

Fiscal Expansions Can Increase Unemployment: Theory and Evidence from OECD countries

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Abstract

Structural VARs indicate that for many OECD countries the unemployment rate significantly increases following increases in government expenditures under a variety of specifications and identification schemes. Fiscal expansions also tend to increase employment, participation rates and real wages. Existing models have difficulties in generating such responses. We show that the empirical regularities can be reproduced with two additions into a standard New Keynesian model with matching frictions: (a) a labor force participation choice and (b) workers' heterogeneity.

JEL classification: E32, E62.

Key Words: unemployment, participation rate, VARs, matching frictions, insiders, outsiders.

1 Introduction

Most macroeconomists would agree that expansionary fiscal policy stimulates employment and lowers unemployment. Indeed, existing studies for the US economy (see, Ravn and Simonelli (2007) and Monacelli et al. (2010)) confirm this conventional wisdom. Our empirical analysis extends the literature by studying the effects of fiscal policy on unemployment in other OECD countries and shows, first, that increases in government spending can actually increase unemployment in many OECD countries and, second, that the existing evidence for the US is not robust to the sample period considered. The fact that fiscal expansions can increase unemployment is somewhat surprising. Yet, it is robust, in the sense that it holds for a number of OECD countries and sample periods and a variety of VAR specifications and identification schemes that one can use to extract fiscal shocks from the data.

Despite the difficulties in their identification, economists have tried to characterize the responses of macroeconomic variables such as investment, consumption and output to fiscal disturbances. Blanchard and Perotti (2002), Perotti (2004) and Gali et al. (2007) use the restriction that government spending does not contemporaneously react to changes in macrovariables to identify fiscal shocks. Ramey and Shapiro (1998), Edelberg et al. (1999), and Burnside et al. (2004) identify fiscal shocks as episodes of significant exogenous and unforeseen increases in government spending in national defense.¹ Canova and Pappa (2007) and Mountford and Uhlig (2009) identify fiscal shocks using sign restrictions. Pappa (2009a), using robust theoretical sign restrictions, was the first to investigate the effects of fiscal shocks on labor market variables such as the real wage and employment. The analysis we conduct here considers many more labor market variables, covers as many as ten OECD countries, and focuses attention on the dynamics of the unemployment rate. Determining how the unemployment rate responds to fiscal expansions is important because many fiscal packages in the real world are typically designed to "create jobs" and because models have recently been proposed to explain its time series properties.

Our empirical analysis shows that the unemployment rate can increase significantly in response to government expenditures shocks in many OECD countries. Results are robust to alternative identification schemes, the inclusion of control variables and different sub-periods for most countries but the US where the response of unemployment to fiscal shocks seems to have changed pattern substantially over time. In addition, we document that fiscal expansions tend to increase the participation rate, the employment rate and the real wage.

Our empirical findings are difficult to reconcile with existing theoretical models for several reasons. First, analyzing the effects of government spending shocks on unemployment in standard RBC and NK models is impossible since standard versions of these models only allow for movements in hours worked and/or employment. Second, even if we incorporate the Diamond-Mortensen-Pissarides search and matching model into standard frameworks, as suggested in Andolfatto (1996), or Walsh (2005), we cannot account for the responses of the participation rate – in these models participation is constant. But, even disregard-

¹Depending on the identification approach the results on the effects of government spending on private consumption differ. Perotti (2007) critically reviews this literature.

ing participation choices, simultaneously generating increases in output, real wages, the employment and the unemployment rate in response to fiscal shocks is difficult.

To circumvent these difficulties we add a participation margin in a New Keynesian model with labor market frictions as in Ravn (2008) and, in the spirit of Lindbeck and Snower (1988), we consider a labor market with insiders and outsiders. Endogenous participation generates an increase in the pool of job seekers after a fiscal expansion since the wealth effect induced by the shock in government's absorption increases labor market participation. The assumptions on workers' heterogeneity and price stickiness are also crucial to generate increases in total employment and the unemployment rate. Sticky prices are necessary for inducing an increase in demand that counteracts the crowding out of vacancies due to the increase in government absorption. However, for low values of the labor supply elasticity participation does not increase enough and the increased labor demand by the sticky price firms is strong enough to fully absorb the supply of new participants. The fact that some new entrants, characterized as outsiders, have a less efficient matching technology guarantees that even for low values of the labor supply elasticity unemployment can increase.

Our paper is related to a number of recent works which have appeared in the literature. Relative to Monacelli et al. (2010), our model incorporates features such as endogenous participation and workers' heterogeneity that can generate increases in unemployment, output, employment and the real wage after a fiscal expansion. Faia et al. (2010) also assume that workers are heterogeneous and introduce labor frictions in the form of labor turnover costs but do not examine the dynamics of unemployment or labor participation in response to fiscal shocks. Finally, Gomes (2009) uses a two-sector dynamic stochastic general equilibrium model with search and matching frictions to study the labor market effects of shocks to public sector employment and wages. In his model unemployment decreases in response to generic government consumption shocks.

The remainder of the paper is organized as follows. Section 2 describes the econometric framework. Section 3 presents the main empirical results. The theoretical model is presented in Section 4. Section 5 describes the dynamics of the benchmark economy and highlights the features that are crucial for replicating qualitatively the empirical results and Section 6 concludes.

2 Data and Estimation Methodology

We obtain quarterly data on GDP, private consumption, private investment, government consumption expenditures, wages, the short-term interest rate, the labor force participation and the unemployment rate from OECD statistics. Total central government tax revenues are obtained for Canada from Statistics Canada, for Australia and Japan from Datastream, for the UK from the Office of National Statistics, and for the US from the Bureau of Economic Analysis. Except for the interest rate, the unemployment and the participation rate and real wages, all other variables are in real per capita terms and all variables are

seasonally adjusted. The time periods span the longest possible sample given by OECD Statistics data: (1968:1-2009:1) for Australia, (1961:1-2009:1) for Canada, (1990:1-2009:1) for Finland, (1978:1-2009:1) for France, (1980:1-2009:1) for Italy, (1980:1-2009:1) for Japan, (1979:1-2009:1) for Norway, (1982:1-2009:1) for Sweden, (1978:1-2009:1) for the UK, and (1964:1-2009:1) for the US. In the main part of the empirical analysis we focus on Australia, Canada, Japan, the UK, and the US because for these countries we have sufficiently long and reliable quarterly data on both government consumption expenditures and total government tax revenues.

To identify the impact that government expenditure shocks have on labor market outcomes we use a structural VAR approach. The variables entering our baseline specification are: the logs of real per capita government expenditures, GDP, consumption, and investment, and the interest rate, real CPI wage, and the unemployment rate. To start with we assume that government expenditures are contemporaneously unaffected by all variables in the model. This assumption appears plausible to us because fiscal policy usually reacts with at least a quarter lag to changes in the economic environment (see for instance Blanchard and Perotti, (2002); Perotti, (2004)). The lag length of our VAR model is based on information criteria and set equal to one. All variables in the VAR model enter as log-deviations from a constant and a quadratic time trend.² In all figures we report 95 percent confidence bands.

3 Empirical Results

Panel A of Figure 1 presents unemployment responses for the baseline SVAR model. For all nine out of the ten OECD countries there is a significant positive response following increases in government expenditures. Government expenditure increases raise unemployment strongly in Finland and Sweden, while they induce no significant effects in Italy. The estimates imply that a 10% increase in government expenditures typically increases the unemployment rate at peak by around 0.2-0.5%. Responses are persistent, indicating that government expenditure increases may have effects on the unemployment rate that are of

²We have checked the stability of our VAR by computing the eigenvalues of the estimated coefficient matrix. We found that all of the eigenvalues lie within the unit circle. We have also checked the robustness of our estimates using a VAR with up to 4 lags. Impulse responses from the 4-lag VAR are similar to our parsimonious 1-lag specification. Also, our results hold independently of the omission of the time trend in the specification. Responses for these specifications are available from the authors upon request.

a long-lasting nature, which is in line with the hysteresis hypothesis (see Blanchard and Summers, (1987)).

In Panel B of Figure 1 we analyze what would happen if, rather than assuming that government expenditure is insensitive to economic conditions, we allow the government expenditure series to react to all VAR variables contemporaneously. Such an assumption can be justified by claiming that automatic stabilizers are present at any point in time. The responses displayed in the second panel of Figure 1 show that there continues to be a positive response in the unemployment rate following government expenditure increases: the increases are significant at the 95% confidence level for nine of the ten countries.

In the analysis so far we have not controlled for tax revenues in the VAR specification. This could be a crucial omission since it does not control for changes in the deficits and it does not rule out (potentially important) contemporaneous effects of distortionary tax changes on output. For that reason in what follows we focus the analysis on Australia, Canada, Japan, the UK, and the US. The variables entering our specification with tax revenues are: the logs of real per capita government expenditures, GDP, consumption, and investment, and the interest rate, real per capita tax revenues, real CPI wage, and the unemployment rate. Panel A of Figure 2 shows that, for all five OECD countries where we have data on tax revenues there is a significant positive response in the unemployment rate following expansionary government spending shocks. In Panel B of Figure 2 we analyze what would happen if, rather than assuming that government expenditure is insensitive to economic conditions, we allow the government expenditure series to react to all VAR variables contemporaneously. The responses displayed in the second panel of Figure 2 show that there continues to be a positive response in the unemployment rate following government expenditure increases at the 95% confidence level for Canada, Japan and the UK.

Given that different identification schemes might induce different dynamics in the endogenous variables, we have checked whether identifying fiscal shocks as unforeseen increases in government expenditure on defense, following the approach of Ramey and Shapiro (1998), changes the pattern of unemployment responses we obtained. In Figure 3 we return to our baseline VAR specification that includes tax revenues but substitute the government expenditure series for the Ramey-Shapiro war dummies for the US.³ In this case, we also

³The Ramey-Shapiro war dummy takes on the value of 1 in 1965:1, 1980:1, 2001:3, and 2003:1. A first-

obtain a positive and statistically significant response in the unemployment rate that has its peak effect after about 2 quarters. The response in the US unemployment rate is persistent and turns negative only after about 10 quarters.

In contrast to our results, Ravn and Simonelli (2007) and Monacelli et al. (2010) find that, for the US, unemployment significantly decreases after an expansionary expenditure shock. It appears that the differences are due to the sample period used in the estimation. Ravn and Simonelli (2007) use data from 1959 to 2004, and Monacelli et al. (2010) use data from 1954 to 2006.⁴ Perotti (2004) also finds that the effects of fiscal shocks change when considering the pre-80s and the post-80s samples. In order to investigate whether this is the case also for the unemployment response and in order to examine the robustness of our results to the subsample used we present in Figure 4 the unemployment responses for different subsample periods for Australia, Canada and the US (the three countries where we have long enough data to cover the pre-1980 period). Subsamples cover the periods 1968-1980, 1968-1985, 1968-1990, 1968-1995, 1968-2000, 1968-2005, and 1968-2009.⁵ The behavior of unemployment responses to government expenditure increases is relatively unstable across subsamples for the US economy. Unemployment reacts negatively to expenditure increases up to the 1990s, and for longer subsamples the reaction is either insignificant or positive, while for Canada the responses are significantly positive regardless of the time-period covered and for Australia they are positive and significant in five of the seven subsamples considered.

To ensure that our results are not driven by a possible structural break that occurred around the turn of the 1980s, and that they are also robust to cross-country differences in the time period covered, we report in Figure 5 impulse responses for the periods 1980-2009, 1985-2009, 1990-2009, and 1995-2005. The responses of unemployment to government expenditure expansions in the US are unstable also for this time period. In the first three subsamples responses of unemployment to government spending shocks are significantly positive, while in the last period considered responses turn again negative and significant on impact. For the other OECD countries, with the exception of Japan where responses

stage regression of the change in government expenditures on the lagged Ramey-Shapiro war dummy yields during the 1964:1-2009:1 period a t-value of 2.73.

⁴In order to have reliable and comparable series we use OECD statistics data for all countries considered. However, our results for the US hold also for data from the BEA and the BLS, and for the data of Simonelli and Ravn (2007) available at: <http://www.eui.eu/Personal/Ravn/>.

⁵We start in 1968 to have the longest possible symmetric sample across the three countries.

are almost never significant, unemployment increases following increases in government expenditures in almost all subsamples.

The increases in unemployment we document are accompanied by increases in output per capita: as the first panel of Figure 6 shows the impact response following the increase in government spending is positive in all countries. Thus, the increase in unemployment is not driven by a possibly adverse effect of the fiscal expansion on output. Interestingly, the estimated responses of private consumption to these expenditure shocks (presented in Panel B of Figure 6) are also positive and significant for all countries except Japan. Instead, the shock crowds out private investment in all the countries but Australia (See Panel C of Figure 6).

Panel A of Figure 7 shows that increases in government spending also increase the real wage on impact. However, the responses are significant at the 95% confidence level only for the UK. In Panels B and C of Figure 7 we present the response of employment and the labor force participation rate.⁶ Consistent with the findings in Pappa (2009b) we find that the employment rate significantly increases following a government consumption expenditure increase in the US and Canada. For Japan and the UK, employment rates significantly decrease while in Australia the response is insignificant. The response of the labor force participation rate is negative and significant for Japan, but positive and significant for the other four countries.

To strengthen our conclusions we have also checked whether results change when we identify fiscal shocks using sign restrictions on the responses of deficits, output, tax revenues and government expenditures. Following Pappa (2009b), we use the restriction that government expenditures, output and deficits are positively correlated contemporaneously, while tax revenues are not allowed to respond negatively to the shock.⁷ In Figure 8 we plot the responses based on the sign restrictions identification. The unemployment rate significantly increases following government expenditure increases and responses are persistent for all five countries. Here real wages increase significantly after the fiscal expansion in all the countries and the responses of employment are insignificant in Japan and the UK. For the

⁶The impulses are generated from a VAR where we replace the unemployment rate by employment and the labor force (both variables are in per capita terms).

