in two ways, firstly that a spending cut in Bad times (the negative of the coefficient estimate) reduces to a much greater extent private consumption, than the corresponding pick up in consumption following an increase in spending in Bad times. A second interpretation is that a spending increase during a period of Bad times where fiscal policy has been conducted in a contractionary way generates much bigger, positive, effects in private consumption.

A contractionary tax shock in Bad times generates strong negative effects on private consumption, but it does not differ significantly in terms of magnitude from the expansionary tax shocks in Bad times. Whereas, in Good times it is expansionary tax shocks that significantly affect the private consumption, though still their magnitude does not differ significantly compared to contractionary tax changes. Furthermore, there are no significant differences in terms of magnitude between contractionary and expansionary tax shocks in Bad and Good times, confirming the result obtained before.

Expansionary spending shocks in Bad times are the most important factor that affects private consumption in the low-LTV group, and it is statistically different from contractionary spending

shocks in Bad times, and expansionary spending shocks in Good times. In addition, as for the high-LTV group, contractionary tax shocks in Bad times affect in a significant manner consumption changes, though its effect differs significantly from the corresponding effect of a expansionary tax shock in Bad times. Hence, a tax hike in Bad times reduces consumption, but not more that the corresponding increase in consumption following a tax cut in Bad times. Therefore, the bigger source of asymmetry comes from the spending shocks, with the contractionary component being more influential in the high LTV group and the expansionary component in the low-LTV group.

TABLE 7: DU

Variables	1	2	3	4
-	H-LTV	H-LTV	L-LTV	L-LTV
$\varepsilon_t^g Bad$	0.4269(2.22)**	0.4297(2.23)**	2.9340(2.00)**	3.5925(2.5
$\varepsilon_t^g Good$	0.0074(0.05)	0.0200(0.12)	1.1154(0.88)	0.2346(0.
$\varepsilon_t^t Bad$	-0.1758(-1.98)**	-0.1754(-1.96)**	-0.6162(-3.53)***	-0.7477(-4.3
$\varepsilon_t^t Good$	-0.2272(-2.82)***	-0.2338(-2.90)***	-0.0242(-0.09)	0.1615(0.(
$\Delta\ddot{Y}_t$	0.3971(4.60)***	-	0.6547(1.83)*	-
$\Delta\ddot{Y}_t Bad$	-	0.3352(3.34)***	-	0.8843(2.4
$\Delta\ddot{Y}_t Good$	-	0.4369(4.61)***	-	0.4907(1.3
Nobs	302	302	233	233
NofBad Times	150	150	120	120
R^2	0.519	0.519	0.474	0.522
X^2 (and p-values) for bg=gg	2.67(0.1019)	2.57(0.1090)	0.91(0.3410)	3.12(0.077
X^2 :bt=gt	0.18(0.6700)	0.23(0.6307)	3.85(0.0498)	8.32(0.003
$X^2 : b\Delta\ddot{Y}_t = g\Delta\ddot{Y}_t$	-	1.25(0.2631)	-	3.33(0.068

t-statistics in parenthesis (in X^2 tests we report p-values).***, **,* statistical significance at 1%, 5% and 10% level of signif., res

According to the DU definition of Bad times (table 7) that makes use of the cyclical component of the unemployment rate, the effects of spending shocks on private consumption for the high LTV group follow the same pattern as those under the first definition of Bad times, i.e. the coefficient estimates are bigger and significant (only) in Bad times. Tax shocks appear to have a relatively stronger effect in Good times, though this is not supported by relevant Chi-square tests. The disposable income proxy has significant and positive coefficient estimates in both Good and Bad times, moreover we cannot reject the null of a similar effect in both states of nature. When examining the coefficient estimates for the low LTV group we see that spending shocks have much bigger effects compared to high LTV group, in addition the effect in Bad times is more pronounced compared to that in Good times. The tax shocks have coefficients of bigger magnitude compared to the high LTV group in Bad times, with their effect being insignificantly estimated in Good times. The disposable income proxy has a bigger effect on private consumption relative to the

high LTV group, having also a more pronounced effect during recessions as expected.

With respect to the high LTV group, as before contractionary spending shocks in Bad times affect mostly private consumption (tables 15 and 15.1, Appendix). Tax shocks, contractionary or expansionary, in Good times affect in an analogous manner consumption; whereas only expansionary tax shocks are significant in Bad times, though the results produced are not statistically different from the effects of an contractionary tax shock.

