The effects of macroeconomic policy shocks on the UK labor market*

Athanasios Tagkalakis†

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Abstract

This paper discusses the dynamic responses of employment, average and total hours, as well as, real wages to monetary, government spending and net taxes shocks in the UK for the period 1970:Q1-2003:Q1. 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. Furthermore, 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, implying 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 increases. 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.

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†Address for correspondence: European University Institute, Department of Economics, Via Piazzuola 43, 50133 Florence, Italy. Email: athanasios.tagkalakis@iue.it

1 Introduction

This paper examines the effects of various macroeconomic policy shocks on the UK labor market, which has experienced a series of reforms that improved its flexibility and performance. We investigate whether the dynamic responses of the labor market variables obtained are in line with what the economic theory would suggest and whether they resemble relevant findings for the US economy.

When comparing employment, average hours per worker, total hours and real wages in the UK with those in the US, Germany, 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. Furthermore, employment appears to be slightly more persistent (see Appendix, figure 18) than average hours over the business cycle in the UK, while in the rest of the countries considered average hours are equally persistent as employment (US and France) or more persistent (Germany and Italy).

Part of this picture could be attributed to the fact that the UK labor market has undergone a period of structural reform in the 1980s and beginning of 1990s. These reforms aimed at improving wage and employment flexibility.[1] Specifically, the Employment Act of 1988 and 1989 aimed at reducing hiring costs, the Unfair Dismissal Variation of Qualifying Period Order of 1979 and 1985 made easier the dismissal of workers by reducing firing costs. A series of legislative actions like the Wages Act of 1986, the Employment Act and Social Security Act of 1980, 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 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[2]. As a result the proportion of workers covered by a 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. 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[3].

As a consequence, since the beginning of the 1990s the cyclical components of employment, total hours and in particular real wages and average hours became much more volatile but less persistent (see Appendix, tables 2 and 3). However, 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. Furthermore, the persistence of the cyclical component of average hours became larger than the one for employment. Hence, since the beginning of the 1990's 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. Moreover, despite the fact that cyclical fluctuations became less persistent for all variables due to increased labor market flexibility, average hours became relatively more

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

[2] 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.

[3] See Millward et al (1992) and Disney et al (1995).

persistent than employment over the cycle, strengthening the labor input adjustment along the extensive margin.

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. Moreover the labor input adjustment takes both the form of employment and average hours adjustment. The aim of this paper is to analyze the pattern of dynamic responses of employment, average hours per worker, total hours, and real wages to fiscal and monetary policy shocks in the UK, and to consider how the responsiveness of labor market variables has evolved over time. The decomposition of total labor input to employment and average hours is crucial because as we mentioned the labor input in the UK adjusts both with respect to the intensive and extensive margin following cyclical movements in economic activity and because several reforms that were introduced in the 1980s aimed at reducing adjustment costs of labor input (like hiring and firing costs). The analysis is carried over 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 perception of the permanence of the shock, and second the relative cost of adjusting hours or employment. When the shock (and the subsequent demand change) is perceived as temporary and there exist adjustment costs to labor, economic agents will adjust along the intensive margin; while when the shock is perceived to be 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 (individual prefer to supply more labor in the period where 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 labour supply and real wages is ambiguous, if the elasticity of labour is big enough labour supply could even decrease and 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, since prices are sticky. 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. 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 (2003)) find that a government spending shock increases output, as well as, employment and total hours, with their responses having hump-shaped pattern. However, Perotti (2004), finds that the effect of a government spending shock on output in UK, Canada and Germany is much smaller (even negative) and not persistent over the last twenty years. Our analysis moves a step forward by examining whether these results are confirmed, and how the responses of employment, real wages and hours to fiscal policy shocks are related to the response profile of output.

The main implication of this analysis is that the responses of employment and hours to a monetary policy shock 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. When considering a smaller sample (1970:Q1-1990:Q4) 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. Hence, 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 spending shock leads to negative responses 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 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) in Australia, UK and USA, in particular in 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 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[4]. 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[5]. The estimation period is 1970:Q1-2003:Q1. The VAR we estimated is of the form:

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

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).

2.1 Identifying monetary and fiscal policy shocks

2.1.1 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[6]:

$$r_t = \Phi(I_t) + \varepsilon_t^m \tag{2}$$

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 is assumed to look at when it undertakes a policy action. Following these assumptions, we

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

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

[6] 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.

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 labour 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[7] 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.

2.1.2 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 vari-

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

ables to economic activity)[8]. 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:

$$\begin{aligned} u_t^g &= a_{gy}u_t^y + a_{gp}u_t^p + a_{gE}u_t^E + a_{gH}u_t^H + a_{greer}u_t^{reer} + a_{gi}u_t^i \\ &\quad +\beta_{gt}\varepsilon_t^t + \beta_{gg}\varepsilon_t^g \end{aligned} \tag{3}$$

$$\begin{aligned} u_t^t &= a_{ty}u_t^y + a_{tp}u_t^p + a_{tE}u_t^E + a_{tH}u_t^H + a_{treer}u_t^{reer} + a_{ti}u_t^i \\ &\quad +\beta_{tt}\varepsilon_t^t + \beta_{tg}\varepsilon_t^g \end{aligned} \tag{4}$$

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

$$\begin{aligned} u_t^{g,CA} &= u_t^g - (a_{gy}u_t^y + a_{gp}u_t^p + a_{gE}u_t^E + a_{gH}u_t^H + a_{greer}u_t^{reer} + a_{gi}u_t^i) \\ &= \beta_{gt}\varepsilon_t^t + \beta_{gg}\varepsilon_t^g \end{aligned} \tag{5}$$

$$\begin{aligned} u_t^{t,CA} &= u_t^t - (a_{ty}u_t^y + a_{tp}u_t^p + a_{tE}u_t^E + a_{tH}u_t^H + a_{treer}u_t^{reer} + a_{ti}u_t^i) \\ &= \beta_{tt}\varepsilon_t^t + \beta_{tg}\varepsilon_t^g \end{aligned} \tag{6}$$

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 next section.

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)[9]. Each revenue component is decomposed into tax rate and tax base, for example:

$$R = S(W_tP_t)W_t(H_t, E_t)E(Y_t)H(Y_t) \tag{7}$$

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

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

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

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:

$$\begin{aligned} dr &= \{[(\frac{\partial s_t}{\partial w_t}+1)\frac{\partial w_t}{\partial e_t}+1]\frac{\partial e_t}{\partial y_t}_t \\ &\quad +[(\frac{\partial s_t}{\partial w_t}+1)\frac{\partial w_t}{\partial h_t}+1]\frac{\partial h_t}{\partial y_t}\}dy_t+\frac{\partial s_t}{\partial p_t}dp_t \qquad (8) \\ a_{ty} &= \{[(\frac{\partial s_t}{\partial w_t}+1)\frac{\partial w_t}{\partial e_t}+1]\frac{\partial e_t}{\partial y_t}_t+[(\frac{\partial s_t}{\partial w_t}+1)\frac{\partial w_t}{\partial h_t}+1]\frac{\partial h_t}{\partial y_t}\} \qquad (9) \\ a_{tp} &= \frac{\partial s_t}{\partial p_t} \qquad (10) \end{aligned}$$

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)[10].

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[11]. 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)[12] which is assumed by Blanchard and Perotti (2002)[13]. 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)[14]. 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 $a_{tp} = 1.2996$[15].

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

[10] 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 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.

[11] 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.

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

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

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

[15] 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.

Perotti (2004) about the presence of indexation lags (more than one quarter) on wage and non-wage components of government spending[16]. 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 analysis in a similar mode as above and its value is -0.2742[17]. 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}.[18]

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)[19]. 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[20]. Regression analysis analogous to the ones described above was followed to get the real wage elasticity of real government purchases $a_{gw} = 0.1757$, this implies that an increase in real wages will generate an increase in real government

[16] 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 $a_{gp} = -0.5$.

[17] 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.

[18] 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 α_{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.

[19] 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.

[20] 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.

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.[21] 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 $a_{tw} = 1.8532$.[22][23]

Table 1: 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 (2004): 1980:1-2001:2	0.82	1.32	-	-	-	-

3 Estimation Results

3.1 Monetary policy shock

First we consider the benchmark VAR specification with employment and average hours[24]. Figures 1 and 2 present the effects of a monetary policy shock[25]. The responses of real government purchases and real net taxes are insignificantly estimated as can be seen[26]. 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,

[21] 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.

[22] 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.

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

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

[25] 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 non-residential investment, LRIGS_UK: real imports LREGS_UK: real exports.

[26] 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).

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 the response is not statistically significant, except after the 18th quarter following the shock[27]. 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.

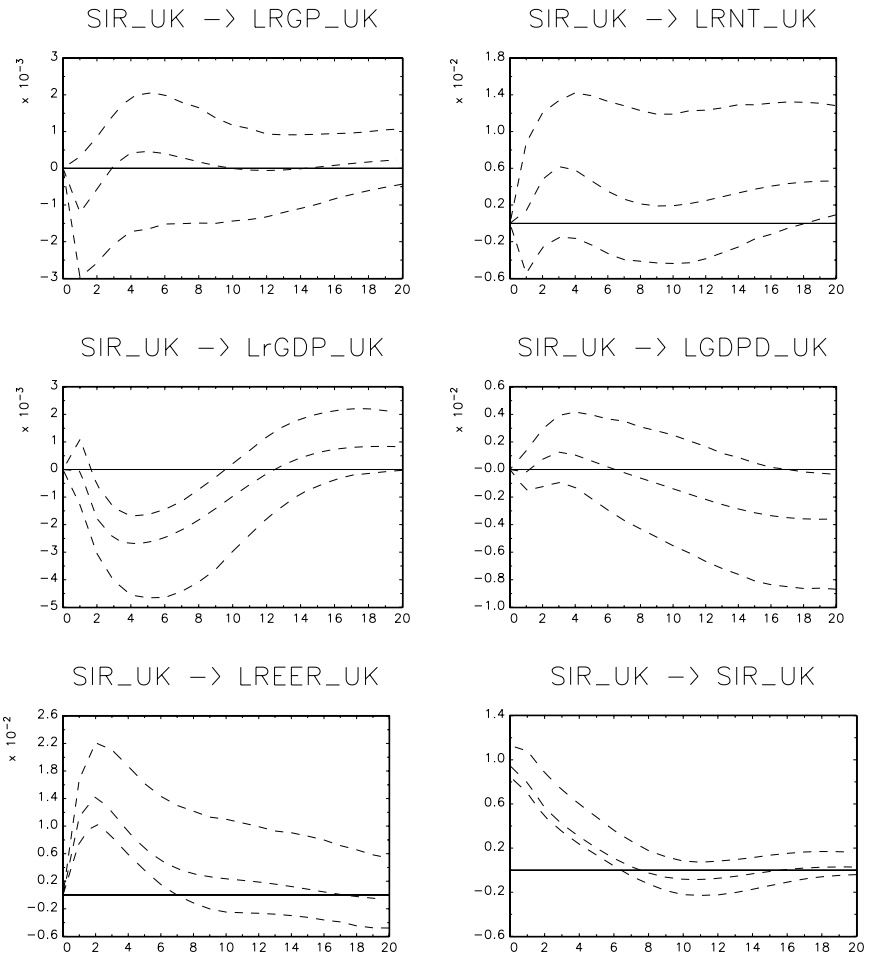

Figure 1: g, t, y, p, reer, i, - responses to a contractionary monetary policy shock

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

[27]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.

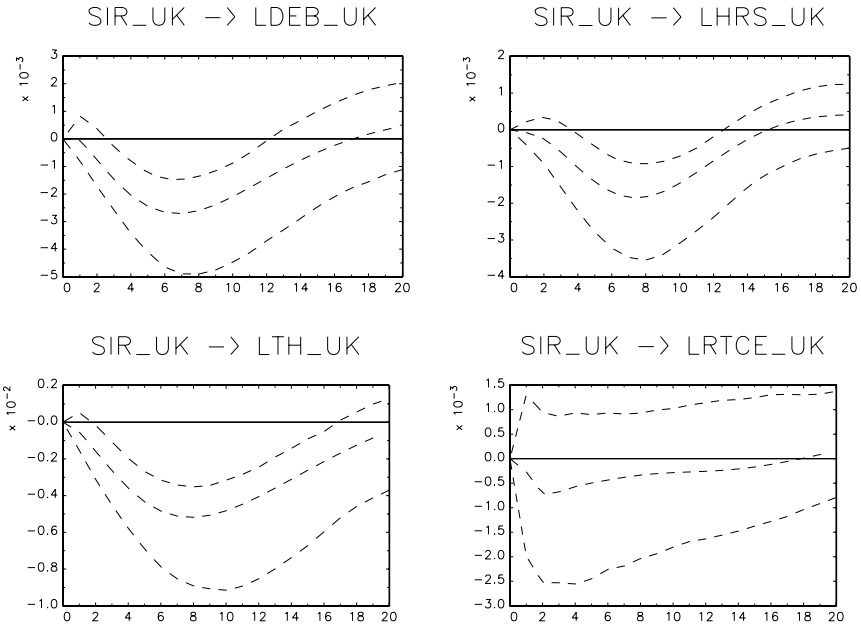

Figure 2: E, H, TH, RW, - responses to a contractionary monetary policy shock

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).[28] 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 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

[28] 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.

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)[29]. 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).

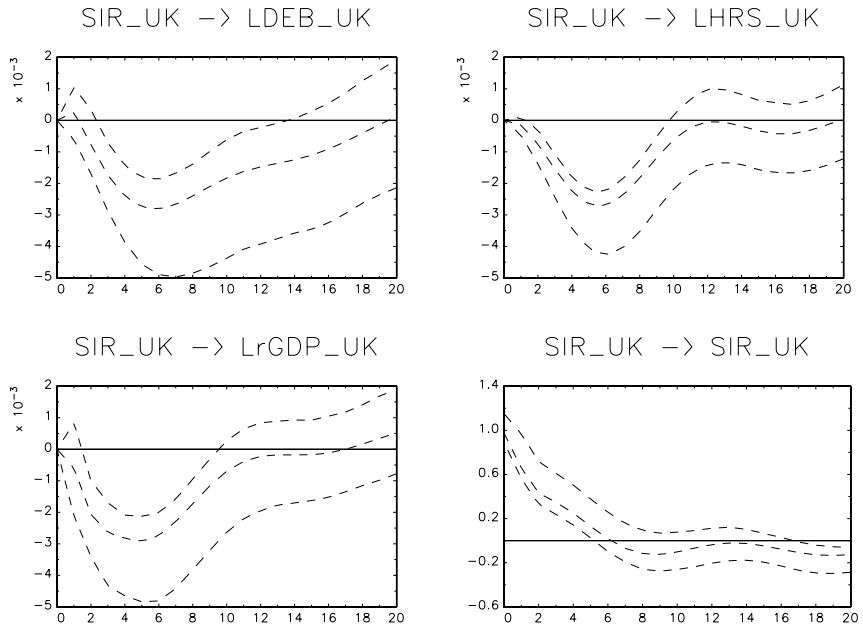

Figure 3: y, E, H, i - responses to a contractionary MP shock (1970:Q1-1990:Q4)

Next, we turn to examine an alternative VAR specification including total hours and real wages instead of employment and average hours.[30] 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 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.[31]

[29] We use a one standard deviation shock.

[30] 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 $a_{tp} = 1.2996$.

[31] 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.

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[32]. 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[33]. In the UK, as we have 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.

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 (2003)), 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

[32] 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.

[33] 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 and transitory response of hours per worker.

period 1963:Q1-2001:Q2 (and in particular those for the period 1980:Q1-2001:Q2).[34] The nominal interest rate responds in a negative and significant manner only after the fifth quarter[35]. 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 of the sterling on impact, that will turn out to be very persistent[36]. 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.