⁷Given that in the theoretical model we use output might not react contemporaneously to expenditure shocks, we also use the above restrictions on the second period after the shock. Results are robust to this change as well.

other countries results are very similar qualitatively with our baseline specification.

According to Gomes (2009) public sector wages may play an important role in shaping unemployment dynamics, since high public wages may induce unemployed to queue for public sector jobs. This is a relevant issue since a large component of government consumption expenditures corresponds to public wages. For example, public wages cover 52% of total government expenditures in Australia, 59% in Canada, 38% in Japan, 53% in the UK and 66.5% in the US. To exclude the possibility that unemployment increases are driven by increases in government wages, we have repeated our exercise replacing the government expenditure series with series of government consumption purchases. The results we obtain in Figure 9 are unchanged relative to the benchmark model.⁸

In economies where the expected present value of future taxes and expenditures matters for private sector agents' choices, current fiscal developments can have complex and sometimes surprising effects since current policy can play a crucial role in shaping expectations of future policy changes. So, for example, an expansionary fiscal shock may end up being contractionary if it induces sufficiently strong expectations of future policy changes in the opposite direction. To control for such effects we have repeated our exercise by including a forward looking variable like stock prices in the baseline VAR. As the first panel of Figure 10 shows, even when we control for changes in expectations, the effects of fiscal expansions on unemployment continue to be positive and significant for all countries (except for Japan). We have also made an attempt to further deal with anticipation effects by including changes of the international oil price in the VAR. Also these regressions produce a significant positive effect of government spending on the unemployment rate in all five countries (see Panel B of Figure 10).

To summarize: the evidence we have collected indicates that fiscal expansions can increase the real wage, the employment and the labor force participation rate together with output and the unemployment rate. This evidence is hard to reconcile with standard models. The fact that increases in government spending increase unemployment and the labor force participation rate gives us a starting point to search for potentially consistent theoretical explanations. In the next section we describe how a model with endogenous labor force participation and insiders and outsiders can account for these facts.

⁸ Australia is excluded due to unavailability of data on government consumption.

4 The Model

Analyzing the effects of government spending shocks on unemployment, or the participation rate in standard models is hard since most models allow only for voluntary movements in hours of work and employment. To analyze unemployment fluctuations researchers found it natural to incorporate the Diamond (1982) and Mortensen and Pissarides (1994) search and matching model into the standard frameworks. Among others, Andolfatto (1996), den Haan, Ramey and Watson (2000), Shimer (2005) and Ravn (2008) have introduced search frictions into a standard RBC model. Walsh (2005), Trigari (2009), Campolmi and Faia (forthcoming), Thomas (2008) and Blanchard and Gali (2010) have added them to New Keynesian models.

However, these studies assume that the labor market participation rate is constant. The empirical analysis has revealed that government spending shocks do affect labor force participation. Hence, it is central to introduce a participation margin in our theoretical model. Following Ravn (2008), we model the labor market participation choice in terms of a trade-off between the reduction in leisure time to participate in the labor market search and the benefits associated with the prospect of finding a new job. Labor market non-participants are modeled as agents that are unmatched and that do not currently look for a job, while unemployed are unmatched agents that actively look for a job.

The traditional macroeconomic literature on unemployment (see Layard et al. (1991) for a literature review) discusses many reasons for why unemployment may occur in equilibrium. Lindbeck and Snower (1988) propose a model of insiders and outsiders for explaining unemployment. In their framework, unemployment occurs because some agents (the outsiders) cannot sell as much labor services as they wish to supply. We find this set up attractive, since in the real world many classes of agents, such as long-term unemployed, spouses, students, or elderly workers may be viewed as outsiders in the sense of Lindbeck and Snower (1988). These agents may often decide not to participate in the labor market and they might differ from the typical unemployed worker in their matching market prospects. Thus, the expected payoff from engaging in search activities is smaller for labor market non-participants (outsiders) than for search active agents (insiders). To incorporate the notion of insiders and outsiders in our model we introduce heterogeneity in the matching function. In particular, we assume that there are two types of unemployed workers

that differ in their prospect of being matched with vacancies, with outsiders facing a less efficient matching technology than insiders. Finally, we will assume that prices are sticky in the short run, as a short-cut for generating a demand effect after a government spending shock.

The economy consists of households that have employed, unemployed and non-participants members. There are two types of firms in the economy: (i) competitive intermediate firms that use capital and labor to produce a good, and (ii) monopolistic competitive retailers that use all intermediate varieties to produce the final good which is then used for consumption, investment and government spending. Price rigidities arise at the retail level, while search frictions occur in the intermediate goods sector.

4.1 Preferences

There is a measure one of households. Households consist of a continuum of agents and the number of individuals in the household is large enough to guarantee insurance over consumption of its members.

At any point in time a fraction n_t of the household's members are employed, a fraction u_t are unemployed and a fraction l_t are labor market non-participants. The difference between non-participants and unemployed is that the latter are actively looking for a job.

$$1 = n_t + u_t + l_t \tag{1}$$

The preferences of the representative household are defined by:

$$u(c_t, l_t) = \frac{c_t^{1-\eta}}{1-\eta} + \Phi \frac{l_t^{1-\zeta}}{1-\zeta} \tag{2}$$

where c_t , denotes consumption, $1/\eta$ is the intertemporal elasticity of substitution, $\Phi > 0$ is a preference parameter and ζ is the inverse of the elasticity of labor supply. That is, households obtain utility from consumption and from the fraction of households that do not participate in market activities and enjoy leisure.⁹ Notice that each household member's consumption is the same independently of their labor market status due to income pooling. Notice also that a member of a household that searches for a job or that is employed suffers the same disutility. That is, search effort is as costly in terms of utility as a full time job.

⁹Such a utility function can be rationalized by the production of home goods. That is, it is equivalent to assuming that households derive utility from market and home goods, c_t^h whereas the home goods are produced by the following production function: $c_t^h = \frac{l_t^{1-\zeta}}{1-\zeta}$.

4.2 Matching

The process through which workers and firms find each other is represented by a matching function that accounts for the imperfections and transaction costs in the labor market.

We model heterogeneity in the matching functions of insiders and outsiders as follows. Every period a constant fraction σ of the currently employed worker-job matches is destroyed and a measure of M new matches are formed. Workers that experience a termination of their match are characterized as insiders and they enter into a period of unemployment. An insider may either remain unemployed, find a new job match, or become an outsider. Insiders become outsiders with probability $\mu \in [0, 1]$. The number of new matches between vacant jobs and unmatched agents will depend on both the labor market tightness and the structure of unemployment. The aggregate number of matches is given by:

$$\begin{aligned} M(v_t, u_t^O, u_t^I) &= m_I(v_t, u_t^I) + m_O(v_t, u_t^O), \quad \text{with} \\ m_I(v, u) &> m_O(v, u) \quad \text{for } \forall v, u > 0 \end{aligned} \quad (3)$$

where v denotes vacancies, u^I denotes the measure of insiders, while u^O denotes the measure of outsiders looking for a job. We assume that the efficiency of the matching process is higher for unemployed insiders than for unemployed outsiders. Thus, the matching function for the two groups of individuals is assumed to satisfy:

$$m_j(v, u^j) = \varrho_m^j v^\alpha (u^j)^{1-\alpha} \quad \text{with } j = I, O \quad \text{and } \varrho_m^I > \varrho_m^O > 0 \quad (4)$$

The probability that a vacant job is matched with a worker is going to depend on the overall labor market tightness, $\theta_t = \frac{v_t}{u_t}$, as in the standard framework, and on the relative size of insiders and outsiders. If we denote by γ_t^f this probability, we have:

$$\gamma_t^f = \frac{m_t}{v_t} = \theta_t^{\alpha-1} \left[\varrho_m^I \left(\frac{u_t^I}{u_t} \right)^{1-\alpha} + \varrho_m^O \left(\frac{u_t^O}{u_t} \right)^{1-\alpha} \right] \quad (5)$$

where $u = u_I + u_O$, and the ratio $\frac{u^j}{u}$, $j = I, O$, defines the share of unemployment for agents of type i . Thus, an increase in the unemployment rate for each type of agents increases the probability that a vacancy will be filled. However, an increase in the unemployment rate for insiders has a stronger impact on this probability than an increase in the unemployment rate of outsiders. The probability for an unemployed worker (insider or outsider) to find a job is:

$$\gamma_t^h = \frac{m_t}{u_t} = \theta_t^\alpha \left[\varrho_m^I \left(\frac{u^I}{u} \right)^{1-\alpha} + \varrho_m^O \left(\frac{u^O}{u} \right)^{1-\alpha} \right] \quad (6)$$

Again, the relative size of the two types of unemployed workers in the economy matters. Hence, an additional outsider searcher creates less of a negative externality for the total sum of individuals looking for a job. The probabilities to find a job for each type of agents are given by:

$$\gamma_{ji}^h = \frac{m_{jt}}{u_t}, j = O, I \quad (7)$$

The employment transition equation is given by:

$$n_{t+1} = (1 - \sigma)n_t + m_{It} + m_{Ot} \quad (8)$$

The transition equation for insiders' unemployment is given by:

$$u_{t+1}^I = (1 - \mu)u_t^I + \sigma n_t - m_{It} \quad (9)$$

Notice that insiders are more often (that is, for many parameter specifications) better off searching than non-participating since they are faced with a better matching technology. Outsiders instead have to decide whether they should participate in the labor market and their decision takes into account the fact that they are less advantageous in matching with firms.

4.3 The problem of the household

The household owns the economy's capital stock. The capital stock evolves over time according to:

$$k_{t+1} = (1 - \delta)k_t + i_t + \xi\left(\frac{k_{t+1}}{k_t}\right)k_{t+1} \quad (10)$$

where δ is the capital's depreciation rate, i_t is gross investment and $\xi(\cdot)$ is a function that regulates capital adjustment costs. We adopt a quadratic specification of the form:

$$\xi\left(\frac{k_{t+1}}{k_t}\right) = \frac{\omega}{2} \left(\frac{k_{t+1}}{k_t} - 1 \right)^2 \quad (11)$$

where the parameter ω regulates the importance of capital adjustment costs for the accumulation of capital.

The representative household maximizes its expected utility given by:

$$E_t \sum_{t=0}^{\infty} \beta^t u(c_t, l_t) \quad (12)$$

choosing sequences of consumption, c_t , the number of insiders in the next period, u_{t+1}^I , and the number of outsiders, u_{t+1}^O , employment for next period, n_{t+1} , next period's bond holdings, B_{t+1} and capital, k_{t+1} , subject to (1), (8), (9), (10) and its budget constraint given by:

$$c_t + i_t + \frac{B_{t+1}}{p_t R_t} \leq r_t k_t + w_t n_t + b u_t + \frac{B_t}{p_t} + \Pi_t - T_t \quad (13)$$

where p_t is the price level, w_t is the real wage, r_t is the real return to capital, b denotes some non-tradable value to being unemployed expressed in terms of unit output, R_t is the gross nominal interest rate, Π_t are the profits of the monopolistic competitive firms and T_t are lump sum taxes paid to the government.

4.4 Intermediate goods firms and job creation

Intermediate goods firms employ the household's labor and capital to produce intermediate goods. The production function for intermediate goods is given by:

$$y_t = F(k_t, n_t) = k_t^\varphi n_t^{1-\varphi} \quad (14)$$

Intermediate firms maximize the discounted value of future profits. Firms adjust employment by varying the number of workers (extensive margin) rather than the number of hours per worker. According to Hansen (1985), most of the employment fluctuations arise from movements in this margin. The firm takes as given the number of workers currently employed and its employment decision concerns the number of vacancies that it posts in the current period, v_t . Firms open as many vacancies as necessary to employ the desired number of workers next period and there is a utility cost from posting a vacancy, \varkappa . Firms also need to decide on the size of the capital stock that they need for production. The problem of a firm with n_t currently employed workers consists of choosing capital and vacancies to maximize:

$$Q(n_t, k_t) = \max x_t F(k_t, n_t) - w_t n_t - r_t k_t - \varkappa v_t + E_t \Lambda_{t+1} Q(n_{t+1}, k_{t+1}) \quad (15)$$

where x_t is the relative price of intermediate goods and $\Lambda_{t+s} = \frac{\beta^s U_{ct+s}}{U_{ct}}$, is the discount factor. The maximization takes place subject to the production function, the law of motion

for aggregate productivity and the job transition function that links the future number of filled jobs to the current stock of filled jobs plus net hiring.

$$n_{t+1} = (1 - \sigma)n_t + \gamma_t^f v_t \quad (16)$$

4.5 Bargaining over wages

Workers and firms split rents through Nash bargaining and the part of the surplus they receive depends on their bargaining power. If we denote by $\vartheta \in (0, 1)$ the firms bargaining power, the Nash bargaining problem is to maximize the weighted sum of log surpluses:

$$\max_{w_t} (1 - \vartheta) \ln V_t^W + \vartheta \ln V_t^F$$

where $V_t^W = w_t - b + (1 - \sigma - (\psi_t^{Ih} + \psi_t^{Oh}))E_t\Lambda_{t+1}V_{t+1}^W$, is the worker's surplus and $V_t^F = x_t(1 - \varphi)\frac{y_t}{n_t} - w_t + \beta E_t\Lambda_{t+1}V_{t+1}^F$, is the firm's surplus of the match.

The solution of the bargaining problem defines the contractual wage as:

$$w_t = (1 - \vartheta) \left[(1 - \varphi)x_t \frac{y_t}{n_t} + \frac{\varkappa(\psi_t^{Oh} + \psi_t^{Ih})}{\gamma_t^f} \right] + \vartheta b \quad (17)$$

Note that in equilibrium, the value of working is the same for insiders and outsiders because otherwise firms could make profits by hiring less of those workers with a lower value and more of those workers with a higher value. In other words, there are decreasing returns in matching to unemployment, so in equilibrium the value of work should be the same in order for there to be no arbitrage opportunities. The wage paid to matched unemployed insiders will therefore be the same as the wage paid to matched unemployed outsiders.

