Do government purchases affect unemployment?

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Abstract

In this online appendix we provide additional information regarding the data set used in the analysis, theory, complete results of the model and additional results.

Appendix A1: Data definitions and sources

The data are from OECD (2008b) unless otherwise noted. The labour market data are also based on the OECD (2008b), but the more detailed description is given in Sparrman (2011). The sample period is from 1980 to 2007 (some variables are calculated using observations from earlier years).

The countries in the panel are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, the United Kingdom and United States (for Germany, the data start in 1991). This data appendix supplements the information provided in the main text.

Government purchases

The change in government purchases (g) is measured as the growth rate in real terms of government purchases, multiplied by government purchases as a share of trend GDP. The formula of g is:

$$g_{it} = \frac{(CGV_{it} + IGV_{it}) - (CGV_{it-1} + IGV_{it-1})}{(CGV_{it-1} + IGV_{it-1})} * \frac{CG_{it} + IG_{it} - CFKG_{it}}{YCT_{it}} * 100 \tag{A1.1}$$

where CG is government consumption, IG government investments, $CFKG$ is consumption of fixed capital, and YCT is trend GDP. The variables are in nominal prices, except those where the last letter V indicates real terms. Note that government purchases do not include transfers such as social security expenditures etc. Note also that we subtract consumption of fixed capital ($CFKG$) from government consumption to obtain the actual expenditure, as the consumption of fixed capital is an imputed measure. $CFKG$ is not subtracted from the real growth rate for reasons of data availability, but this is unimportant as there is presumably little variation over time in the imputed consumption of fixed capital. Investment data are missing for some countries (Spain, Italy, Switzerland) and we use government consumption only for these countries.

Trend GDP is equal to the backward-looking, 10-year moving average of real GDP (YQ) multiplied by the two-year moving average of the price deflator ($PGDP$) to create a variable in nominal terms. Some of the volume variable series are calculated on the basis of the relevant identities with values and deflators, as they are not published by the OECD.

Export market indicator

The export market (XM) indicator is calculated as a weighted average of the GDP gap of the trading partners, where the GDP gap is the deviation of GDP from the Hodrick Prescott-trend (with smoothing parameter 100), and the weights reflect the share of the exports from country i that goes to each of the trading partners j. The formula is

$$XM_{it} = \Sigma_j w_{ijt} * GAP_{jt} \tag{A1.2}$$

where $w_{ijt} = x_{ijt}/\Sigma_j x_{ijt}$. x_{ijt} is exports from country i to county j in year t. The trading partners consist of the other countries in the sample and the rest of 'the world'. The export data are from SITC Revision 2 OECD (2010), and are used to calculate the export shares for each country in the sample. The time series are prolonged backwards with

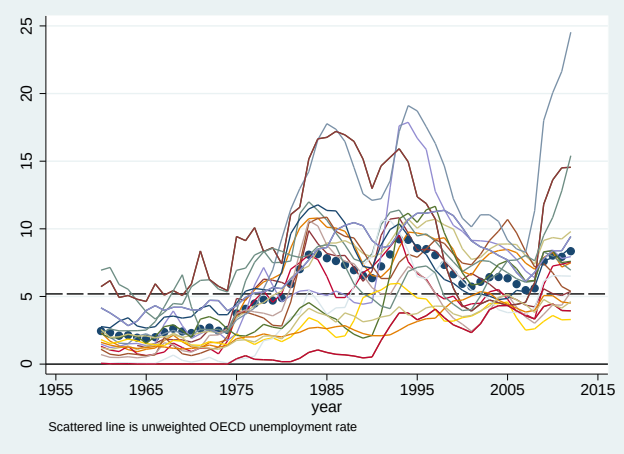

Figure A1.1: Unemployment rates in the OECD countries. Per cent.

the exports to the world when observations are missing. The GDP gap for each of the twenty OECD countries is calculated using data from OECD (2008b). The world GDP gap is constructed using data for the real GDP in The Conference Board (2010). We have used the $GDPGK$-series with GDP expressed in 1990 U.S. dollars, which covers 123 countries in the database.

Other variables

Shadow economy
The shadow economy index is developed by Elgin and Oztunali (2012). The data set is constructed using a two-sector dynamic general equilibrium model. The model is calibrated to match various reported macroeconomic variables, and the size of the shadow economy is derived from the calibrated model.
Corruption index
The corruption index (CPI) scores and ranks countries/territories based on how corrupt a countrys public sector is perceived to be. It is a composite index, a combination of surveys and assessments of corruption, collected by a variety of reputable institutions. The CPI is the most widely used indicator of corruption worldwide. Corruption is ranked from 0 to 10, i.e. from highly corrupt to no corruption. Source: Transparency International $http://www.transparency.org/cpi2014/in_detail$

The unemployment rate - we use the standardised unemployment rate (UNR) from Economic Outlook OECD (2008a). The unemployment rate for the individual countries as well as the OECD average are presented in Figure A1.1.

Output gap - is defined as the actual GDP minus potential GDP, as a share of potential GDP. It is measured in percentage points and collected from OECD (2008b).

Election year - is collected from Armingeon et al. (2010), and the original data source is the European Journal of Political Research (Political Data Yearbook, various issues); Mackie and Rose (1991); Keesing's Archive; Parline database. The variable describes the date of the election of national parliaments (lower house). The variable covers the years during the period 1960 to 2008.

Gross Public Debt - is taken from Armingeon et al. (2010), and the original data source is several versions of OECD Economic Outlook. See details regarding versions

and missing observations in Codebook by Armingeon et al. (2010).

Openness - is total trade (export and imports) as a percentage of GDP. The variable is taken from Armingeon et al. (2010). See details regarding versions and missing observations in Codebook by Armingeon et al. (2010).

Credit - is credit in the economy, measured as a ratio to GDP. Source: The World Bank Indicators.