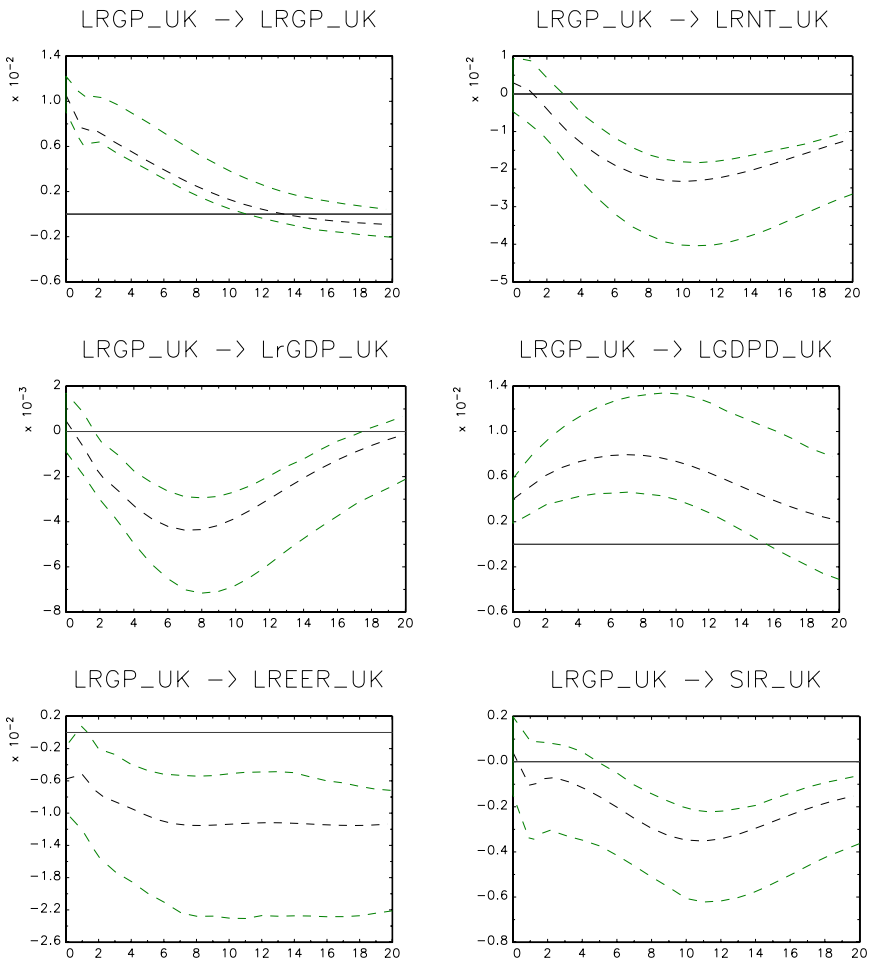

Figure 4: g, t, y, p, reer, i - an expansionary g shock

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

[34] 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).

[35] 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.

[36] 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).

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.

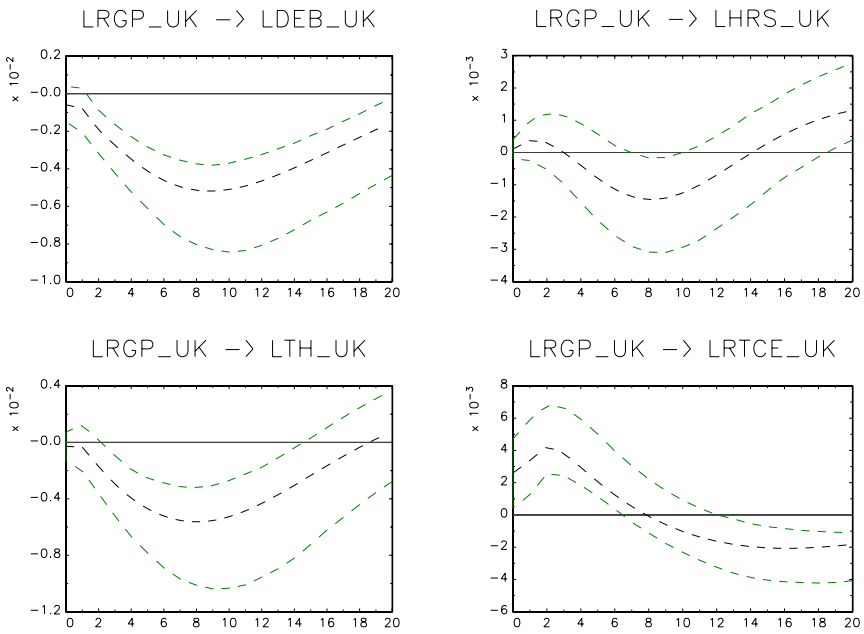

Figure 5: E, H, TH, RW - an expansionary g shock

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[37]. 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[38]. 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 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

[37] See Appendix, figures 23 and 24.

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

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.[39] 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 labour market variables, particularly real wages, despite the fact that it had a slightly smaller size. Moreover, the responses of the labour market variables were less persistent, because the spending response was also less persistent.

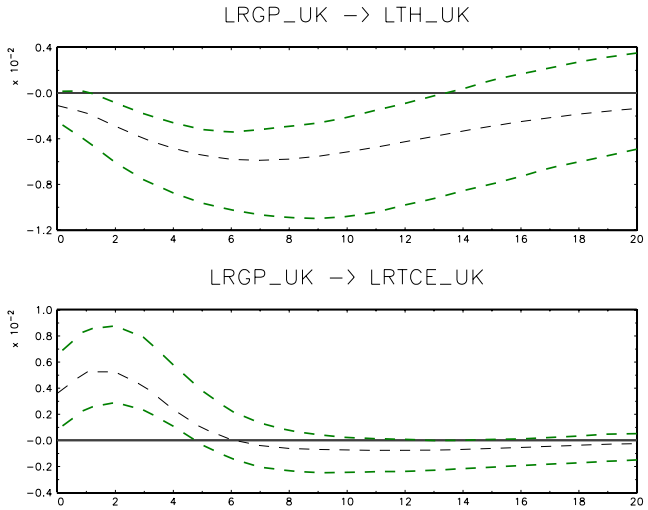

Figure 6: TH, RW - expansionary g shock 1970:Q1-90:Q4

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 labour input and real wages variables from the VAR; still we get the same pattern of reaction for real GDP[40]. This is in line with the 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.

3.2.1 GDP components

These results are quite puzzling, so further investigation is required in order to understand what hinges behind the responses of real wages, labour input and output. Therefore we will

[39] 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).

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

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[41]. 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 labour 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 investment 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[42]. 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[43].

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

[42] 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.

[43] 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)

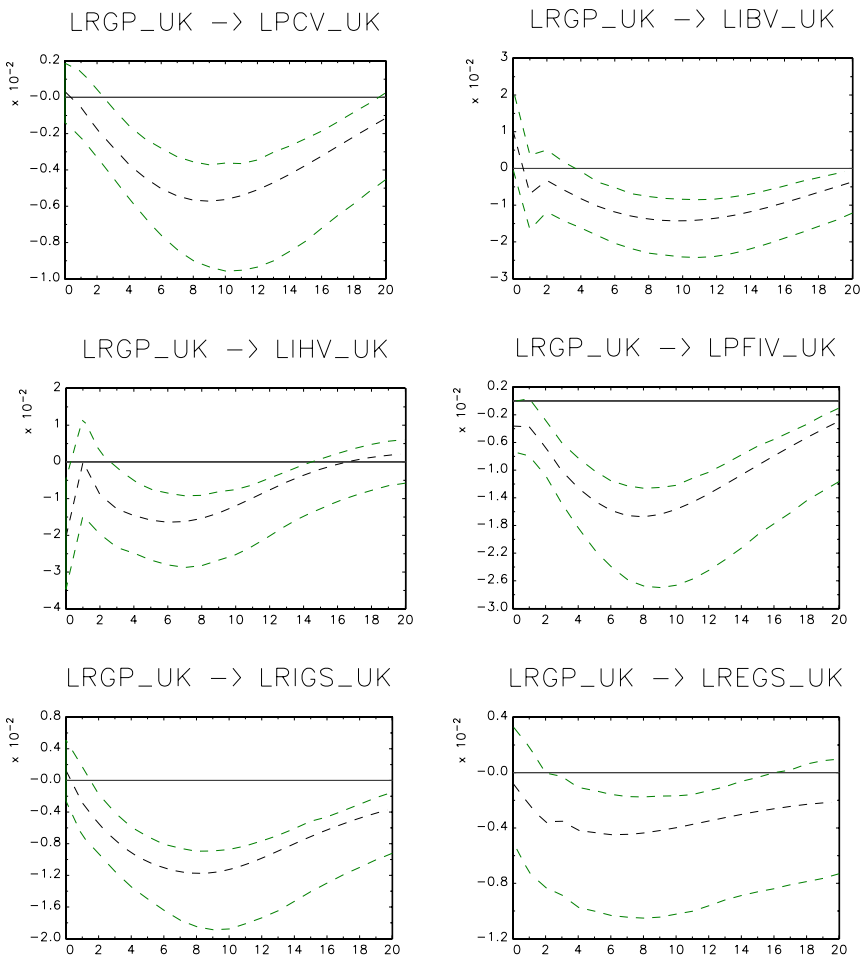

Figure 7: response of GDP components to an expansionary g shock

It appears that there is a "labour 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 labour 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 labour 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 labour 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 labour 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.

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).

3.2.2 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[44], consequently both the labour market variables and the output respond in a more persistent manner to the shock (see Appendix, figure 26).[45]. 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

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

[45] 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).[46][47]

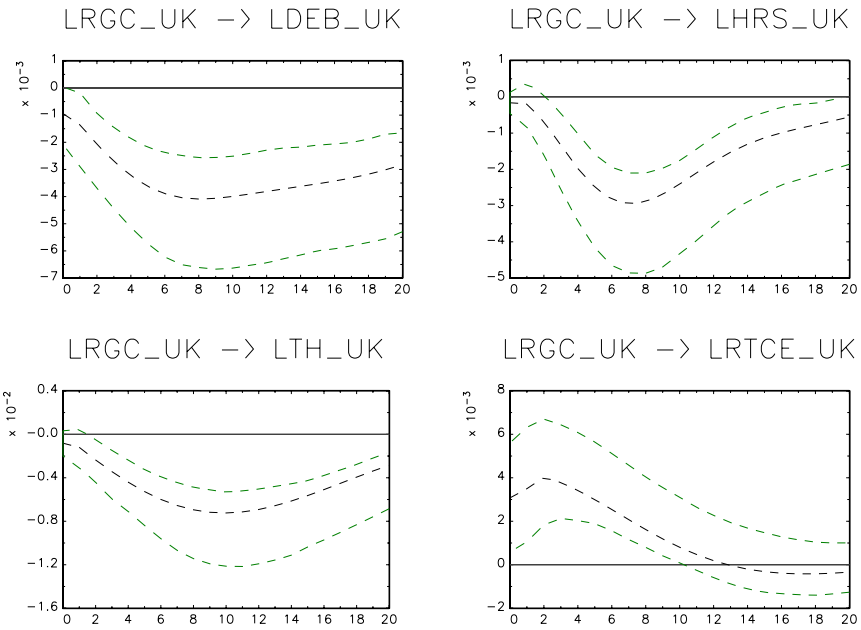

Figure 8: E, H, TH, RW - an expansionary government consumption shock

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).[48] 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. 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, 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).[49] 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,

[46] 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).

[47] 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).

[48] Allowing for $a_{wgc,w} = 0.2538$ 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).

[49] Similarly for consumption and imports.

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).

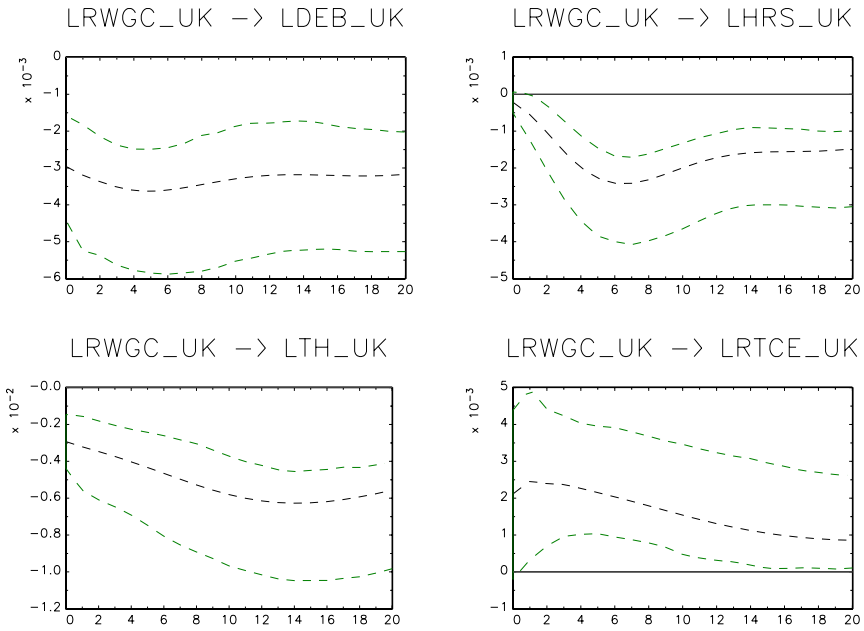

Figure 9: E, H, TH, RW - an expansionary wage consumption shock

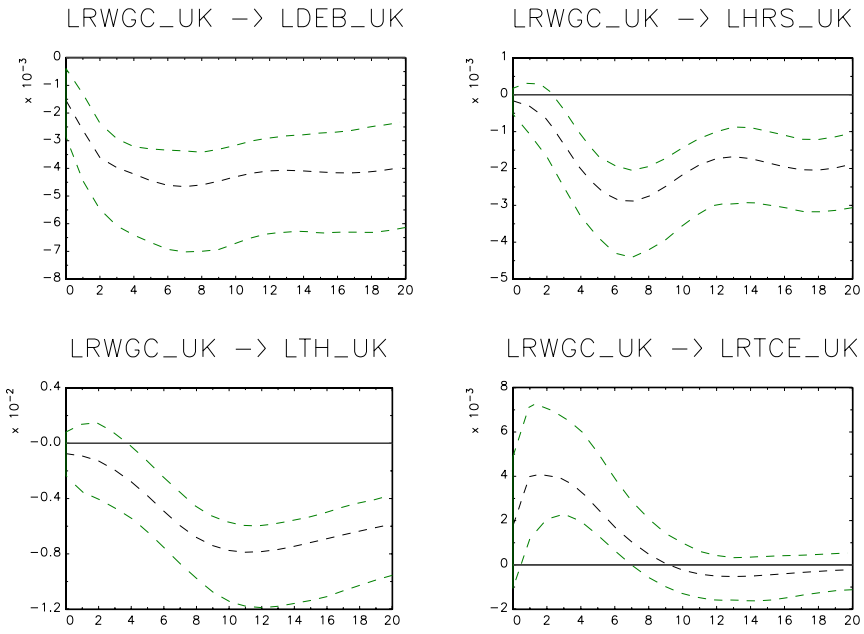

Figure 10 : E, H, TH, RW - an expansionary wage consumption shock (1970:Q1-1990:Q4)

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.[50] 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 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[51] 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.[52] 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, labour input and output.

[50] 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).

[51] In this case *reer* does not react in a statistically significantly manner.

[52] 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.