4.6 Retailers and price setting

There is a continuum of monopolistically competitive retailers indexed by i on the unit interval. Retailers buy intermediate goods from firms and differentiate them with a technology that transforms one unit of intermediate goods into one unit of retail goods. Retail goods are then used for consumption, government spending and investment. Note that the relative price of intermediate goods, x_t , coincides with the real marginal cost faced by the retailers. Let y_{it} be the quantity of output sold by retailer i . Final goods can be expressed as the composite of individual retail goods:

$$y_t = \left[\int_0^1 y_{it}^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}} \quad (18)$$

where $\varepsilon > 1$ is the constant elasticity of demand for intermediate goods. The retail good is sold at its price, $p_t = \left(\int_0^1 p_{it}^{1-\varepsilon} di \right)^{\frac{1}{1-\varepsilon}}$. The resulting demand for each intermediate good depends on its relative price and aggregate demand:

$$y_{it} = \left(\frac{p_{it}}{p_t} \right)^{-\varepsilon} y_t \quad (19)$$

Following Calvo (1983) we assume that in any given period each retailer can reset its price with a fixed probability $1 - \chi$. Hence, the price index is given by:

$$p_t = [(1 - \chi)p_t^{*1-\varepsilon} + \chi p_{t-1}^{1-\varepsilon}]^{1/(1-\varepsilon)} \quad (20)$$

The firms that are able to reset their price, p_t^* , choose it so as to maximize expected profits given by:

$$E_t \sum_{t=0}^{\infty} \chi^s \Lambda_{t+s} \left[\frac{p_{it}^*}{p_{t+s}} - x_{t+s} \right] y_{it+s} \quad (21)$$

4.7 Fiscal policy

The government consumes exogenously part of the retail goods and finances its expenditures via lump sum taxes.

$$bu_t + G_t = T_t$$

4.8 Monetary Policy

There is an independent monetary authority which sets the nominal interest rate as a function of current inflation, according to the rule:

$$R_t = \bar{R} \exp(\zeta_\pi \pi_t) \quad (22)$$

where π_t measures inflation in deviation from the steady state.

4.9 Closing the model

Aggregate production must equal private and public demand:

$$y_t = c_t + i_t + G_t + \varkappa v_t \quad (23)$$

4.10 Parameterization

We solve the model by approximating the equilibrium conditions around a non-stochastic steady state in which all prices are flexible. The full list of our parameter choices is given in Table 1. The quarterly discount factor is set to 0.99, which implies a quarterly real rate of interest of approximately 1 percent. The risk aversion parameter η is set to 2 and the utility of leisure has elasticity $\zeta = 4$. The implied value of the labor supply is somewhat lower than what researchers usually assume in the literature. In the next section we will show that workers' heterogeneity is key for using low values of this elasticity.

Following Blanchard and Diamond (1989) we set $\alpha = 0.6$ and, using Hosios condition, we also set the bargaining parameter equal to the elasticity of matching, i.e., $\alpha = \vartheta$.

Davis, Haltiwanger and Schuh (1996) compute a quarterly worker separation rate of about 8 percent, while Hall (1995) reports this rate to be between 8 and 10 percent. Thus, we set the separation rate parameter σ to 0.09. The probability of becoming an outsider is set to 0.1. With this parameterization we match that long term unemployment (outsiders) represents 21% of total unemployment, in line with CPS data. The values of ρ_m^O and ρ_m^I are set so that the total unemployment rate and the market tightness equal 7% and 0.25, respectively. The level of benefits in the steady state is set so that labor force participation equals 70%; the vacancy to output ratio is set equal to 0.01.

The depreciation rate is set equal to 0.025 and the capital share is set equal to 0.36. Capital adjustment costs are included to moderate the response of investment with respect to fiscal shocks. We set parameter ω to match the ratio of the investment to output variance for the US economy when we include TFP and monetary shocks in the model. The probability that a firm does not change its price within a given period, ψ , is set equal to 0.75, implying that the average period between price adjustments is around 4 quarters. The value used for the persistence of the government spending shock is the average of the cross country values we have obtained in Section 3.

5 How expansionary government spending shocks increase unemployment

We first investigate the properties of the benchmark model and examine the mechanisms leading to the results of interest.

5.1 The benchmark model

Figure 11 presents the effects of a government expenditure shock on output, employment, unemployment (total and for the two types of workers), the real wage, the participation rate, consumption and investment.

An increase in government spending induces a negative wealth effect that makes households increase their labor supply. As a result, the participation rate increases. Also, the increase in government absorption is crowding out private consumption, investment and hiring. On the other hand, the increase in demand induced by the government expansion increases labor demand, and, in turn, wages and employment increase. Non-participants evaluate that it is good to invest in search when government spending increases since there is the extra benefit of facing the more efficient search technology after an employment spell. But, since it is the insiders that get the extra jobs, the unemployment rate of the outsiders increases. Consequently, total unemployment increases on impact because of the increase in participation and the increase in the unemployment rate of outsiders. As insiders are hired by the firms to face the increased demand, total unemployment decreases; but when the demand effect fades away total unemployment starts rising again. In line with the empirical results, the responses of unemployment are very persistent.

5.2 The role of price stickiness

Price stickiness is necessary for obtaining our results. In Figure 12 we present the responses of an economy which is otherwise identical to the benchmark except for the assumption of price stickiness. With flexible prices, the increase in government absorption would crowd out vacancy posting (as it crowds out consumption and investment) since it would decrease the resources available for filling vacancies. Although the wealth effect of the shock would increase participation and the labor supply in equilibrium, the decrease in vacancy posting would decrease demand for employment and output and increase the unemployment of both types of agents, generating output and employment responses which are in contrast with the empirical evidence we have reported.

5.3 The role of the participation margin and workers' heterogeneity

We have modeled the participation margin in order to be able to analyze the behavior of labor force participation in reaction to expenditure shocks. However, the use of the par-

ticipation margin might be important in generating the results. In Figure 13 we plot the responses of the variables when agents are homogeneous, prices are sticky and there is no participation margin and when agents are homogeneous, prices are sticky and there is a participation margin.¹⁰ The fact that there is a pool of non-participants that move into the labor force when the negative wealth effect from the increase in the government absorption kicks in is not enough to generate an increase in unemployment after a government spending shock. In fact, the two models with or without the participation decision would be almost identical. Workers' heterogeneity is crucial for generating the increase in total unemployment after the spending shock for low values of the labor supply elasticity. If agents were homogeneous, an increase in government spending would increase labor demand and unemployment would be reduced. It is the fact that outsiders have a hard time to find a job relative to the insiders that makes total unemployment increase in equilibrium when the labor supply elasticity is low.

For higher values of the labor supply elasticity, the presence of a participation margin would be sufficient to generate increases in unemployment after a fiscal expansion. We show this in Figure 14 where we plot the response of unemployment in the homogeneous agents model when we vary ζ , the variable determining the Frisch elasticity, $1/\zeta$. For high values of the labor supply elasticity, the wealth effect increases participation and makes unemployment increase even when agents are homogenous. Thus, while both the presence of the labor participation margin and workers' heterogeneity matter, the latter is crucial for generating a positive response of total unemployment when the labor supply elasticity takes low values.

5.4 Other important features

We performed a number of sensitivity analysis exercises to investigate the robustness of our conclusions with respect to changes in the remaining parameters of the model. The most

¹⁰For the homogeneous workers' model, the variable u^I disappears and $u^O = u$. The matching function is given by: $m_t = \rho_m v^\alpha u^{1-\alpha}$ and agents maximize:

$$u(c_t, n_t) = \frac{c_t^{1-\eta}}{1-\eta} - \Phi \frac{n_t^{1-\zeta}}{1-\zeta}$$

subject to (10), (8), and (13), and (1) becomes: $n_t + u_t = 1$.

With the participation margin, agents solve the same problem as in the benchmark economy with the only difference that $u^I = 0$. All models are parameterized to deliver comparable steady state values for the labor market variables.

crucial parameters for the dynamics of unemployment are the cost of posting a vacancy as a percentage of GDP, \varkappa , the adjustment cost parameter, ω , the labor supply elasticity, $1/\zeta$ and the relative size of outsiders to total unemployment.

The size of the vacancy cost is important to determine how much the government expansion crowds out the creation of vacancies. If the cost associated with the creation of vacancies is very small ($\varkappa = 0.001$ in Panel A of Figure 14) an increase in government spending does not crowd out substantially job creation and the wealth and the demand effects lead to increases in employment and vacancies, decreasing unemployment for both types of workers.

The presence of capital adjustment costs ensures that the crowding out of investment is limited so that capital and employment do not fall after the expenditure expansion. The size of capital adjustment costs affects the magnitude of the initial response to the shock as well as its persistence since it affects the accumulation of capital. The sensitivity of total unemployment responses to changes in ω is presented in Panel B of Figure 15. Notice that in the model with no capital ($\omega \rightarrow \infty$) the wealth effect of the increase in government absorption becomes stronger and unemployment increases significantly on impact after the fiscal expansion.

On the other hand, when the labor supply elasticity decreases (for values of $\zeta \geq 10$), the wealth effect of the increase in government absorption does not increase labor force participation significantly. As a result, the unemployed of both types can be employed in firms that face increased demand for their products and unemployment decreases instantaneously after the fiscal expansion (see Panel C of Figure 15).

Finally the relative size of insiders and outsiders in total unemployment matters. The relative size of outsiders and insiders in total unemployment is determined by the parameter μ . Panel D of Figure 15 plots the responses of total unemployment when we vary μ . Unemployment decreases after an expansionary expenditure shock for $0.1 < \mu < 0.95$, or, in other words, if the share of outsiders in total unemployment varies between [9%, 90%]. When the share of outsiders in total unemployment is below 9%, expenditure increases lead to a fall in total unemployment.

Hence, for low values of the relative size of outsiders, the model predicts reductions in total unemployment after a fiscal expansion. Interestingly for the US the share of long-term unemployed to total unemployed is significantly different for the different subsamples

considered. According to the Labor Force Statistics from the Current Population Survey, the average value of the percentage of unemployed with unemployment duration higher than 27 weeks in total unemployment is 14.3% for the sample period 1954:2010, while for the sample period 1954-1979 it is 10% and for the period 1980:2010 it accounts for 17.3% of total unemployment. Moreover, in the beginning of the 1980s this percentage equals 20% and is pretty much higher relative to its average value. This evidence squares well with our theoretical model since it can explain the changes in the behavior of unemployment in response to fiscal shocks over time in the US by changes in the share of outsiders (viewed as long-term unemployed) in this country.

5.5 The response of private consumption

Our model was designed to show that it is possible to generate an increase in total unemployment after an expenditure expansion under reasonable assumptions and the goal of the previous section has been to highlight the elements needed to reproduce the empirical regularities. However, the proposed model fails to account for the consumption dynamics we have presented in Section 3. In particular, in the model private consumption decreases after expenditure increases. Given that we are primarily concerned with reproducing the dynamics of the labor market after an expenditure increase, we have not included in the baseline model mechanisms that would overcome this shortcoming. Here we show that if government and private consumption are complements as in Linnemann and Schaubert (2003), the theoretical consumption responses become more consistent with the data.¹¹

Preferences are now defined by:

$$u(c_t, l_t) = \frac{\left[\left\{ \nu c_t^{\frac{\xi-1}{\xi}} + (1-\nu) G_t^{\frac{\xi-1}{\xi}} \right\}^{\frac{\xi}{\xi-1}} \right]^{1-\eta}}{1-\eta} + \Phi \frac{l_t^{1-\zeta}}{1-\zeta}$$

where the degree of substitutability between private and public consumption is regulated by ξ . The share parameter ν determines how much public consumption affects utility: when $\nu = 1$, public consumption is useless from the agents' point of view and the model is identical to the baseline specification.

¹¹ Complementarity between consumption and leisure (see Hall and Milgrom (2005)) could in principle generate increases in private consumption after a fiscal shock. Shimer (2010) shows how to incorporate income pooling with non separable utility between consumption and leisure. However, when a labor participation margin is allowed the utility specification used by Shimer is not easily applicable.

In Figure 16 we present responses when $\nu=0.7$ and $\xi = 0.4$. When public and private consumption are complements an increase in government expenditures increases private consumption at the expense of a larger crowding out of investment in equilibrium. At the same time, the complementarity between private and public consumption does not cancel out the negative wealth effect due to the increase in government's absorption and labor force participation increases generating an increase in total unemployment in equilibrium.

6 Conclusions

We empirically examined the effect of government expenditure shocks on labor market variables and, in particular, on unemployment for OECD countries and found that a fiscal expansion can lead to a significant increase in the unemployment rate for many countries and many of the time periods considered. We have shown that results are robust to the identification scheme used to extract fiscal shocks from the data, the subsample period, and the inclusion of additional control variables for the majority of countries that we have available data, except for the US where the response of unemployment to government spending shocks is sensitive to the time period analyzed.

Our empirical results suggest, against the common wisdom, that government expansions can lead to increases in unemployment. Following a recent trend we consider a New Keynesian model with search frictions, endogenous participation and workers' heterogeneity to explain the empirical findings. In contrast to the existing literature, our model can generate depending on the exact parametrization, positive or negative responses of unemployment in response to positive government spending shocks and can possibly explain the reason behind the differences in the unemployment responses to government spending shocks in the US subsamples. The introduction of workers' heterogeneity is crucial for deriving our results. When the economy is populated by insiders and outsiders facing different matching prospects in the labor market, total unemployment may increase after a fiscal expansion. This is because the negative wealth effect induced by the increase in government absorption increases labor force participation. However, outsiders unemployment increases more than the fall in insiders unemployment and total unemployment increases in equilibrium.

While our empirical analysis is potentially subject to the standard critiques raised to VAR exercises (see, e.g., Chari et al. (2007) and Ramey (2009)) it is unlikely that empirical

analysis conducted with different tools will lead to results that are different from those we have since the dynamics of unemployment we present are robust to different identification schemes, possible controls for anticipated effects and specifications of the VAR. Thus, any model with features different from those we consider must be compared with the particular stylized facts we present.