Descriptive statistics of the explanatory variables in this paper

Table A1.1: Sample mean and standard deviation of unemployment and explanatory variables

Variable	**Mean**	**Std**
Unemployment rate (u), per cent	7.10	3.44
Export market, first difference (ΔXM)	0.02	0.44
Govt. Purchases		
Change govt. purchases	0.54	0.61
Unexpected changes in govt. purchases	0.00	0.43
Interaction g_{it} and $\widetilde{Y}_{it}$	0.51	1.84
Interaction g_{it} and the predicted LMI_{it}	-0.03	0.59
Change govt. non-wage consumption ($cgnw_{it}$)	0.39	1.31
Change govt. wage consumption (cgw_{it})	0.12	0.33
Change govt. investments (gi_{it})	0.07	0.40
Interaction ($gi_{it} - \overline{gi}_{i.}$) and $\widetilde{Y}_{it}$	0.22	1.01
Interaction ($cgnw_{it} - \overline{cgnw}_{i.}$) and $\widetilde{Y}_{it}$	-0.14	4.09
Interaction ($cgw_{it} - \overline{cgw}_{i.}$) and $\widetilde{Y}_{it}$	0.15	0.94
Interaction ($gi_{it} - \overline{gi}_{i.}$) and predicted LMI_{it}	-0.03	0.36
Interaction ($cgnw_{it} - \overline{cgnw}_{i.}$) and predicted LMI_{it}	0.02	0.50
Interaction ($cgw_{it} - \overline{cgw}_{i.}$) and predicted LMI_{it}	0.03	0.19
Change govt. net lending, per cent of GDP	0.18	1.75
Spending reduction	0.16	0.43
Other variables		
Tax increase	0.09	0.33
Debt, share of GDP	0.65	0.29
Outputgap from OECD ($\widetilde{Y}_{it}$)	-0.40	2.26
Log GDP 1st diff	0.03	0.02
Predicted direct and indirect taxes divided by trend GDP (tax), 1st diff.	0.99	1.42
Year$_{t-1}$ forecast of GDP growth year t	2.44	1.09
Year$_{t-1}$ forecast of output gap year t	-0.60	1.52
Year$_{t-1}$ forecast of unemployment year t	6.42	3.69
Year$_{t-1}$ forecast of GDP growth year $t+1$	2.79	0.91
Year$_{t-1}$ forecast of output gap year $t+1$	-0.36	1.36
Year$_{t-1}$ forecast of unemployment year $t+1$	5.85	3.47
Labour market institutions (LMI)		
Employment protection (EPL)	2.04	1.09
Benefit replacement ratio (BRR)	0.48	0.20
Benefit duration (BD)	0.50	0.32
Interaction - BRR and BD	-0.01	0.07
Interaction - CO and UDNET	0.03	0.10
Interaction - CO and TW	0.02	0.06
Union density (UDNET)	0.39	0.21
Coordination (CO)	3.18	1.26
Tax wedge (TW)	0.48	0.13
Variables used in appendix		
Interaction g_{it} and size of shadow economy	0.00	0.04
Size of shadow economy, share	0.17	0.06
Interaction g_{it} and debt ratio ($g_{it} * (debt_{it-1} - \overline{debt})$)	-0.05	0.20
Interaction g_{it} and debt ratio, squared ($g_{it} * ((debt_{it-1} - \overline{debt}) * abs(debt_{it-1} - \overline{debt}))$)	-0.01	0.08
Interaction g_{it} and openness ($g_{it} * (open_{it-1} - \overline{open})$)	0.01	0.35
Interaction g_{it} and openness ($g_{it} * (open_{it-1} - \overline{open}_t)$)	0.01	0.33
Openness prev. Period, precent of GDP	0.67	0.33
Interaction g_{it} and credit ($g_{it} * (Credit_{it-1} - \overline{Credit})$)	-0.04	0.42
Credit, share of GDP	1.16	0.56
Interaction g_{it} and corruption ($g_{it} * (Corruption_{it-1} - \overline{Corruption})$)	0.10	0.92
Corruption	7.96	1.34

Table A1.2: Real growth in government purchases, multiplied by the ratio of government purchases to trend GDP country-specific mean and standard deviation

Country	**1980-89**		**1990-99**		**2000-07**		**1960-07**	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Australia	0.87	0.57	0.64	0.26	0.80	0.21	0.90	0.55
Austria	0.23	0.24	0.48	0.29	0.13	0.30	0.53	0.46
Belgium	0.17	0.53	0.35	0.37	0.43	0.29	0.75	0.70
Canada	0.72	0.36	0.25	0.52	0.82	0.20	0.88	0.66
Denmark	0.16	0.52	0.54	0.45	0.52	0.31	0.51	0.55
Finland	0.79	0.32	0.20	0.85	0.37	0.35	0.77	0.81
France	0.80	0.24	0.44	0.41	0.49	0.20	0.72	0.38
Germany	0.19	0.51	0.45	0.48	0.13	0.21	0.68	0.78
Ireland	-0.04	1.41	1.11	0.50	1.45	1.37	1.02	1.13
Italy	0.59	0.24	0.04	0.37	0.40	0.17	0.51	0.37
Japan	0.53	0.47	0.73	0.62	-0.08	0.21	1.03	1.14
Netherlands	0.67	0.32	0.65	0.24	0.93	0.76	0.81	0.54
New Zealand	0.28	0.94	0.54	1.01	0.93	1.14	0.68	1.13
Norway	0.87	0.53	1.18	0.61	0.90	0.53	1.22	0.61
Portugal	0.93	0.66	0.94	0.61	0.21	0.61	0.80	0.74
Spain	0.96	0.50	0.79	0.46	1.18	0.18	0.91	0.40
Sweden	0.50	0.31	0.41	0.56	0.24	0.45	0.80	0.76
Switzerland	0.36	0.27	0.10	0.24	0.07	0.15	0.21	0.27
United Kingdom	0.20	0.32	0.30	0.39	0.74	0.82	0.46	0.60
United States	0.67	0.42	0.26	0.28	0.44	0.23	0.51	0.58
Total	0.52	0.61	0.52	0.58	0.56	0.65	0.74	0.73

Table A1.3: Public debt as a ratio to GDP for the countries in the panel over the sample period.