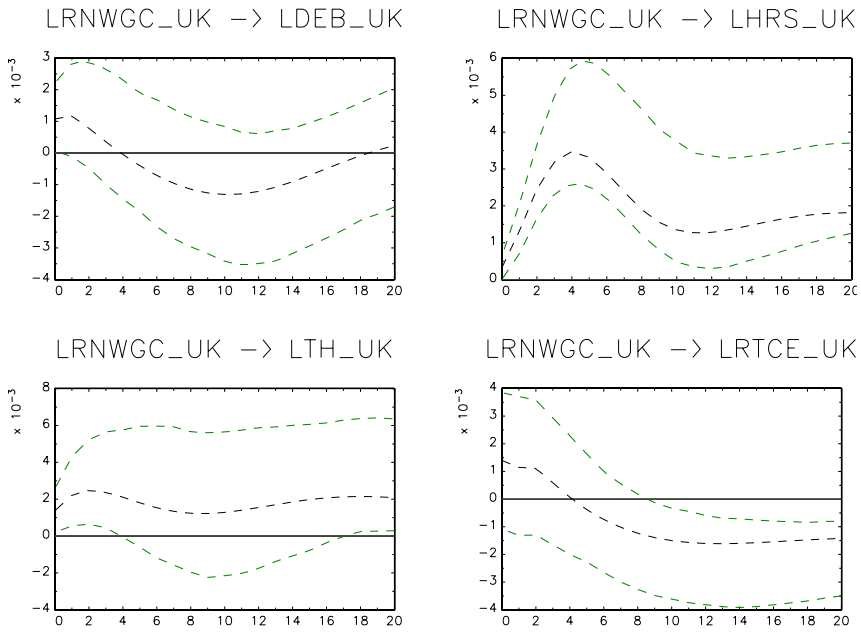

Figure 11: E, H, TH, RW - non wage government consumption shock

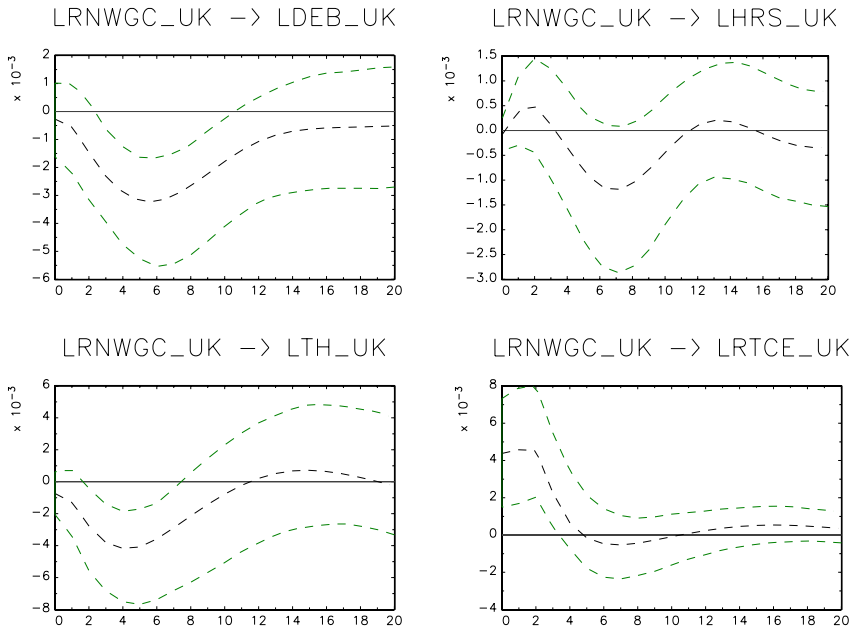

Figure 12: E, H, TH, RW - expansionary non-wage government consumption shock (1970:Q1-1990:Q4)

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).[53]

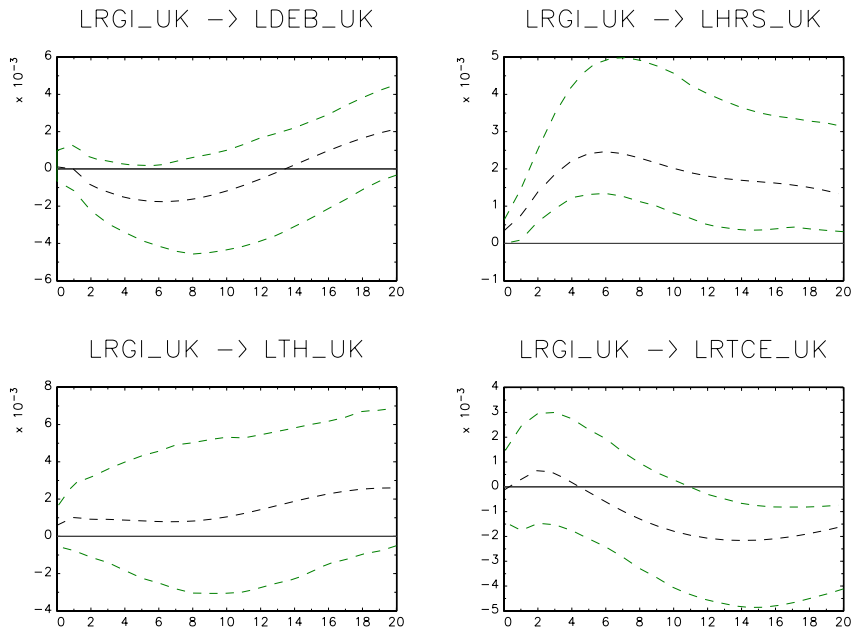

Figure 13: E, H, TH, RW - an expansionary government investment shock

Findings: Overall, after having examined the effects of different spending components on labour 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 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

[53] 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.

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 labour 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 labour 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 labour costs, firms adjust their labour 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. 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).

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 labour 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 labour supply and real wages is ambiguous, if the elasticity of labour is big enough labour supply could even decrease and real wages increase. Introducing price stickiness and monopolistic competition we can generate an increase in 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 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.

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.[54] 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.[55] 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 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),[56] 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

[54] 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.

[55] 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.

[56] 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.

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[57].

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 (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.[58] Alternatively, the relative movements of labour demand and labour supply that decrease employment and real wage on impact lower labour 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.

[57] 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.

[58] 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.

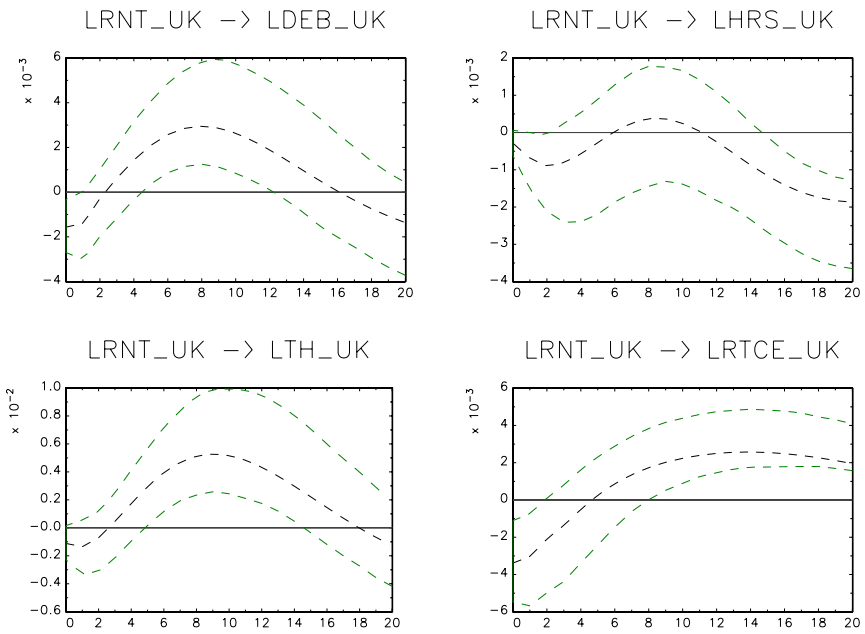

Figure 14: E, H, TH, RW - a contractionary net tax shock

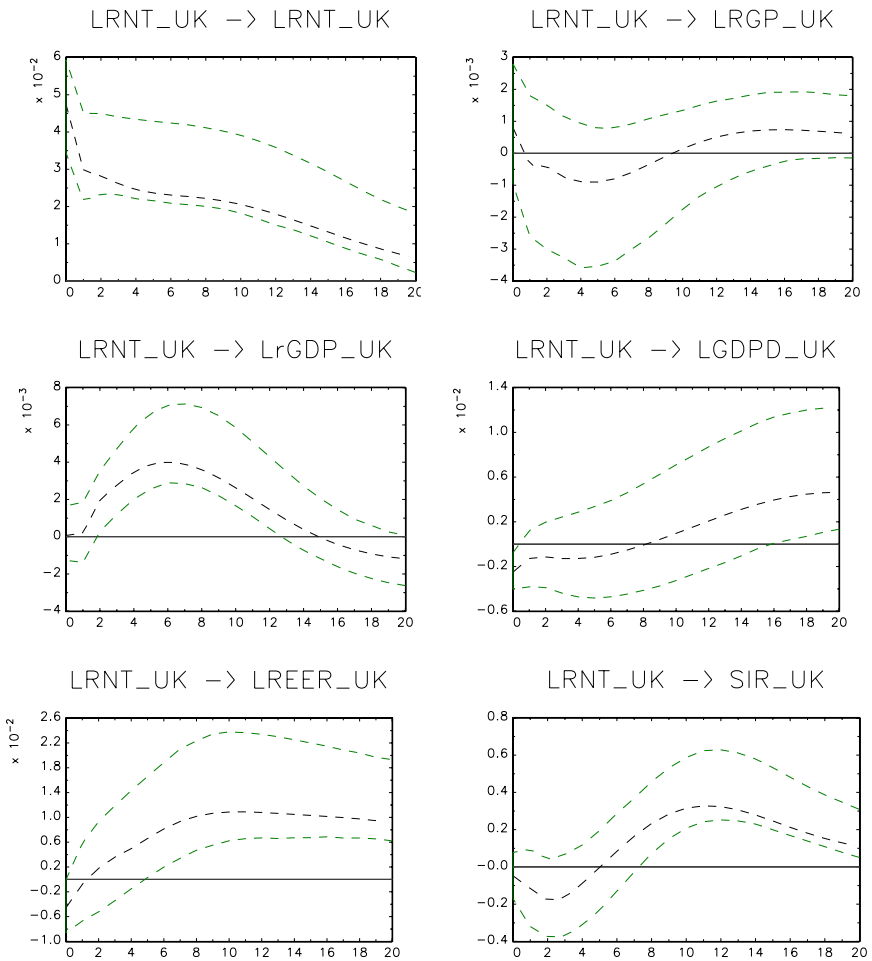

Figure 15: g, t, y, p, reer, i - a contractionary net tax shock

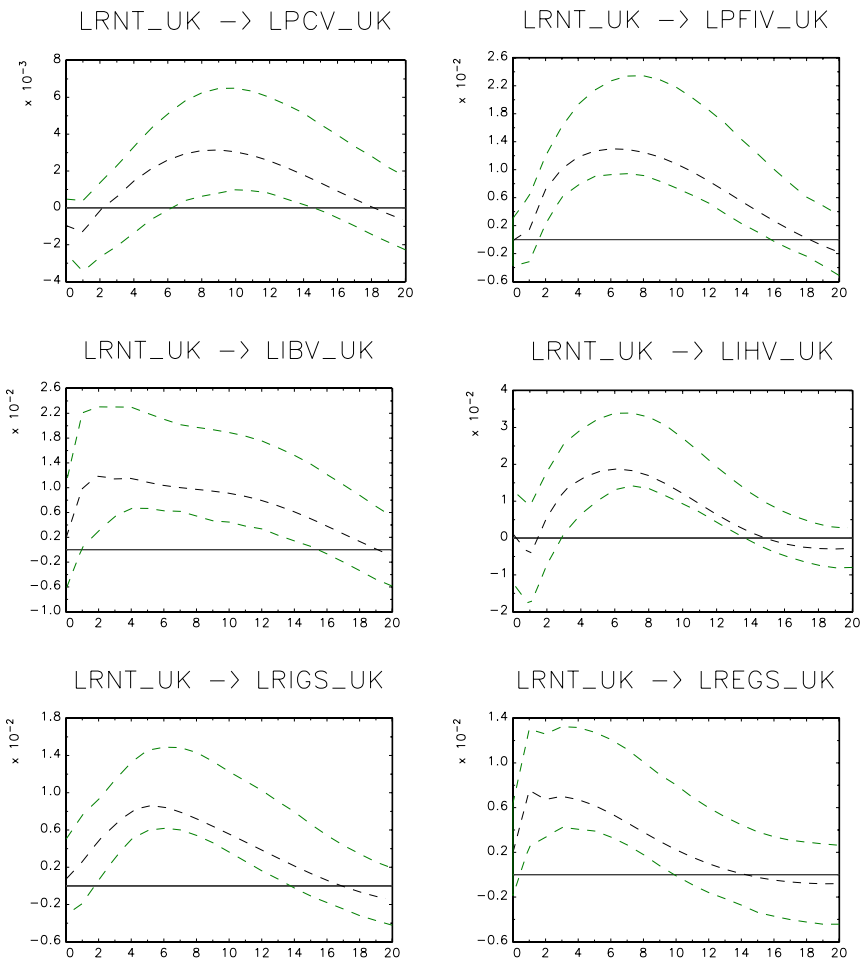

Figure 16: GDP components - a contractionary net tax shock

4 Discussion

This paper has investigated the dynamic responses of employment, average hours per worker, total hours and real wages to monetary, government spending and net taxes shocks in the UK. Moreover, we have considered separately the effects of a government consumption and a government investment shock. Government consumption was 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 a smaller sample (1970:Q1-1990:Q4) 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 1980Q:1-2001Q:2). 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.

5 References

Alesina,A., Perotti, R., Schiantarelli, F. and Ardgana, S. (2002). "Fiscal Policy, Profits and Investment," *American Economic Review*, **92** (3), 571-89.

Ardagna, S. (2002). "Fiscal Policy in Unionized Labor Markets," Working Paper Wellesley College.

Blanchard, O and Perotti,R. (2002). "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output," *Quarterly Journal of Economics*, **117** (4), 1329-1368.

Burnside, C., Eichenbaum, M., and Fisher, J.D.M. (2003). "Fiscal shocks and their Consequences", NBER, Working Paper 9772.

Christiano L., Eichenbaum, M. and Evans, C. (1996). "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds," *Review of Economics and Statistics,* **78** (1), 16-34.

Christiano L., Eichenbaum, M. and Evans, C. (1999). "Monetary policy shocks: What Have we Learned and to What End?", in: J.Taylor and M.Woodford (eds.), *Handbook of Macroeconomics*, North Hollands.

Disney, R.A., Gosling, A. and Machin, A. (1995). "British Unions in Decline: Determinants of the 1980's Fall in Union Recognition," *Industrial and Labor Relations Review*, **48**, 403-19.

Dolado, J.J. and Lutkepohl, H. (1996). "Making Wald tests work for cointegrated VAR systems," *Econometric Reviews*, **15**, 369-386.

Fatas, A. and Mihov, I. (2001), "The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence", CEPR, Discussion Paper 2760.

Finn, M.G., (1998), "Cyclical Effects of Government's Employment and Goods Purchases," *International Economic Review*, **39**(3) 635–57.

Gali, J., Lopez-Salido, J.D. and Valles, J. (2003), "Understanding the Effects of Government Spending on Consumption", mimeo, Universitat Pompeu Fabra.

Gerlach S. and Smets, F. (1995), "The Monetary Transmission Mechanism: Evidence from G7 Countries", CEPR, Discussion Paper, 1219.

Giorgio, C., Richardson, P., Roseveare, D. and van den Noord, P. 1995. "Potential output, output gaps, and structural budget balances", *OECD Economic Studies,* **24**, 167-209.

Green, F., (1992), "Recent trends in British trade union density", *British Journal of Industrial Relations*, **30**, 445-58.

