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By

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# The Effect of Government Size on the Steady-State Unemployment Rate: A Dynamic Perspective

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## Abstract

The relationship between government size and the unemployment rate is investigated using a panel error-correction model that describes both the short-run dynamics and long-run determination of the unemployment rate. Using data from twenty OECD countries from 1970 to 1999 and after correcting for simultaneity bias, we find that government size, measured as total government outlays as a percentage of GDP, plays a significant role in affecting the steady-state unemployment rate. Importantly, when government outlays are disaggregated, transfers and subsidies are found to significantly affect the steady-state unemployment rate while government purchases of goods and services play no significant role.

**JEL Code**: C23; H10; H19; H50; J64

**Keywords**: Steady-State Unemployment Rate; Government Size; Error Correction Model; Dynamic Panel Data Model; Arellano-Bond Estimator

## 1. Introduction

Since the early 1970s, OECD countries on average have experienced increases in unemployment rates, but individual country experiences have varied considerably (Figure 1). Have governments and their policies played a role in affecting these unemployment experiences? In seeking to answer this question, most studies have followed a disaggregated or program-specific approach. In these studies, variables are constructed to measure the effects of specific government programs or policies. In particular, changes in labor-market institutions, such as unemployment benefits, statutory minimum wages, employment protection legislations and tax wedges, have been examined extensively (Bean, et al., 1986, Oswald, 1997, Nickell, 1997, Nickell and Layard, 1999, Blanchard and Wolfers, 2000, Nickell, et al., 2005). The empirical results are mixed. For example, Oswald (1997) found that labor-market rigidities, such as overly generous unemployment benefits and high labor taxes do not seem to contribute to the high unemployment rates in Europe. But Nickell, et al. (2005) concluded that broad movements in unemployment rates across the OECD can be explained by shifts in labor-market institutions, such as employment protection legislations, unemployment benefits and labor taxes.

The program-specific approach to assessing the role of government in affecting the unemployment rate is likely to give an incomplete and inaccurate picture. Specifying all the channels through which government programs might affect unemployment may not be possible. Even when major programs are investigated, their multidimensional characteristics make their measurement difficult: "Reducing them to quantitative indexes is not easy: how does one compare, for example, two unemployment insurance systems,

if the first has more generous unemployment benefits, but also more conditionality of benefits on search effort?" (Blanchard, 2006, p.38).

As an alternative to the program-specific approach, an aggregate approach uses government size, measured in various ways, as a portmanteau variable to capture the diverse channels by which government and its programs can affect the unemployment rate (Abrams (1999), Christopoulos et al.(2002, 2005), Feldmann (2006)). This approach is not without its own drawbacks, however, and is subject to the same type of criticism levied on the monetarist's reduced-form approach to explaining the transmission mechanism for money: a "black box" approach that may mistake the direction of causation. Regardless, the aggregate approach has proven to be highly consistent in finding that government size has played a crucial role in a nation's unemployment experiences.

Abrams (1999) was the first to apply the aggregate approach to explaining unemployment rates. Using data from twenty OECD countries, Abrams found support for a positive link between a nation's steady-state unemployment rate and its government size (total government outlays as a percentage of GDP).[1] Feldmann (2006) estimated a static panel data model with country random effects for 19 industrial countries. He also found that the larger the size of government the higher the unemployment rate.[2] It is important to note that the results from Abrams (1999) and Feldmann (2006) are subject to potential simultaneity bias because in both studies all regressors, including government

[1] Abrams (1999) is a rather preliminary study because the regression equation has only one explanatory variable, i.e., government size and the pooled OLS estimation is unable to control for the unobserved country characteristics.

[2] Compared to other studies, Feldmann (2006) used a different measure of government size, i.e., the "Economic Freedom of the World" index and its four component indices, which measure the extent of government consumption, transfers and subsidies, government enterprises and investment, and a nation's top marginal income tax rate, respectively. The indices are developed by Gwartney and Lawson (2004).

size measures, are treated as exogenous while in fact government size is likely to be jointly determined with the unemployment rate. For instance, government spending on unemployment benefits tends to increase during recessions. Thus, their estimated positive effect of government size on the unemployment rate could simply be an artifact of reverse causality.

Several studies have also combined time series techniques with the aggregate approach to analyze the unemployment dynamics. Christopoulos and Tsionas (2002) focused on the short-run dynamics by estimating bivariate vector autoregressive models for ten OECD countries. They found unidirectional causality running from government size to the unemployment rate. Given the well-known fact that bivariate VARs are very restrictive and the estimated relationship tends to be unstable when additional variables are included in the model, Wang and Abrams (2011) specified a more general VAR model. They also found unidirectional causality from government size to the unemployment rate. Christopoulos, et al. (2005) employed panel cointegration tests and concluded that there is a positive long-run relationship between government size and the unemployment rate and that causality runs one-way from government size to the unemployment rate.[3]

We seek to further test the relationship between government size and the unemployment rate by developing an error-correction model, which describes both the

[3] The conclusions in Christopoulos, et al. (2005) should be taken with caution. First, there is no direct link between the presence of cointegration and the direction of causality. Secondly, in residual-based cointegration tests such as the panel cointegration tests employed in Christopoulos, et al. (2005), alternating the dependent variable in cointegration regression often yields conflicting results. In such cases, interpretation of test results can be tricky. In Christopoulos, et al. (2005), the null hypothesis of no cointegration can be rejected when the unemployment rate is used as the dependent variable in the cointegrating regression, but not so when government size is the dependent variable. The inconsistent test results should be interpreted as a lack of cointegration (long-run relationship) between government size and the unemployment rate rather than unidirectional causality.

short-run dynamics and long-run determination of the unemployment rate. We hypothesize that the steady-state unemployment rate, the rate that the economy gravitates towards in the long run,[4] is determined by government size and various institutional factors while short-run fluctuations in the unemployment rate are affected by business cycles and inflation shocks. Our model and estimation method allow for the unobserved country characteristics and explicitly control for simultaneity bias. The empirical study is based on a panel of twenty OECD countries from 1970 to 1999.[5] Our main conclusions are: (1) increases in government size, measured as total government outlays as a percentage of GDP, tend to raise the steady-state unemployment rate; (2) different types of government outlays have different effects on the steady-state unemployment rate, with transfers and subsidies having a large significant effect and government purchases having an insignificant effect; and (3) available measures of labor-market institutions play no significant role in affecting the steady-state unemployment rate.

It should be noted that the error-correction model that we develop is a reduced-form model. Like any reduced-form models, it tries to establish a statistical association between the unemployment rate and government outlays, which do not necessarily prove a behavior causal relationship.[6] In contrast, structural models specify the mechanisms through which government outlays might affect the unemployment rate. However, structural models are only as good as the explicit structures that are specified. If

[4] Our steady-state unemployment rate is the "natural rate" for the economy. In our steady state, the expected inflation rate equals the actual inflation rate. This unemployment rate is also called NAIRU, the non-accelerating inflation rate of unemployment.

[5] We terminate the sample in 1999 due to the adoption of the euro, which causes a structural break. More discussion on this issue can be found in Section 5. Countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.

[6] The VAR models in Christopoulos and Tsionas (2002) and Wang and Abrams (2011) are also reduced-form models. Likewise, the unidirectional Granger causality found in these papers should not be taken as evidence of a behavior causal relationship.

important structural channels are omitted, the structural estimates will give a misleading picture. We do not know all, perhaps not even most, of the structural linkages between the many government programs and work incentives. In addition, most public-policy programs differ substantially in detail across countries. This raises the possibility of measurement errors for structural models.

Section 2 provides some theoretical considerations linking government size to the steady-state unemployment rate. Section 3 briefly outlines the evolution of government size and unemployment rates in OECD countries between 1970 and 1999. Section 4 sets up the error-correction model and discusses several methodological issues. Empirical results are reported in Section 5. Sensitivity analysis is summarized in Section 6. Section 7 concludes the paper.

## 2. Linking Government Size to Unemployment

Hall (1979) shows that a nation's steady-state unemployment rate ($U^*$), the long-run rate that an economy gravitates towards after shocks have dissipated, depends only upon a finding rate (*f*) and a separation rate (*s*). When an economy reaches its steady-state unemployment rate, the number of people finding employment (the finding rate times the number unemployed) exactly equals the number of workers losing employment (the separation rate times the number of employed). Mathematical manipulation of this relationship yields the equation for the steady-state unemployment rate:[7]

$$U^* = \frac{s}{s+f} \tag{1}$$

[7] See Hall (1979). This simplified equation assumes a constant size for the labor force.