Country	**1980-89**		**1990-99**		**2000-07**		**1960-07**	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Australia	0.24	0.01	0.33	0.07	0.19	0.03	0.26	0.09
Austria	0.48	0.09	0.65	0.06	0.70	0.04	0.50	0.19
Belgium	1.08	0.17	1.31	0.07	1.01	0.09	1.00	0.28
Canada	0.62	0.10	0.93	0.08	0.75	0.06	0.68	0.17
Denmark	0.66	0.10	0.73	0.07	0.48	0.09	0.63	0.14
Finland	0.17	0.02	0.52	0.18	0.49	0.04	0.34	0.20
France	0.35	0.04	0.57	0.12	0.70	0.04	0.48	0.17
Germany	0.38	0.04	0.51	0.10	0.65	0.04	0.43	0.17
Ireland	0.94	0.15	0.80	0.16	0.34	0.04	0.70	0.26
Italy	0.91	0.06	1.18	0.13	1.18	0.03	0.91	0.29
Japan	0.65	0.10	0.87	0.22	1.59	0.14	0.80	0.50
Netherlands	0.79	0.11	0.86	0.07	0.59	0.04	0.71	0.13
New Zealand	.	.	0.49	0.09	0.31	0.04	0.39	0.11
Norway	0.34	0.04	0.34	0.05	0.47	0.10	0.39	0.08
Portugal	.	.	0.66	0.03	0.69	0.04	0.68	0.04
Spain	0.47	0.02	0.64	0.11	0.55	0.08	0.58	0.11
Sweden	0.62	0.09	0.74	0.13	0.59	0.06	0.56	0.19
Switzerland	.	.	0.45	0.08	0.54	0.04	0.49	0.08
United Kingdom	0.47	0.05	0.45	0.08	0.44	0.03	0.53	0.16
United States	0.52	0.08	0.68	0.04	0.59	0.03	0.56	0.09
Total	0.59	0.26	0.69	0.27	0.64	0.31	0.60	0.28

Appendix A2: The empirical specification

In this appendix, we briefly set out a simplified version of the theory behind the framework in Nymoen and Sparrman (2014), which is the basis for the empirical specification in equation 1 in the main text. This framework has the virtue of providing a link between the static model of Layard-Nickell and the dynamic specification used in empirical analysis.

Nymoen and Sparrman (2014) is based on a medium-run dynamic model with three main equations, which capture price setting, wage formation, as well as a stylized model of aggregate demand. It leads to a cointegrated vector autoregression (VAR) with three endogenous variables: the rate of unemployment, the real exchange rate and the wage share, cf. equation (A2.9) below.

In price setting, the firm sets the product price, q_t, on the basis of the nominal marginal labour costs $w_t - a_t$, where w_t denotes the hourly wage cost and a_t denotes hourly labour productivity. Lower case letters denote logs.

In wage bargaining between employers and unions, the wage setters set the nominal wage, aiming for a specific product real wage $w_t - q_t$.

Due to nominal rigidities and expectational errors, the actual product real wage may deviate from the values that the price and wage setters aim for. However, a crucial assumption in Nymoen and Sparrman (2014) is that the product real wage implied by the price setting and the product real wage implied by the wage bargaining are both cointegrated with the actual product real wage.

Two important exogenous variables are pi_t, which denotes an index of import prices, and a_t:

pi_t is represented as a random-walk with drift:

$$pi_t = g_{pi} + pi_{t-1} + \varepsilon_{pit} \tag{A2.1}$$

This equation represents a common nominal trend in our model. The log of labour productivity a_t represents a common real trend:

$$a_t = g_a + a_{t-1} + \varepsilon_{at} \tag{A2.2}$$

ε_{pit}, and ε_{at} are assumed to be innovations with zero expectations.

Let p_t denote the logarithm of the consumer price index. p_t is defined by:

$$p_t = \phi q_t + (1-\phi) pi_t \tag{A2.3}$$

where the parameter $1-\phi$ measures the share of imports in total consumption.

The price and wage setting are given by

$$\Delta q_t = c_q + \psi_{qw}\,\Delta w_t + \psi_{qpi}\,\Delta pi_t - \varsigma\, u_{t-1} + \theta_q\, ecm^f_{t-1} + \varepsilon_{qt}, \tag{A2.4}$$

$$\Delta w_t = c_w + \psi_{wq}\,\Delta q_t + \psi_{wp}\,\Delta p_t - \varphi\, u_{t-1} - \theta_w\, ecm^b_{t-1} + \varepsilon_{wt}, \tag{A2.5}$$

where ε_{qt}, and ε_{wt} are innovations and all parameters are assumed to be non-negative. From the assumption of cointegration, the equilibrium correction terms are defined by (cf. Nymoen and Sparrman (2014))

$$ecm^f_t = w_t - q_t - \quad a_t \qquad\qquad - \vartheta\, u_t + m_q \tag{A2.6}$$

$$ecm^b_t = w_t - q_t - \iota\, a_t - \omega\,(p_t - q_t) + \varpi\, u_t - m_w, \tag{A2.7}$$

The dynamic relationship between u_t, the rate of unemployment in period t and $re_t = pi_t - q_t$, the logarithm of the real exchange rate, is given by:

$$u_t = c_u + \alpha\, u_{t-1} - \rho\, re_{t-1} + \epsilon_{u,t},\ \rho \gtreqless 0, -1 < \alpha < 1, \tag{A2.8}$$

An increase in the real exchange rate, i.e. a depreciation, leads to improved competitiveness, which increases exports, leading to an increase in GDP so that unemployment falls. Hence, $\rho \gtreqless 0$. The simplest interpretation of (A2.8) is that it represents a stylised dynamic aggregate demand relationship, where the effects of other variables, e.g. the real interest rate, have been subsumed in the disturbances $\epsilon_{u,t}$, $t = 1, 2, ..., T$. Thus, $\epsilon_{u,t}$ will in general be autocorrelated.

The structural wage–price model can be written as a reduced-form dynamic system for re and the logarithm of the wage share, defined as $ws_t = w_t - a_t - q_t$. Putting these three equations together, we obtain the 3-equation VAR:

$$\underset{\mathbf{y}_t}{\begin{pmatrix} re_t \\ ws_t \\ u_t \end{pmatrix}} = \underset{\mathbf{R}}{\begin{pmatrix} l & -k & n \\ \lambda & \kappa & -\eta \\ -\rho & 0 & \alpha \end{pmatrix}} \underset{\mathbf{y}_{t-1}}{\begin{pmatrix} re_{t-1} \\ ws_{t-1} \\ u_{t-1} \end{pmatrix}} + \underset{\mathbf{P}}{\begin{pmatrix} e & 0 & -d \\ \xi & -1 & \delta \\ 0 & 0 & c_u \end{pmatrix}} \underset{\mathbf{x}_t}{\begin{pmatrix} \Delta pi_t \\ \Delta a_t \\ 1 \end{pmatrix}} + \underset{\epsilon_t}{\begin{pmatrix} \epsilon_{re,t} \\ \epsilon_{ws,t} \\ \epsilon_{u,t} \end{pmatrix}} \tag{A2.9}$$

The first two rows of the autoregressive coefficients matrix $\mathbf{R}$ contain reduced-form coefficients that are known expressions of the parameters of the structural supply side model; see the online Appendix of Nymoen and Sparrman (2014). The third row contains the parameters of (A2.8). For $\mathbf{y}_t$ to be stationary, none of the eigenvalues of $\mathbf{R}$ can have moduli on the complex unit circle.