Gregg, P. and Yates, A., (1991), "Changes in trade union and wage setting arrangements in the 1980s", *British Journal of Industrial Relations*, **29**, 361-376.

Hamermesh, D.S. (1993). *Labor Demand*, Princeton University Press, Princeton, New Jersey.

Hamilton, J.D. (1994). *Time Series Analysis*, Princeton University Press, Princeton, New Jersey.

Hess, G.D. and Shin, K. (1997), "International and Intranational Business Cycles", *Oxford Review of Economic Policy*, **13** (3), 93-109.

Hess, G.D. and Shin, K. (1998), "Intranational Business Cycles in the United States", *Journal of International Economics*, **44**, 289-313.

Lane, P.R. and Perotti, R., (2003). "The importance of composition of fiscal policy: evidence from different exchange rate regimes," *Journal of Public Economics*, **87**, 2253-79.

Mason, R. and Bain, P. (1993). "The determinants of trade union membership in Britain", *Industrial and Labor Relations Review*, **46**, 332-52.

Millard, S. (2000). "The effects of labour market flexibility in the United Kingdom: Theory and practice". Bank of England, Working Paper 109.

Millward, N., Stevens, M., Smart, D., and Hawes, W.R., (1992). *Workplace Industrial Relations in Transition*, Aldershot: Dartmouth Publishing.

Mojon, B. and Peersman, G. (2001). "A VAR description of the effects of monetary policy in the individual countries of the euro area", ECB Working paper 92.

OECD (2003), Economic Outlook, OECD.

Peersman G. and Smets, F. (2001). "The Monetary Transmission Mechanism in the Euro Area: More Evidence from VAR Analysis", ECB Working paper 91.

Perotti, R. (2004). "Estimating the Effects of Fiscal Policy in OECD Countries", mimeo, IGIER-Universita' Bocconi.

Tagkalakis, A. (2003). The Dynamic Responses of Heads and Average Hours per Worker to a Monetary and Fiscal Policy Shock. mimeo, Bank of England.

Toda, H.Y. and Yamamoto, T. (1995). "Statistical Inference in Vector Autoregressions with Possibly Integrated Processes", *Journal of Econometrics*, **66**, 225-250.

Trigari, A. (2003). "Equilibrium Unemployment, Job Flows and Inflation Dynamics", mimeo, New York University.

van den Noord, P. (2002), "Automatic stabilizers in the 1990s and the beyond", in: M. Buti, J. von Hagen, and C. Martinez-Mongay, eds: *The behavior of fiscal authorities*, 130-48, Palgrave, New York.

6 Appendix

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;[59] 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.

[59] 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.

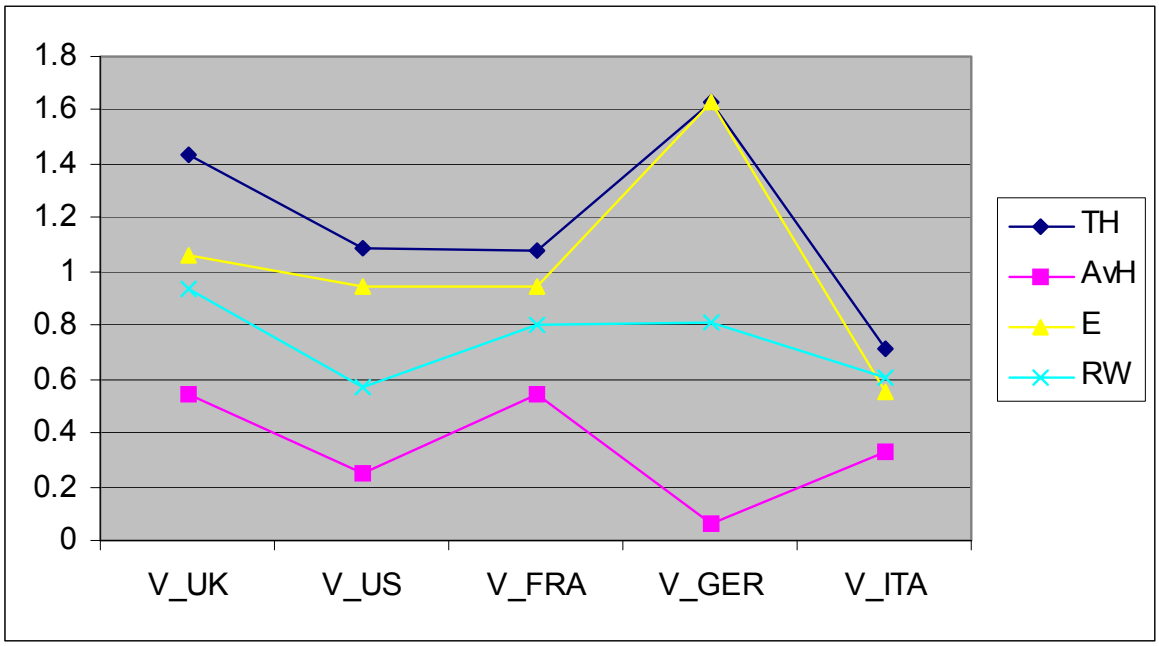

Figure 17: Volatility Measures

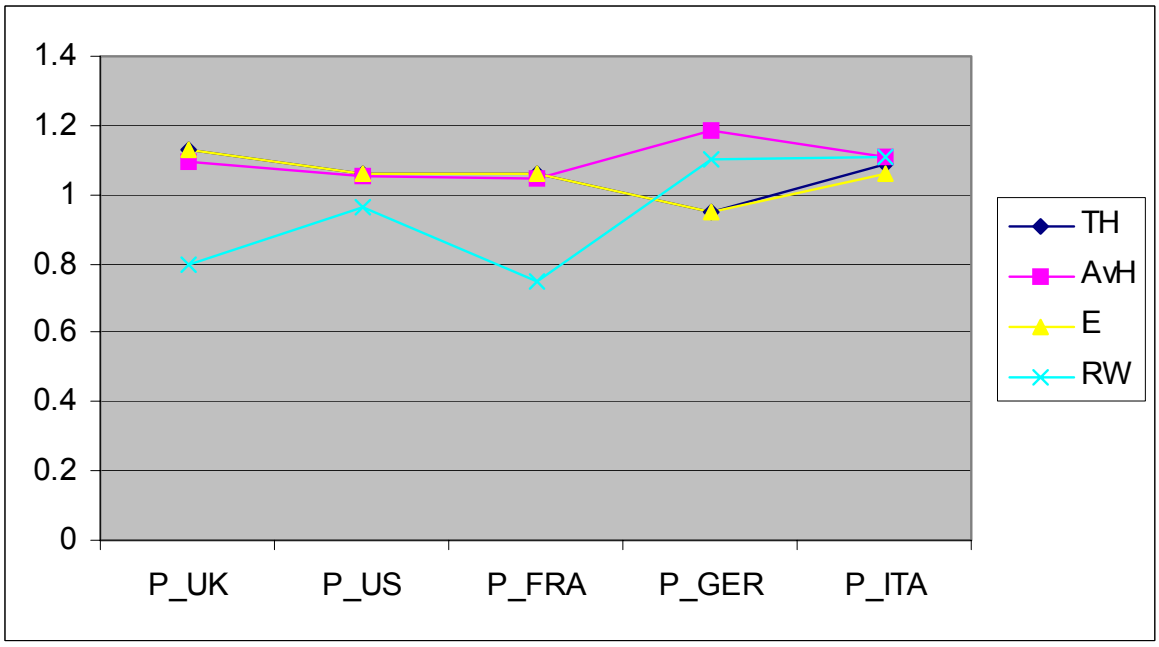

Figure 18: Persistence measures

TABLE 2: UK variables

variable	volatility	1970:Q1-1990:Q4	1991:Q1-2003:Q1
Total Hours	1. 432 4	1.42568	1.54851
Average hours	0.545 28	0.54705	0.95095
Employment	1. 058 5	1.05485	1.09297
Real Wages	0.935 06	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[60], 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[61]. Notice also that average hours' cyclical fluctuations became more persistent than those of employment over the second part of the sample.

TABLE 3: UK variables

variable	persistence ratios	1970:Q1-1990:Q4	1991:Q1-2003:Q1
Total Hours	1. 130 4	1.16901	0.92756
Average hours	1.094 4	1.11907	0.98486
Employment	1.129 2	1.18309	0.84648
Real Wages	0.798 76	0.82970	0.67675

6.2 Monetary policy shock - Figures

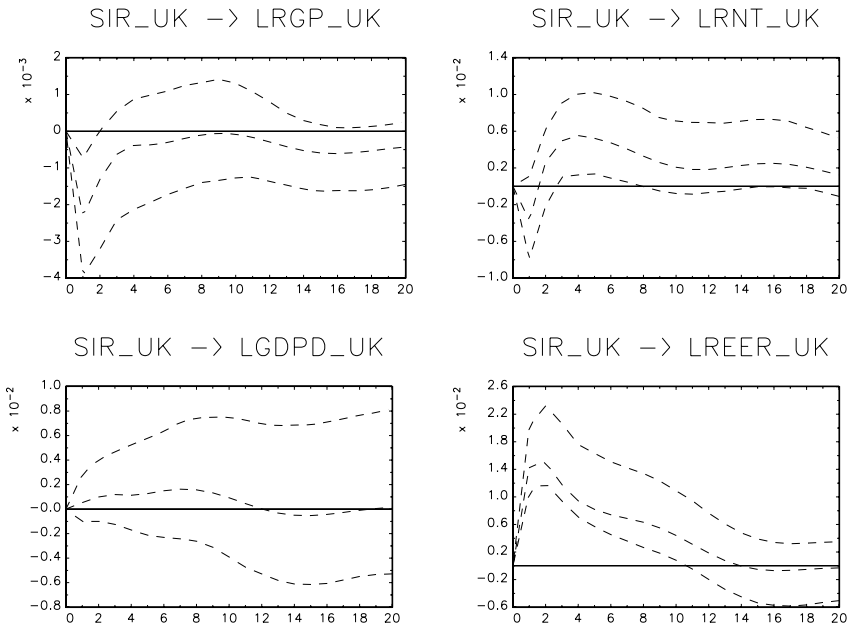

Figure 19: g, t, p, reer - responses to a contractionary MP shock (1970:Q1-1990:Q4)

[60] 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).

[61] 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).

6.3 Government Spending Shock - Figures

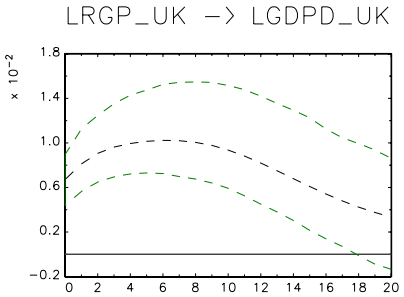

Figure 20: g shock on p with a_{gp}=−1

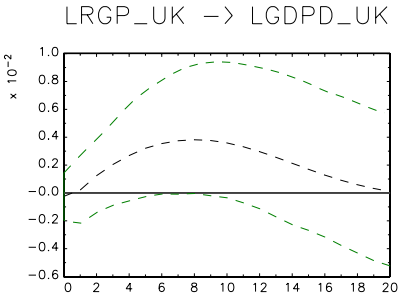

Figure 21: g shock on p with a_{gp}=0

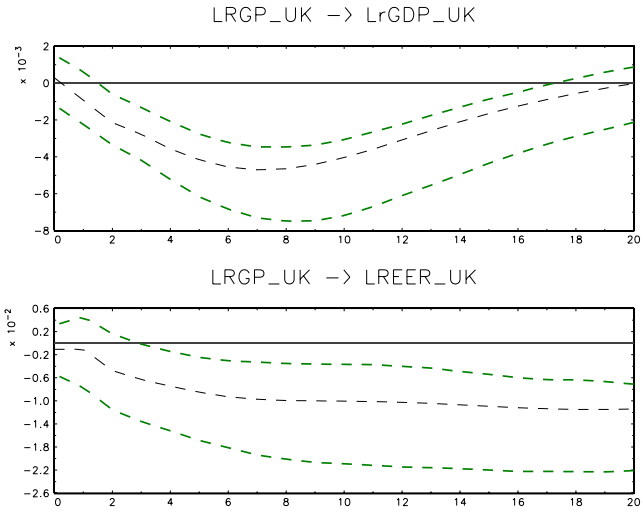

Figure 22: g shock on y and reer with a_{greer}=−0.065565

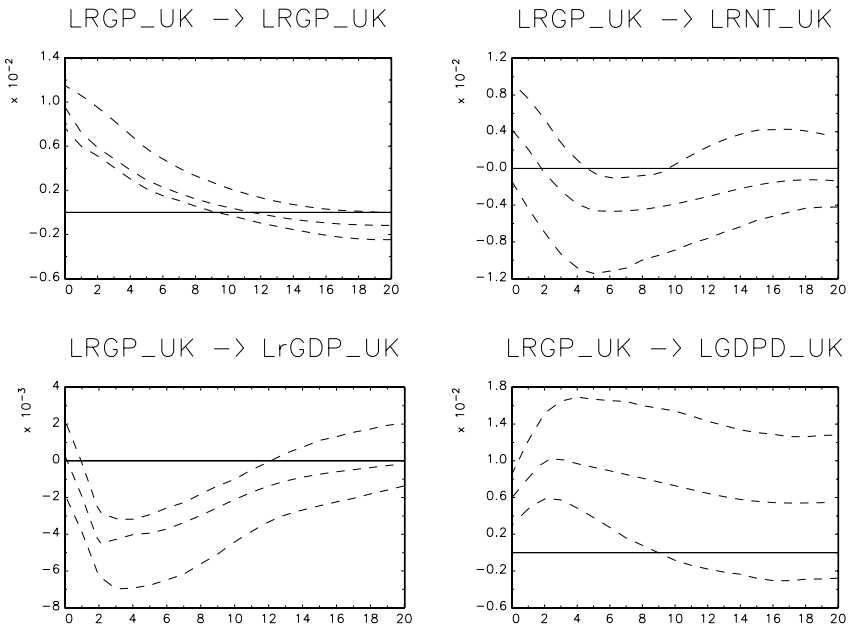

Figure 23: g, t, y, p - g shock (1970:Q1-90:Q4)

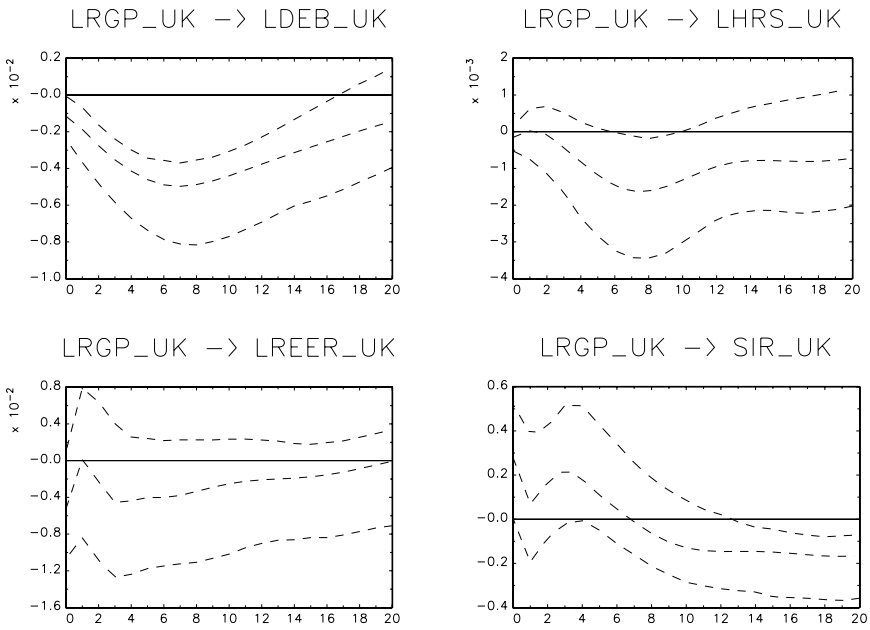

Figure 24: E, H, reer, i - g shock (1970:Q1-90:Q4)