Factors that increase the separation rate or decrease the finding rate raise the steady-state unemployment rate. Clearly, various specific government programs can be expected to affect the finding and separation rates. For example, Feldstein (1976, 1978) found that unemployment insurance reduces the finding rate and raises the unemployment rate. Publicly provided health care, often a major component of government spending, is likely to affect both the separation and finding rates. A worker who knows that health care continues after quitting a job is more likely to quit thereby raising the separation rate; a member of the labor force who receives publicly provided health care during bouts of unemployment is likely to extend the bout of unemployment and lower the finding rate. Both of these effects, if operative, would raise the steady-state unemployment rate.

Karras (1993), on the other hand, noted that government expenditures on capital and infrastructure, types of public investment spending, tend to increase labor productivity (and the demand for labor) and cause negative wealth effects that increase labor supply. To the extent that these effects work to raise the finding rate, the steady-state unemployment rate would fall. However, government consumption expenditures on capital and infrastructure do not necessarily raise labor productivity, especially when taking into account possible crowding-out effects on private investment spending.

The abovementioned specific programs merely illustrate some of the channels through which government programs might affect the unemployment rate. Total government outlays, a broad measure of government activity, serve to measure the combined effects of the outlays-cum-taxation of all programs. The question whether such an aggregative measure of government activity serves as a useful variable for explaining

the steady-state unemployment rate must be resolved empirically. The answer to this question is important for assessing the social desirability of expanding the role of government in the economy and fiscal policies in basic macroeconomic models. For example, if government size affects the steady-state unemployment rate, it should be included as an argument in the long-run aggregate supply function. Changes in government outlays would then affect aggregate supply as well as aggregate demand in the traditional model.

Our baseline model uses total government outlays to explain unemployment, but we also separate total government outlays into transfer outlays and government purchases of goods and services to see if these programs produce different effects as suggested by Karras (1993). We also experiment with various institutional and regulatory variables. These are discussed in detail in Section 5.

## 3. Government Size and Unemployment: Stylized Facts from OECD Countries

Figure 1 plots the unemployment rate of each of the twenty OECD countries for the period 1970-1999.[8] Generally speaking, unemployment rates have increased over time with some dramatic increases occurring in some countries. The average unemployment rate was 2.4 percent in 1970 and increased to 7.1 percent in 1999.

Figure 2 provides country graphs of total government outlays as a percentage of GDP (GO), which reveals substantial heterogeneity in individual country experience. For two countries in the sample, Ireland and the United Kingdom, GO decreased over the period. For the other countries, government size grew at various rates. GO rose by a mere

[8] Subject to data availability. Data for Germany includes only West Germany prior to merger with East Germany. Variable definitions and sources are given in the Appendix.

1.9 percentage points for Netherlands, but by over 23 percentage points for Japan. Overall, there appears to be a secular increase in GO over the thirty-year period. The average GO increased from 33.6 percent in 1970 to 45.4 percent in 1999.

What types of government outlays increased over this period? To help answer this question, we disaggregate GO into two conceptually distinct categories: transfers and subsidies as a percentage of GDP (TR) and government purchases of goods and services as a percentage of GDP (G). Figures 3 and 4 provide country graphs of TR and G, respectively. [9] On average, both G and TR have increased over time. Comparing 1970 and 1999, transfers increased from 14 to 20 percent of GDP while government purchases increased from 19.6 to 25.4 percent of GDP. While G and TR increased by roughly the same amounts on average, substantial variations exist among countries. For example, almost all of Japan's increases in GO came from increases in G while the vast majority of Spain's came from increases in TR.

Clearly, over the last three decades of the twentieth century, unemployment rates and the size of government have increased on average in OECD countries. Can increases in unemployment rates be linked to the growth in government? If so, do government purchases of goods and services and transfer programs produce similar effects on the unemployment rate? The next two sections will shed some light on these issues.

## 4. The Methodology

Our empirical analysis of the unemployment dynamics starts with a two-equation error-correction model:

[9] Data on Japan's total government outlays (GO) are available for the full sample period. However, data on government purchases (G) and transfers (TR) are available only for the period 1970-1990.

$$U_{i,t}^{*} = \gamma\, GOV_{i,t} + \beta' X_{i,t} + \nu_i + \varepsilon_{i,t}, \tag{2}$$

$$\Delta U_{i,t} = \lambda\,(U_{i,t-1}^{*} - U_{i,t-1}) + \delta\, GRO_{i,t} + \theta\, \Delta INF_{i,t} + \eta_i + \varpi_{i,t}. \tag{3}$$

For country *i* in period *t*, equation (2) describes the determination of the steady-state unemployment rate, and equation (3) captures the period-to-period evolution of the observed unemployment rate. In particular, the steady-state or natural long-run unemployment rate $U^{*}$ is determined by government size, *GOV*, and a vector, *X*, of regulatory and labor market institutions including the minimum wage, trade union density rate, and the unemployment benefits replacement rate.[10] The period-to-period evolution of the observed unemployment rate, $\Delta U_{i,t}$, is assumed to be affected by three factors: (i) the deviation of the actual unemployment rate from its steady-state level in the previous period, $(U_{i,t-1}^{*} - U_{i,t-1})$; (ii) the business cycle, measured by the real GDP growth rate, $GRO_{i,t}$;[11] and (iii) inflation shock, $\Delta INF_{i,t}$, which captures the short-run (expectation-adjusted) "Phillips curve" effect.[12] In equation (3), $\lambda$ should lie between 0 and 1, with larger value of $\lambda$ suggesting faster speed of adjustment to unemployment disequilibrium. Country fixed effects $\nu_i$ and $\eta_i$ capture the unobserved country-specific characteristics, such as cultural, demographic, religious and legal factors, and time-invariant political and

[10] Other labor-market institutions, such as employment protection legislations, strictness of unemployment benefit conditions, active labor market programs and degree of coordination in collective bargaining, have also been shown to have significant impacts on the unemployment rate. See Scarpetta (1996), Elmeskow et al. (1998), Heckman and Pages-Serra (2000), Feldmann (2006), Nickell et al. (2005), Belot and van Ours (2004), Botero et al. (2004). They are not included in our study due to the lack of time series data for the period considered.

[11] Theoretically, lagged real GDP growth should be used in equation (3) to reflect the business cycle effect since movements in the unemployment rate tend to lag the real GDP growth. However, as our sample consists of annual data, the current real GDP growth seems to be more appropriate. Empirically, we find that the current real GDP growth works better than the lagged one.

[12] For simplicity, we use the lagged inflation rate as a proxy for the expected inflation rate so that the first difference, $\Delta INF_{i,t}$, measures the unexpected inflation, the factor presumably driving the Phillips curve tradeoff. Phelps (1994, p.326) used the same variable as a proxy for demand shocks.

labor-market institutions. Error terms $\varepsilon_{i,t}$ and $\varpi_{i,t}$ are assumed to be independently and identically distributed (i.i.d.) across *i* and over *t*.

Since the steady-state unemployment rate is unobserved, we cannot estimate the error-correction model directly. Instead of using estimates or proxies for $U^*$ (Abrams, 1999), we reduce the two-equation error-correction model into a single equation

$$U_{i,t} = \rho_1 U_{i,t-1} + \rho_2 GOV_{i,t-1} + \rho_3 GRO_{i,t} + \rho_4 \Delta INF_{i,t} + \phi' X_{i,t-1} + u_i + \xi_{i,t} \quad (4)$$

where

$$\rho_1 = 1-\lambda,\ \rho_2 = \lambda\gamma,\ \rho_3 = \delta,\ \rho_4 = \theta,\ \phi = \lambda\beta, \quad (5)$$

$u_i = \lambda v_i + \eta_i$ represents the country fixed effects and $\xi_{i,t} = \lambda \varepsilon_{i,t} + \varpi_{i,t}$ the i.i.d. error term. Hence, if we can estimate equation (4) consistently, we can then recover the parameters in the error-correction model using the relationships in equation (5).

Note that equation (4) is a dynamic panel data model with country fixed effects. For dynamic panel data models, the Arellano-Bond estimator (Arellano and Bond, 1991), or the generalized method-of-moment (GMM) estimators in general, is often the obvious estimator of choice because it is consistent under a variety of conditions.[13] To estimate equation (4), the Arellano-Bond estimator takes the following steps: (1) first-difference the equation to remove the fixed effect $u_i$; and (2) apply a GMM estimator to the first-differenced equation. Since unemployment, growth, inflation and government size are likely to be jointly determined, to control for simultaneity bias, we treat $GRO_{i,t}$ and

[13] The Arellano-Bond estimator (or GMM estimators in general) is consistent whether a dynamic panel data model has fixed or random effects, see Hsiao (2003). For a random-effect model, it remains consistent even if regressors are correlated with the random effects. Our model is specified to contain fixed effects because fixed-effect models are in general more appropriate in macroeconomic analysis than random-effect models, see Judson and Owen (1999). Judson and Owen also discussed the finite-sample performance of the Arellano-Bond estimator for the typical macroeconomic panel datasets.