The second term, $\mathbf{Px_t}$, in (A2.9) shows that foreign price growth, Δpi_t, and exogenous productivity growth, Δa_t, play a role in the dynamic behaviour of $\mathbf{y}_t$. Foreign price growth (Δpi_t) affects the vector of the real variable $\mathbf{y}_t$, as dynamic price homogeneity is not imposed from the outset, unlike long-run price homogeneity. The dynamic price–wage homogeneity implies that the coefficients e and ξ in the $\mathbf{P}$ matrix are both restricted to zero.

The right-hand column of $\mathbf{P}$ contains the three intercepts, of which d and δ will be affected by labour market institutions affecting wage and price setting as implied by the Layard-Nickell model. The vector $(\epsilon_{re,t}, \epsilon_{prw}, \epsilon_{u,t})$ contains the VAR disturbances, which are reduced-form expressions of the structural disturbances. These are white noise.

The final equation

The VAR model (A2.9) is solved for the unemployment rate, which determines the equilibrium rate as a parameter. The solution implies a third-order dynamics for u, given that c and δ are time varying due to changes in institutional variables. This final equation model can be written as:

$$u_t = \beta_0 + \beta_1 u_{t-1} + \beta_2 u_{t-2} + \beta_3 u_{t-3} + \rho d_{t-1} - \rho k d_{t-2} k \rho \delta_{t-2} + c_t - l c_{t-1} - \lambda k c_{t-2} + l k c_{t-2} + \varepsilon_{u,t} \tag{A2.10}$$

where the autoregressive coefficients can be expressed in terms of the VAR parameters:

$$\begin{aligned} \beta_1 &= \alpha + \kappa + l \\ \beta_2 &= -\left[\alpha l(1-\kappa) + \kappa(\alpha + l) + n\rho + \lambda k\right] \\ \beta_3 &= \alpha\lambda k + \rho(n\kappa - \eta k) \end{aligned} \tag{A2.11}$$

And the final equation disturbance $\epsilon_{u,t}$:

$$\begin{aligned}\varepsilon_{u,t} = &-(l-\kappa)\epsilon_{u,t-1} + (\lambda k + l\kappa)\varepsilon_{u,t-2} - \rho\epsilon_{re,t-1} + \rho\kappa\epsilon_{re,t-2} \\ &+ k\rho\epsilon_{ws,t-2} - \rho e\Delta pi_{t-1} + \rho(\xi k + ek)\Delta pi_{t-2} + kp\Delta a_{t-2}\end{aligned} \tag{A2.12}$$

Following the results in Nymoen and Sparrman (2014) β_1 is positive, and may be larger than one, while the second autoregressive parameter is expected to be negative because all the coefficients inside the brackets are positive. Finally, $\beta_1 > -\beta_2$ because the additional terms in β_2 are products of factors that are less than one, while the third autoregressive coefficient, β_3, is likely to be markedly smaller in magnitude than the first two coefficients: $\alpha\lambda k$ is a small number and $\rho(n\kappa - \eta k)$ may be negative.

The institutional labour market variables that affect the wage share are represented in the variable d. The distributed lag can be motivated by theory. An institutional reform in period t affects wage and price setting in $t+1$, and this leads to an unemployment response in the final equation model in period $t+2$. As described in Nymoen and Sparrman (2014), this dynamic can be re-parameterized in terms of Δd_{t-1} and d_{t-2}. The re-parameterization will not affect the properties of the disturbances. Hence, we use the following notation in the empirical specification:

$$\beta_4\Delta\mathcal{I}_{it-1} + \beta_5\mathcal{I}_{it-2} \tag{A2.13}$$

Demand shocks, such as changes in government purchases (g) and the export market indicator (XM) will enter the third equation of the VAR (A2.9) through changes in the constant term, c. By re-parameterizing the c-variables in equation A2.10, we use the following notation for the dynamics of demand shocks:

$$\beta_7\Delta y_{it} + \beta_8 y_{t-1} + \beta_9\Delta y_{it-2} \tag{A2.14}$$

where y represents the demand variables g and XM.

With our notation, the final equation can be written as:

$$\begin{aligned}u_t = &\beta_0 + \beta_1 u_{t-1} + \beta_2 u_{t-2} + \beta_3 u_{t-3} + \beta_4\Delta\mathcal{I}_{it-1} + \beta_5\mathcal{I}_{it-2} \\ &+ \beta_7\Delta g_{it} + \beta_8 g_{t-1} + \beta_9\Delta g_{it-2} \\ &+ \beta_7\Delta XM_{it} + \beta_8 XM_{t-1} + \beta_9\Delta XM_{it-2} + \varepsilon_{u,t}\end{aligned} \tag{A2.15a}$$

$$\begin{aligned}\varepsilon_{u,t} = &-(l-\kappa)\epsilon_{u,t-1} + (\lambda k + l\kappa)\varepsilon_{u,t-2} - \rho\epsilon_{re,t-1} + \rho\kappa\epsilon_{re,t-2} + k\rho\epsilon_{ws,t-2} \\ &- \rho e\Delta pi_{t-1} + \rho(\xi k + ek)\Delta pi_{t-2} + kp\Delta a_{t-2}\end{aligned} \tag{A2.15b}$$

Complete results of model 4 in Table 2 in the main text

In this section, we present the complete results of the results in the main text, Table 2, model 4, including the coefficients for the labour market institutions. This is done in Table A2.1, model 1. The residuals are presented in figures A2.1 and A2.2. The graphs show no clear sign of autocorrelation or heteroscedasticity, which could have been a sign of misspecification.

The other columns present additional results based on different assumptions regarding the lag structure. Model 2 shows the same specification but with a richer lag structure for the change in government purchases and the export market. We observe that the results for

g_{it} are consistent with the simplification we have made in model 1, as Δg_{it} and g_{it-1} have almost the same coefficient value, and thus can be put together in g_{it}, while the coefficient of Δg_{it-1} is small and insignificant.

The three forms of the export market indicator are all significant in models 2 and 3. However, with time dummies, the coefficients for the export market become much smaller and the coefficient of ΔXM_{it-1} and XM_{it-1} become insignificant, reflecting considerable co-movement of the export markets for all countries. The dynamic of the export market is therefore reduced to ΔXM_{it} in model 1. In contrast, the coefficient for the change in government purchases is not affected from model 2 to model 3, presumably because any co-movement in government purchases across countries is not linked to co-movement in unemployment.