Expansionary spending shocks generate a very pronounced effect in Bad times for the low-LTV group, which though does not differ much from the coefficient estimate of a contractionary spending action in Bad times (table 15.1); however it significantly different from the impact of a spending expansion on private consumption in Good times. Tax effects are mostly important in Bad times, with the expansionary and contractionary effects being of symmetric nature.

Findings: Overall the results obtained under both narrow (DY) and broad notions of slowdown in economic activity (DU) provide support for the presence of asymmetric effects of fiscal policy in the high and low LTV groups. Under all definitions a tax shock (tax hike) reduces consumption the most in Bad times in the low LTV group, but it has minimal effects in Good times. On the contrary, in more financially developed economies (the high-LTV group) a tax shock appears to have a negative effect of a similar magnitude during both upturns and downturns of economic activity. Furthermore, the effect of a tax shock in Bad times is much bigger in the low LTV group as can judged from the magnitude of the coefficient estimates.

Moreover, after decomposing the tax shocks into their contractionary and expansionary components we see that they are affecting consumption effectively both in Bad and Good times for the high-LTV group. In particular the most pronounced effects on private consumption are obtained when considering the following cases: a contractionary tax shock in Bad times as defined by DY (i.e. a tax hike or a tax cut when tax policy was previously set in a contractionary manner), an expansionary tax shock in Bad times as defined by DU (i.e. a tax cut) and an expansionary tax shock in Good times.

In the low-LTV group the most pronounced effects on private consumption come from the contractionary component of a tax shock. Hence, a tax cut in Bad times, when policy was previously conducted in contractionary manner, boosts substantially private consumption (the opposite if we consider a tax hike). The expansionary component of tax shocks is effective in Bad times, though only in the case of less severe recession episodes (like DU).

Government spending shocks affect consumption expenditure the most during recessions in both LTV groups, however the effect is much more pronounced in countries with less developed financial systems as was predicted by the model. Additionally, in the high-LTV group it is the contractionary component of spending shocks that affects consumption the most, i.e. a spending cut during a recession period (e.g. in order to improve the fiscal balances) has devastating effects

on consumption; alternatively, a spending increase in a recession period, when fiscal policy was pursued in an contractionary manner boosts effectively private consumption. On the other hand, it is the expansionary component of spending shocks that raises private consumption in Bad times for the low-LTV group, because an increase in government spending (in the presence of binding liquidity constraints) raises disposable income encouraging people to increase their spending. The disposable income proxy has positive and significant effects in both LTV groups, with its effect being much more pronounced in the low LTV group as expected. In addition, there is limited evidence that the coefficient estimates are of bigger magnitude in Bad times for the low LTV group. On the contrary, when considering the high LTV group, in most cases, there is clear evidence of a bigger coefficient in Good times.

Therefore, during recession episodes fiscal policy in the low LTV group shares (or drives) the stabilization properties of the whole OECD sample case, i.e. fiscal policy (both spending and tax) shocks are more effective in mitigating recessions rather than muting expansions, with respect to its effect on private consumption. Alternatively, fiscal policy actions are more able in shortening recessions than lengthening expansions. Whereas, for the high LTV group, an unanticipated increase in spending boosts private expenditure only in Bad times as for the low LTV group, however tax policy is equally effective under all states of nature. This is due to the fact that taxation has a direct effect on individuals' income and since most people can smooth their consumption at all times, tax changes will have similar effects under all states of nature.

Robustness Test Nevertheless, the results obtained so far might be affected by the fact that some or all the countries that have been categorized to the low-LTV group have switched status from 1995 onwards, due to financial liberalization. According to Jappelli and Pagano (1994), the LTV ratio was 60% in Austria, Japan and Portugal, 75% in Belgium and Netherlands, 50% in Greece, and 56% in Italy in 1994. We shall explore how our results change if we assign Belgium and Netherlands in the high LTV group from 1995 onwards. A similar exercise will be done for the other two groups of countries i.e. Austria, Japan and Portugal, and finally Italy and Greece.