$\Delta INF_{i,t}$ as endogenous, $U_{i,t-1}$ and $GOV_{i,t-1}$ as predetermined, and the institutional variables as strictly exogenous.[14] The instruments for the Arellano-Bond estimator include lagged levels of the dependent variable, lagged levels of the predetermined and endogenous regressors, and differences of the strictly exogenous regressors.

Several important hypotheses can be tested based on the estimation results of the error-correction model. A positive and significant estimate of $\gamma$ would support what Christopolous and Tsionas (2002) and Christopolous, et al. (2005) have called the "Abrams curve", that is, a positive association between government size and the steady-state unemployment rate. A negative and significant estimate of $\theta$ would point to the short-run Phillips curve tradeoff between inflation and unemployment rate. Business cycle theory suggests that $\delta$<0. If Okun's law applies to our study, we would expect that $\delta \approx -0.3$, that is, for every one percentage point increase in the real GDP growth rate, there is roughly a 0.3 percentage point decrease in the unemployment rate.

Our two-equation error-correction model provides some major improvements over those adopted in the existing literature. First, equation (2) alone may seem to suggest a contemporaneous relationship between the unemployment rate and government size, which is unrealistic. However, by combining equations (2) and (3), our error-correction model is actually path-dependent. This is easily seen in equation (4), the dynamic panel model. Specifically, by including the lagged unemployment as an explanatory variable,

[14] We follow the standard practice of treating the labor market institutions as exogenous, although in the long run institutions are not exogenously determined but vary in response to the evolution of the unemployment rate. Since the Arellano-Bond estimator is essentially a GMM estimator of the first difference of equation (4), treating the labor market institutions as exogenous is harmless as long as $E(\Delta X_{i,t-1}\Delta\xi_{i,t}) = 0$, which is true if $E(X_{i,s}\xi_{i,t}) = 0$ for all $s \le t$. Since our analysis is based on annual data and changes in institutions take time, we can safely assume that labor market institutions are uncorrelated with current and further unemployment shock and are hence exogenous.

the unemployment rate in any given period is projected to depend on the entire history of government size while the effect of government size diminishes over time.[15] In contrast, the existing empirical studies have used static models and have hence overlooked the impact of past government size on current unemployment. Secondly, by distinguishing endogenous ($GRO_{i,t}$ and $\Delta INF_{i,t}$), predetermined ($U_{i,t-1}$ and $GOV_{i,t-1}$) and strictly exogenous regressors (institutional variables), our model estimation is not subject to simultaneity bias. Other studies have made no such distinctions. In addition, Abrams (1999) used 5-year averages both to obtain a proxy for the unobserved steady-state unemployment rate and to take out the business cycle effect. Unfortunately, using period-averaged data are likely to aggravate the simultaneity problem.[16] Third, our study is based on annual data which allows better exploration of the within-country variations. This is important for cross-country studies where samples tend to cover a relative short period of time.

**5. Empirical Results**

In this section, we present briefly the estimation results of equation (4), followed by details of the empirical findings from the error-correction model of equations (2) and (3). Our results are obtained using annual observations from twenty OECD countries for the period 1970-1999. We focus on the OECD countries because their data are of high

[15] The effect of $GRO_{i,t-j}$ on $U_{i,t}$ is $\rho_1^{\,j-1}\rho_2$ where $\rho_1 \in (0,1)$ if $\lambda$ in equation (3) is between 0 and 1.

[16] Suppose the true data generating process is $y_{i,t} = \alpha + \beta x_{i,t} + \varepsilon_{i,t}$, where $x_{i,t}$ is predetermined so that $x_{i,t}$ is correlated with lagged values of $\varepsilon_{i,t}$ but not the current $\varepsilon_{i,t}$. There is no simultaneity problem if annual data is used to estimate the regression. However, if period-averaged data is used, then the estimated regression becomes $\bar{y}_i = \alpha + \beta \bar{x}_i + \bar{\varepsilon}_i$. Since $\bar{x}_i$ is correlated with $\bar{\varepsilon}_i$, the parameter estimates are therefore subject to the simultaneity bias.

quality and cross-country compatibility. Our sample ends in 1999, which coincides with the introduction of the euro. Combining the pre-euro and post-euro periods will no doubt increase the sample size and make this study appear more up to date. But it will also subject our estimation results to the complications of a structural break.[17] Therefore, instead of taking up the ambitious task of investigating the relationship between government size and unemployment rate in the midst of a major structural break, we content ourselves with focusing on the pre-euro period.

To obtain accurate parameter estimates, it is important that our sample display enough variations. Table 1 reports some descriptive statistics of the pooled data. From these statistics and the time series plots in Figures 1-4, it is clear that substantial within- and across-country variations are present in our sample. As a preliminary step in the empirical analysis, we examine the country graphs of unemployment rates against government size variables (Figures 5-7). There appears to be a strong positive relationship between the unemployment rate and GO (total government outlays as a percentage of GDP), and between the unemployment rate and TR (transfers and subsidies as a percentage of GDP). However, the relationship between the unemployment rate and G (government purchases of goods and services as a percentage of GDP) seems much weaker. These observations are corroborated by the correlation coefficients in Table 2.

We consider five model specifications. Specification 1, our baseline specification, uses GO as an overall measure of the government size and assumes that the steady-state

[17] A few tests (e.g. Wacheter and Tzavalis (2004)) have been developed to detect a structural break in dynamic panel data models. But to the best of our knowledge, none of them allows for endogenous regressors. Furthermore, even if we know the timing of the break, it is not clear how to properly model it. Including a year dummy for the EMU is, in our opinion, naïve and inadequate. The unemployment dynamics may be dramatically different in the euro zone due to its single monetary policy and stringent fiscal policy rules. As a result, it may be necessary to set up a separate model for the EMU members in the post-euro period.

unemployment rate is determined by both the government size and the labor-market institutions. In specification 2, we disaggregate GO and enter G and TR separately in equation (2) to capture any different effects these outlays might have on the unemployment rate.[18] Specifications 3 and 4 are obtained by dropping the labor-market institutions from specifications 1 and 2, respectively, and specification 5 is obtained by dropping government size from the baseline specification.

OECD provides data on several regulatory and labor market institutions that seem on *a priori* grounds to be relevant for affecting the unemployment rate. *Trade union density rate* is a measure of the extent of union involvement in the labor market. If trade unions can successfully raise wages above the market clearing levels, we should expect higher union density to be associated with higher unemployment rate. *Minimum wage* measures the statutory minimum wage as a percentage of the nation's median wage. High minimum wage can be expected to prevent labor market clearing, reduce the finding rate, and hence raise the unemployment rate, other things equal. U*nemployment benefits replacement rate* measures gross unemployment benefits as a percentage of the previous gross wage earnings. Presumably the higher the replacement rate, the lower the opportunity cost of unemployment and the lower the finding rate. While minimum wages and replacement rates are specific government programs and, as such, including them in equation (2) is not in keeping with the pure aggregative approach, they are so commonly used in other studies that we felt they should be included in our baseline specification. As will be seen, their inclusion or exclusion from the model has no effect on our findings.

[18] It would be desirable to separate out government outlays on active labor market programs so that we can test if and to what extend such outlays would lower the unemployment rate. We are not able to do so due to lack of data in 1970s and early 1980s.

Table 3 presents the one-step Arellano-Bond estimates of equation (4).[19] The five columns correspond to the five specifications described above. The Arellano-Bond estimator seems to be appropriate for these specifications as the Sargan tests cannot reject the validity of the over-identifying restrictions and the second-order autocorrelation in $\Delta\xi_{i,t}$ is insignificant at any conventional level.[20]

Table 4 reports the estimation results of the error-correction model of equations (2) and (3), which are derived from the Arellano-Bond estimates of equation (4) and the relationships in equation (5). The five columns again correspond to the five model specifications. In the remaining of this section, we focus on the empirical findings from the error-correction model.

As for the short-run dynamics (equation (3)), all five specifications yield similar results. As expected, the coefficients on both the real GDP growth and the unexpected inflation are negative and significant. In particular, for every one percentage point increase in the real GDP growth rate, there is roughly a 0.27 percentage point decrease in the unemployment rate, a result strikingly close to that reported by Okun (1962).[21] In contrast, the impact of unexpected inflation is much smaller. For every one percentage point increase in the unexpected inflation, there is merely a 0.08 percentage point decrease in the unemployment rate. The speed of adjustment to unemployment

[19] The two-step Arellano-Bond estimates are not reported here because their standard errors tend to be biased downward in small samples, see Arellano and Bond (1991).