7 References

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8 Appendix (Not for publication)

8.1 First order conditions

Households

The first order conditions for the household are given below:

$$c_t^{-\eta} = \lambda_{ct}$$

$$\lambda_{ct} \left(1 + \omega \left[\frac{k_{t+1}}{k_t} - 1 \right] \right) = \beta E_t \lambda_{ct+1} \left(1 - \delta + r_{t+1} + \frac{\omega}{2} \left(\frac{k_{t+2}}{k_{t+1}} - 1 \right)^2 \right)$$

$$\phi l_t^{-\zeta} = \psi_t^{Oh} \lambda_{nt} + b \lambda_{ct}$$

$$\lambda_{ut} = \beta E_t [\lambda_{nt+1} \psi_{t+1}^{Ih} + \lambda_{ct+1} b + \lambda_{ut+1} ((1 - \mu) - \psi_{t+1}^{Ih}) - \phi l_{t+1}^{-\zeta}]$$

$$\lambda_{nt} = \beta E_t [\lambda_{ct+1} w_{t+1} + (1 - \sigma) \lambda_{nt+1} + \sigma \lambda_{ut+1} - \phi l_{t+1}^{-\zeta}]$$

$$\lambda_{ct} \pi_{t+1} = \beta E_t \lambda_{ct+1} R_t$$

where $\psi_t^{Ih} = \frac{m_t^I}{u_t^I}$ and $\psi_t^{Oh} = \frac{m_t^O}{u_t^O}$.

Intermediate firms

The first order conditions for the firm are given by:

$$x_t F_{kt} = r_t$$

$$\frac{\varkappa}{\gamma_t^f} = \beta E_t \left(\frac{c_t}{c_{t+1}} \right)^\eta \left[x_{t+1} F_{nt+1} - w_{t+1} + (1 - \sigma) \frac{\varkappa}{\gamma_{t+1}^f} \right]$$

Retailers

The optimal price for a retailer that can reset her price in the current period solves:

$$p_{it}^* = \frac{\varepsilon}{\varepsilon - 1} \frac{E_t \sum_{t=0}^{\infty} \chi^s \Lambda_{t+s} x_{t+s} y_{it+s}}{E_t \sum_{t=0}^{\infty} \chi^s \Lambda_{t+s} y_{it+s}} \quad (24)$$

8.2 Steady state

The steady state is one with no employment, or unemployment growth and zero inflation.

$$\sigma n = \psi^{Ih} u_I + \psi^{Oh} u_O \quad (25)$$

$$\mu u_I = \psi^{Oh} u_O \quad (26)$$

$$1/\beta = 1 - \delta + r \quad (27)$$

$$1/\beta = R \quad (28)$$

$$\phi l^{-\zeta} = \psi^{Oh} \lambda_n + b c^{-\eta} \quad (29)$$

$$\lambda_u = \beta [\lambda_n \psi^{Ih} + \lambda_u ((1 - \mu) - \psi^{Ih}) - \phi l^{-\zeta} + b c^{-\eta}] \quad (30)$$

$$\lambda_n = \beta [c^{-\eta} w + (1 - \sigma) \lambda_n + \sigma \lambda_u - \phi l^{-\zeta}] \quad (31)$$

$$r = \varphi x \frac{y}{k} \quad (32)$$

$$\frac{i}{k} = \delta \quad (33)$$

$$y = Z k^\varphi (n)^{1-\varphi}, Z = 1 \quad (34)$$

$$1 = l + u_I + u_O + n \quad (35)$$

$$y = c + i + g + \varkappa v \quad (36)$$

$$\theta_O = v/u_O, \quad \theta_I = v/u_I \quad (37)$$

$$\psi^{Ih} = \rho_m^I \theta_I^\alpha, \quad \psi^{Oh} = \rho_m^O \theta_O^\alpha$$

$$\gamma^f = \theta^{\alpha-1} \left[\varrho_m^I \left(\frac{u^I}{u} \right)^{1-\alpha} + \varrho_m^O \left(\frac{u^O}{u} \right)^{1-\alpha} \right] \quad (38)$$

$$\gamma^f = \psi^{If} + \psi^{Of} \text{ with} \quad (39)$$

$$\psi^{If} = \psi^{Ih}/\theta_I \quad \psi^{Of} = \psi^{Oh}/\theta_O \quad (40)$$

$$\frac{\varkappa}{\gamma^f} (1 - \beta(1 - \sigma)) = \beta \left[\frac{y}{n} x (1 - \varphi) - w \right] \quad (41)$$

$$w = (1 - \vartheta) \left[(1 - \varphi)x \frac{y}{n} + \frac{\varkappa(\psi^{Oh} + \psi^{Ih})}{\gamma^f} \right] + \vartheta b \quad (42)$$

$$x = \frac{\varepsilon - 1}{\varepsilon} \quad (43)$$

Substituting (25) and (26) and the fact that $\frac{\theta_I}{\theta_O} = \frac{u_O}{u_I}$ in the remaining equations we get:

$$n = u_O \frac{\rho_m^O \theta_O^\alpha}{\mu \sigma} [\rho_m^I \left(\frac{\mu}{\rho_m^O} \right)^\alpha \theta_O^{\alpha(1-\alpha)} + \mu] = B(\theta_O) u_O \quad (44)$$

$$\lambda_n = \frac{c^{-\eta}(w - b)}{\frac{1}{\beta} - (1 - \sigma) + \rho_m^O \theta_O^\alpha - \frac{\beta \sigma (\rho_m^I \theta_I^\alpha - \rho_m^O \theta_O^\alpha)}{1 - (1 - \mu)\beta + \beta \rho_m^I \theta_I^\alpha}} = \frac{c^{-\eta}(w - b)}{T(\theta_O)} \quad (45)$$

$$\theta_I = \left(\frac{\mu}{\rho_m^O} \right) \theta_O^{(1-\alpha)} \quad \text{that is } \theta_I(\theta_O) \quad (46)$$

$$\lambda_u = \lambda_n \frac{\beta(\rho_m^I \theta_I^\alpha - \rho_m^O \theta_O^\alpha)}{1 - \beta(1 - \mu) - \beta \rho_m^I \theta_I^\alpha} \quad \text{that is } \lambda_u(\theta_O) \quad (47)$$

$$\frac{y}{n} = \left[\frac{y}{k} \right]^{\frac{\varphi}{1-\varphi}} = \left[\frac{r}{\varphi} \frac{\varepsilon}{\varepsilon - 1} \right]^{\frac{\varphi}{1-\varphi}} \quad (48)$$

from (35) we have

$$l = 1 - \left[1 + B(\theta_O) + \frac{\psi^{Oh}}{\mu} \right] u_O \quad (49)$$

We can write the resource constraint as:

$$\frac{c}{y} = 1 - \frac{\delta}{\frac{y}{k}} + \frac{g}{y} - \frac{\varkappa}{y} \theta_O u_O \quad (50)$$

and $c = \frac{c}{y} y$, while $y = \frac{y}{n} n$.

from (45) we have:

$$w = c^\eta \lambda_n T(\theta_O) + b \quad (51)$$

Using (41) together with (42) we can write:

$$u_O = \frac{\beta \vartheta [1 - \varphi] x \frac{y}{n} - b}{1 - \beta(1 - \sigma) - (1 - \alpha)\beta(\psi^{Oh} + \psi^{Ih})} \frac{\gamma^f}{\frac{y}{n} T(\theta_O) \frac{\varkappa}{y}}$$

then using the equation for wages:

$$w = (1 - \vartheta) \left[(1 - \varphi)x \frac{y}{n} + \frac{\varkappa(\psi^{Oh} + \psi^{Ih})}{\gamma^f} \right] + \vartheta b$$

and equation (51) we have one equation in one unknown θ_O and its solution solves for the steady state of the model.

8.3 Loglinear conditions

State variables are 3: capital, employment and insider unemployment.

$$\widehat{n}_{t+1} = (1 - \sigma)\widehat{n}_t + \frac{m_I}{n}\widehat{m}_{It} + \frac{m_O}{n}\widehat{m}_{Ot} \quad (\text{A1})$$

$$\widehat{m}_{It} = \alpha\widehat{v}_t + (1 - \alpha)\widehat{u}_t^I \quad (\text{A2})$$

$$\widehat{m}_{Ot} = \alpha\widehat{v}_t + (1 - \alpha)\widehat{u}_t^O \quad (\text{A3})$$

$$\widehat{\psi}_t^{Ih} = \widehat{m}_{It} - \widehat{u}_t^I \quad (\text{A4})$$

$$\widehat{\psi}_t^{Oh} = \widehat{m}_{Ot} - \widehat{u}_t^O \quad (\text{A5})$$

$$\widehat{k}_{t+1} = (1 - \delta)\widehat{k}_t + \delta\widehat{i}_t \quad (\text{A6})$$

$$\widehat{u}_{t+1}^I = (1 - \mu)\widehat{u}_t^I + \sigma\frac{n}{u^I}\widehat{n}_t - \frac{m_I}{u^I}\widehat{m}_{It} \quad (\text{A7})$$

$$\widehat{l}_t + n\widehat{n}_t + u^I\widehat{u}_t^I + u^O\widehat{u}_t^O = 0 \quad (\text{A8})$$

$$\frac{\eta}{\beta}\widehat{c}_t + \frac{\omega}{\beta}k_t = E_t\left\{\frac{\eta}{\beta}\widehat{c}_{t+1} - r\widehat{r}_{t+1} - \omega k_{t+2} + \frac{\beta\omega}{1 + \beta}k_{t+1}\right\} \quad (\text{A9})$$

$$\frac{\psi^{Oh}\lambda_n}{\psi^{Oh}\lambda_n + bc^{-\eta}}(\widehat{\psi}_t^{Oh} + \widehat{\lambda}_{nt}) - \frac{\eta bc^{-\eta}}{\psi^{Oh}\lambda_n + bc^{-\eta}}\widehat{c}_t = -\zeta\widehat{l}_t \quad (\text{A10})$$

$$\lambda_u\widehat{\lambda}_{ut} = \beta E_t\{\psi^{Ih}\lambda_n\widehat{\lambda}_{nt+1} + \psi^{Ih}[\lambda_n - \lambda_u]\widehat{\psi}_{t+1}^{Ih} + \lambda_u[(1 - \mu) - \psi^{Ih}]\lambda_{ut+1} + \phi\zeta l^{-\zeta}\widehat{l}_{t+1} - b\eta c^{-\eta}\widehat{c}_{t+1}\} \quad (\text{A11})$$

$$\lambda_n \widehat{\lambda}_{nt} = \beta E_t \{ w c^{-\eta} \widehat{w}_{t+1} - \eta w c^{-\eta} \widehat{c}_{t+1} + (1 - \sigma) \lambda_n \widehat{\lambda}_{nt+1} + \sigma \lambda_u \widehat{\lambda}_{ut+1} + \phi \zeta l^{-\zeta} \widehat{l}_{t+1} \} \quad (\text{A12})$$

$$\widehat{c}_t = E_t \widehat{c}_{t+1} - \frac{1}{\eta} (\widehat{R}_t - E_t \pi_{t+1}) \quad (\text{A13})$$

$$\widehat{y}_t = \varphi \widehat{k}_t + (1 - \varphi) [\widehat{z}_t + \widehat{n}_t] \quad (\text{A14})$$

$$\widehat{\psi}_t^{If} = \widehat{m}_{It} - \widehat{v}_t \quad (\text{A15})$$

$$\widehat{\psi}_t^{Of} = \widehat{m}_{Ot} - \widehat{v}_t \quad (\text{A16})$$

$$\begin{aligned} \frac{1}{\psi^{If} + \psi^{Of}} \left[\psi^{If} \widehat{\psi}_t^{If} + \psi^{Of} \widehat{\psi}_t^{Of} \right] + \eta \widehat{c}_t &= \eta E_t \widehat{c}_{t+1} + \frac{\psi^{If} + \psi^{Of}}{\varkappa} \beta (1 - \varphi) x \frac{y}{n} E_t [\widehat{n}_{t+1} - \widehat{x}_{t+1} - \widehat{y}_{t+1}] + \\ &\beta \frac{w(\psi^{If} + \psi^{Of})}{\varkappa} E_t \widehat{w}_{t+1} + \frac{1 - \sigma}{\psi^{If} + \psi^{Of}} E_t \left[\psi^{If} \widehat{\psi}_{t+1}^{If} + \psi^{Of} \widehat{\psi}_{t+1}^{Of} \right] \end{aligned}$$

$$w \widehat{w}_t = (1 - \vartheta)(1 - \varphi) x \frac{y}{n} [\widehat{x}_t + \widehat{y}_t - \widehat{n}_t] + (1 - \vartheta) \frac{\varkappa}{\psi^{If} + \psi^{Of}} \left[\psi^{Ih} \widehat{\psi}_t^{Ih} + \psi^{Oh} \widehat{\psi}_t^{Oh} \right] \quad (\text{52})$$

$$-(1 - \vartheta) \frac{\varkappa(\psi^{Ih} + \psi^{Oh})}{\psi^{If} + \psi^{Of}} \left[\psi^{If} \widehat{\psi}_t^{If} + \psi^{Of} \widehat{\psi}_t^{Of} \right] \quad (\text{53})$$

$$\pi_t = \beta E_t \pi_{t+1} + \frac{(1 - \beta \chi)(1 - \chi)}{\chi} \widehat{x}_t \quad (\text{A19})$$

$$\widehat{R}_t = \xi_\pi \pi_t + \varepsilon_t^R \quad (\text{A20})$$

$$\widehat{r}_t = \widehat{x}_t + \widehat{y}_t - \widehat{k}_t \quad (\text{A21})$$

$$\widehat{y}_t = \frac{c}{y} \widehat{c}_t + \frac{i}{y} \widehat{i}_t + \frac{G}{y} \widehat{g}_t + \frac{\varkappa}{y} v \widehat{v}_t \quad (\text{A22})$$