Under all definitions of Bad times the results remain qualitatively similar both for the high and low LTV categories, the only difference is in quantitative terms. Specifically the coefficients of all variables in most cases become bigger, in absolute terms, especially in Bad times for the low LTV group, whereas for the high LTV group the coefficient estimates do not change much or they decrease[42]. This implies that the effect of fiscal policy on private consumption is stronger in recessions in the low LTV group, when fewer countries are characterized as having less financially developed economies overtime. This is true only if OECD countries are converging in terms of the development of their financial markets, and fewer countries or none is included in the

[42]Results are available upon request.

low LTV group after 1995[43][44]. Hence, in the event of convergence of financial development and harmonization of financial systems in OECD countries overtime, all or most of the low LTV group observations refer to the prior to 1995 period observations. In this case, fiscal policy (taxation and government expenditure) in the low LTV group has greater impact on consumption especially in Bad times, than if we allow the countries under consideration to be assigned to the low LTV group after 1995. An explanation for this could be that fiscal policy has become less effective in boosting output and private demand overtime in the event of financial liberalization and abolishment of restrictions on credit availability to consumers[45].

3.5 Conclusions

This paper has presented in a simple theoretical framework the idea that fiscal policy can have asymmetric effects on consumption in recessions and expansions in the presence of binding liquidity constraints. Fiscal policy will be more effective in stimulating private consumption and pushing the economy out of a recession, when liquidity constraints bind for a large fraction of the population. This idea was investigated empirically on a panel of nineteen OECD countries.

Before characterizing periods of expansions and recessions using alternative definitions, we showed that, in OECD countries, fiscal policy has Keynesian effects on private consumption expenditure, i.e. a spending shock has a positive effect and a tax shock has a negative effect on private consumption, with the spending effect being more pronounced. Moreover, it is the expansionary component of the spending shocks (or expansionary spending shocks) that exert the bigger effect on private consumption rather than their contractionary component (or contactionary spending shocks); whereas the contractionary and expansionary components of the tax shocks affect symmetrically private consumption. After considering recession and expansion episodes, we found that both tax and spending shocks affect consumption changes in Bad times more than in Good times. This happens because private consumption is affected the most by

[43] When we assign Belgium and Netherland to the high LTV countries after 1995 the high LTV observations increase from 302 to 316 and the low LTV observations decrease from 233 to 219. After including Japan, Portugal and Austria in the high LTV group the observation becomes 337 and 198, respectively for the high and low LTV countries. Finally, after including Greece and Italy in the high LTV group the observations used in the regressions are 351 and 184 respectively for the high and low LTV groups.

[44] With respect to DY, after the reassignment of Belgium and Netherlands to the high LTV group after 1995 we have 154 and 107 Bad time episodes, respectively for the high and low LTV groups. When reassigning Austria, Japan and Portugal we get 163 and 98 episodes of Bad times respectively in high and low LTV groups. After reassigning Greece and Italy to the high LTV group after 1995 we get 169 and 92 episodes of bad times, respectively in the two LTV groups. When considering DU we have 163 and 98, then 168 and 98 and finally 176 and 90 Bad time episodes in high and low LTV groups.

[45] Perotti (2004) examined the fiscal multiplier in the US, UK, Germany, Australia, and New Zealand and discussed the possibility of declined potency of fiscal policy after the 1980.

the expansionary component of spending shocks in Bad times, while both contractionary and expansionary tax shocks are important in Bad times.

Following Jappelli and Pagano (1994), we used as a proxy for credit constraints the maximum ratio of the loan to the value of the house in housing mortgages (LTV ratio), and we assigned country-decade observations to a high and low LTV group following the work of Perotti (1999). Using this measure we showed that fiscal policy has asymmetric effects in high and low LTV groups. Specifically, a spending shock has much more pronounced effects in the low LTV group than in the high LTV group (in particular, the expansionary component of a spending shock), similarly for the tax shock, though the results appear to be less significant (in this case the difference is statistically significant when considering the effects of the contractionary component of a tax shock).