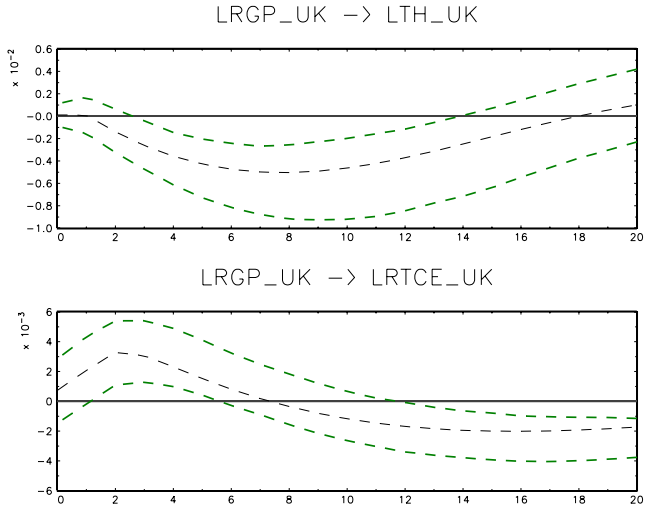

Figure 25: g shock on TH and RW with: a_{gw}=0.1757

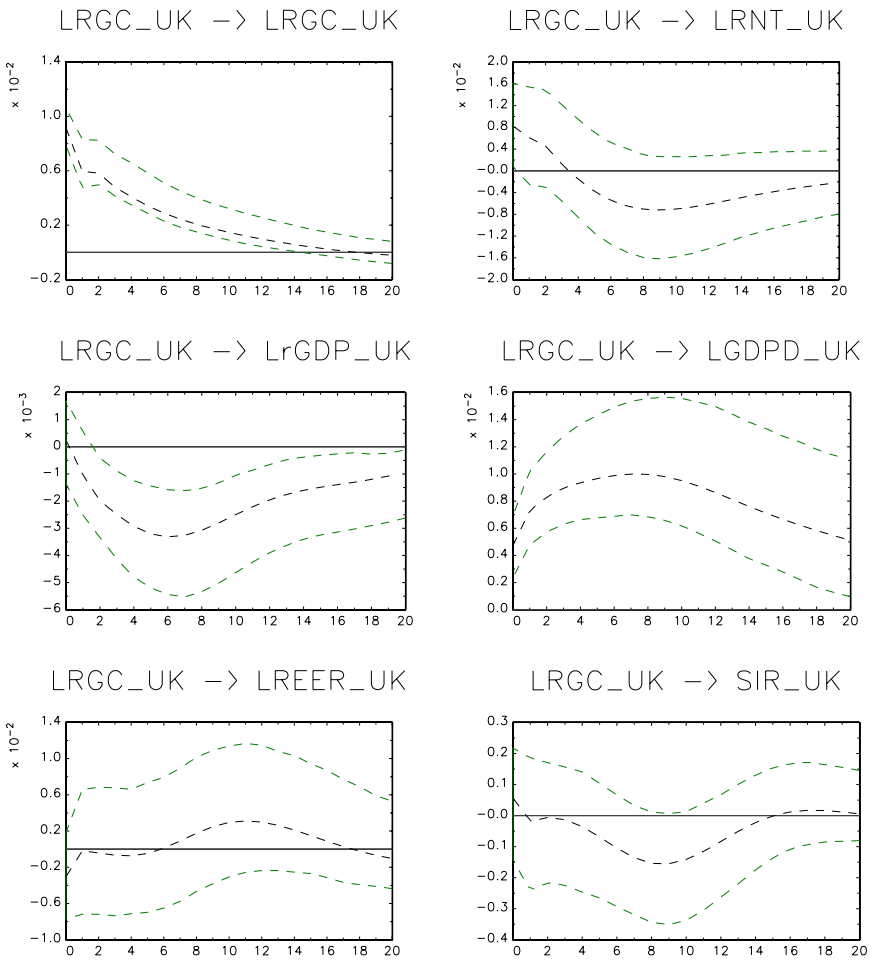

Figure 26: gc, t, y, p, reer, i, - government consumption (gc) shock

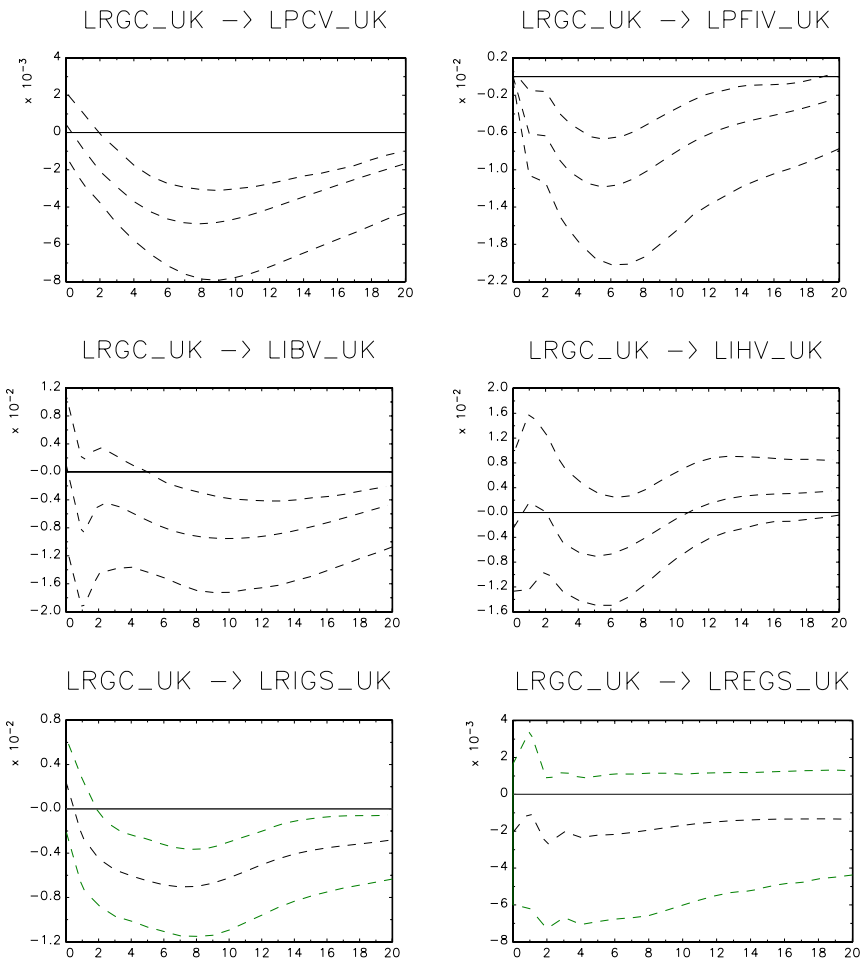

Figure 27: GDP components - government consumption (gc) shock

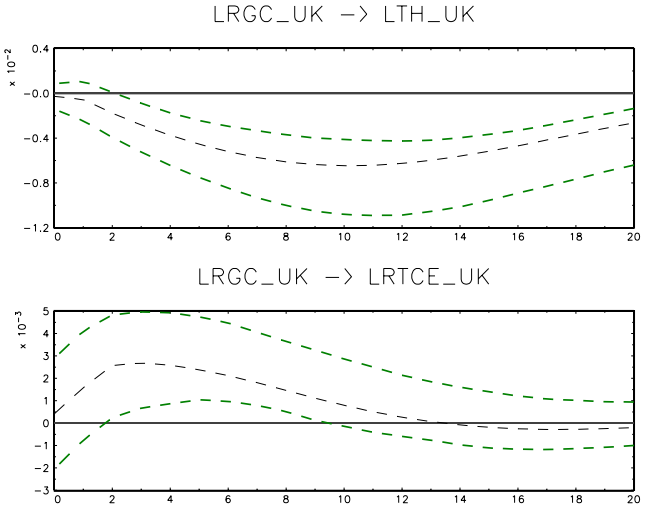

Figure 28: gc shock on TH and RW with $a_{gc,w}$=0.2255

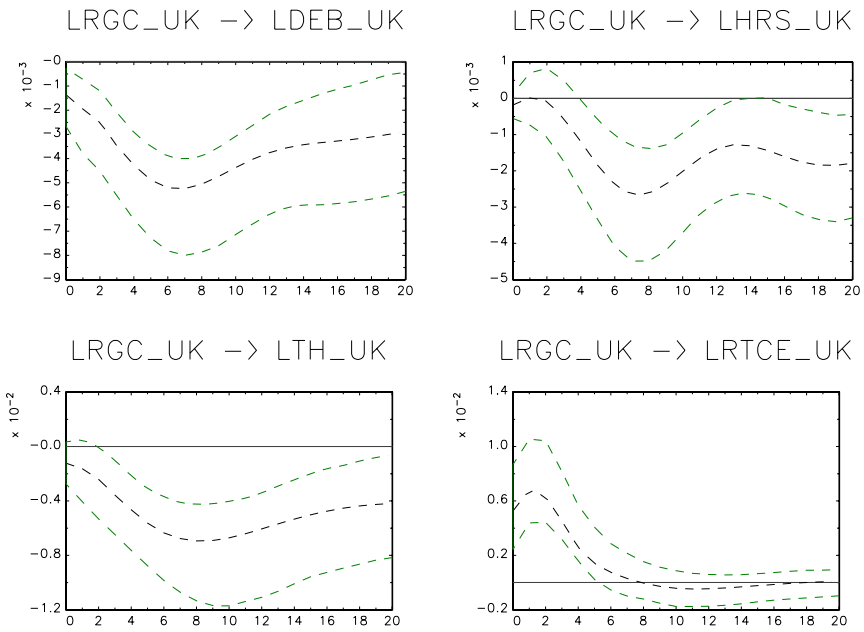

Figure 29: E, H, TH, RW - gc shock (1970:Q1–1990:Q4)

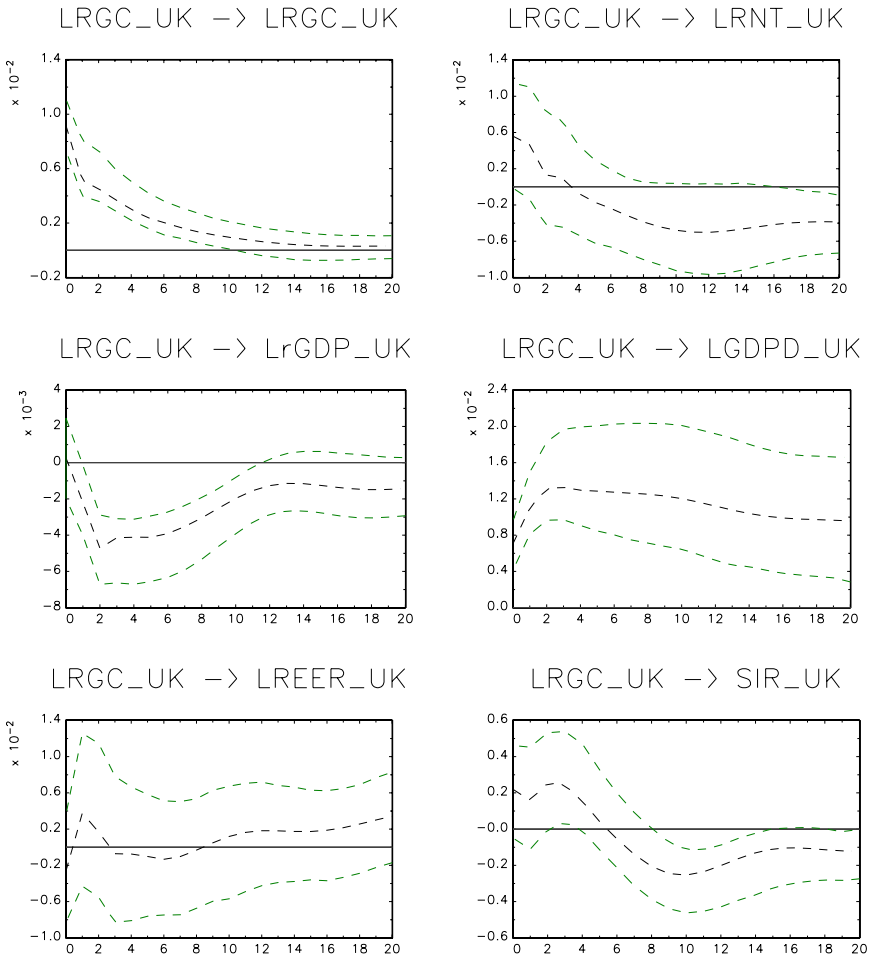

Figure 30: gc, t, y, p, reer, i - gc shock (1970:Q1-1990:Q4)

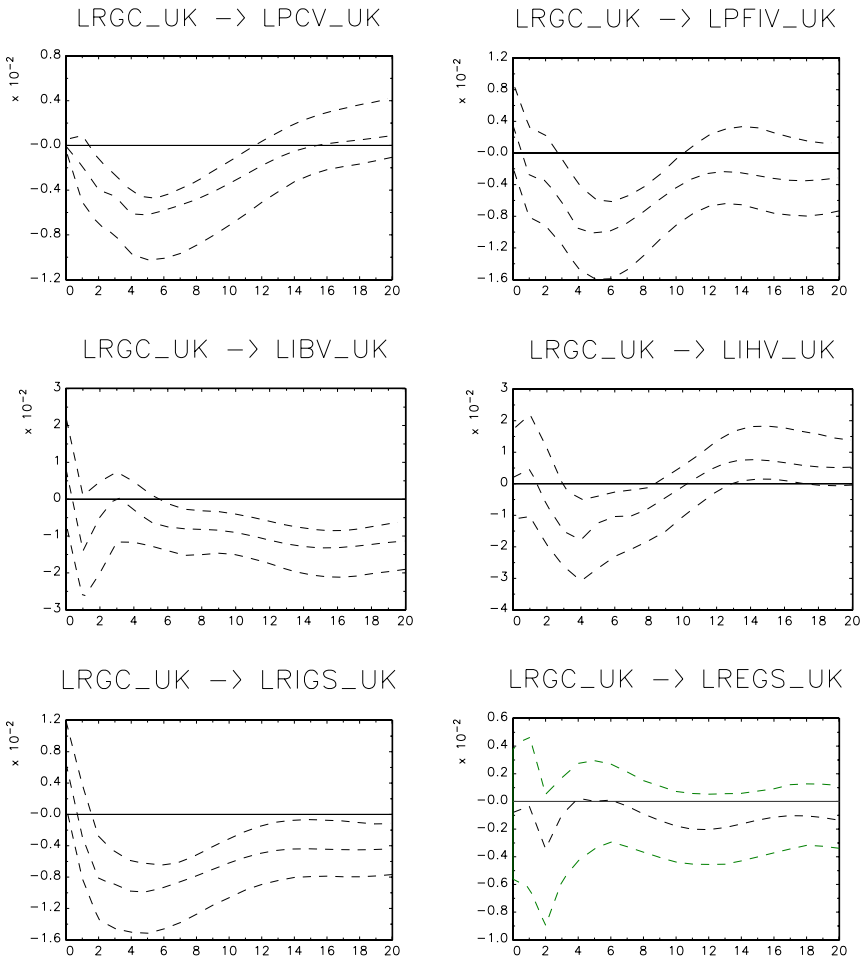

Figure 31: GDP components- gc shock (1970:Q1-1990:Q4)