Note that model 2 corresponds to equation (A2.15a), with autocorrelated and heteroscedastic robust standard errors, except that we have omitted the third lag of unemployment, which was numerically close to zero and statistically insignificant.

Table A2.1: Full results of model 4 in the main text Table 2 in model 1. The other models explore the lag structure of the change in government purchases and of export markets.

	Model 1	Model 2	Model 3	Model 4
Unemployment previous period (u_{it-1})	1.312***	1.320***	1.319***	1.329***
	(22.01)	(22.70)	(23.43)	(26.98)
Unemployment two years ago (u_{it-2})	-0.479***	-0.513***	-0.508***	-0.509***
	(-8.02)	(-10.69)	(-10.11)	(-11.29)
Lag. mark. institutions(LMI):				
Employment protection (EPL), 1st diff. previous period	0.0132	0.327	0.308	0.0697
	(0.04)	(0.77)	(0.74)	(0.19)
EPL, two years ago	0.0399	0.158	0.157	0.0764
	(0.24)	(1.01)	(1.03)	(0.48)
Benefit replacement ratio (BRR), 1st diff. previous period	1.316	2.195**	2.215**	1.606**
	(1.38)	(2.37)	(2.33)	(2.21)
BRR, two periods ago	1.019*	1.666***	1.689**	1.450**
	(1.73)	(2.87)	(2.85)	(2.30)
Benefit duration (BD), 1st diff. previous period	-0.282	-0.332	-0.339	-0.140
	(-0.47)	(-0.40)	(-0.42)	(-0.25)
BD, two periods ago	-0.830*	-1.013**	-1.019**	-0.993**
	(-1.88)	(-2.55)	(-2.55)	(-2.38)
Interaction - BRR and BD 1st diff. previous period	1.984	3.111	2.834	2.453
	(0.73)	(1.04)	(0.98)	(0.92)
Interaction - BRR and BD two periods ago	3.303*	3.329*	3.334*	3.695**
	(1.89)	(1.90)	(1.87)	(2.16)
Interaction - CO and UDNET 1st diff. previous period	-3.857	-5.487	-5.284*	-4.286
	(-1.38)	(-1.70)	(-1.95)	(-1.48)
Interaction - CO and UDNET two periods ago	-0.965	-1.120	-1.077	-0.880
	(-1.38)	(-1.35)	(-1.26)	(-1.07)
Interaction - CO and TW 1st diff. previous period	-11.98**	-8.335*	-8.028*	-6.969
	(-2.29)	(-1.78)	(-1.75)	(-1.47)
Interaction - CO and TW two periods ago	-0.875	-1.946	-1.980	-1.525
	(-0.51)	(-1.22)	(-1.25)	(-0.93)
Union density (UDNET), 1st diff. previous period	1.621	0.0404	0.132	2.064
	(0.43)	(0.01)	(0.04)	(0.54)
UDNET, two periods ago	0.280	1.760	1.749	1.009
	(0.25)	(1.47)	(1.47)	(0.82)
Coordination (CO), 1st diff. previous period	0.0199	-0.395	-0.428	-0.254
	(0.08)	(-1.26)	(-1.31)	(-0.69)
CO, two periods ago	-0.0439	-0.148	-0.149	-0.110
	(-0.36)	(-1.03)	(-1.04)	(-0.79)
Tax wedge (TW), 1st diff. previous period	1.447	-4.505*	-4.179*	-0.520
	(0.63)	(-1.86)	(-1.80)	(-0.24)
TW, two periods ago	3.182*	2.135	2.147	2.861*
	(2.03)	(1.26)	(1.29)	(1.75)
Export market:				
Export market, 1st diff. (ΔXM_{it})	-0.463***	-0.477***	-0.470***	-0.374**
	(-3.28)	(-5.09)	(-4.89)	(-2.74)
Export market, prev. period (XM_{it-1})		0.182**	0.188**	0.0702
		(2.57)	(2.64)	(0.57)
Export market, 1st diff. prev. period (ΔXM_{it-1})		-0.194**	-0.192**	-0.0996
		(-2.46)	(-2.54)	(-0.79)
Change govt. purchases, (g_{it})	-0.320***		-0.267***	-0.283***
	(-4.21)		(-3.43)	(-3.64)
Government purchases:				
Change govt. purchases, 1st diff. (Δg_{it})		-0.274***		
		(-3.40)		
Change govt. purchases, prev. period (g_{it-1})		-0.300**		
		(-2.71)		
Change govt. purchases, 1st diff. prev. period (Δg_{it-1})		0.0574		
		(0.68)		
Time dummies	Yes	No	No	Yes
Obs = Country*Average groups	502	483	483	483
Standard deviation of residuals	0.62	0.63	0.63	0.60

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Dependent variable: The rate of unemployment. Estimation method: Within country estimate with heteroscedastic and within country autocorrelated robust standard errors, see Stock and Watson (2008).