After introducing in the analysis the alternative recession and expansion categorizations we found that the results provide evidence for the presence of asymmetric effects of fiscal policy in upturns and downturns in countries with more and less developed consumer credit markets. In most cases considered, tax shocks reduce consumption the most in Bad times when analyzing the low LTV group (for the most severe recession episodes (as modeled by DY) this is attributed to the contractionary component of the tax shock, i.e. a tax cut in Bad times, if policy was previously conducted in contractionary manner, boosts significantly private consumption (whereas a tax hike decreases consumption). When considering the high LTV group tax shocks have negative effects of a similar magnitude during Good and Bad times (in particular we refer to the contractionary component of tax shocks in Bad times (i.e. a tax hike or a tax cut when tax policy was previously set in a contractionary manner) and the expansionary component of tax shocks in Good times (i.e. a tax cut) when considering severe recession episodes (as those modeled by definition DY)). Moreover, the effect of a tax shock in Bad times is much bigger in the low LTV group.

Government spending shocks affect private consumption expenditure the most during recessions in both LTV groups, nevertheless the effect is much stronger in countries with less developed financial systems as was anticipated. Though this effect originates from different components of the spending shock in the two groups. For example, with respect to the high-LTV group it is the contractionary component of the spending shocks that affects consumption the most[46], while in the low LTV group it is the expansionary component of government spending shocks that influences private consumption the most. These hold both for narrow (DY) and broad (DU) definitions of recession episodes, and can be explained by the fact that credit constraints bind for more people in economies with less developed consumer credit markets, as well as, by the fact

[46]Therefore a spending cut during a recession period has devastating effects on private consumption; alternatively, a spending increase in a recession period, when fiscal policy was previously pursued in an contractionary manner, boosts effectively private consumption.

that during deep recession episodes credit constraints bind for a larger fraction of the population, both in more and less developed consumer credit markets.

The normative aspect of this analysis points to the need for discretionary fiscal policy actions as a way of mitigating economic slumps. The unanticipated components of both tax policy and government spending decisions are effective in Bad times in all OECD countries no matter what the level of their financial development is, however their effects are much bigger in countries where consumers have limited access to credit markets. In addition, when fiscal policy shocks are procyclical (i.e. negative spending shocks and positive tax shocks in recessions) then a "switch" to countercyclical shocks (spending increases and tax cuts) could improve significantly consumption outcomes. Hence, unless OECD countries (and specifically EMU countries) are converging overtime in the degree of development of their financial systems there are reasons for not impairing fiscal flexibility by stringent fiscal rules (such as the Stability and Growth Pact or SGP). Because, for example, if countries are in a recession but still face the danger of breaching the 3 % limit implied by the SGP they will have to take one-off measures to correct their fiscal position, though this will bring them into deeper recession since it will affect negatively private consumption.

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3.7 Appendix

3.7.1 Maximum LTV ratio versus domestic credit to the private sector as a percent of GDP

TABLE 8

Countries	Maximum LTV ratio	Domestic Credit to Private sector as a percentage of GDP		
	1980-1994	1980	1994	2001
Australia	high	26.279	67.897	89.765
Austria	low	73.355	91.658	106.890
Belgium	low	29.645	76.004	77.069
Canada	high	66.726	78.004	80.753
Germany	high	74.785	101.680	121.040
Denmark	high	40.808	31.128	141.790
Spain	high	67.577	74.556	105.880
Finland	high	47.485	69.759	57.672
France	high	102.130	87.906	89.813
United Kingdom	high	27.625	109.450	138.840
Greece	low	43.757	31.019	38.139
Ireland	high	29.037	45.245	111.820
Italy	low	55.991	59.527	79.978
Japan	low	131.080	203.170	186.750
Netherlands	low	90.393	88.229	142.600
Norway	high	51.386	71.445	82.840
Portugal	low	73.158	62.666	146.200
Sweden	high	75.930	108.920	104.650
United States	high	78.458	95.673	145790

As Jappelli and Pagano (1994) suggest even if a country has a big domestic credit (to the private sector) to GDP ratio, i.e it is characterized by high level of financial intermediation, this does not necessarily imply that consumers will have easy access to credit;[47][48] this is the case with Japan and Austria and Netherlands as can be seen in Table 8.[49] On the other hand, easier access to consumer credit, does not necessarily lead to a larger fraction of credit to the private sector as a percentage of GDP, as is the case for Australia, Finland, France and Norway. Therefore,

[47] High indicates above 80 percent and low below 80 percent.

[48] Source: World Bank, World Development Indicators.