[20] The Arellano-Bond estimator is essentially a GMM estimator of the first difference of equation (4). Its consistency requires that there is no second-order autocorrelation in the error term of the first-differenced equation ( $\Delta\xi_{i,t}$ ).

[21] Okun (1962), in his so-called Method 1, regressed the first difference in unemployment rate on a constant and the real GNP growth rate. The estimated coefficient on the real GNP growth rate was -0.3. Okun's study differs from ours in terms of data, the regression equation and the estimation method. In particular, Okun estimated his regressions by OLS and treated the real GNP growth rate as exogenous.

disequilibrium ($\lambda$) is estimated to be 0.12 for specification 1 and 0.14 for specification 2, which suggests the half-life to convergence[22] being 4.7~5.4 years.

In the long run (equation (2)), increases in government outlays tend to raise the steady-state unemployment rate.[23] In specification 1, government size is found to have a positive effect on the steady-state unemployment rate. The effect is both statistically and economically significant. A 10 percentage point increase in GO (e.g. total government outlays increase from 30% to 40% of GDP) leads to a 2.2 percentage point increase in the steady-state unemployment rate (e.g. unemployment rate increases from 4% to 6.2%). This is somewhat less than the impact reported by Abrams (1999) and Christopoulos et al. (2005), who found that a 10 percentage point increase in GO raises the steady-state unemployment rate by approximately 3 percentage points. In specification 2, we find that transfers and subsidies have a positive and significant effect on the steady-state unemployment rate, while the effect of government purchases is positive but insignificant. A 10 percentage point increase in TR (e.g. transfers and subsidies increase from 10% to 20% of GDP) leads to a 5.7 percentage point increase in the steady-state unemployment rate. The results remain virtually the same when G is dropped from the regression.[24] In both specifications, the regulatory and labor-institution variables do not seem to play a significant role in the determination of the steady-state unemployment rate. When we drop the labor institutions from the regression, the results on the remaining variables hardly change (specifications 3 and 4).

[22] The half-life to convergence is the expected number of years needed for the initial unemployment disequilibrium to be reduced by half. It is calculated as $-\ln(2)/\ln(1-\lambda)$.

[23] The positive link between government size and the steady-state unemployment rate is not likely to be spurious due to considerable across-country variations in both variables.

[24] Details are available upon request.

The lack of significance of the labor-market institutions seems to contradict the conventional wisdom. One may suspect that the unemployment effects of institutions are picked up by the government outlays. However, when we drop the government size variable from the regression, labor-market institutions remain insignificant (specification 5). This result is broadly consistent with some of the previous studies that have followed the program-specific approach (Oswald, 1997). It appears that some of the institutions might not provide binding constraints, while others do not accurately describe the labor market structure. For example, the statutory minimum wage in OECD countries often proves to be too low to have a significant effect on the unemployment rate of adult men. Moreover, union density may not be an accurate measure of union involvement in the labor market as union wage negotiations in many countries cover a large proportion of workers that are not union members (Nickell, 1997).[25]

## 6. Sensitivity Analysis

In this section, we examine the robustness of our empirical findings from five aspects: (i) sensitivity to different measures of government size; (ii) sensitivity to additional explanatory variables; (iii) stability of parameter estimates cross country and over time; (iv) sensitivity to heteroskedastic error terms; and (v) sensitivity to different instrument sets used in the Arellano-Bond estimator. Tables 5 and 6 summarize the sensitivity analysis for specifications 1 and 2 of the error-correction model, respectively. To facilitate comparison, columns (1) and (2) in Table 4, which we shall refer to as the

[25] Collective bargaining coverage (measured as the percentage of employees covered by collective bargaining agreements) is likely to be a better measure of union's role in wage determination. In many OECD countries, there is a wide gap between density and coverage. Taking France as an example, its density is about 10% but coverage is 95% in 1994. Unfortunately, OECD data on collective bargaining coverage is very limited, available only for 1980, 1990 and 1994.

"benchmark", are copied into column (a) in Table 5 and column (a) in Table 6, respectively

Different measures of government size

We re-estimate the model by replacing the OECD's total government outlays as a percentage of GDP (GO) with the World Bank's broadest measure of government size, total government expenditures as a percentage of GDP (GE).[26] The results are very close to the benchmark, except that GE is estimated to have a larger effect on the steady-state unemployment rate than the GO (column (b) in Table 5). A 10 percentage point increase in GE leads to a 4.0 percentage point increase in the steady-state unemployment rate. However, once we disaggregate total government expenditures into transfers and government purchases, all coefficient estimates become very close to the benchmark (column (b) in Table 6).

Additional explanatory variables

Several studies have considered the real interest rate as a determinant of the long-run unemployment rate (Phelps, 1994, Blanchard and Wolfers, 2000). In addition, oil price shocks are often expected to affect the short-term unemployment fluctuations. Therefore, we experimented by adding the real interest rate to equation (2) and an oil price shock to equation (3), where the oil price shock is measured as the first difference of the annual percentage change in nominal oil prices. In applying the Arellano-Bond estimator to equation (4), we treat the lagged real interest rate as predetermined and oil price shock as strictly exogenous. The results are reported in columns (c) in Tables 5 and

[26] GO differs from GE, in part, because the former includes consolidated accounts that would include some outlays from non-federal governments. Some researcher have used GO (e.g., Abrams, 1999) and others have used GE (e.g., Christopoulos and Tsionas, 2002, and Christopoulos, et al., 2005). Definitions for these variables are provided in the Appendix.

6. The real interest rate is found to have a positive and significant effect while the effect of the oil price shock is insignificant. The effect of total government outlays is very close to the benchmark. While the effect of government purchases turns negative, it remains statistically insignificant. The positive effect of transfers and subsidies becomes considerably larger than the benchmark. Union density becomes positive and significant in specification 1 while unemployment benefits become negative and significant in specification 2. There is no significant change in the coefficient estimate on unemployment disequilibrium, real GDP growth or inflation shock, or the estimated half-life to convergence.

Stability of parameter estimates cross country and over time

To see if the parameters are stable cross country, we re-estimate the model using two sub-samples. First, we notice that Japan and Spain represent potential outliers. Almost all of Japan's dramatic growth in government over the period was in the form of government purchases, while Spain's was in transfers and subsidies (Figures 2-4). Spain's unemployment rate rose dramatically while Japan's increased little (Figure 1). To see if the results reported in section 5 are driven by these two countries, we dropped both Spain and Japan from the sample. The results are almost identical to the benchmark (columns (d) in Tables 5 and 6). Secondly, unemployment rates in the European and non-European countries may have followed different dynamics. Therefore, we re-estimate the model using data from the 16 OECD-European countries. The results are again almost identical to the benchmark (columns (e) in Tables 5 and 6).

To see if the parameters are stable over time, we re-estimate the model using sub-samples 1970-1989 and 1980-1999, respectively.[27] The results based on sub-sample 1970-1989 differ slightly from the benchmark (columns (f) of Tables 5 and 6). The effect of real GDP growth on the short-run unemployment dynamics is smaller and the effect of transfers and subsidies on the steady-state unemployment rate is larger as compared to the benchmark. In contrast, the results based on sub-sample 1980-1999 differ more significantly from the benchmark (columns (g) of Tables 5 and 6). The effects of total government outlays, real GDP growth and inflation shocks are larger than the benchmark. In addition, some of the labor-market institutions turn significant at the 5% or 10% level. Increases in union density and unemployment benefits seem more likely to raise the steady-state unemployment rate in the later years of our sample than in the earlier years. Overall, the findings reported in section 5 seem robust to changes in the estimation sample.

Heteroskedastic error terms

The results in Section 5 are obtained under the assumption that the error term $\xi_{i,t}$ in equation (4) is homoskedastic. To allow for heteroscedastic errors, we re-calculate the t-statistics using the robust estimates of the standard errors (columns (h) in Tables 5 and 6). Although the t-statistics are significantly reduced for total government outlays, transfers and subsidies and real GDP growth, our conclusions are not affected by these changes. In particular, the significance level of total government outlays is reduced from 1% to 5%. Transfers and subsidies, unemployment disequilibrium, real GDP growth and

[27] It is probably more informative to re-estimate our model using data from each of the three decades. However, the decade sub-samples are too small to make any reliable comparison.

inflation shock remain significant at the 1% level, while government purchases and the labor-market institutions remain insignificant.