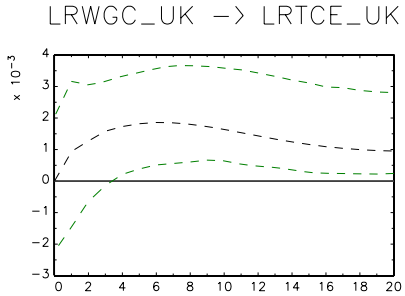

Figure 32 : wgc shock on RW with $a_{wgc,w}$=0.2538

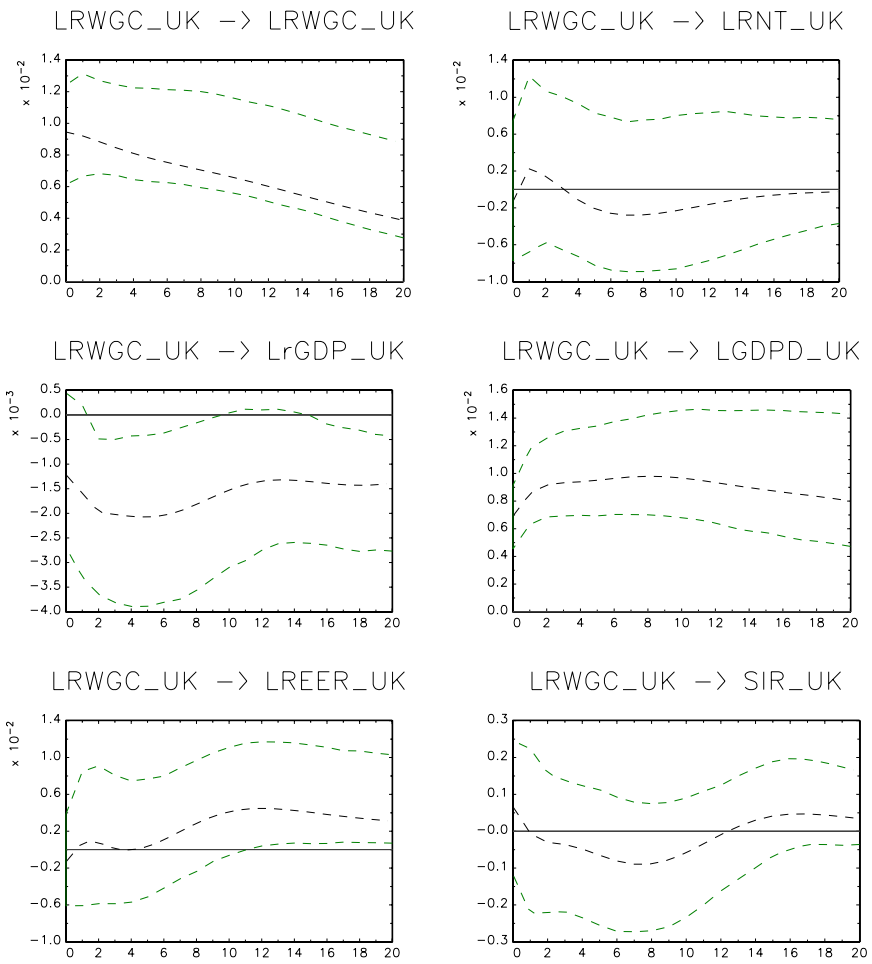

Figure 33: wgc, t, y, p, reer, i - wage government consumption (wgc) shock

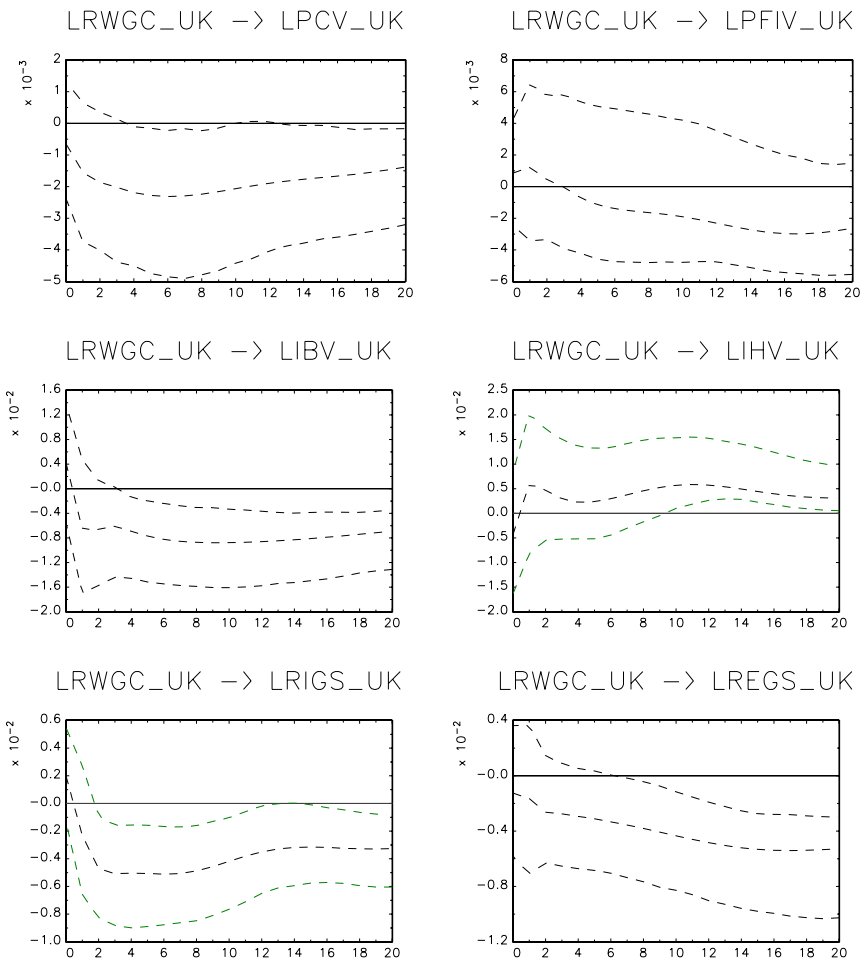

Figure 34: GDP components -wage government consumption (wgc) shock

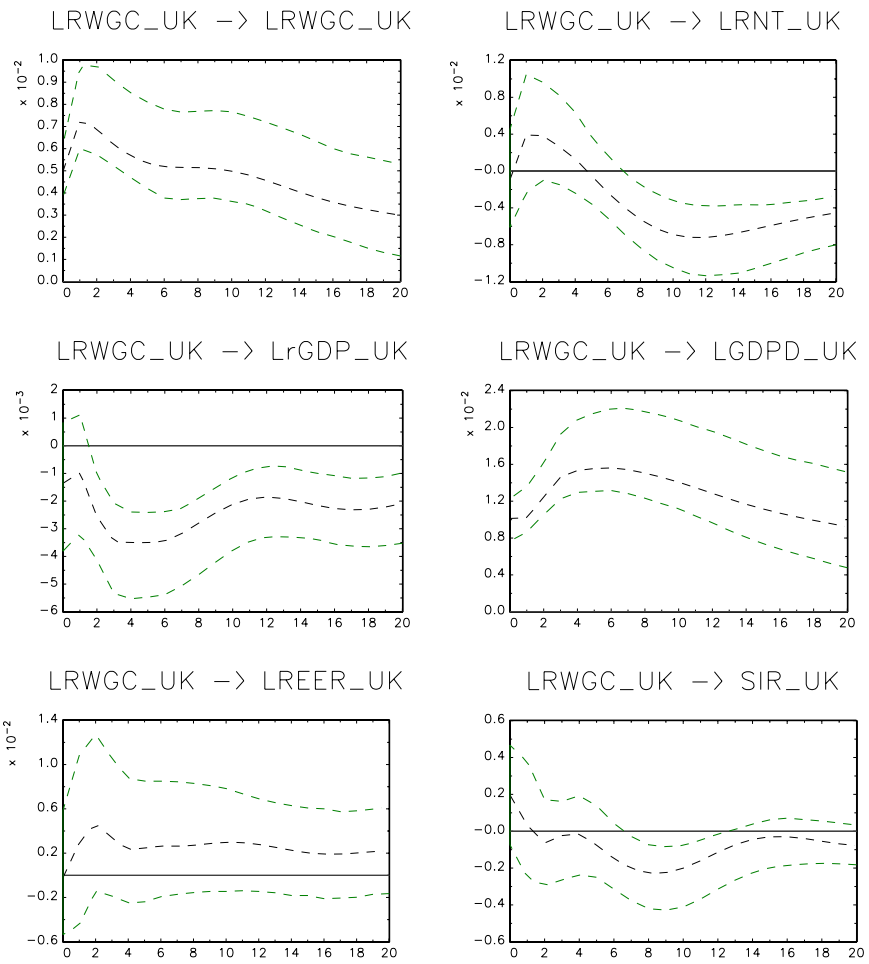

Figure 35: wgc, t, y, p, reer, i - wgc shock (1970:Q1–1990:Q4)

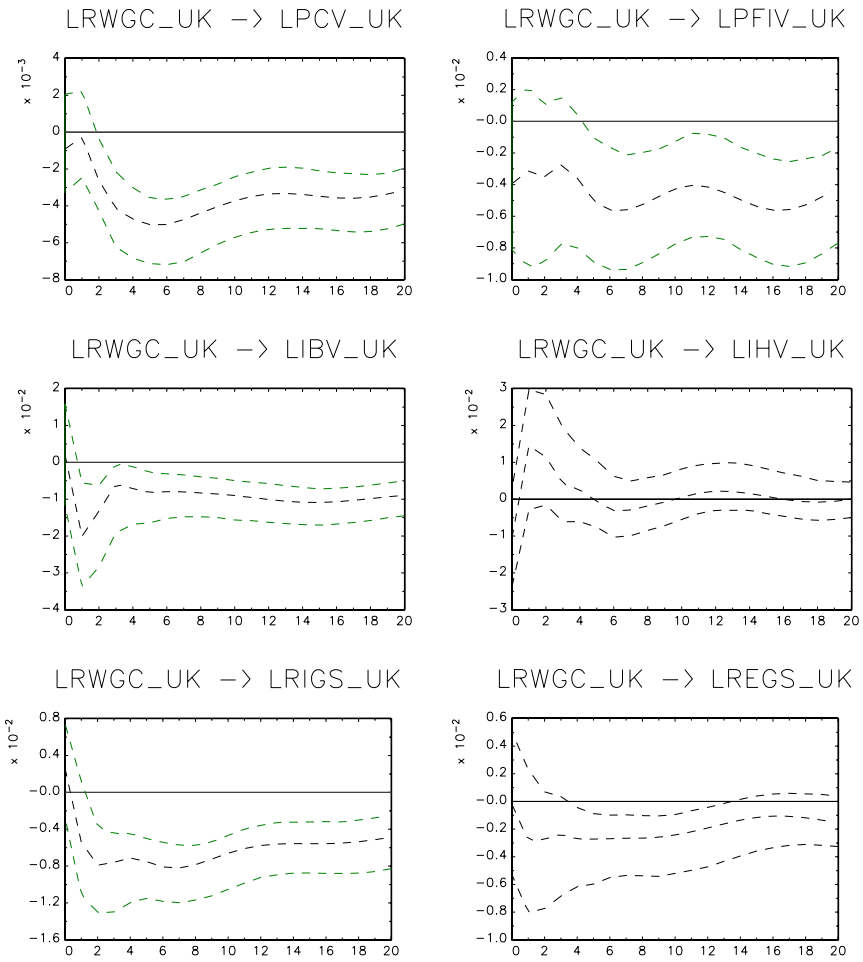

Figure 36: GDP components - wgc shock (1970:Q1-1990:Q4)