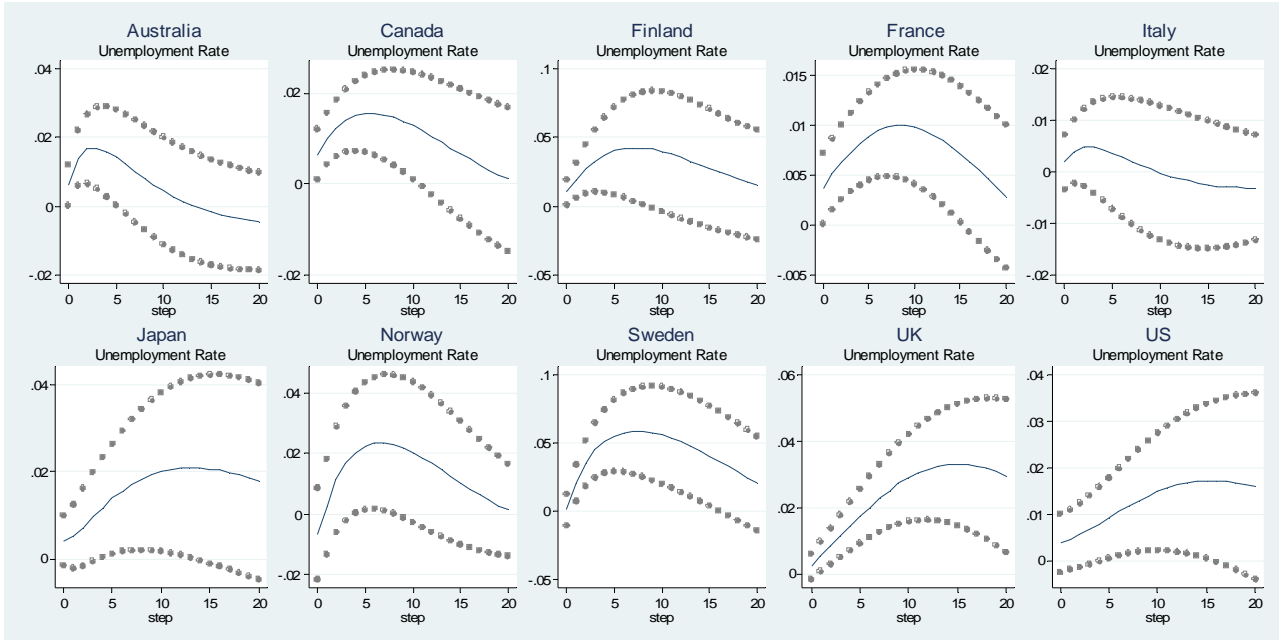
The model contains 22 equations in 22 unknowns ($n_t, m_{It}, m_{Ot}, v_t, u_{It}, u_{Ot}, \psi_t^{Ih}, \psi_t^{If}, \psi_t^{Oh}, \psi_t^{Of}, k_t, i_t, w_t, l_t, c_t, r_t, \lambda_{nt}, \lambda_{ut}, \pi_t, R_t, y_t, x_t$) and we solve it using the generalized Schur form.

Table 1: Parameter values

β	discount factor	0.99
$1/\eta$	intertemporal elasticity of substitution	2
$1/\zeta$	elasticity of labor supply	0.25
Φ	utility of leisure parameter	2.35
$\alpha=\theta$	relative bargaining power	0.6
ρ_m^I	elasticity of new matches with respect to number of insiders	0.9
ρ_m^O	elasticity of new matches with respect to number of outsiders	0.7
σ	separation rate	0.09
μ	probability of becoming outsider	0.1
κ/y	cost of vacancies as a % to GDP	0.01
δ	depreciation rate	0.025
ω	capital adjustment costs	5.5
φ	capital share	0.36
ψ	probability of not changing price	0.75
$\varepsilon/(\varepsilon-1)$	gross steady state markup	1.2
ρ_g	persistence of government spending shock	0.75

Figure 1. The Effect of Government Expenditure Shocks on the Unemployment Rate

Panel A: Baseline VAR Ordering with Government Expenditures First



Panel B: Robustness VAR Ordering with Government Expenditures Last

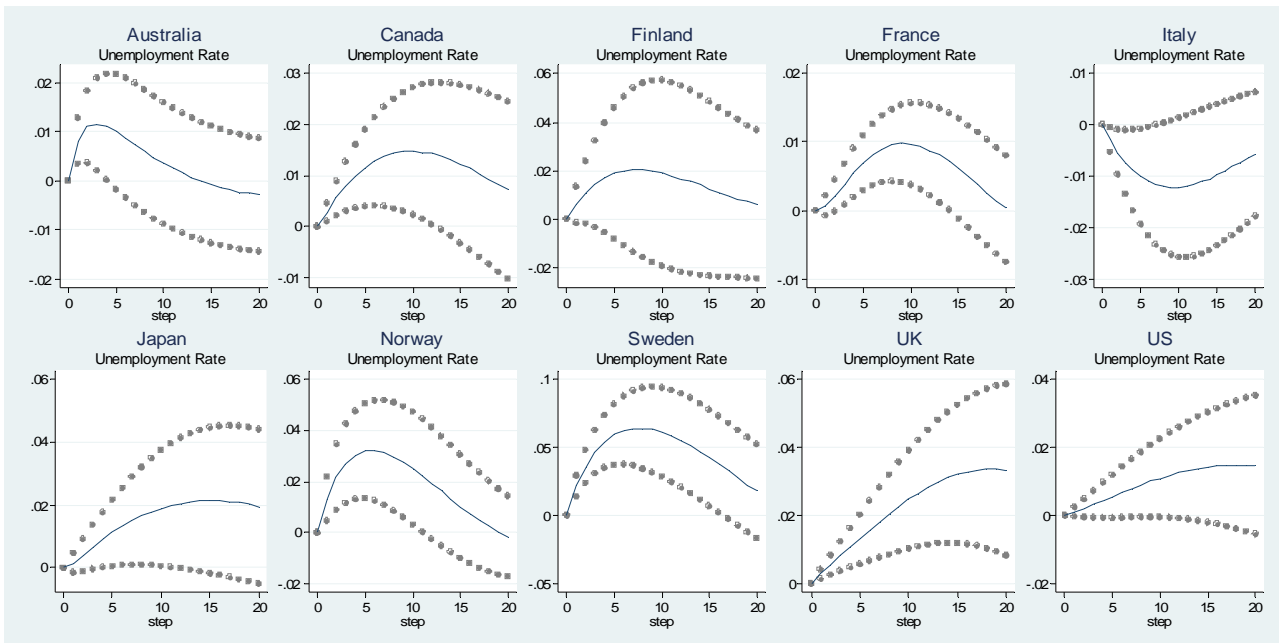
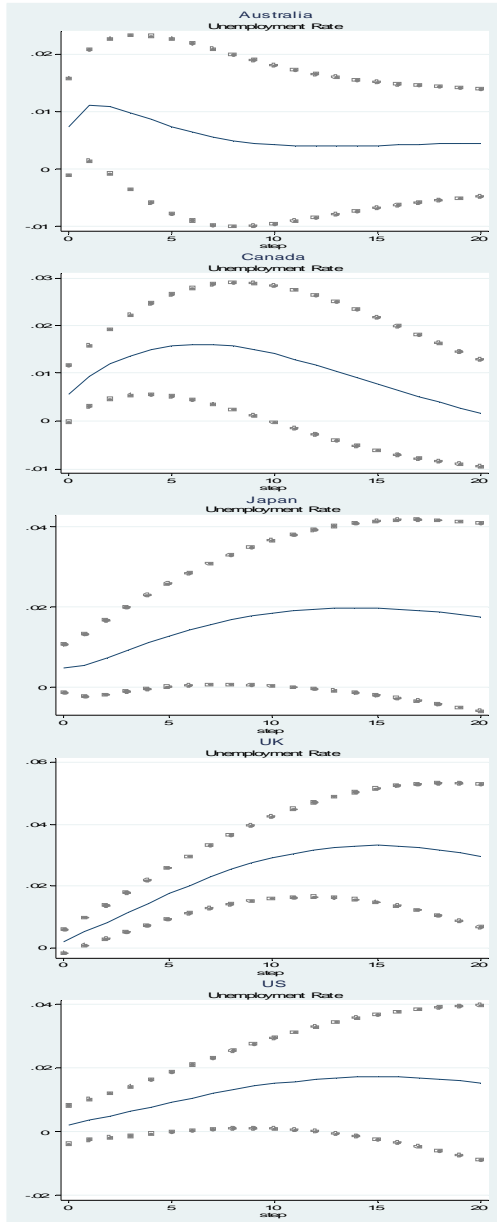


Figure 2. The Effect of Government Expenditure Shocks on the Unemployment Rate (Controlling for Tax Revenues)

Panel A: Baseline VAR Ordering With Government Expenditures Last



Panel B: Robustness VAR Ordering With Government Expenditures Last

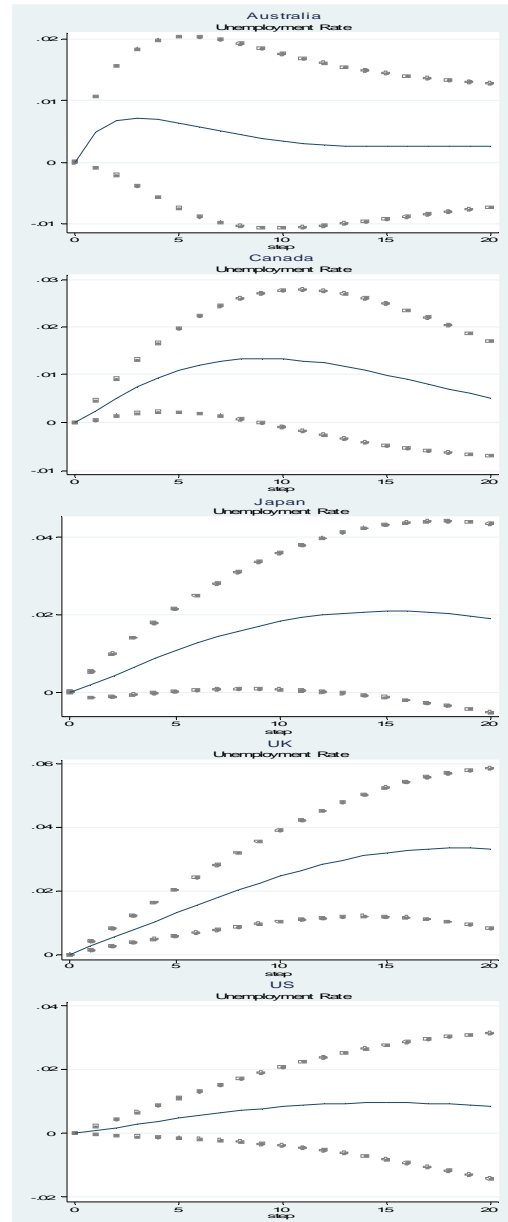


Figure 3. The Effect of Government Expenditure Shocks on the Unemployment Rate (Ramey-Shapiro War Dummy Approach)

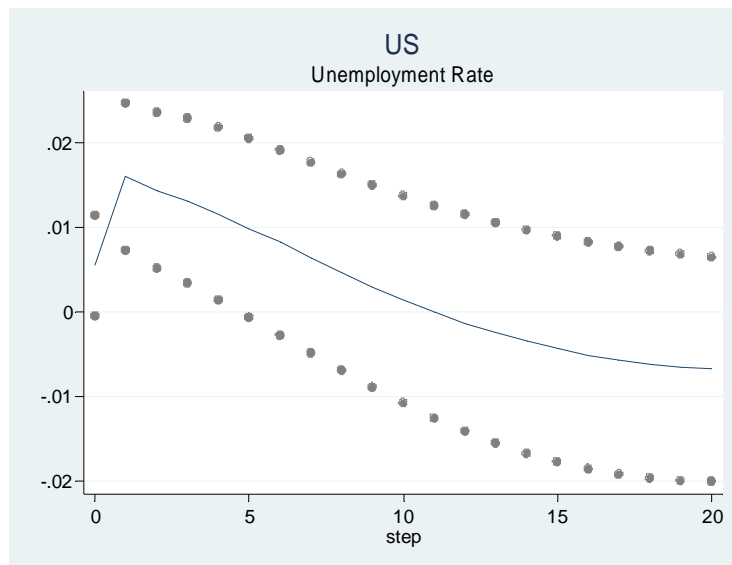


Figure 4. The Effect of Government Expenditure Shocks on the Unemployment Rate
(Different Sub-Samples Including the Pre-1980 Period)