Different instrument sets

In Section 5, the Arellano-Bond estimator is constructed using the "optimal" instrument set.[28] While theoretically, adding more instruments (or moment conditions) would improve the asymptotic efficiency of the estimator, the finite-sample bias can be quite severe as the number of moment conditions expands, outweighing the gains in efficiency (Ziliak, 1997). This is because the Arellano-Bond estimator uses lagged values of the endogenous and predetermined variables as instruments and lags dated far into the past have weak correlation with the endogenous regressors. So we experimented with instrument sets that consist of fewer lags of the endogenous and predetermined variables, the results are very close to the benchmark.[29]

## 7. Concluding Remarks

Although many empirical studies have been done on the effect of government size on economic growth[30], the effect of government size on the unemployment rate has received little attention. In addition, the few studies that did look at this issue suffer a number of econometric problems that could render their conclusions invalid.

The aggregate approach and our error-correction model provide new insights into and additional support for the hypothesis that government size plays a significant role in affecting a nation's steady-state unemployment rate. Our findings are not subject to

[28] The "optimal" instrument set for the Arellano-Bond estimator consists of levels of the dependent variable and endogenous regressors lagged by two or more periods, levels of the predetermined regressors lagged by one or more periods, and first differences of the strictly exogenous regressors.
[29] Detailed results are not reported here but available upon request.
[30] See Agell et al. (1997) for a review.

simultaneity bias or reverse causality, a significant improvement over the previous studies, such as Abrams (1999) and Feldmann (2006). Importantly, we find that government transfers and subsidies produce a significantly different impact on the unemployment rate than do government purchases of goods and services. While increases in transfers and subsidies are linked to higher steady-state unemployment rates, we find no significant role for government purchases, given the level of aggregation used in this study.

Our estimates for the magnitude of the effect of transfers on the unemployment rate provide a straightforward explanation for Eurosclerosis, the hardening of Europe's economic arteries. On average, transfers and subsidies in the 16 OECD-European countries have increased by 6.7 percent of GDP between 1970 and 1999.[31] Our model (Table 4, specification 2) would project approximately a 3.8 percentage point increase in the steady-state unemployment rate. In contrast, the actual unemployment rates of these countries have increase by an average of 5.8 percent between 1970 and 1999. Thus, our model suggests that two-third of the secular rise in unemployment rates in OECD-Europe can be attributed to increases in government transfers and subsidies. [32]

Recent health care reform in the United States can be expected to raise the steady-state unemployment rate. While it is difficult to estimate to what extent the Patient Protection and Affordable Care Act of 2010 would increase government transfers and subsidies, as a thought experiment, should the program raise transfers as a percent of

[31] Data for some countries are not available for all years. We took the closest years available in calculating changes in the transfers and subsidies and the employment rates.

[32] Transfers and subsidies are estimated to have a much larger effect when interest rate and oil price shock are added to the model (column (c) in Table 6). For a 6.7 percentage point increase in TR, this model specification predicts a 5.3% increase in the steady state unemployment rate, which is strikingly close to the 5.8% increase in the observed unemployment rates.

GDP by 5 percent, our model suggests a rise in the U.S. steady-state unemployment rate of approximately 2.8 percent. [33] Since the U.S. "full employment" unemployment rate is currently estimated to be around 5 percent, the new steady-state unemployment rate would rise to 7.8 percent. This would put the U.S. close to Western Europe's steady-state unemployment rate.

[33] The original Administration's estimate was that the recent health care reform was going to add nothing to cost. However, administration's spending projections for health care legislation have never come close to the actual expenditures. Take Medicare for example. Enacted in 1965, the initial projection was that it would cost $9 billion a year by 1990. The actual figure for 1990 turned out to be $67 billion.

**Appendix: Variable Definitions and Sources**

*Unemployment rate*: Unemployment as a percentage of total labor force. Source: OECD Historical Statistics, various issues.

GO: Total outlays of (consolidated) government as a percentage of GDP. Source: OECD Historical Statistics, various issues.

GE: Central government nonrepayable current and capital expenditures as a percentage of GDP. Source: World Bank, World Development Indicators (2004).

TR: Central government subsidies and other current transfers as a percentage of GDP. Source: World Bank, World Development Indicators (2004).

*Real GDP growth rate*: Annual percentage change in real GDP measured in U.S. dollar. Source: World Bank, World Development Indicators (2004).

*Inflation shock*: First difference of the CPI-based inflation rate. Source: World Bank, World Development Indicators (2004).

*Real interest rate*: Money market interest rate minus the CPI-based inflation rate. Source: International Financial Statistics, IMF.

*Oil price shock*: First difference of the percentage change in nominal oil prices. Source: International Financial Statistics, IMF.

*Minimum wage*: Statutory minimum wage as a percentage of a nation's median wage. Source: OECD Labour Market Statistics (2001).

*Trade union density rate*: Percentage of employees that are trade union members. Source: OECD Labour Market Statistics (2001).

Unemployment benefits replacement rate: Gross unemployment benefits as a percentage of the previous gross wage earnings. Data for odd years are available from OECD Labour Market Statistics (2001), data for even years are obtained using linear interpolation.

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## Table 1: Summary Statistics

| | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Unemployment rate | 6.75 | 4.43 | 0.20 | 23.80 |
| Total government outlays as % of GDP (GO) | 45.66 | 9.48 | 20.80 | 69.80 |
| Government purchases as % of GDP (G) | 25.39 | 6.66 | 1.16 | 48.13 |
| Transfers & subsidies as % of GDP (TR) | 20.27 | 7.49 | 1.65 | 39.69 |
| Real GDP growth rate | 2.69 | 2.41 | -7.28 | 10.16 |
| Inflation shock | -0.19 | 2.79 | -13.54 | 11.51 |
| Minimum wage | 21.70 | 25.97 | 0 | 76.70 |
| Trade union density rate | 45.34 | 18.97 | 8.30 | 91.10 |
| Unemployment benefits replacement rate | 27.40 | 13.29 | 0.30 | 71.00 |

## Table 2: Correlation Matrix

| | Unemployment rate | Total government outlays as % of GDP (GO) | Government purchases as % of GDP (G) | Transfers & subsidies as % of GDP (TR) | Real GDP growth rate | Inflation shock | Minimum wage | Trade union density rate | Unemployment benefits replacement rate |
|---|---|---|---|---|---|---|---|---|---|
| Unemployment rate | 1.00 | | | | | | | | |
| Total government outlays as % of GDP (GO) | 0.27 | 1.00 | | | | | | | |
| Government purchases as % of GDP (G) | 0.04 | 0.62 | 1.00 | | | | | | |
| Transfers & subsidies as % of GDP (TR) | 0.30 | 0.72 | -0.11 | 1.00 | | | | | |
| Real GDP growth rate | -0.06 | -0.21 | -0.12 | -0.16 | 1.00 | | | | |
| Inflation shock | -0.18 | -0.12 | -0.07 | -0.09 | 0.05 | 1.00 | | | |
| Minimum wage | 0.25 | -0.05 | -0.05 | -0.02 | -0.02 | -0.04 | 1.00 | | |
| Trade union density rate | -0.17 | 0.41 | 0.32 | 0.23 | -0.01 | -0.01 | -0.55 | 1.00 | |
| Unemployment benefits replacement rate | 0.27 | 0.54 | 0.07 | 0.62 | -0.09 | -0.08 | 0.08 | 0.16 | 1.00 |

## Table 3: Arellano-Bond Estimates of the Reduced-Form Model --- Equation (4)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Unemployment rate ( $U_{i,t-1}$ ) | 0.880*** (45.46) | 0.863*** (44.47) | 0.883*** (47.08) | 0.864*** (45.59) | 0.901*** (48.60) |
| Total government outlays as % of GDP ( $GO_{i,t-1}$ ) | 0.026*** (2.97) | | 0.028*** (3.32) | | |
| Government purchases as % of GDP ( $G_{i,t-1}$ ) | | 0.013 (1.40) | | 0.013 (1.44) | |
| Transfers & subsidies as % of GDP ( $TR_{i,t-1}$ ) | | 0.079*** (4.90) | | 0.075*** (5.16) | |
| Real GDP growth rate ( $GRO_{i,t}$ ) | -0.274*** (-17.53) | -0.270*** (-17.61) | -0.276*** (-17.78) | -0.270*** (-17.73) | -0.286*** (-18.15) |
| Inflation shock ( $\Delta INF_{i,t}$ ) | -0.083*** (-6.94) | -0.079*** (-6.72) | -0.084*** (-7.04) | -0.079*** (-6.76) | -0.085*** (-6.98) |
| Minimum wage | 0.0004 (0.12) | 0.002 (0.66) | | | 0.002 (0.46) |
| Trade union density rate | 0.008 (1.10) | -0.003 (-0.37) | | | 0.011 (1.53) |
| Unemployment benefits replacement rate | -0.0003 (-0.04) | -0.002 (-0.28) | | | 0.007 (1.02) |
| | | | | | |
| Sargan test of over-identifying restrictions | 534.32 (1.000) | 538.97 (1.000) | 534.35 (1.000) | 541.47 (1.000) | 513.79 (1.000) |
| Arellano-Bond test for 1st-order autocorrelation of $\Delta\xi_{i,t}$ | -5.85*** (0.000) | -5.80 (0.000) | -5.89*** (0.000) | -5.82*** (0.000) | -5.84*** (0.000) |
| Arellano-Bond test for 2st-order autocorrelation of $\Delta\xi_{i,t}$ | -0.87 (0.386) | -0.94 (0.346) | -0.86 (0.387) | -0.98 (0.327) | -0.90 (0.366) |
| Estimated variance of the error term $\xi_{i,t}$ | 0.884 | 0.854 | 0.882 | 0.851 | 0.916 |

Notes: Numbers in parentheses are t-statistics associated with coefficient estimates or p-values associated with test statistics. ***, **, * denotes statistical significance at the 1%, 5%, 10% level, respectively.