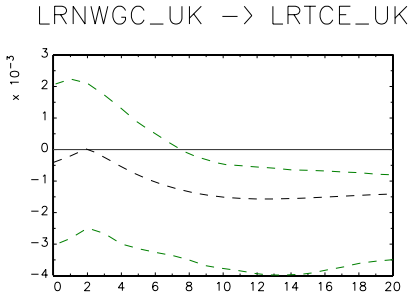

Figure 37 : nwgc shock on RW with $a_{nwgc,w}$=0.3596

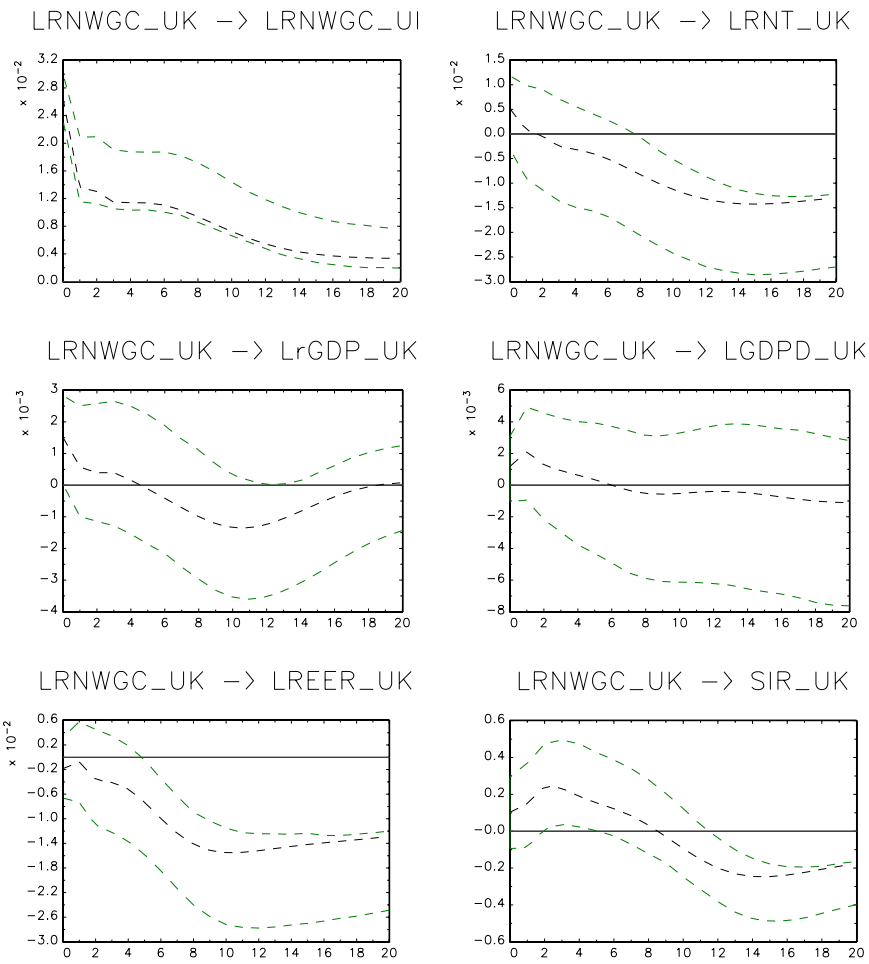

Figure 38: nwgc, t, y, p, reer, i - non-wage government consumption (nwgc) shock

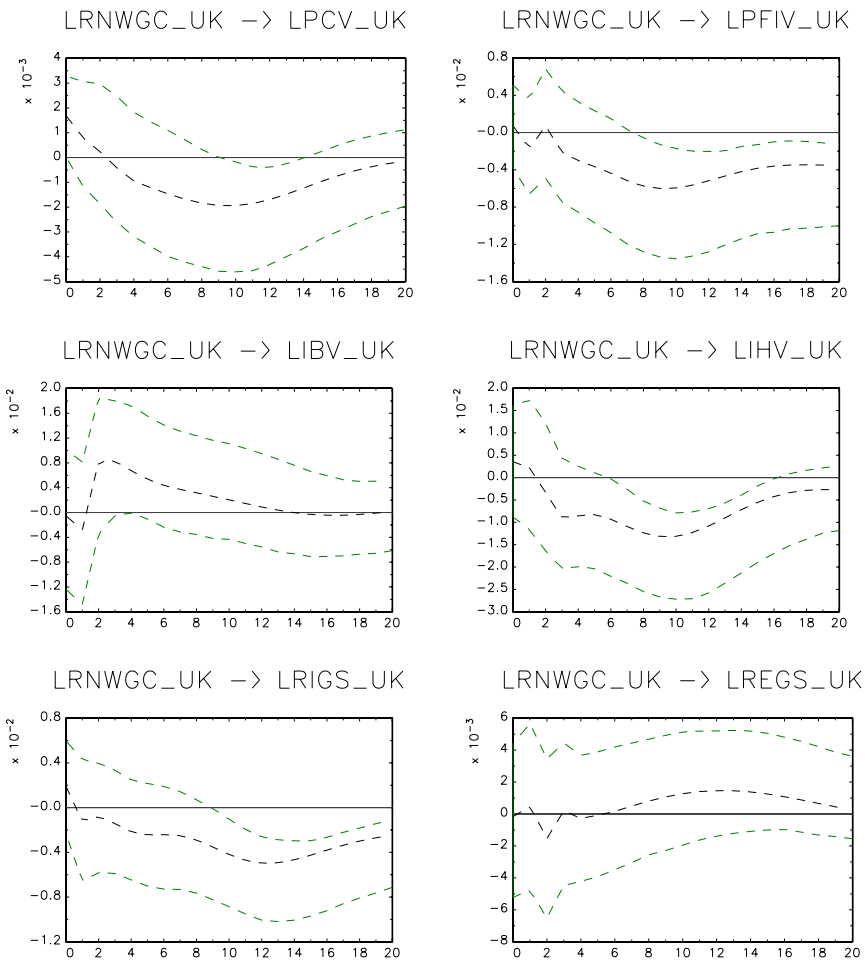

Figure 39: GDP components - nwgc shock

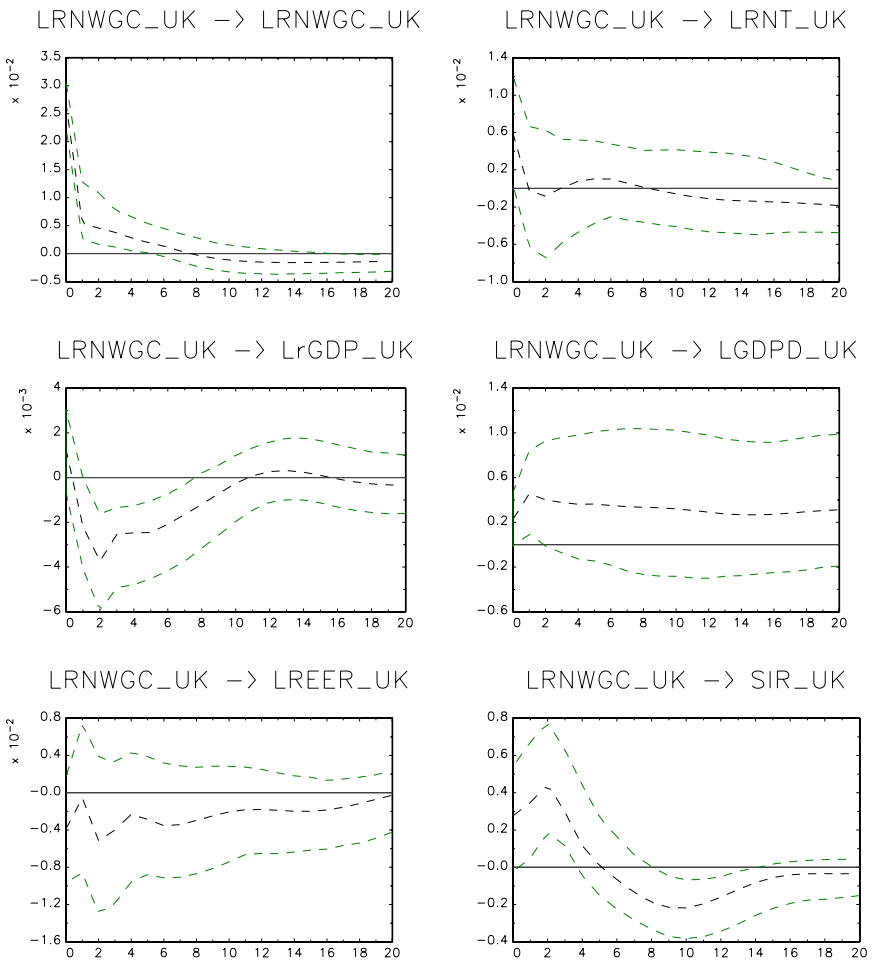

Figure 40: nwgc, t, y, p, reer, i - nwgc shock (1970:Q1-1990:Q4)

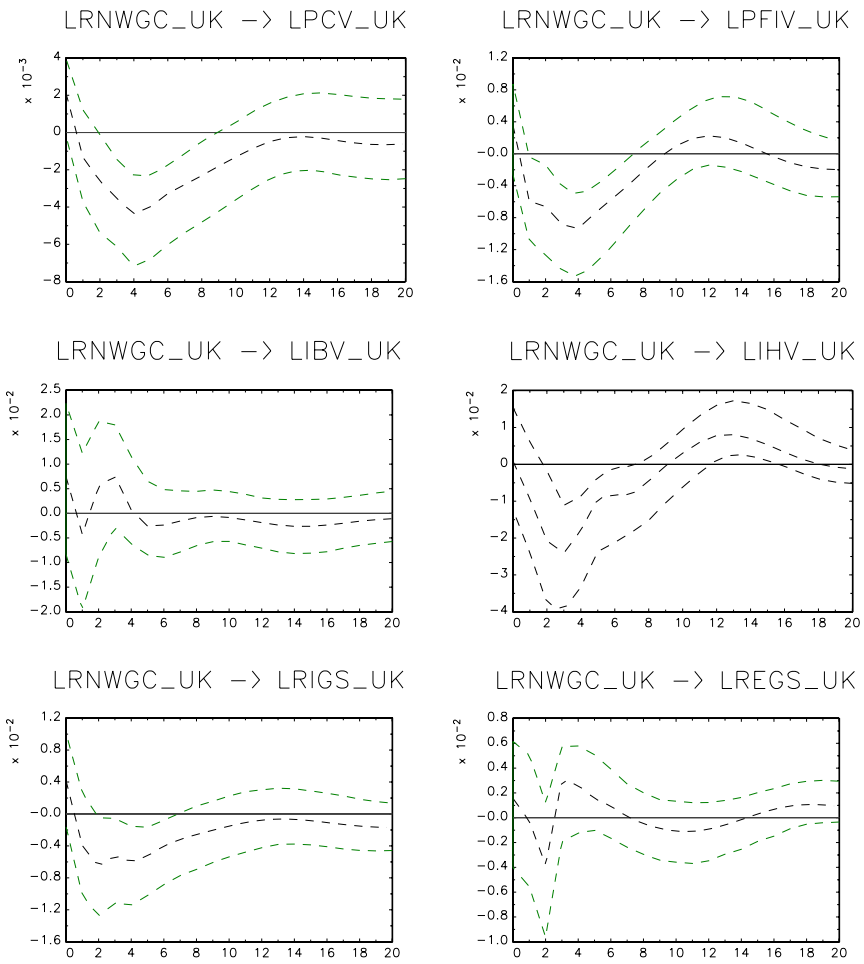

Figure 41: GDP components - nwgc shock (1970:Q1-1990:Q4)

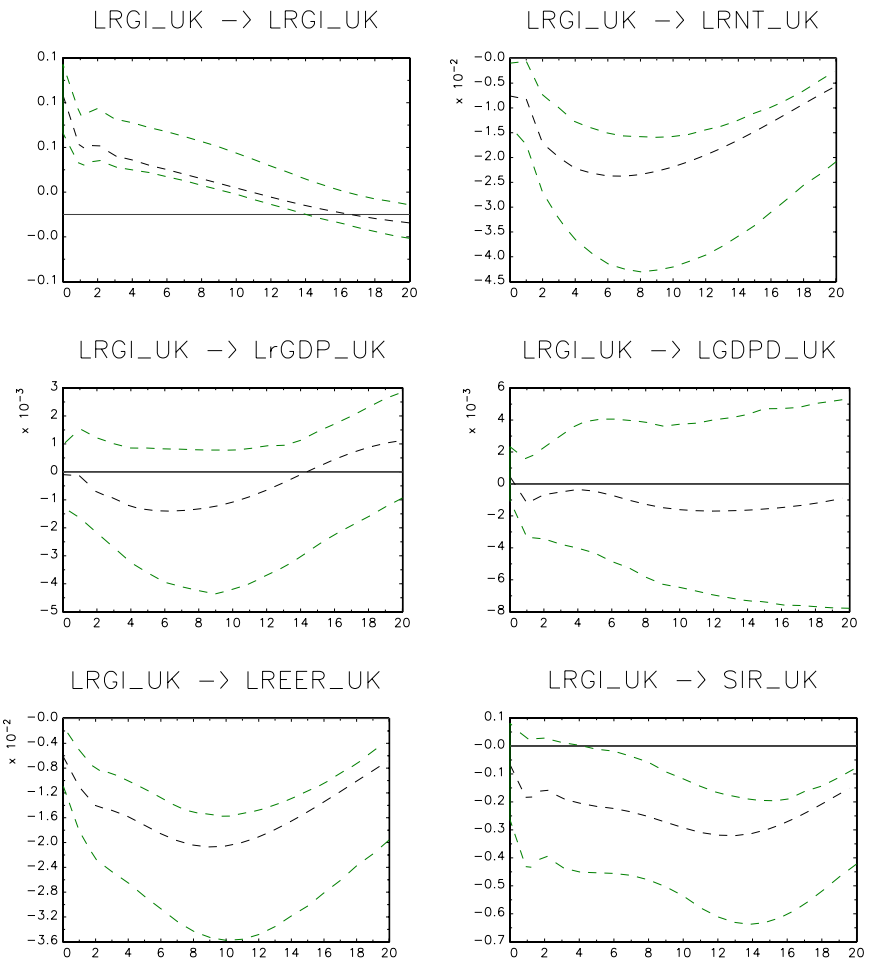

Figure 42: gi, t, y, p, reer, i - government investment (gi) shock

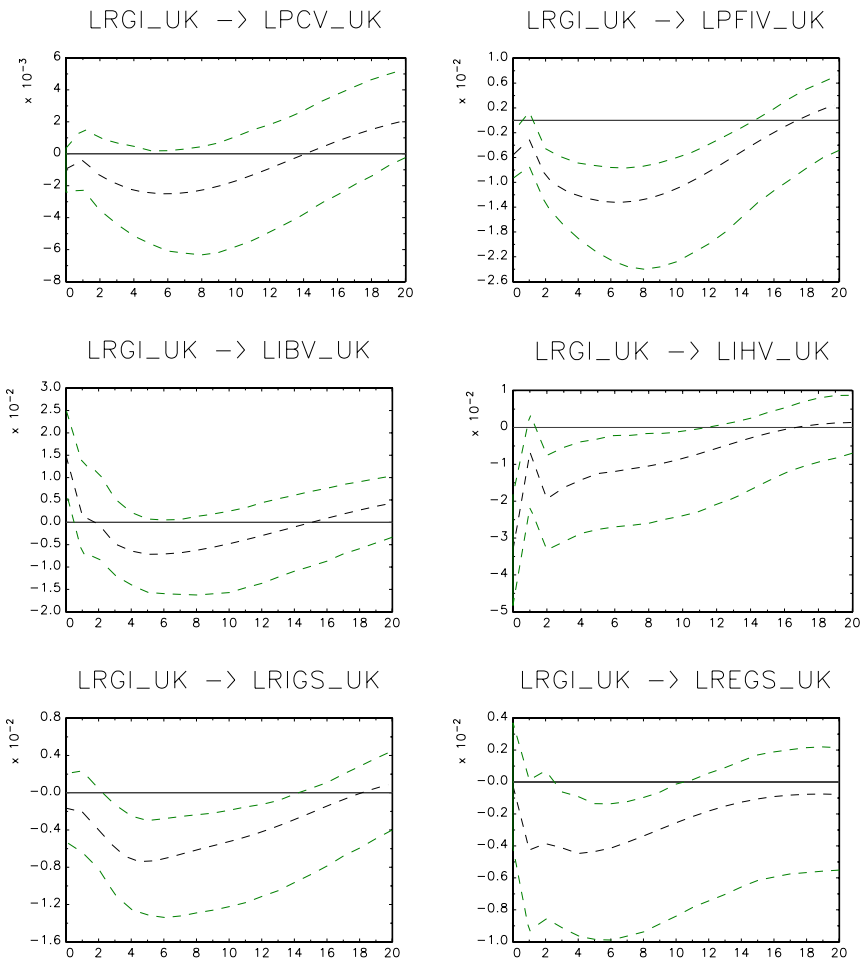

Figure 43: GDP components - gi shock

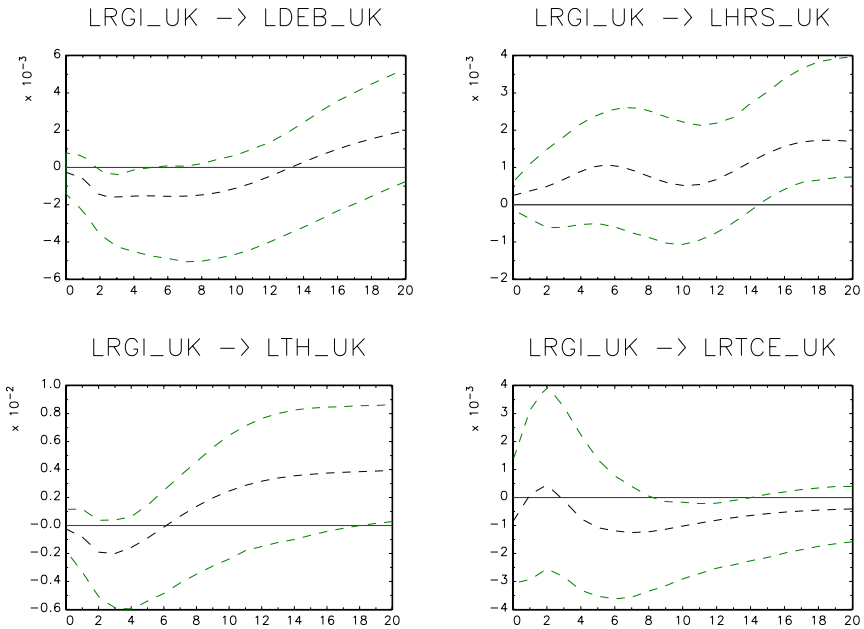

Figure 44: E, H, TH, RW - gi shock (1970:Q1–1990:Q4)