[49] The 2001 entry for Sweden corresponds to 1999 information.

there other factors that determine consumers' behavior towards credit across countries, e.g. tax incentives, demographics, even cultural factors. While, the LTV ratio will be affected mostly by supply side factors, e.g. regulation, costs of enforcing loan contracts related to the length of the judicial process, information sharing mechanisms among lenders etc.

TABLE 9: MAXIMUM LTV RATIO

Country	L-LTV	H-LTV	Country	L-LTV	H-LTV
Australia	1970-79	1980-2001	Greece	1970-2001	-
Austria	1970-2001	-	Ireland	-	1970-2001
Belgium	1970-2001	-	Italy	1970-2001	-
Canada	1970-1979	1980-2001	Japan	1970-2001	-
Germany	1970-79	1980-2001	Netherlands	1970-2001	-
Denmark	-	1981-2001	Norway	1970-1979	1980-2001
Spain	1970-79	1980-2001	Portugal	1970-2001	-
Finland	-	1970-2001	Sweden	-	1970-2001
France	-	1970-2001	USA	-	1970-2001
UK	-	1970-2001			

3.7.2 Fiscal shocks: Decomposition into expansionary and contractionary components

TABLE 10

Variables	OECD	HLTV	LLTV
$\varepsilon_t^g Con$	0.0125(0.04)	0.1962(0.86)	0.6147(0.39)
$\varepsilon_t^g Exp$	4.3423(3.69)***	0.1319(0.53)	5.5095(3.91)***
$\varepsilon_t^t Con$	-0.6386(-3.88)***	-0.1434(-1.45)	-0.7774(-4.12)***
$\varepsilon_t^t Exp$	-0.5286(-1.46)	-0.2750(-2.45)**	-1.0306(-1.02)
ΔY_t	0.6182(1.93)*	0.4111(4.78)**	0.5345(1.51)
$\varepsilon_t^g Con = \varepsilon_t^g Exp$	4.70(0.0302)+	0.02(0.8747)+	4.02(0.0449)+
$\varepsilon_t^t Con = \varepsilon_t^t Exp$	0.07(0.791)+	0.56(0.4545)+	0.06(0.8120)+
Joint	5.57(0.0619)+	0.56(0.7540)+	4.99 (0.0824)+
Nobs	535	302	233
R^2	0.376	0.515	0.460

t-statistics in parenthesis, ***, **,* statistical significance at 1%, 5% and 10% level of significance, respectiv

+Chi-square tests, p-values in parenthesis

TABLE 11

Variables			
ε_t^qLLTV(Con)	.6793(0.40)	ΔY_t(HLTV-LLTV)	.131(0.50)
ε_t^qLLTV(Exp)	5.623(3.76)***	ε_t^qLLTV(Con)=ε_t^qLLTV(Exp)	3.70(0.0544)+
ε_t^lLLTV(Con)	-.776(-3.89)***	ε_t^lLLTV(Con)=ε_t^lLLTV(Exp)	0.00(0.9922)+
ε_t^lLLTV(Exp)	-.766(-0.79)	Joint for LLTV ($X^2(2)$)	4.20(0.1225)+
ε_t^q(HLTV-LLTV)Con	-.829(-0.50)	ε_t^q(HLTV-LLTV)Con=ε_t^q(HLTV-LLTV)Exp	3.11(0.0780)+
ε_t^q(HLTV-LLTV)Exp	-5.260(-3.54)***	ε_t^l(HLTV-LLTV)Con=ε_t^l(HLTV-LLTV)Exp	0.01(0.9363)+
ε_t^l(HLTV-LLTV)Con	.453(0.46)	Joint for HLTV-LLTV ($X^2(2)$)	3.54(0.1702)+
ε_t^l(HLTV-LLTV)Exp	.538(2.06)**	Nobs	535
ΔY_tLLTV	.565(1.62)	R^2	0.424

t-statistics in parenthesis. ***, **,* statistical significance at 1%, 5% and 10% level of significance, respectively.

+Chi-square tests, p-values in parenthesis.