Australia

Canada

US

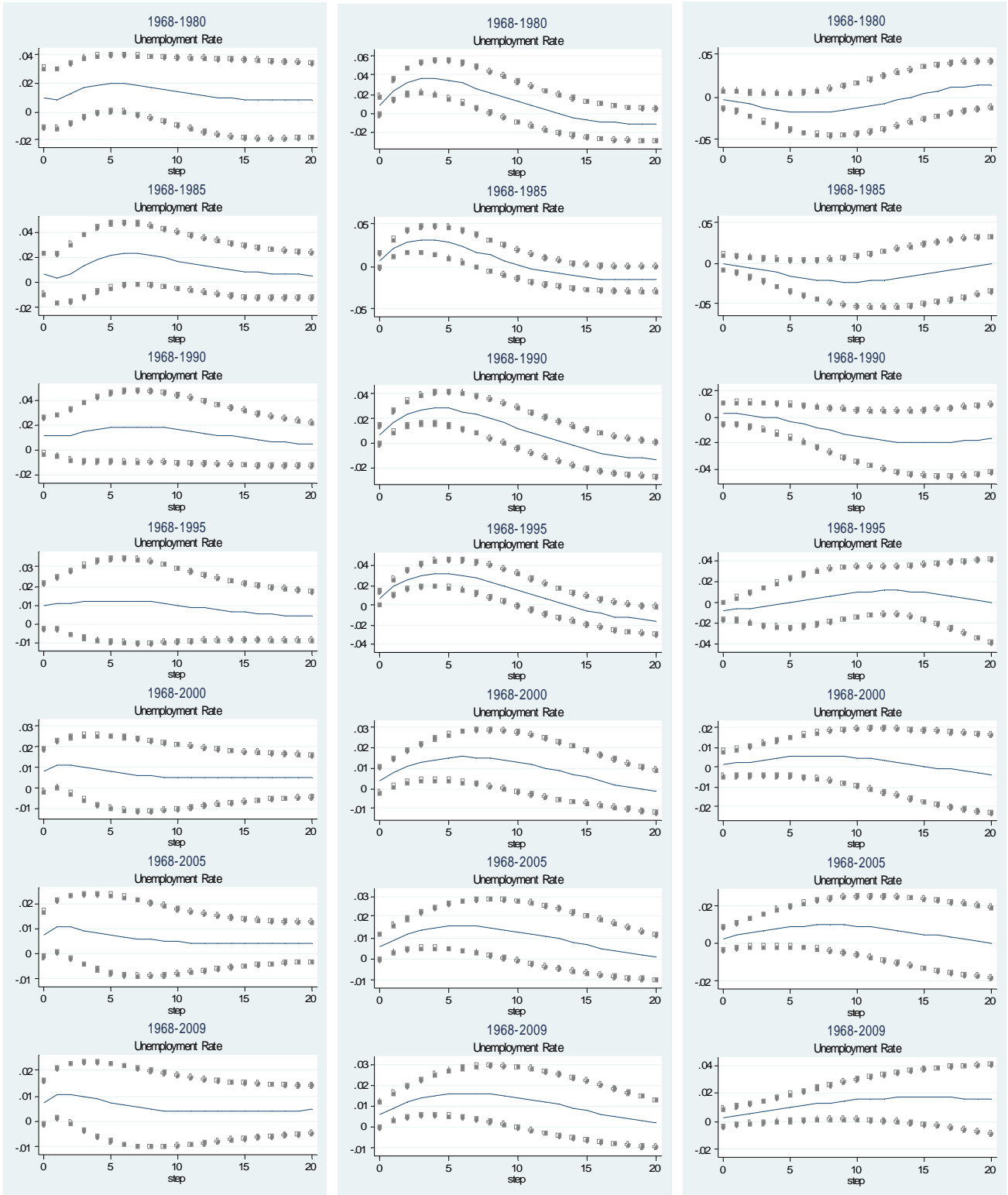
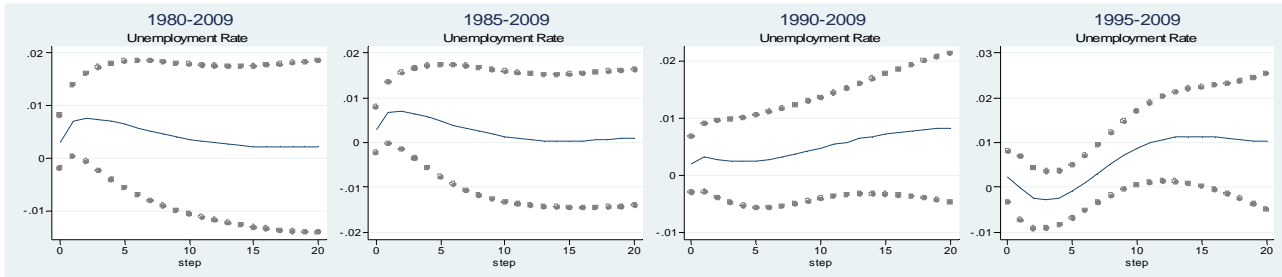
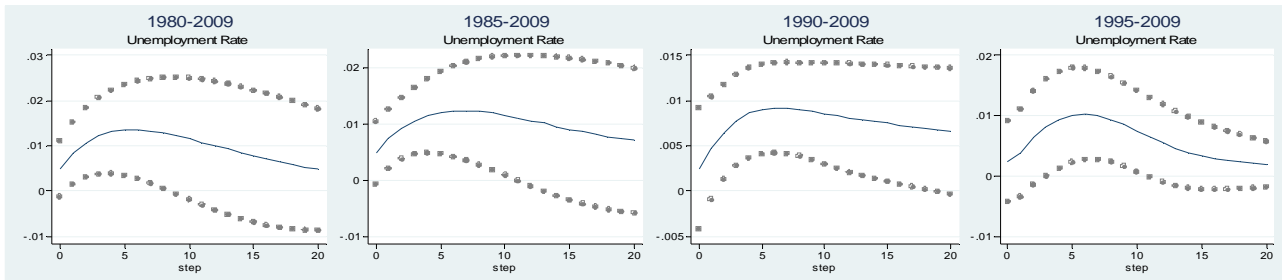


Figure 5. The Effect of Government Expenditure Shocks on the Unemployment Rate
(Different Sub-Samples Excluding the Pre-1980 Period)

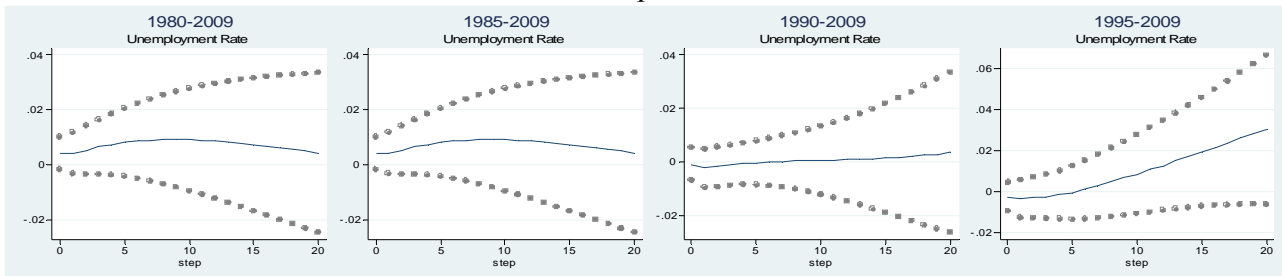
Australia



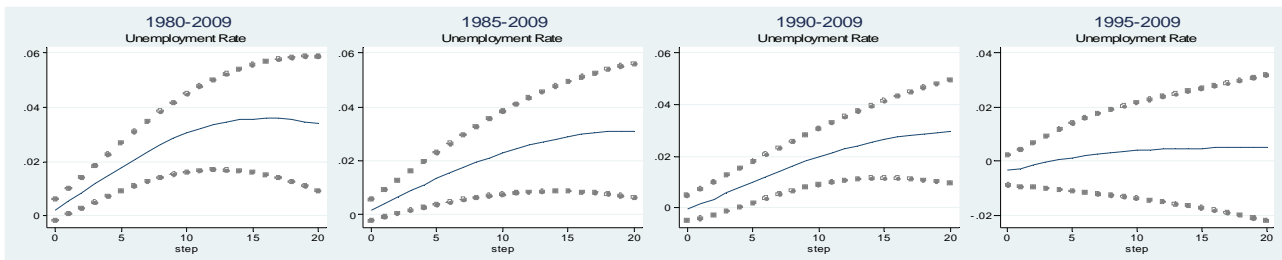
Canada



Japan



UK



US

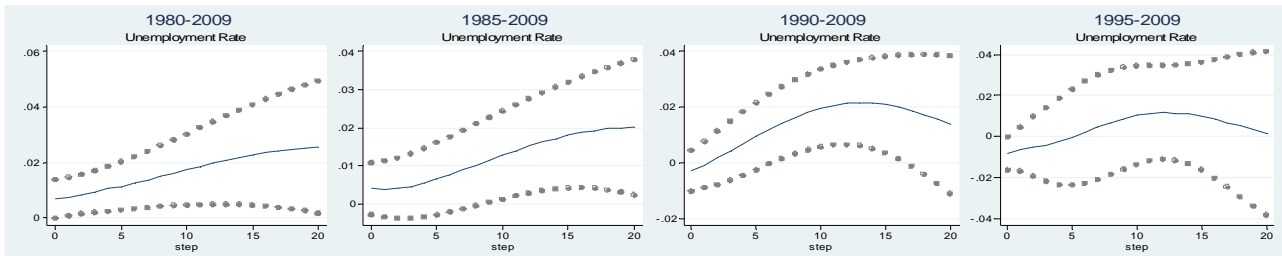


Figure 6. The Effect of Government Expenditure Shocks on Output, Consumption, and Investment

Panel A: Output

Panel B: Consumption

Panel C: Investment

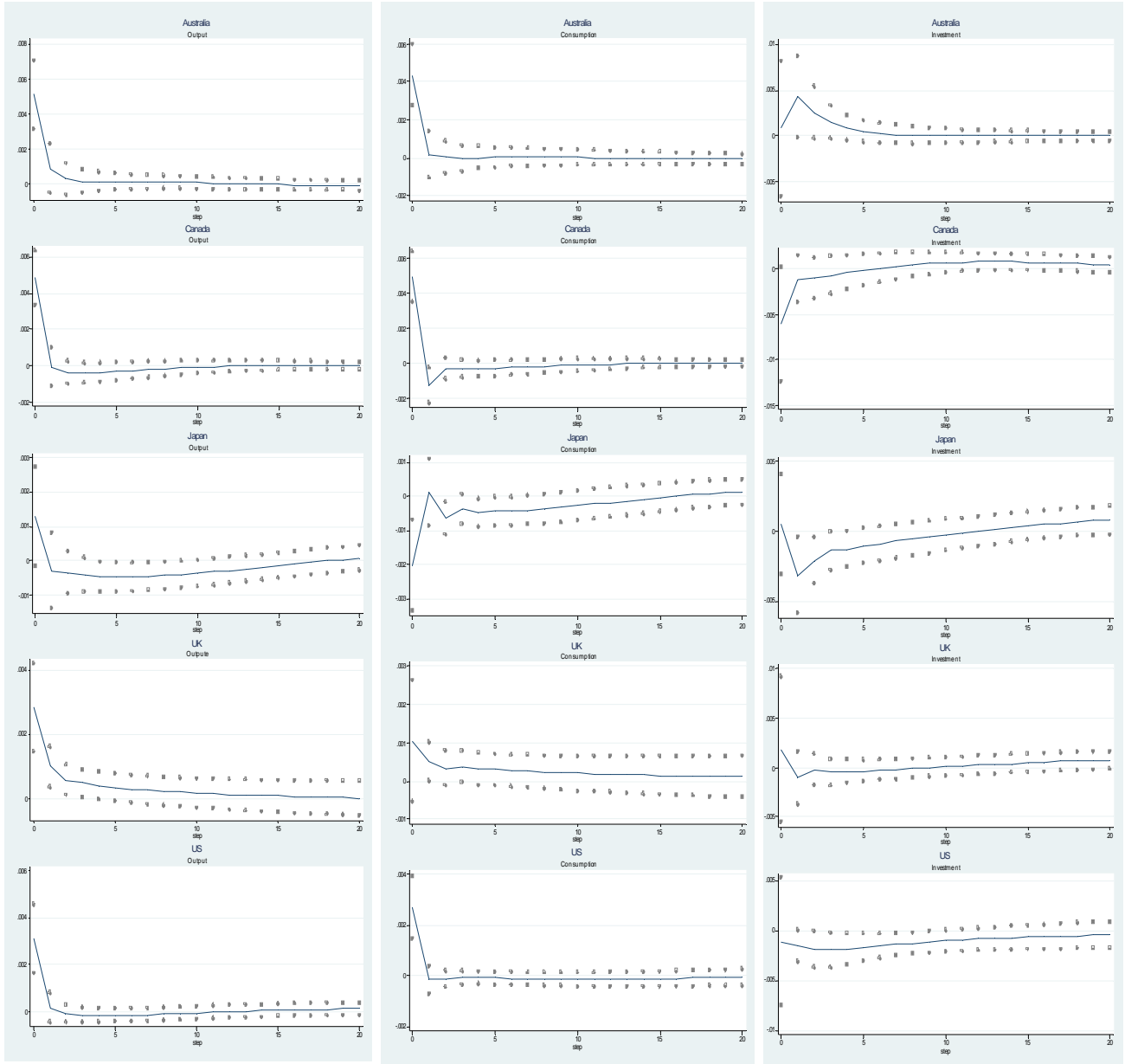


Figure 7. The Effect of Government Expenditure Shocks on Real Wages, Employment, and Labor Force Participation