## Table 4: Arellano-Bond Estimates of the Error-Correction Model --- Equations (2) and (3)

| **Long-run parameters --- Equation (2)** | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Total government outlays as % of GDP (GO) | 0.219***<br>(3.16) | | 0.237***<br>(3.59) | | |
| Government purchases as % of GDP (G) | | 0.094<br>(1.44) | | 0.094<br>(1.48) | |
| Transfers & subsidies as % of GDP (TR) | | 0.574***<br>(5.10) | | 0.549***<br>(5.57) | |
| Minimum wage | 0.003<br>(0.12) | 0.016<br>(0.66) | | | 0.017<br>(0.45) |
| Trade union density rate | 0.066<br>(1.13) | -0.020<br>(-0.37) | | | 0.114<br>(1.60) |
| Unemployment benefits replacement rate | -0.002<br>(-0.04) | -0.014<br>(-0.28) | | | 0.074<br>(1.00) |
| **Short-run parameters --- Equation (3)** | | | | | |
| Unemployment disequilibrium ( $U^{*}_{i,t-1} - U_{i,t-1}$ ) | 0.120***<br>(6.18) | 0.137***<br>(7.06) | 0.117***<br>(6.23) | 0.136***<br>(7.18) | 0.099***<br>(5.34) |
| Real GDP growth rate ( $GRO_{i,t}$ ) | -0.274***<br>(-17.53) | -0.270***<br>(-17.61) | -0.276***<br>(-17.78) | -0.270***<br>(-17.73) | -0.286***<br>(-18.15) |
| Inflation shock ( $\Delta INF_{i,t}$ ) | -0.083***<br>(-6.94) | -0.079***<br>(-6.72) | -0.084***<br>(-7.04) | -0.079***<br>(-6.76) | -0.085***<br>(-6.98) |
| | | | | | |
| Half-life to convergence (years) | 5.44 | 4.71 | 5.58 | 4.74 | 6.65 |

Notes: t-statistics are reported in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, 10% level, respectively.

## Table 5: Sensitivity Analysis: Error-Correction Model, Specification 1

| | Benchmark | Alternative measure of government size | Additional regressors | 18 countries (drop Japan & Spain) | 16 European countries | 20 countries 1970-1989 | 20 countries 1980-1999 | Error heteroskedasticity |
|---|---|---|---|---|---|---|---|---|
| **Long-run parameters --- Equation (2)** | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) |
| Total government outlays as % of GDP (GO)[a] | 0.219***<br>(3.16) | | 0.194***<br>(2.88) | 0.227***<br>(3.04) | 0.237***<br>(3.25) | 0.207**<br>(2.32) | 0.299***<br>(3.25) | 0.219**<br>(1.99) |
| Total government expenditures as % of GDP (GE)[b] | | 0.396***<br>(4.79) | | | | | | |
| Real interest rate | | | 0.325***<br>(3.31) | | | | | |
| Minimum wage | 0.003<br>(0.12) | 0.007<br>(0.30) | -0.005<br>(-0.02) | 0.010<br>(0.32) | -0.0007<br>(-0.01) | -0.018<br>(-0.50) | -0.035<br>(-0.77) | 0.003<br>(0.18) |
| Trade union density rate | 0.066<br>(1.13) | 0.050<br>(0.97) | 0.112**<br>(1.97) | 0.060<br>(0.94) | 0.063<br>(1.06) | 0.053<br>(0.52) | 0.162**<br>(2.10) | 0.066<br>(0.81) |
| Unemployment benefits replacement rate | -0.002<br>(-0.04) | -0.020<br>(-0.39) | -0.061<br>(-1.09) | -0.002<br>(-0.03) | -0.028<br>(-0.46) | -0.033<br>(-0.41) | 0.167*<br>(1.67) | -0.002<br>(-0.03) |
| **Short-run parameters --- Equation (3)** | | | | | | | | |
| Unemployment disequilibrium ($U^{*}_{i,t-1} - U_{i,t-1}$) | 0.120***<br>(6.18) | 0.137***<br>(6.92) | 0.128***<br>(6.25) | 0.113***<br>(5.56) | 0.116***<br>(5.90) | 0.121***<br>(4.98) | 0.141***<br>(4.47) | 0.120***<br>(6.38) |
| Real GDP growth rate ($GRO_{i,t}$) | -0.274***<br>(-17.53) | -0.273***<br>(-17.85) | -0.293***<br>(-16.93) | -0.273***<br>(-16.83) | -0.278***<br>(-16.73) | -0.226***<br>(-12.78) | -0.363***<br>(-15.26) | -0.274***<br>(-7.18) |
| Inflation shock ($\Delta INF_{i,t}$) | -0.083***<br>(-6.94) | -0.079***<br>(-6.69) | -0.092***<br>(-6.55) | -0.085***<br>(-6.62) | -0.081***<br>(-6.27) | -0.076***<br>(-6.12) | -0.090***<br>(-4.10) | -0.083***<br>(-6.40) |
| Oil price shock | | | -0.007<br>(-0.09) | | | | | |
| | | | | | | | | |
| Half-life to convergence (years) | 5.44 | 4.72 | 5.06 | 5.77 | 5.60 | 5.37 | 4.55 | 5.44 |

[a]: general government figures
[b]: central government figures

Notes:
1. Column (a) corresponds to column 1 in Table 4.
2. Full sample consists of 20 countries over the period 1970-1999.
3. t-statistics are reported in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, 10% level, respectively.

## Table 6: Sensitivity Analysis: Error-Correction Model, Specification 2

| | Benchmark | Alternative measure of government size | Additional regressors | 18 countries (drop Japan & Spain) | 16 European countries | 20 countries 1970-1989 | 20 countries 1980-1999 | Error heteroskedasticity |
|---|---|---|---|---|---|---|---|---|
| **Long-run parameters --- Equation (2)** | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) |
| Government purchases as % of GDP (G)[a] | 0.094<br>(1.44) | | -0.035<br>(-0.51) | 0.094<br>(1.37) | 0.103<br>(1.53) | 0.084<br>(1.16) | 0.057<br>(0.58) | 0.094<br>(0.91) |
| Government purchases as % of GDP (G')[b] | | 0.079<br>(0.41) | | | | | | |
| Transfers & subsidies as % of GDP (TR) | 0.574***<br>(5.10) | 0.548***<br>(4.41) | 0.780***<br>(6.22) | 0.608***<br>(5.05) | 0.603***<br>(5.20) | 0.689***<br>(4.83) | 0.614***<br>(4.49) | 0.574***<br>(2.58) |
| Real interest rate | | | 0.278***<br>(3.68) | | | | | |
| Minimum wage | 0.016<br>(0.66) | 0.019<br>(0.74) | 0.010<br>(0.46) | 0.018<br>(0.71) | 0.016<br>(0.38) | 0.007<br>(0.25) | -0.025<br>(-0.60) | 0.016<br>(1.20) |
| Trade union density rate | -0.020<br>(-0.37) | -0.008<br>(-0.14) | -0.017<br>(-0.35) | -0.027<br>(-0.48) | -0.024<br>(-0.44) | -0.063<br>(-0.78) | 0.081<br>(1.10) | -0.020<br>(-0.35) |
| Unemployment benefits replacement rate | -0.014<br>(-0.28) | -0.004<br>(-0.08) | -0.098**<br>(-2.20) | -0.018<br>(-0.34) | -0.029<br>(-0.56) | -0.052<br>(-0.85) | 0.154*<br>(1.77) | -0.014<br>(-0.24) |
| **Short-run parameters --- Equation (3)** | | | | | | | | |
| Unemployment disequilibrium<br>$(U^{*}_{i,t-1} - U_{i,t-1})$ | 0.137***<br>(7.06) | 0.133***<br>(6.82) | 0.160***<br>(7.66) | 0.133***<br>(6.47) | 0.135***<br>(6.84) | 0.151***<br>(6.13) | 0.149***<br>(5.03) | 0.137***<br>(7.32) |
| Real GDP growth rate ( $GRO_{i,t}$ ) | -0.270***<br>(-17.61) | -0.273***<br>(-17.87) | -0.289***<br>(-17.03) | -0.268***<br>(-16.88) | -0.272***<br>(-16.73) | -0.218***<br>(-12.61) | -0.359***<br>(-15.50) | -0.270***<br>(-7.18) |
| Inflation shock ( $\Delta INF_{i,t}$ ) | -0.079***<br>(-6.72) | -0.078***<br>(-6.67) | -0.089***<br>(-6.47) | -0.080***<br>(-6.38) | -0.076***<br>(-6.02) | -0.069***<br>(-5.60) | -0.099***<br>(-4.63) | -0.079***<br>(-6.39) |
| Oil price shock | | | -0.018<br>(-0.25) | | | | | |
| | | | | | | | | |
| Half-life to convergence (years) | 4.71 | 4.88 | 3.99 | 4.86 | 4.77 | 4.25 | 4.30 | 4.71 |