TABLE 12

Variables	DY	DY
$\varepsilon_t^q Bad(Exp)$	5.842(4.04)***	5.730(3.96)***
$\varepsilon_t^q Bad(Con)$	0.903(0.59)	1.147(0.74)
$\varepsilon_t^q Good(Exp)$	0.715(0.77)	1.111(1.30)
$\varepsilon_t^q Good(Con)$	0.191(0.14)	-0.546(-0.41)
$\varepsilon_t^l Bad(Exp)$	-0.606(-1.07)	-0.470(-0.85)
$\varepsilon_t^l Bad(Con)$	-0.842(-4.33)***	-0.846(-4.38)***
$\varepsilon_t^l Good(Exp)$	-0.701(-2.13)**	-0.686(-2.08)**
$\varepsilon_t^l Good(Con)$	-0.033(-0.08)	0.0417(0.10)
ΔY_t	0.642(2.07)**	-
$\Delta Y_t Bad$	-	0.705(2.16)**
$\Delta Y_t Good$	-	0.522(1.58)
Nobs	535	535
R^2	0.428	0.435

t-statistics in parenthesis (in X^2 tests we report p-values).

***, **,* statistical significance at 1%, 5% and 10% level of signif., respectively.

TABLE 12.1

Wald tests corresponding to Table 12	DY	DY
ε_t^gBad(Exp)=ε_t^gBad(Con)	4.52(0.033)	3.73(0.053)
ε_t^gGood(Exp)=ε_t^gGood(Con)	0.08(0.775)	1.03(0.309)
ε_t^gBad(Con)=ε_t^gGood(Con)	0.15(0.694)	0.82(0.366)
ε_t^gGood(Exp)=ε_t^gBad(Exp)	10.23(0.001)	8.53(0.003)
ε_t^tBad(Exp)=ε_t^tBad(Con)	0.14(0.705)	0.38(0.540)
ε_t^tGood(Exp)=ε_t^tGood(Con)	1.49(0.222)	1.78(0.182)
ε_t^tBad(Con)=ε_t^tGood(Con)	2.69(0.100)	3.18(0.074)
ε_t^tGood(Exp)=ε_t^tBad(Exp)	0.02(0.881)	0.12(0.728)
ε_t^gBad(Con)=ε_t^gGood(Con) & ε_t^gGood(Exp)=ε_t^gBad(Exp)	10.82(0.004)	10.10(0.006)
ε_t^tBad(Con)=ε_t^tGood(Con) & ε_t^tGood(Exp)=ε_t^tBad(Exp)	2.70(0.259)	3.25(0.196)
$\Delta\ddot{Y}_t$Bad=$\Delta\ddot{Y}_t$Good	-	0.61(0.433)

p-values in parenthesis

TABLE 13

Variables	DU	DU
$\varepsilon_t^g Bad(Exp)$	4.207(2.49)**	3.882(2.34)**
$\varepsilon_t^g Bad(Con)$	1.031(0.70)	1.610(1.09)
$\varepsilon_t^g Good(Exp)$	0.303(0.27)	0.987(1.02)
$\varepsilon_t^g Good(Con)$	0.587(0.41)	-0.508(-0.38)
$\varepsilon_t^t Bad(Exp)$	-1.010(-2.89)***	-0.839(-2.50)**
$\varepsilon_t^t Bad(Con)$	-0.731(-3.93)***	-0.743(-4.11)***
$\varepsilon_t^t Good(Exp)$	-0.365(-0.65)	-0.445(-0.84)
$\varepsilon_t^t Good(Con)$	0.130(0.59)	0.051(0.26)
$\Delta\ddot{Y}_t$	0.642(2.06)**	-
$\Delta\ddot{Y}_t Bad$	-	0.792(2.41)**
$\Delta\ddot{Y}_t Good$	-	0.470(1.46)
Nobs	535	535
R^2	0.449	0.475

t-statistics in parenthesis (in X^2 tests we report p-values).