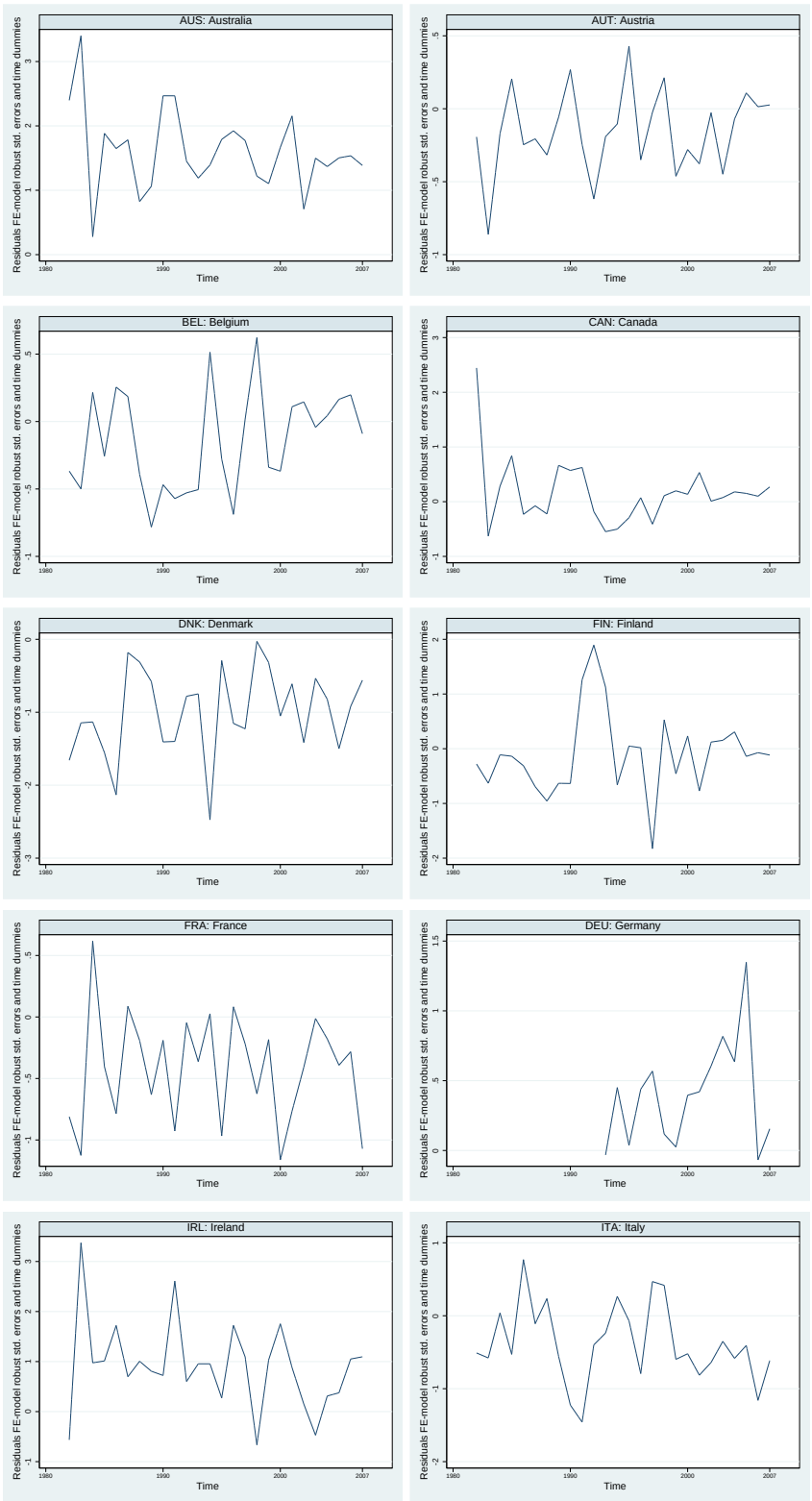

Figure A2.1: Estimated residuals of fixed effect model 4 in main text in Table 2.

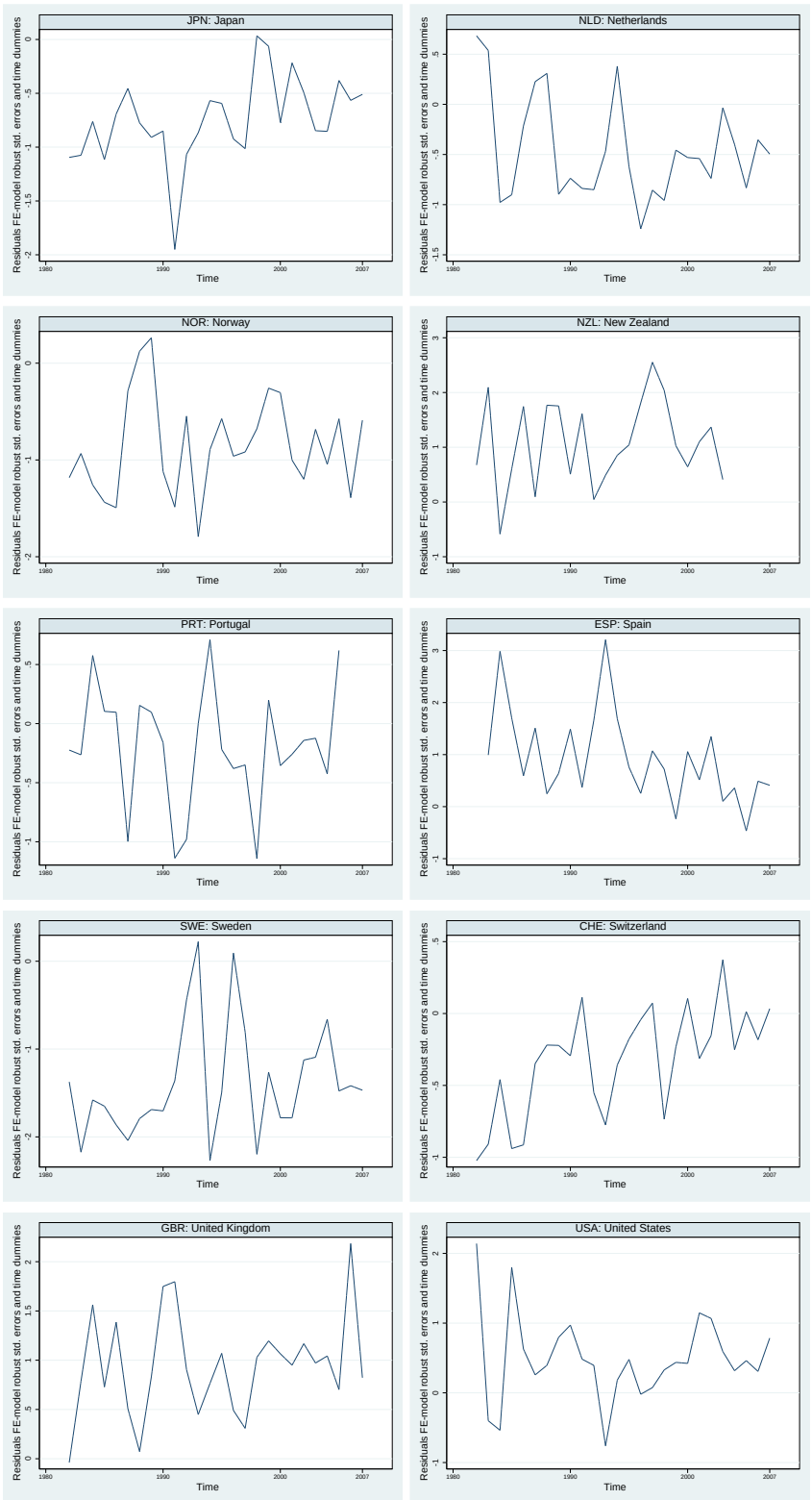

Figure A2.2: Estimated residuals of fixed effect model 4 in main text in Table 2.