[a]: general government figures
[b]: central government figures

Notes:
1. Column (a) corresponds to column 2 in Table 4.
2. Full sample consists of 20 countries over the period 1970-1999.
3. t-statistics are reported in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, 10% level, respectively.

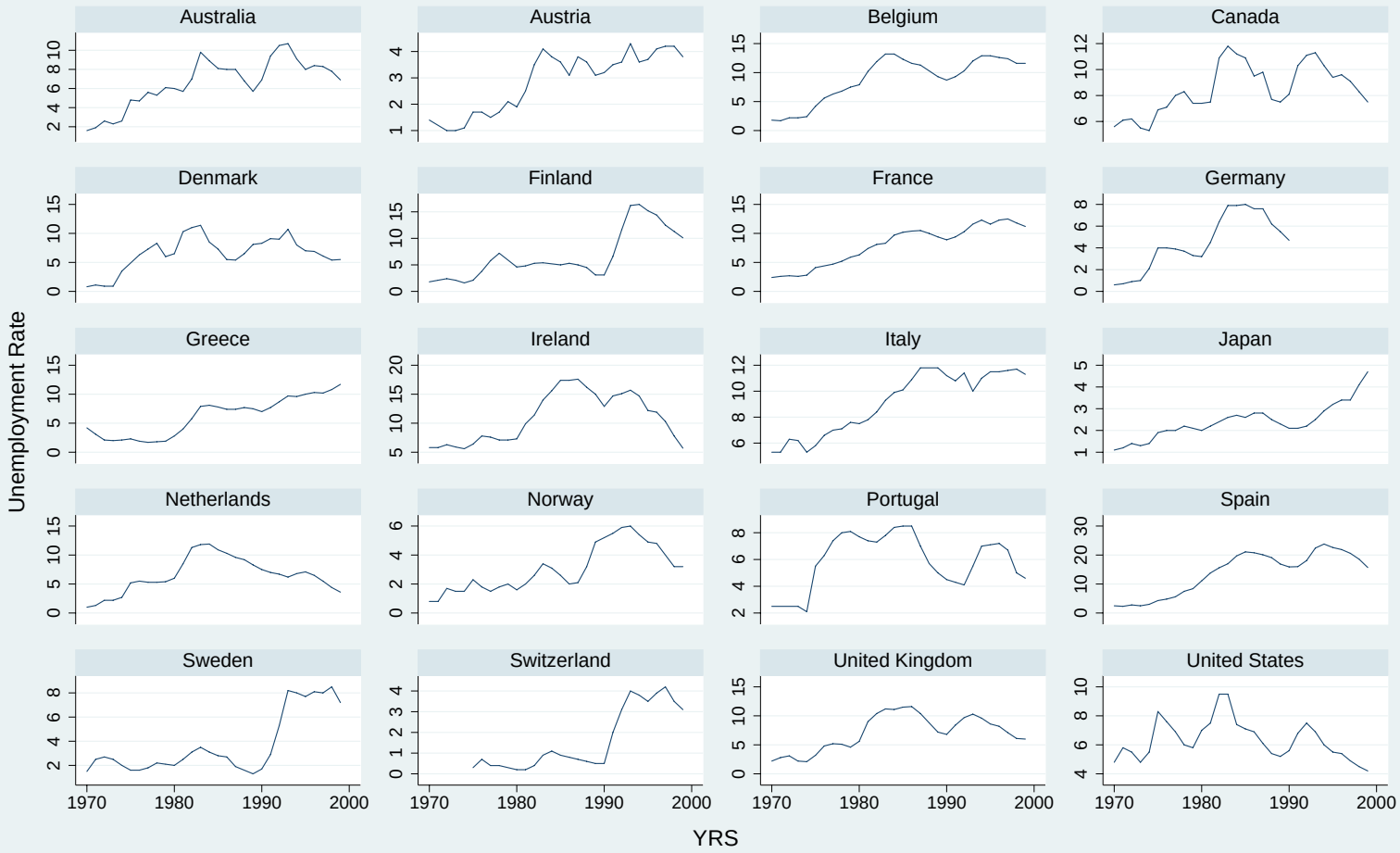


Figure 1: Unemployment Rates in OECD Countries (1970−1999)

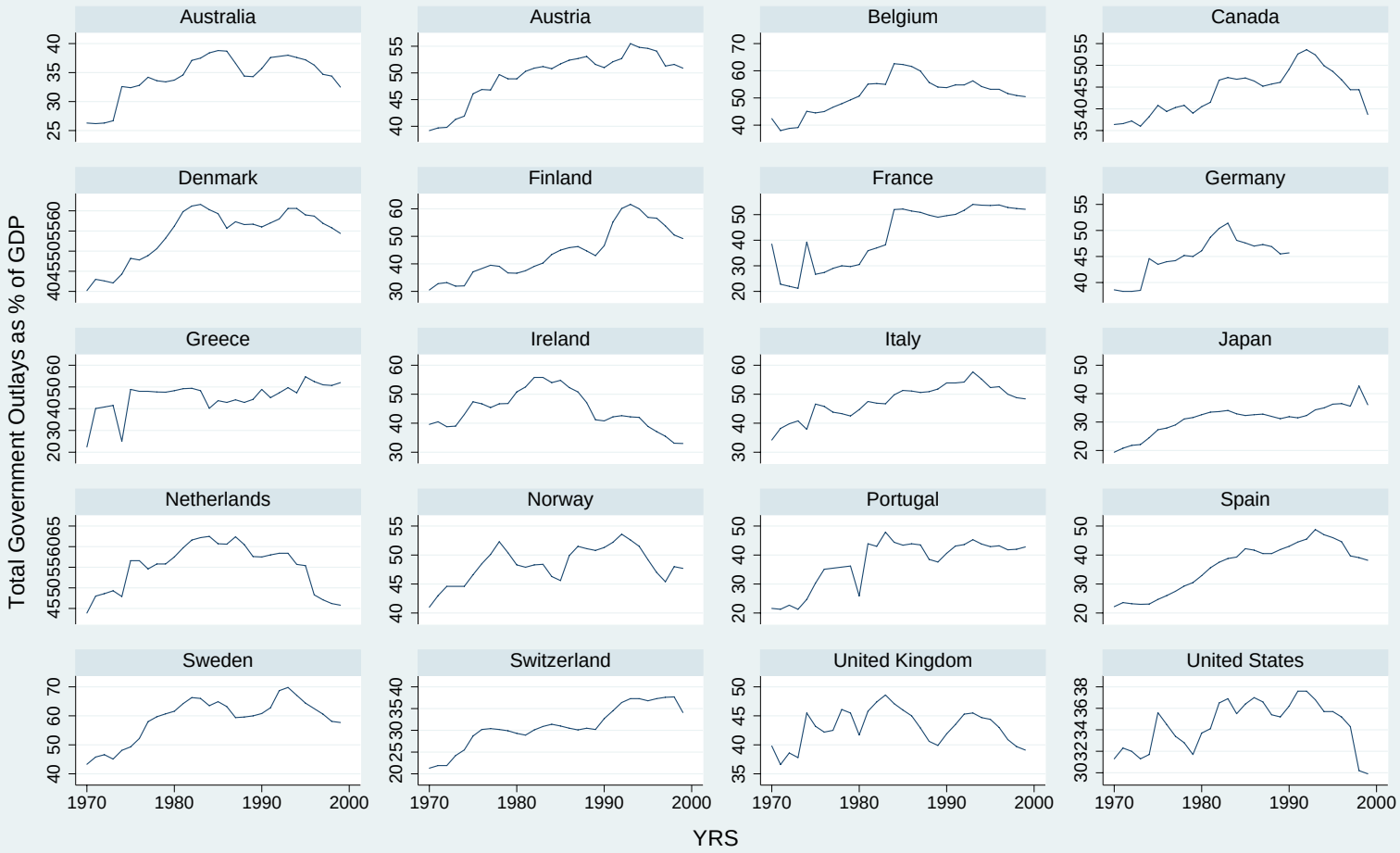


Figure 2: Total Government Outlays in OECD Countries
(1970−1999)