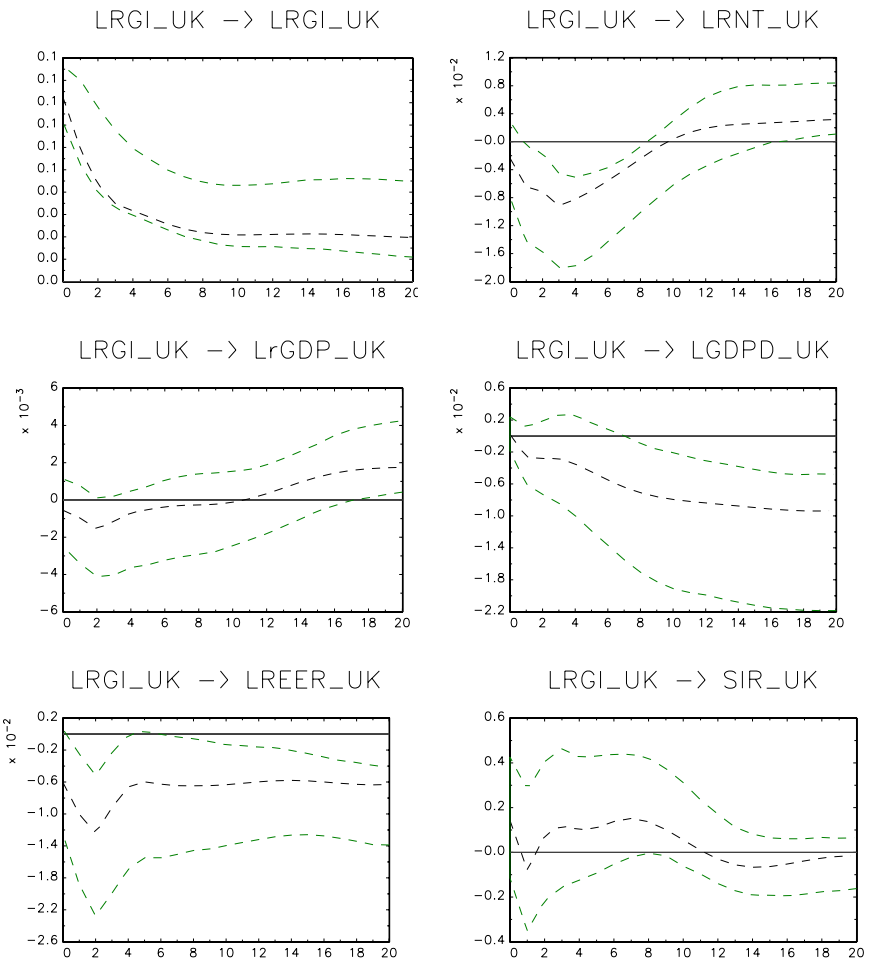

Figure 45: gi, t, y, p, reer, i - gi shock (1970:Q1–1990:Q4)

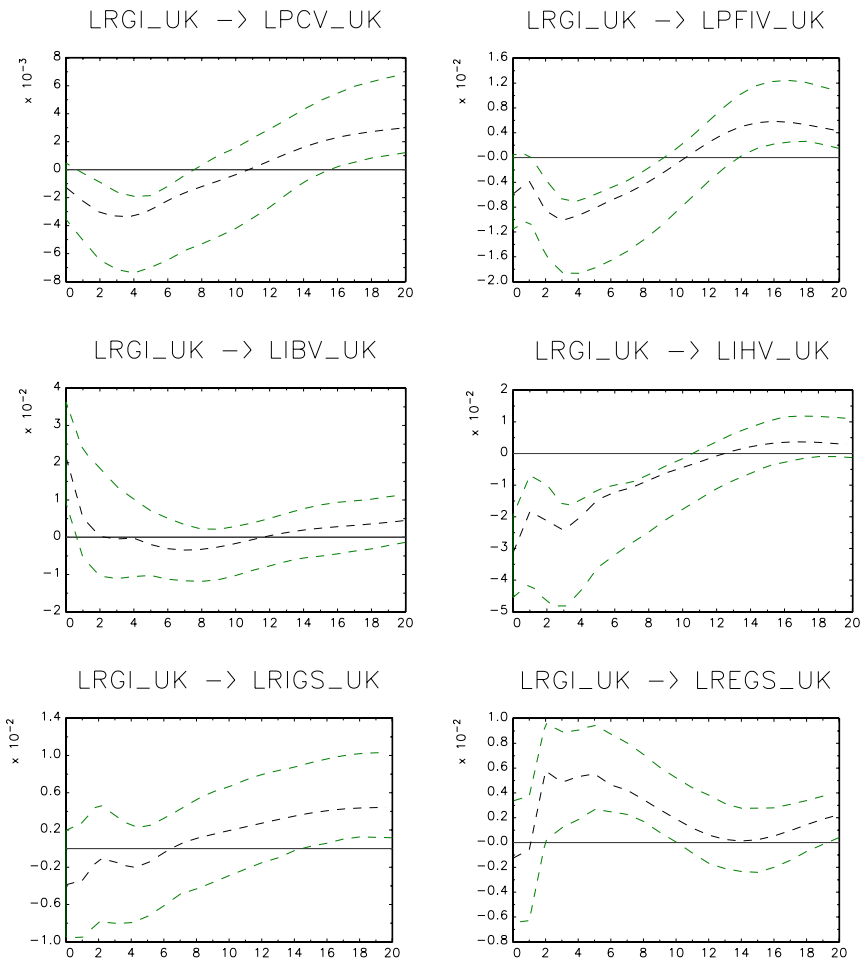

Figure 46: GDP components - gi shock (1970:Q1-1990:Q4)

6.4 Net tax shock - Figures

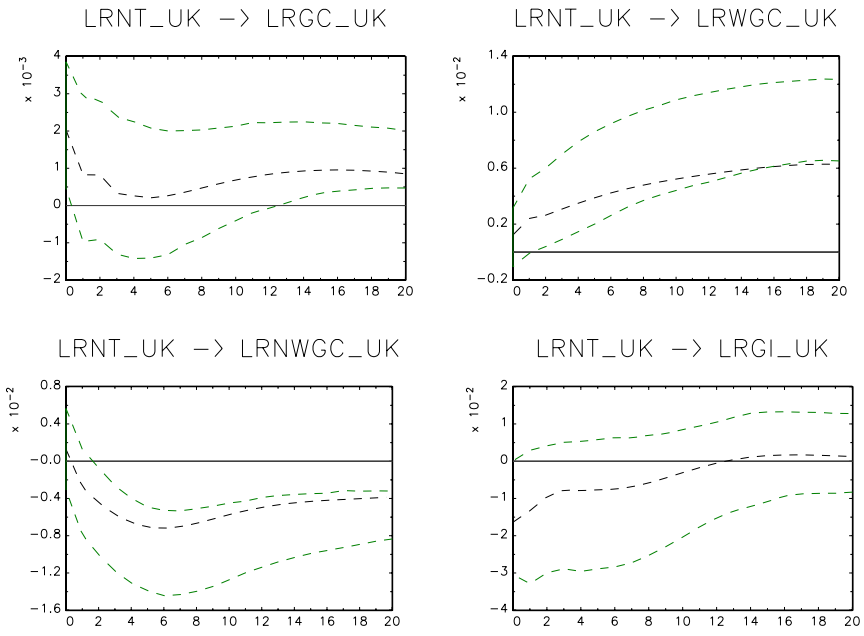

Figure 47: Spending components - a contractionary net tax shock

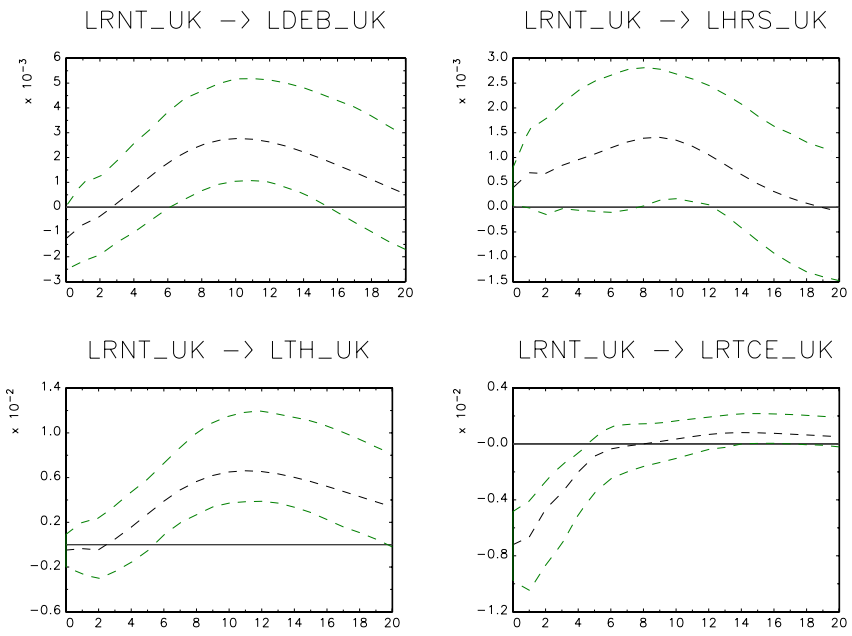

Figure 48: E, H, TH, RW - net tax shock (1970:Q1-1990:Q4)

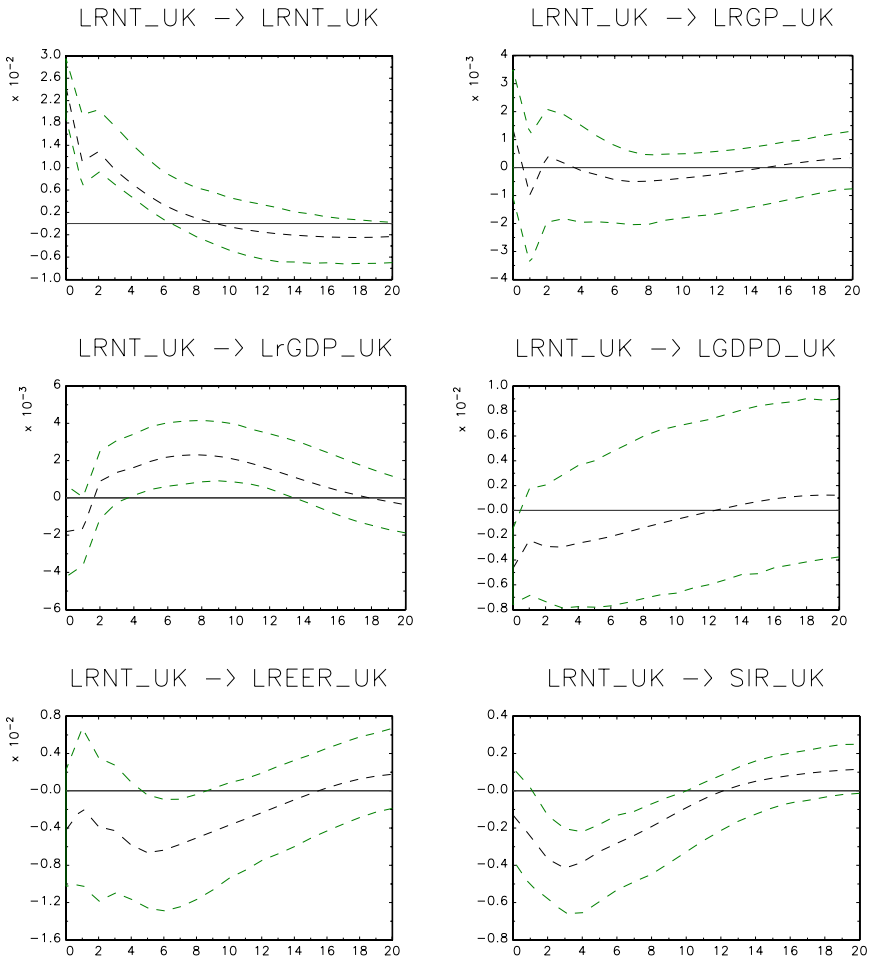

Figure 49: g, t, y, p, reer, i - net tax shock (1970:Q1-1990:Q4)

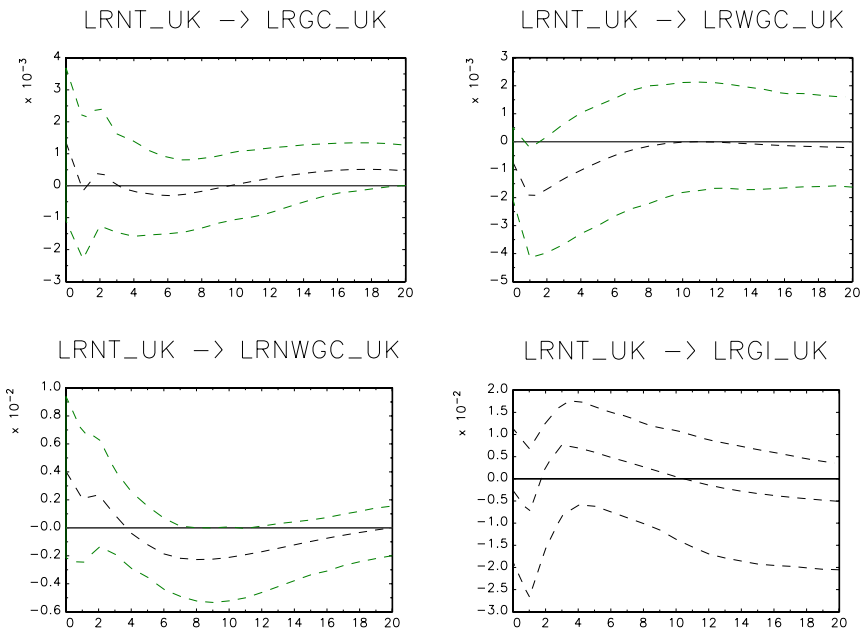

Figure 50: Spending components - net tax shock (1970:Q1–1990:Q4)

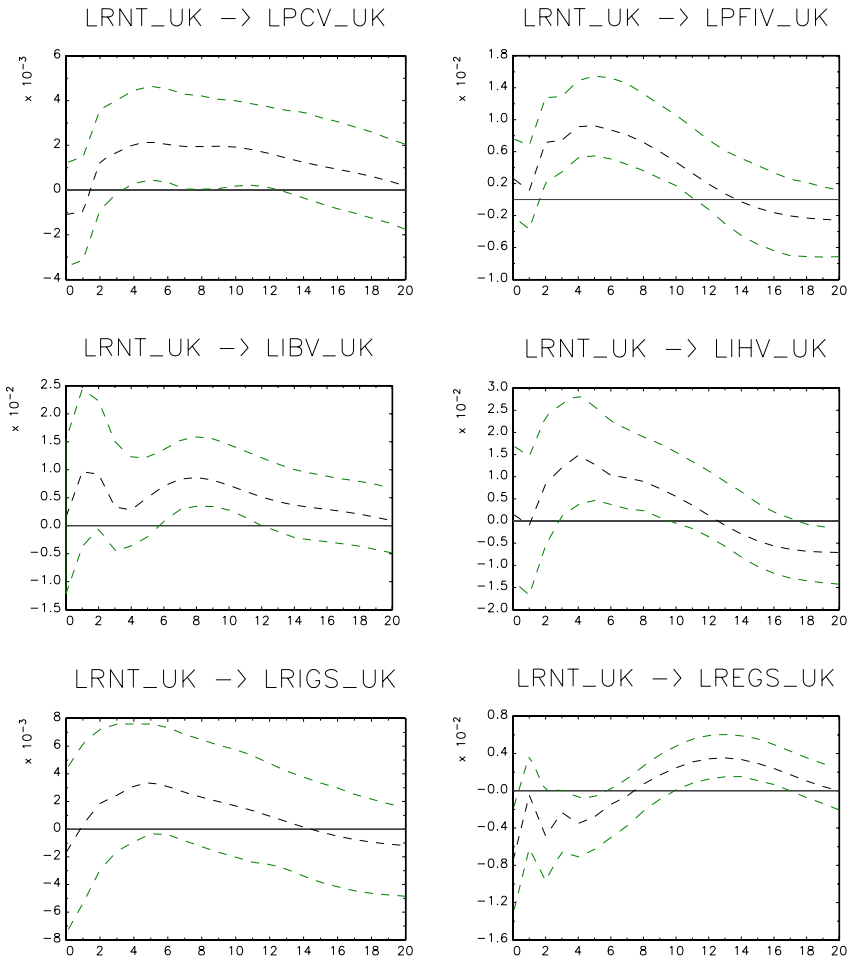

Figure 51: GDP components - net tax shock (1970:Q1-1990:Q4)