Appendix A3: Fiscal policy rule

In this appendix, we present the fiscal policy rule and estimation results that are used in the main text, Table 2, model 5, to explore a possible difference between expected and unexpected changes in government purchases. Typically, theoretical considerations would suggest that the effect is stronger when policy changes are unexpected, cf. Ramey (2011). To explore this distinction, we postulate a simple policy rule, whereby the change in government purchases depends on the lagged change in government purchases, as well as the lagged growth rate of GDP (Δy) and the lagged debt to GDP ratio ($\frac{D}{Y}$), see equation A3.1.

$$g_{it} = \alpha_{0i} + \alpha_{1i} g_{it-1} + \alpha_{2i} \Delta ln(y)_{it-1} + \alpha_{3i} (\frac{D}{Y})_{it-2} \tag{A3.1}$$

The country-specific estimates of the fiscal policy rule are presented in table A3.1.

Table A3.1: The country-specific fiscal policy rule

	Australia	Austria	Belgium	Canada	Denmark	Finland	France
Change govt. purchases, prev. period (g_{it-1})	-0.02	0.25	0.13	0.53**	0.10	0.14	0.12
	(0.17)	(0.21)	(0.19)	(0.16)	(0.19)	(0.17)	(0.21)
log GDP 1st diff. prev. period	14.22**	-0.45	3.50	9.83**	5.89	14.62**	5.21
	(3.58)	(5.86)	(6.12)	(3.22)	(5.96)	(3.95)	(5.04)
Debt, two periods ago	-0.97	-0.28	0.46	-0.59	0.27	-0.81	-1.03*
	(0.60)	(0.57)	(0.45)	(0.47)	(0.72)	(0.54)	(0.44)
Obs	20	28	28	28	28	28	28

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Germany	Ireland	Italy	Japan	Netherlands	Norway
Change govt. purchases, prev. period (g_{it-1})	-0.33*	0.40**	0.59***	0.14	0.12	0.14
	(0.17)	(0.17)	(0.17)	(0.21)	(0.20)	(0.20)
log GDP 1st diff. prev. period	9.60*	18.84***	6.78	-1.16	10.20	2.76
	(5.36)	(5.91)	(4.35)	(5.18)	(7.08)	(6.55)
Debt, two periods ago	-0.62	-0.52	-0.03	-0.67**	-0.39	0.21
	(0.65)	(0.71)	(0.39)	(0.30)	(0.78)	(1.36)
Obs	17	28	28	28	28	28

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Dependent variable: Change in government purchases(g_{it}). Estimation method: Ordinary least squares.

	New Zealand	Portugal	Spain	Sweden	Switzerland	United Kingdom	United States
Change govt. purchases, prev. period (g_{it-1})	-0.48*	-0.22	0.16	0.01	0.01	-0.13	0.36**
	(0.26)	(0.37)	(0.20)	(0.21)	(0.23)	(0.20)	(0.16)
log GDP 1st diff. prev. period	-7.81	25.73*	21.07***	0.73	-4.89	1.85	6.43**
	(16.55)	(12.63)	(4.98)	(5.63)	(3.13)	(9.14)	(3.08)
Debt, two periods ago	0.99	-3.61	-1.46*	-1.10	0.52	-1.81	-1.89**
	(2.33)	(4.44)	(0.75)	(0.90)	(0.54)	(2.56)	(0.69)
Obs	15	13	21	28	18	28	28

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Dependent variable: Change in government purchases(g_{it}). Estimation method: Ordinary least squares.

We then define the unexpected change in government purchases as the prediction error from equation A3.1, i.e. the difference between the actual change in government purchases (g_{it}) and the predicted change from equation A3.1 ($\hat{g}_{it}$).

Appendix A4: Additional results

In this section, we present additional results to those in the main text sections IV and V.

The effect of debt, openness, shadow economy and credit

We have also tried other possible interaction effects. Giavazzi and Pagano (1990) argue that a severe fiscal contraction might be expansionary in situations where there is concern about the risks of high public debt. This suggests that the effect of government purchases may depend on the level of public debt. In a recent study using structural VARs on quarterly data for 44 advanced and developing countries, Ilzetzki et al. (2013) find that the fiscal multiplier depends on the level of government debt, and that the fiscal multiplier is zero in high debt countries. To explore the possible importance of public debt, we interact the change in government purchases with lagged public debt as a ratio to GDP (measured as deviation from the sample mean, which is equal to 0.65), cf. Table A4.1, models 1 and 2. We also interact with debt squared, to allow for non-linear effects, and we include debt as a separate explanatory variable, as the levels of debt might well be correlated with the level of unemployment, cf. Bertola (2010). However, while the point estimates suggest that higher debt might reduce the effect of increased government purchases on unemployment, the coefficients are imprecisely determined and not statistically significant.

We also explore whether the effect of government purchases depends on the openness of the country, as suggested by traditional Keynesian analysis. In an analysis of 14 EU countries, Beetsma and Giuliodori (2010) find a clear positive effect of a rise in government purchases on GDP in "closed economies" (defined as countries where the ratio of exports plus imports to GDP is below sample average), and no significant effect in the remaining "open economies". Ilzetzki et al. (2013) also find a stronger expansionary effect in closed economies than in open ones.

To analyse the effect of openness, we interact the change in government purchases with an indicator of openness, based on the ratio of exports plus imports to GDP. As the degree of openness has increased over time, we consider two different specifications of this indicator, one where the indicator measures the deviation of the exports plus imports ratio from the overall sample mean, implying that the indicator also captures the increase in openness over time, and one where the indicator is measured as deviation from the year mean, thus omitting the change in openness over time. The results are found in Table A4.1, models 3 and 4. As the results show, it is only the indicator measured as deviation from the year mean that is significant at the 10 per cent level (model 4). The coefficient is positive, which suggests that the effect of changes in government purchases is smaller in open countries.

In model 5, we explore whether the size of the shadow economy affects the effect of government purchases by including an interaction term between government purchases and the size of the shadow economy. However, the interaction term is imprecisely determined, providing no evidence that the size of the shadow economy affects the effect of a change in government purchases.

In model 6, we introduce an interaction between the change in government purchases and the level of credit in the economy, measured as a ratio to GDP. The amount of credit can be viewed as an indication of the level of financial development. The interaction term is insignificant and close to zero, providing no evidence that credit affects the effect of a change in government purchases.