Panel A: Real wage

Panel B: Employment

Panel C: Labor Force Participation

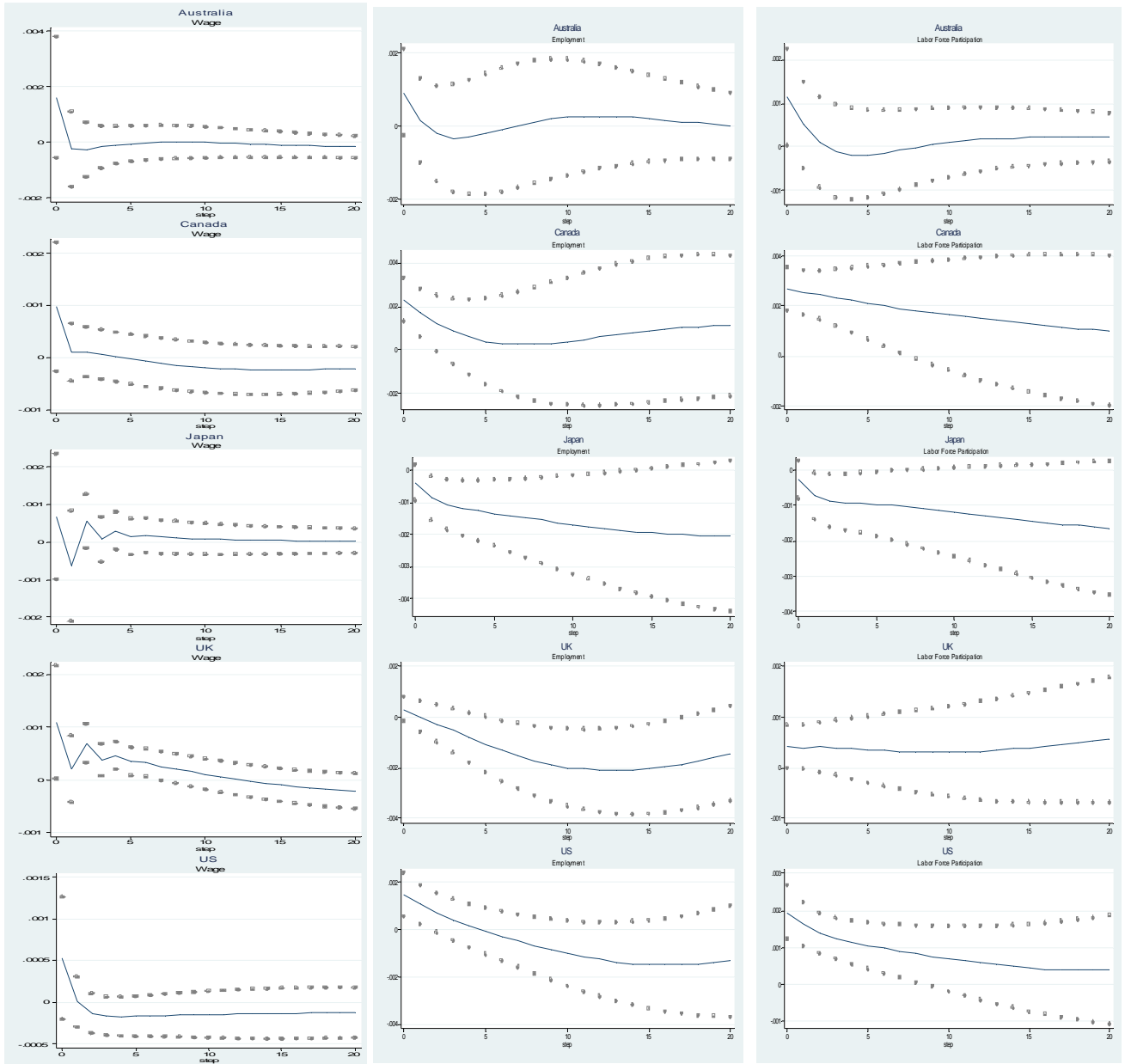


Figure 8. The Effect of Government Expenditure Shocks on the Unemployment Rate
(The Sign Restriction Approach)

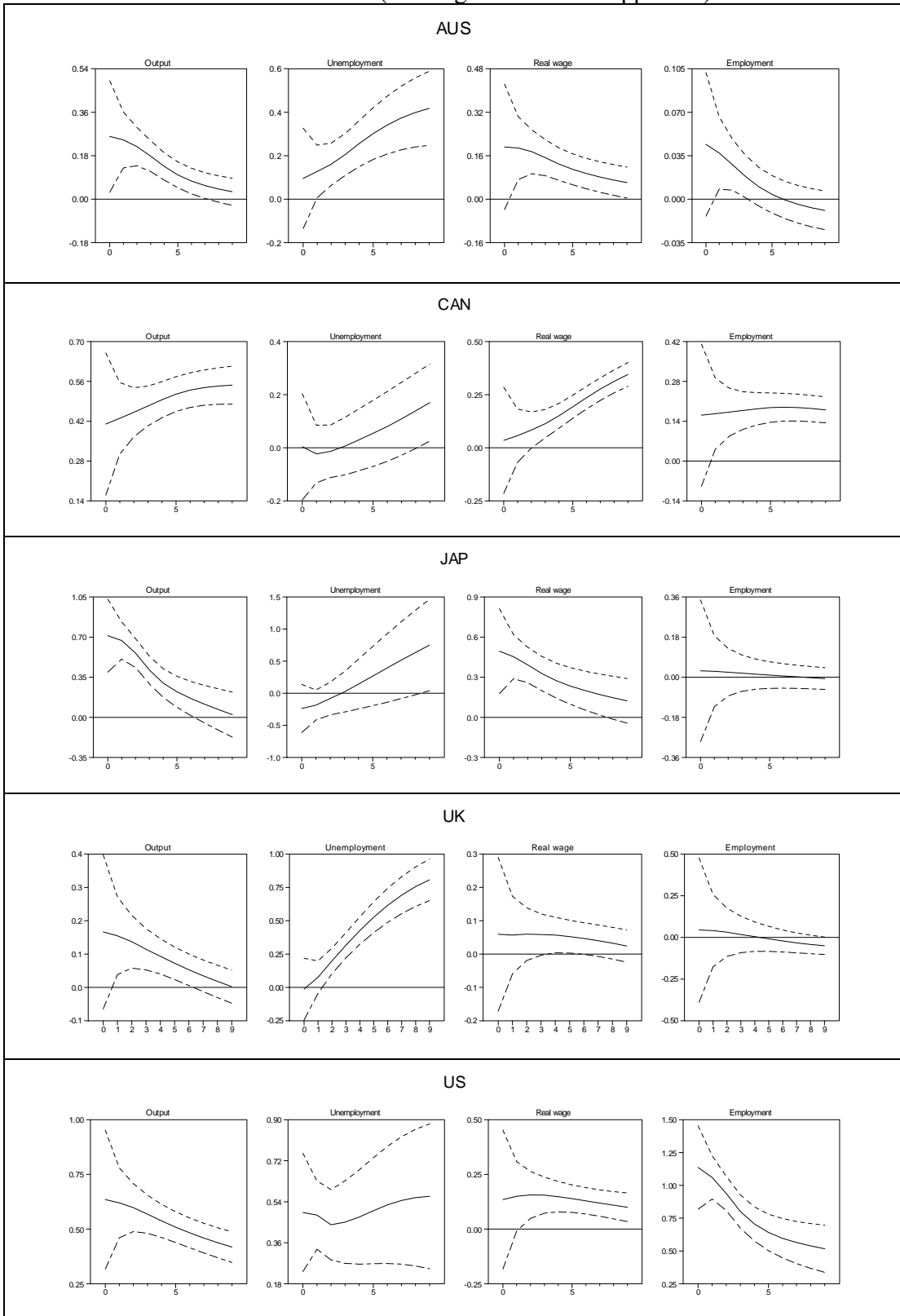


Figure 9. The Effect of Government Consumption Shocks on the Unemployment Rate (Excluding Public Wages and Salaries)