***, **,* statistical significance at 1%, 5% and 10% level of signif., respectively.

TABLE 13.1

Wald tests corresponding to Table 13	DU	DU
ε_t^gBad(Exp)=ε_t^gBad(Con)	1.49(0.222)	0.76(0.383)
ε_t^gGood(Exp)=ε_t^gGood(Con)	0.02(0.891)	0.68(0.409)
ε_t^gBad(Con)=ε_t^gGood(Con)	0.06(0.809)	1.31(0.252)
ε_t^gGood(Exp)=ε_t^gBad(Exp)	4.61(0.031)	2.78(0.095)
ε_t^lBad(Exp)=ε_t^lBad(Con)	0.41(0.521)	0.05(0.819)
ε_t^lGood(Exp)=ε_t^lGood(Con)	0.59(0.442)	0.65(0.420)
ε_t^lBad(Con)=ε_t^lGood(Con)	9.87(0.001)	9.62(0.001)
ε_t^lGood(Exp)=ε_t^lBad(Exp)	0.88(0.347)	0.39(0.534)
ε_t^gBad(Con)=ε_t^gGood(Con) & ε_t^gGood(Exp)=ε_t^gBad(Exp)	4.98(0.083)	4.79(0.091)
ε_t^lBad(Con)=ε_t^lGood(Con) & ε_t^lGood(Exp)=ε_t^lBad(Exp)	12.98(0.001)	12.63(0.001)
ΔY$_t$Bad=ΔY$_t$Good	-	1.89(0.169)

p-values in parenthesis

TABLE 14: DY

Variables	1	2	3	4
-	H-LTV	H-LTV	L-LTV	L-LTV
$\varepsilon_t^g Bad(Exp)$	0.040(0.12)	0.092(0.28)	6.746(4.32)***	6.646(4.27)***
$\varepsilon_t^g Bad(Con)$	0.954(2.87)***	0.890(2.62)***	2.221(1.17)	2.402(1.25)
$\varepsilon_t^g Good(Exp)$	0.002(0.01)	-0.036(-0.12)	1.049(0.62)	1.917(1.13)
$\varepsilon_t^g Good(Con)$	-0.118(-0.46)	-0.087(-0.34)	0.165(0.08)	-1.301(-0.51)
$\varepsilon_t^l Bad(Exp)$	-0.091(-0.58)	-0.105(-0.66)	-2.343(-1.32)	-1.914(-1.06)
$\varepsilon_t^l Bad(Con)$	-0.342(-2.33)**	-0.335(-2.27)**	-0.951(-1.57)***	-0.952(-1.59)***
$\varepsilon_t^l Good(Exp)$	-0.317(-2.37)**	-0.317(-2.38)**	-0.765(-1.01)	-0.897(-1.25)
$\varepsilon_t^l Good(Con)$	-0.088(-0.81)	-0.097(-0.88)	-0.214(-0.22)	-0.159(-0.14)
$\Delta \hat{Y}_t$	0.383(4.44)***	-	0.536(1.53)	-
$\Delta \hat{Y}_t Bad$	-	0.342(3.38)***	-	0.604(1.67)*
$\Delta \hat{Y}_t Good$	-	0.406(4.22)***	-	0.371(0.97)
Nobs	302	302	233	233
R^2	0.545	0.543	0.512	0.517

t-statistics in parenthesis (in X^2 tests we report p-values).***, **,* statistical significance at 1%, 5% and 10% level of signif., respectively

TABLE 14.1:DY

Wald tests corresponding to Table 14	HLTV	HLTV	LLTV	LLTV
ε_t^gBad(Exp)=ε_t^gBad(Con)	2.83(0.092)	2.05(0.152)	2.92(0.087)	2.53(0
ε_t^gGood(Exp)=ε_t^gGood(Con)	0.07(0.796)	0.01(0.915)	0.07(0.789)	0.76(0
ε_t^gBad(Con)=ε_t^gGood(Con)	7.69(0.005)	5.95(0.014)	0.58(0.445)	1.39(0
ε_t^gGood(Exp)=ε_t^gBad(Exp)	0.01(0.926)	0.09(0.762)	6.23(0.012)	4.20(0
ε_t^tBad(Exp)=ε_t^tBad(Con)	0.98(0.322)	0.80(0.371)	0.58(0.446)	0.27(0
ε_t^tGood(Exp)=ε_t^tGood(Con)	1.33(0.249)	1.22(0.269)	0.14(0.707)	0.28(0
ε_t^tBad(Con)=ε_t^tGood(Con)	2.36(0.124)	2.01(0.156)	0.40(0.526)	0.49(0
ε_t^tGood(Exp)=ε_t^tBad(Exp)	1.40(0.237)	1.20(0.273)	0.68(0.408)	0.29(0
ε_t^gBad(Con)=ε_t^gGood(Con) & ε_t^gGood(Exp)=ε_t^gBad(Exp)	8.27(0.016)	7.03(0.029)	8.32(0.015)	8.15(0
ε_t^tBad(Con)=ε_t^tGood(Con) & ε_t^tGood(Exp)=ε_t^tBad(Exp)	2.95(0.228)	2.48(0.289)	1.10(0.578)	0.83(0
ΔY_tBad=ΔY_tGood	-	0.44(0.509)	-	0.73(0