In model 7, we include an interaction term for the degree of corruption, as measured

Table A4.1: The effect of debt, openness, shadow economy and credit

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Unemployment previous period (u_{it-1})	1.27***	1.27***	1.25***	1.25***	1.27***	1.28***	1.18***
	(0.07)	(0.08)	(0.06)	(0.06)	(0.06)	(0.06)	(0.04)
Unemployment two years ago (u_{it-2})	-0.47***	-0.47***	-0.43***	-0.43***	-0.48***	-0.46***	-0.38***
	(0.08)	(0.08)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)
Export market, 1st diff. (ΔXM_{it})	-0.41***	-0.42***	-0.42***	-0.42***	-0.45***	-0.50***	-0.18
	(0.12)	(0.13)	(0.13)	(0.13)	(0.14)	(0.14)	(0.15)
Govt. purchases (g_{it}) and monetary regime:							
g_{it} - EMU	-0.34**	-0.36**	-0.51*	-0.50**	-0.36***	-0.43***	-0.20***
	(0.15)	(0.14)	(0.24)	(0.21)	(0.12)	(0.14)	(0.06)
g_{it} - Fixed	-0.47***	-0.49***	-0.48***	-0.49***	-0.46**	-0.49***	-0.40**
	(0.15)	(0.16)	(0.15)	(0.15)	(0.16)	(0.12)	(0.18)
g_{it} - Float	-0.22**	-0.22**	-0.23**	-0.19*	-0.28**	-0.26**	-0.23***
	(0.10)	(0.10)	(0.10)	(0.10)	(0.11)	(0.11)	(0.07)
Interaction g_{it} and predicted LMI	-0.35***	-0.33***	-0.27***	-0.26**	-0.25**	-0.28***	-0.27***
	(0.10)	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.06)
Dummy for EMU	-0.19	-0.19	0.16	0.18	-0.17	-0.10	-0.03
	(0.19)	(0.18)	(0.17)	(0.17)	(0.19)	(0.20)	(0.16)
Dummy for Fixed	0.33	0.34	0.43*	0.45*	0.31	0.32	0.13
	(0.22)	(0.22)	(0.21)	(0.22)	(0.23)	(0.23)	(0.23)
Interaction g_{it} and debt ratio							
($g_{it} * (debt_{it-1} - \overline{debt})$)	0.22	-0.11					
	(0.27)	(0.54)					
Govt. debt, lagged levels	0.18	0.24					
	(0.31)	(0.38)					
Interaction g_{it} and debt ratio, squared							
($g_{it} * ((debt_{it-1} - \overline{debt}) * abs(debt_{it-1} - \overline{debt}))$)		0.78					
		(1.22)					
Interaction g_{it} and openness							
($g_{it} * (open_{it-1} - \overline{open})$)			0.33				
			(0.21)				
Openness prev. period			-2.26***	-2.34***			
			(0.67)	(0.68)			
Interaction g_{it} and openness							
($g_{it} * (open_{it-1} - \overline{open_t})$)				0.41*			
				(0.21)			
Interaction g_{it} and size of shadow economy					-1.67		
					(1.60)		
Size of shadow economy					22.44		
					(13.82)		
Interaction g_{it} and credit							
($g_{it} * (Credit_{it-1} - \overline{Credit})$)						-0.01	
						(0.07)	
Credit						0.05	
						(0.19)	
Interaction g_{it} and corruption							
($g_{it} * (Corruption_{it-1} - \overline{Corruption})$)							-0.04
							(0.05)
Corruption							-0.01
							(0.06)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lab. market inst (LMI).	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs = Country*Average groups	455	455	502	502	502	478	254
Standard deviation of residuals	0.56	0.56	0.58	0.58	0.59	0.61	0.42

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Dependent variable: The rate of unemployment. Estimation method: Within country estimate with heteroscedastic and within country autocorrelated robust standard errors, see Stock and Watson (2008).

by an index from Transparency International that goes from 0 to 10, where a higher number indicates less corruption. The point estimate suggests that the effect of government purchases is larger in countries with less corruption, but the effect is imprecisely determined and far from statistically significant.

Controlling for forecasts

In Table A4.2, model 2, we control for possible endogeneity of government purchases by also including consensus forecasts for GDP growth, unemployment and the output gap. One might conjecture that government purchases would respond to such forecasts, and that the correlation we find between government purchases and unemployment is due to both variables being correlated with the forecasts. However, the significant negative impact on unemployment remains, even when controlling for forecasts. Column 1 shows the estimation of model 4 from the main text Table 2, but with the same sample as in Table A4.2, model 2. We observe that the lower value of the coefficient in Table A4.2 reflects the limited sample, and not the fact that the consensus forecasts are included.

Table A4.2: The effect of additional forecast variables

	Model 1[a]	Model 2[b]
Unemployment previous period (u_{it-1})	0.94***	0.99***
	(0.10)	(0.10)
Unemployment two years ago (u_{it-2})	-0.19*	-0.21*
	(0.10)	(0.11)
Export market, 1st diff. (ΔXM_{it})	-0.20	-0.22
	(0.15)	(0.14)
Change govt. purchases (g_{it})	-0.19	-0.21*
	(0.11)	(0.12)
Controls:		
Log GDP 1st diff. prev. period	-9.12	-21.62
	(13.80)	(14.07)
Outputgap 1st diff. prev. period	-0.10	-0.03
	(0.13)	(0.13)
Predicted direct and indirect taxes divided by trend GDP, 1st diff.	-0.02	-0.02
	(0.05)	(0.05)
Predicted direct and indirect taxes divided by trend GDP, 1st diff. prev. period	0.03	0.01
	(0.04)	(0.03)
Year$_{t-1}$ forecast of GDP growth year t		0.04
		(0.07)
Year$_{t-1}$ forecast of output gap year t		0.01
		(0.07)
Year$_{t-1}$ forecast of unemployment year t		-0.12
		(0.09)
Year$_{t-1}$ forecast of GDP growth year $t+1$		-0.00
		(0.08)
Year$_{t-1}$ forecast of output gap year $t+1$		0.06
		(0.07)
Year$_{t-1}$ forecast of unemployment year $t+1$		0.10
		(0.08)
Time dummies	Yes	Yes
Lab. market inst (LMI).	Yes	Yes
Obs = Country*Average groups	201.0	201.0
Standard deviation of residuals	0.39	0.39

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

a) Estimation method: Within country estimate with heteroscedastic and within country autocorrelated robust standard errors (Stock and Watson (2008)).

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