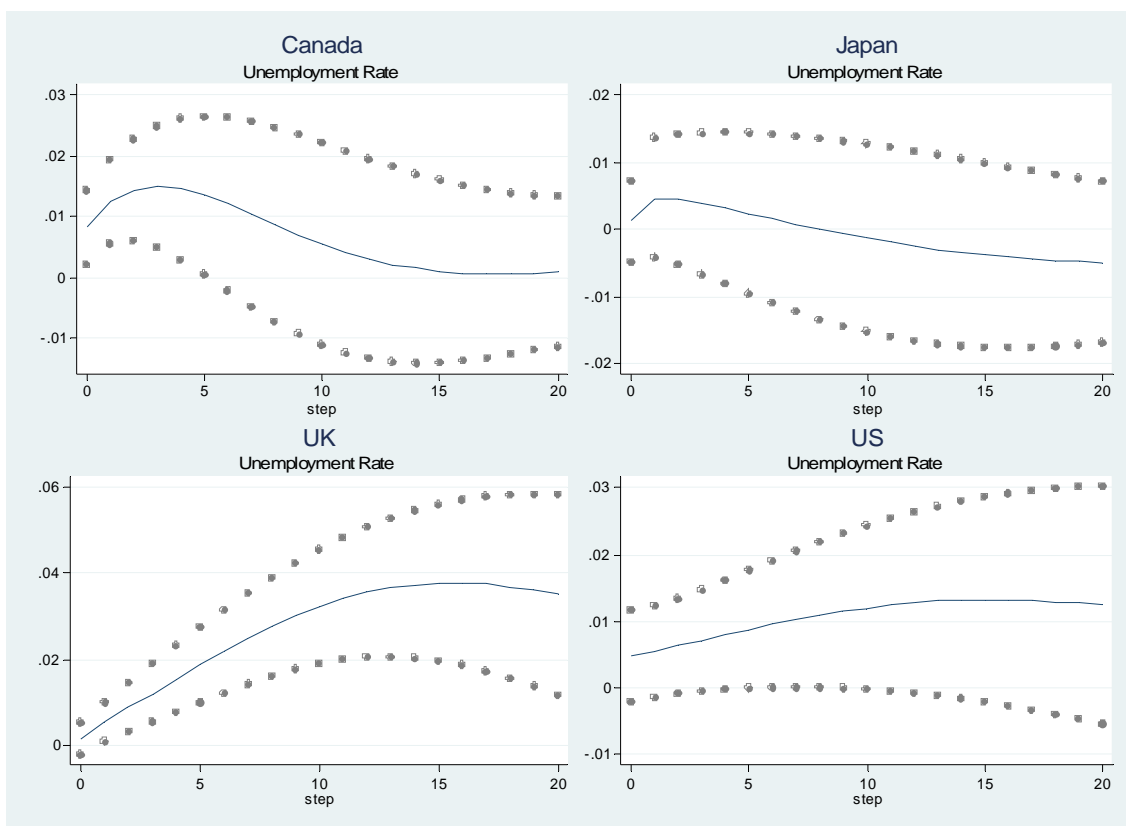


Figure 10. The Effect of Government Expenditure Shocks on the Unemployment Rate

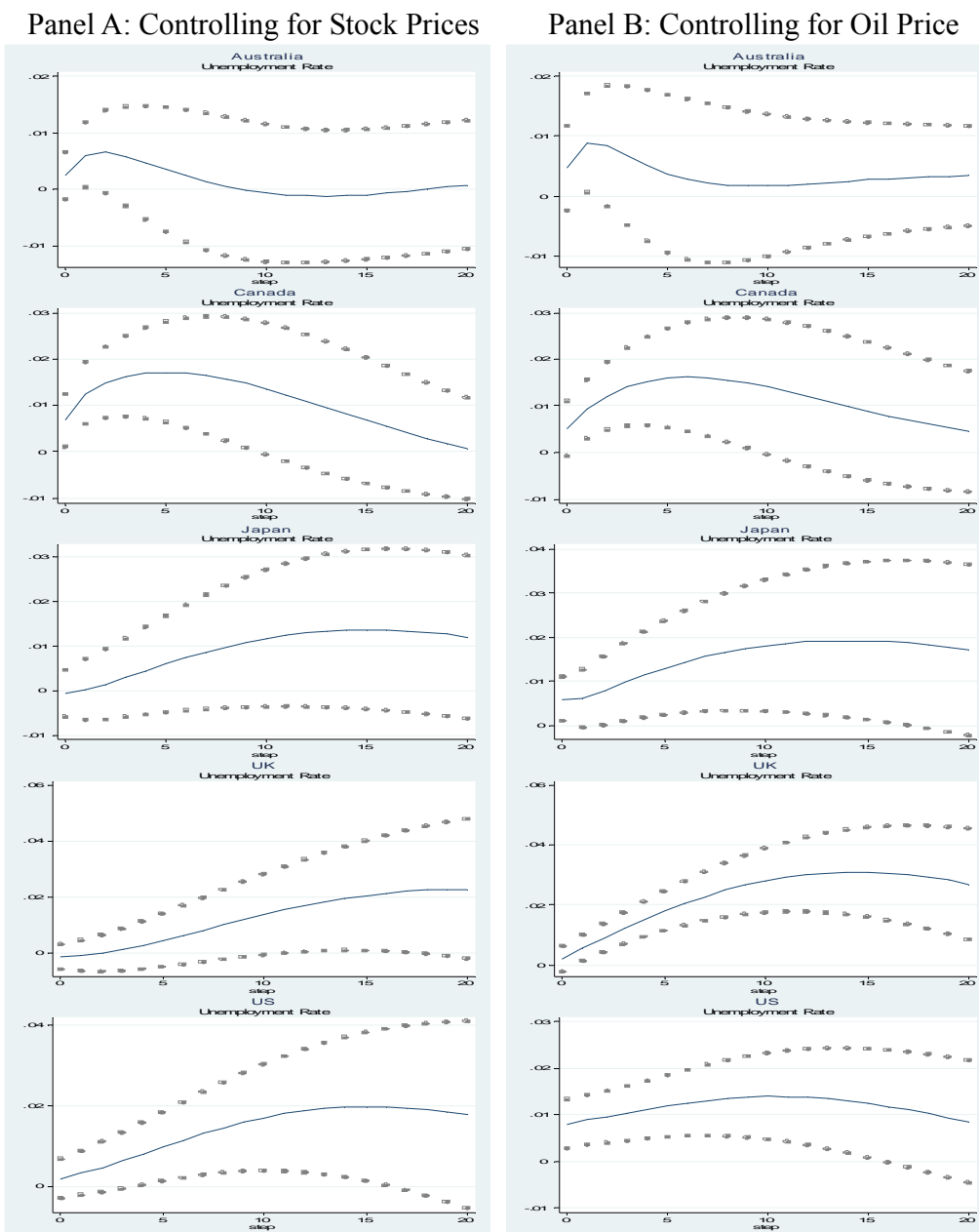


Figure 11. Theoretical Impulse Responses: Benchmark Economy

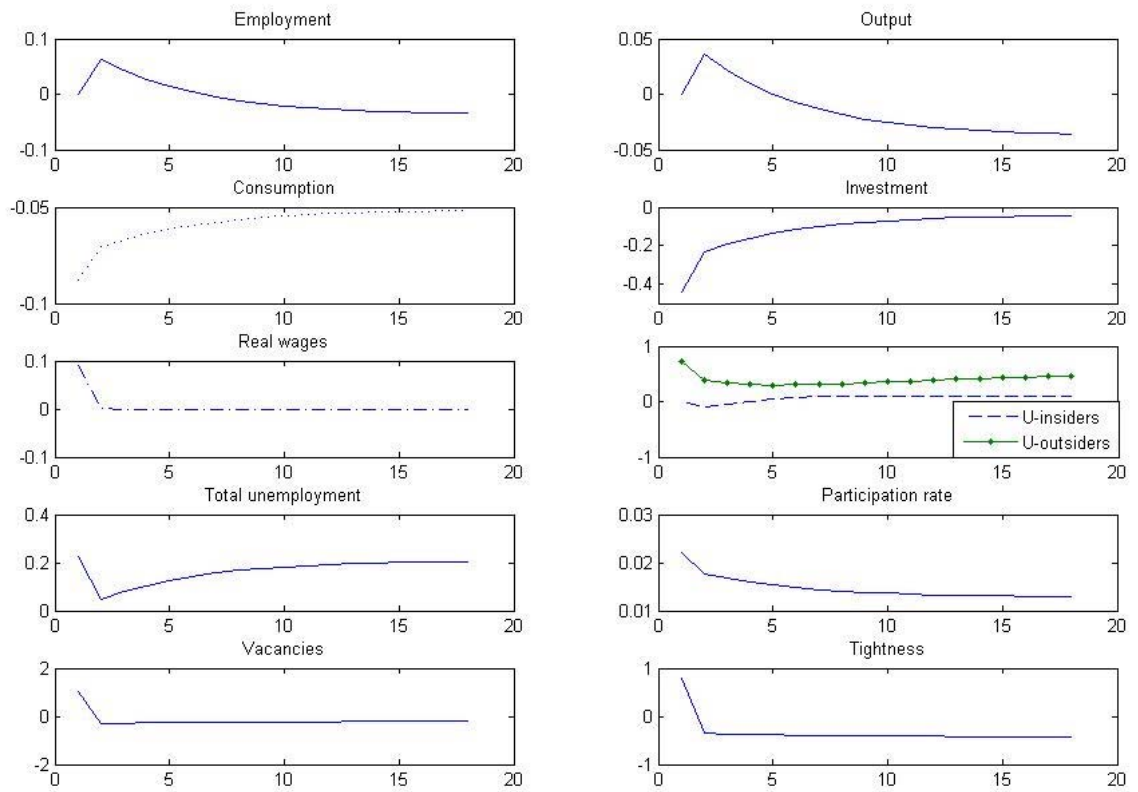


Figure 12. Theoretical Impulse Responses: Flexible vs. Sticky Prices

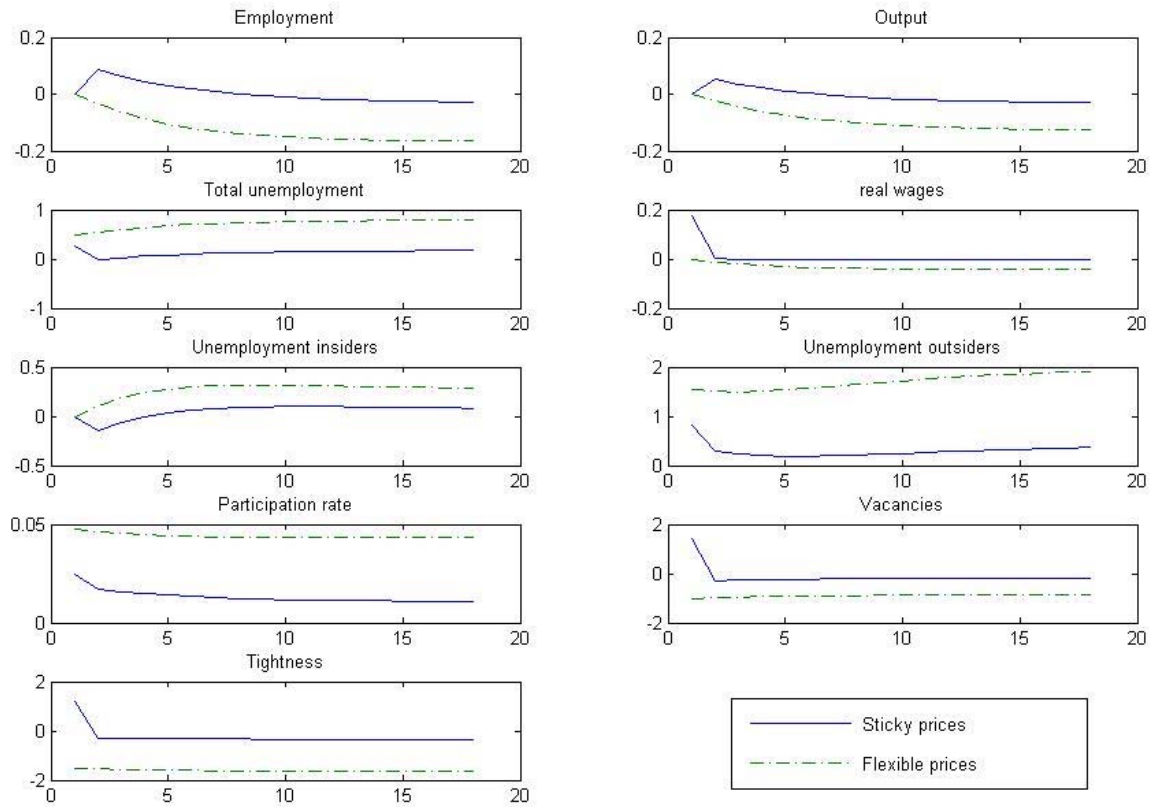


Figure 13. Theoretical Impulse Responses: Participation Margin

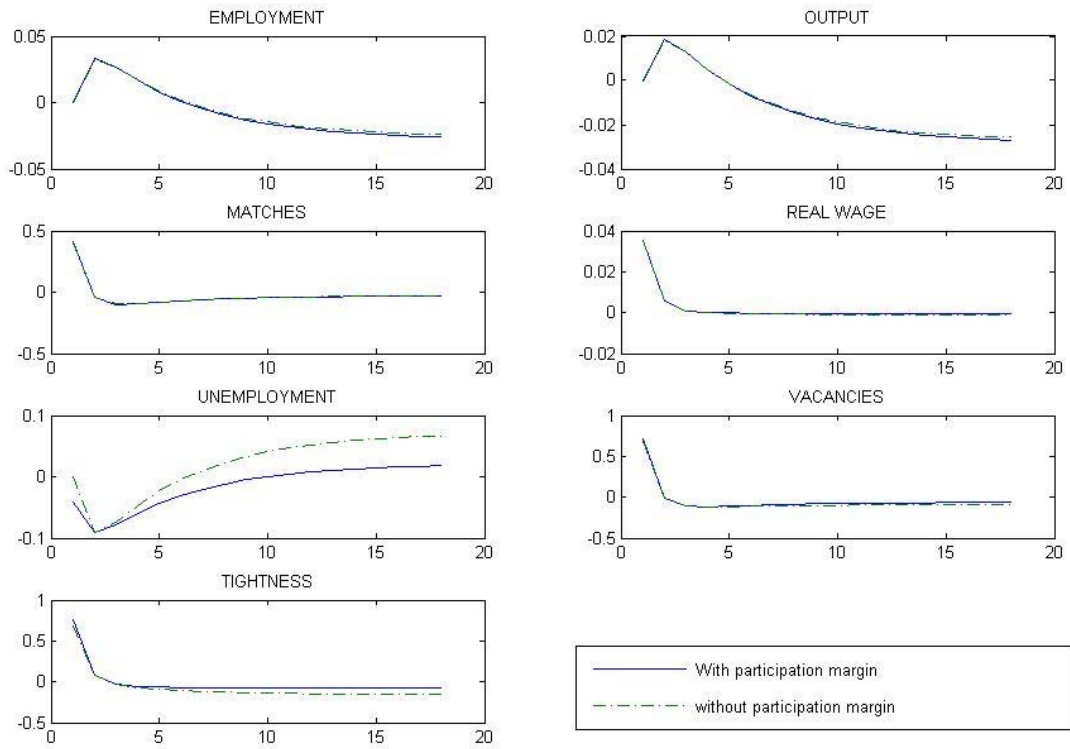


Figure 14. Participation margin and the labor supply elasticity

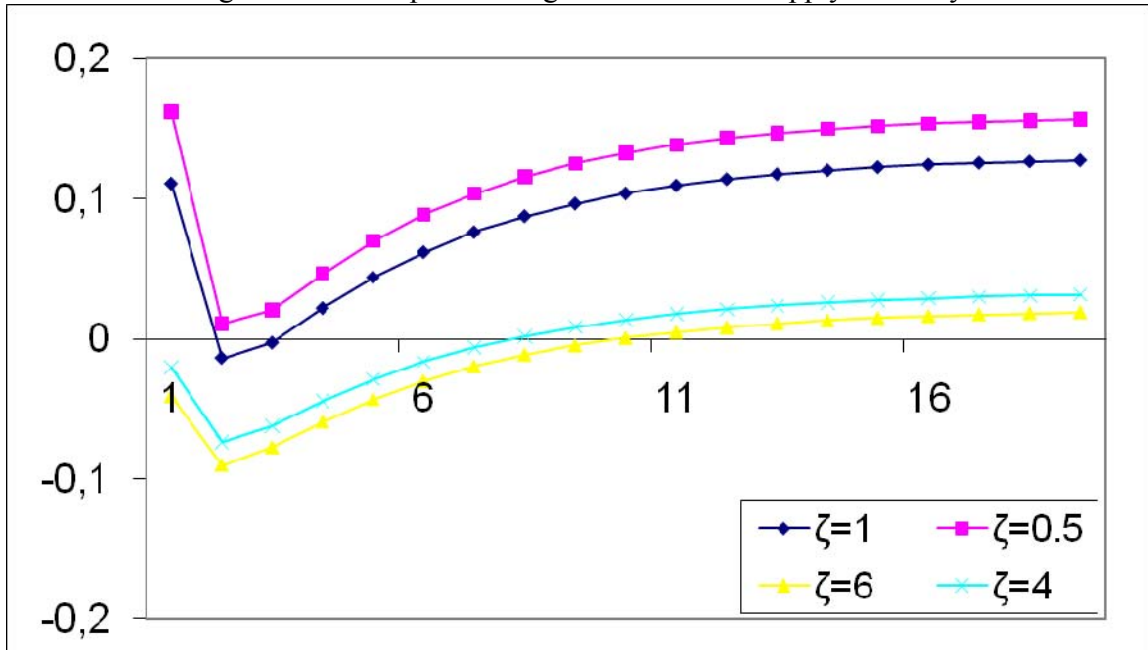


Figure 15. Sensitivity analysis

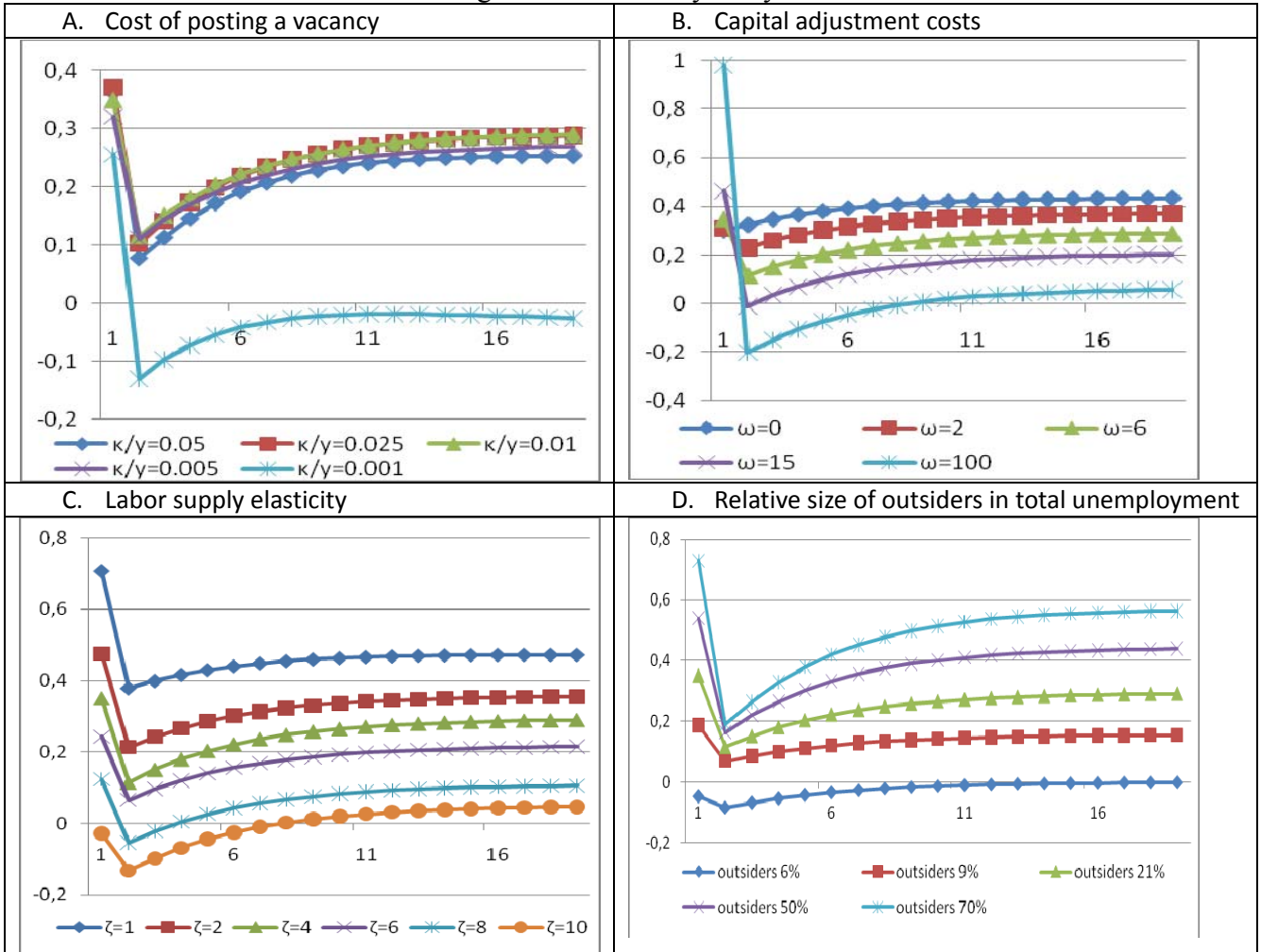


Figure 16. Complementarities of private and public consumption