p-values in parenthesis

TABLE 15: DU

Variables	1	2	3	4
-	H-LTV	H-LTV	L-LTV	L-LTV
$\varepsilon_t^g Bad(Exp)$	0.215(0.60)	0.306(0.86)	7.742(2.75)***	7.184(2.63)***
$\varepsilon_t^g Bad(Con)$	0.676(2.06)**	0.601(1.84)*	2.686(1.47)	3.218(1.76)*
$\varepsilon_t^g Good(Exp)$	0.066(0.22)	0.024(0.08)	-0.372(-0.16)	1.614(0.72)
$\varepsilon_t^g Good(Con)$	-0.058(-0.21)	-0.004(-0.02)	1.426(0.66)	-1.002(-0.42)
$\varepsilon_t^t Bad(Exp)$	-0.329(-2.16)**	-0.365(-2.33)**	-2.721(-2.64)***	-2.458(-2.46)**
$\varepsilon_t^t Bad(Con)$	-0.004(-0.02)	0.040(0.24)	-1.039(-3.67)***	-1.027(-3.75)***
$\varepsilon_t^t Good(Exp)$	-0.273(-1.74)*	-0.250(-1.58)	-0.316(-0.25)	-1.011(-0.89)
$\varepsilon_t^t Good(Con)$	-0.185(-1.60)	-0.211(-1.80)*	0.273(0.65)	-0.003(-0.01)
$\Delta \ddot{Y}_t$	0.409(4.72)***	-	0.609(1.84)*	-
$\Delta \ddot{Y}_t Bad$	-	0.325(3.19)***	-	0.733(2.15)**
$\Delta \ddot{Y}_t Good$	-	0.460(4.54)***	-	0.340(0.97)
Nobs	302	302	233	233
R^2	0.522	0.518	0.520	0.542

t-statistics in parenthesis (in X^2 tests we report p-values).***, **,* statistical significance at 1%, 5% and 10% level of signif., re

TABLE 15.1:DV

Wald tests corresponding to Table 15	HLTV	HLTV	LLTV	LLTV
ε_t^gBad(Exp)=ε_t^gBad(Con)	0.66(0.416)	0.27(0.601)	1.80(0.179)	1.15(0.284)
ε_t^gGood(Exp)=ε_t^gGood(Con)	0.07(0.791)	0.00(0.952)	0.21(0.645)	0.43(0.512)
ε_t^gBad(Con)=ε_t^gGood(Con)	3.44(0.063)	2.33(0.126)	0.24(0.621)	1.98(0.159)
ε_t^gGood(Exp)=ε_t^gBad(Exp)	0.12(0.728)	0.42(0.516)	4.89(0.027)	2.47(0.115)
ε_t^lBad(Exp)=ε_t^lBad(Con)	1.50(0.221)	2.16(0.142)	2.15(0.142)	1.65(0.198)
ε_t^lGood(Exp)=ε_t^lGood(Con)	0.16(0.692)	0.03(0.861)	0.17(0.684)	0.56(0.455)
ε_t^lBad(Con)=ε_t^lGood(Con)	0.91(0.340)	1.61(0.204)	6.46(0.011)	4.41(0.035)
ε_t^lGood(Exp)=ε_t^lBad(Exp)	0.07(0.787)	0.29(0.591)	2.36(0.124)	1.03(0.309)
ε_t^gBad(Con)=ε_t^gGood(Con) & ε_t^gGood(Exp)=ε_t^gBad(Exp)	4.06(0.131)	3.48(0.175)	6.53(0.038)	7.01(0.030)
ε_t^lBad(Con)=ε_t^lGood(Con) & ε_t^lGood(Exp)=ε_t^lBad(Exp)	0.91(0.634)	1.63(0.441)	12.08(0.002)	8.88(0.011)
ΔY_tBad=ΔY_tGood	-	1.61(0.204)	-	2.12(0.119)

p-values in parenthesis