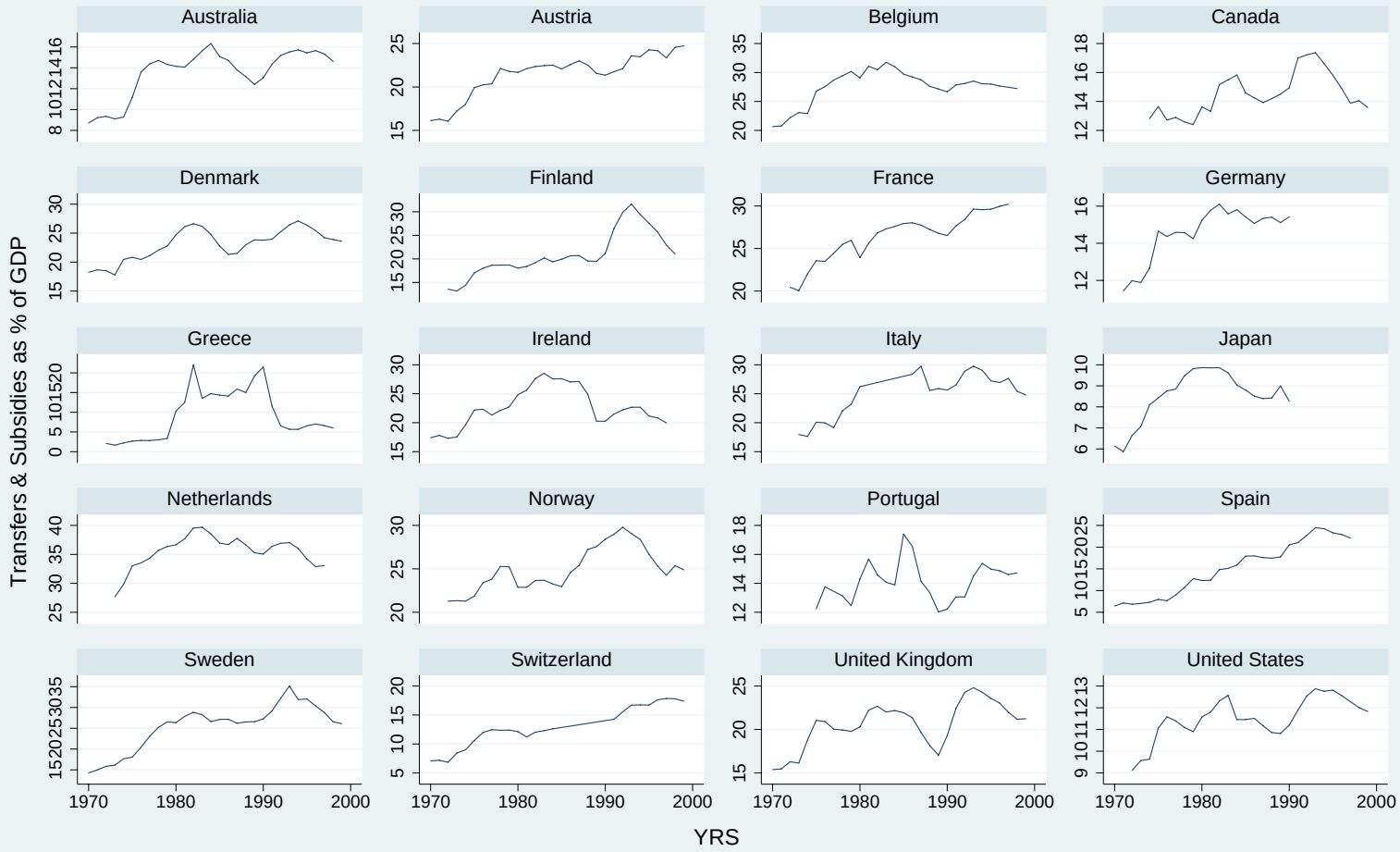


Figure 3: Transfers & Subsidies in OECD Countries
(1970−1999)


Figure 4: Government Purchases in OECD Countries
(1970−1999)

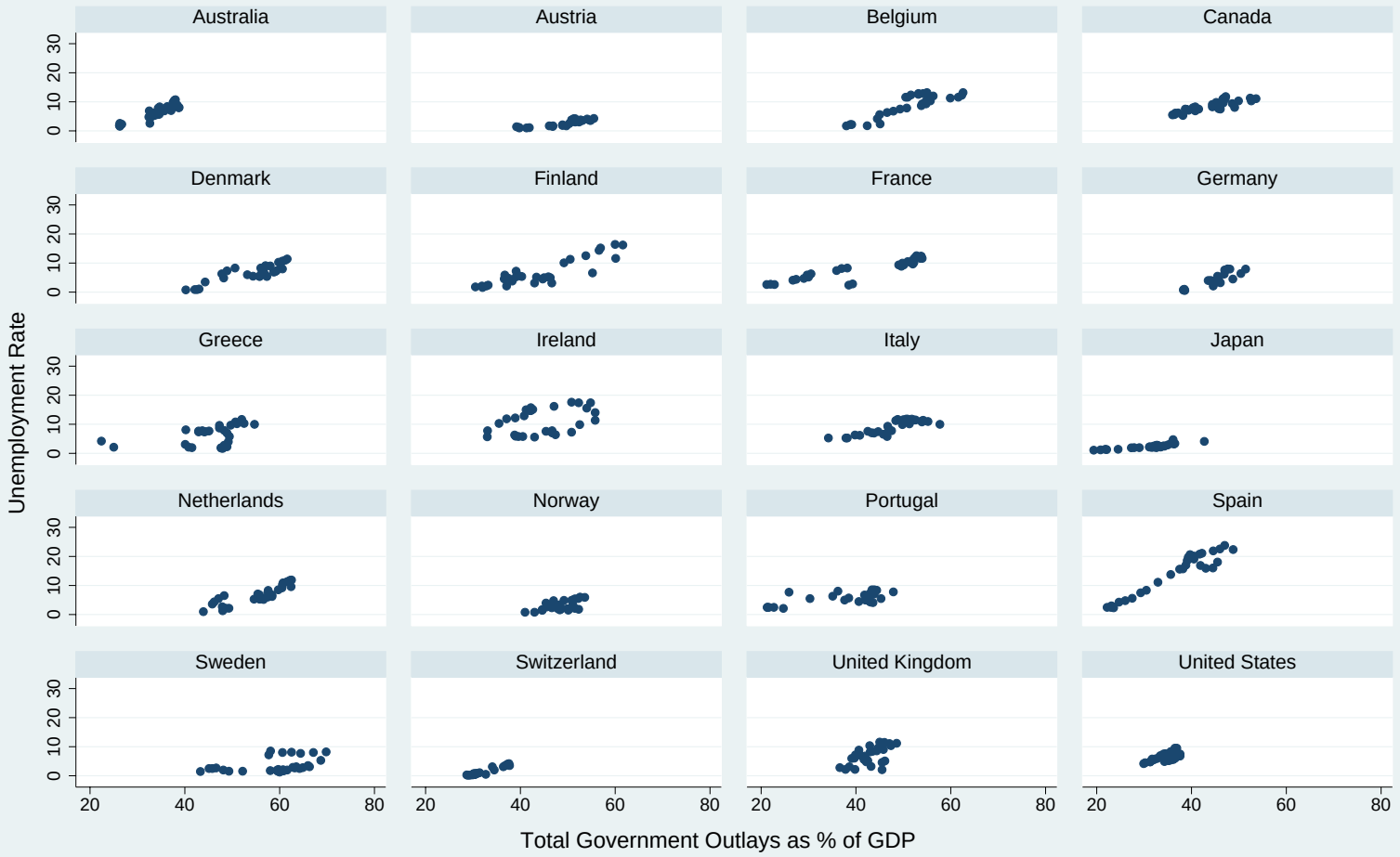


Figure 5: Unemployment Rate vs. Total Government Outlays in OECD Countries (1970−1999)

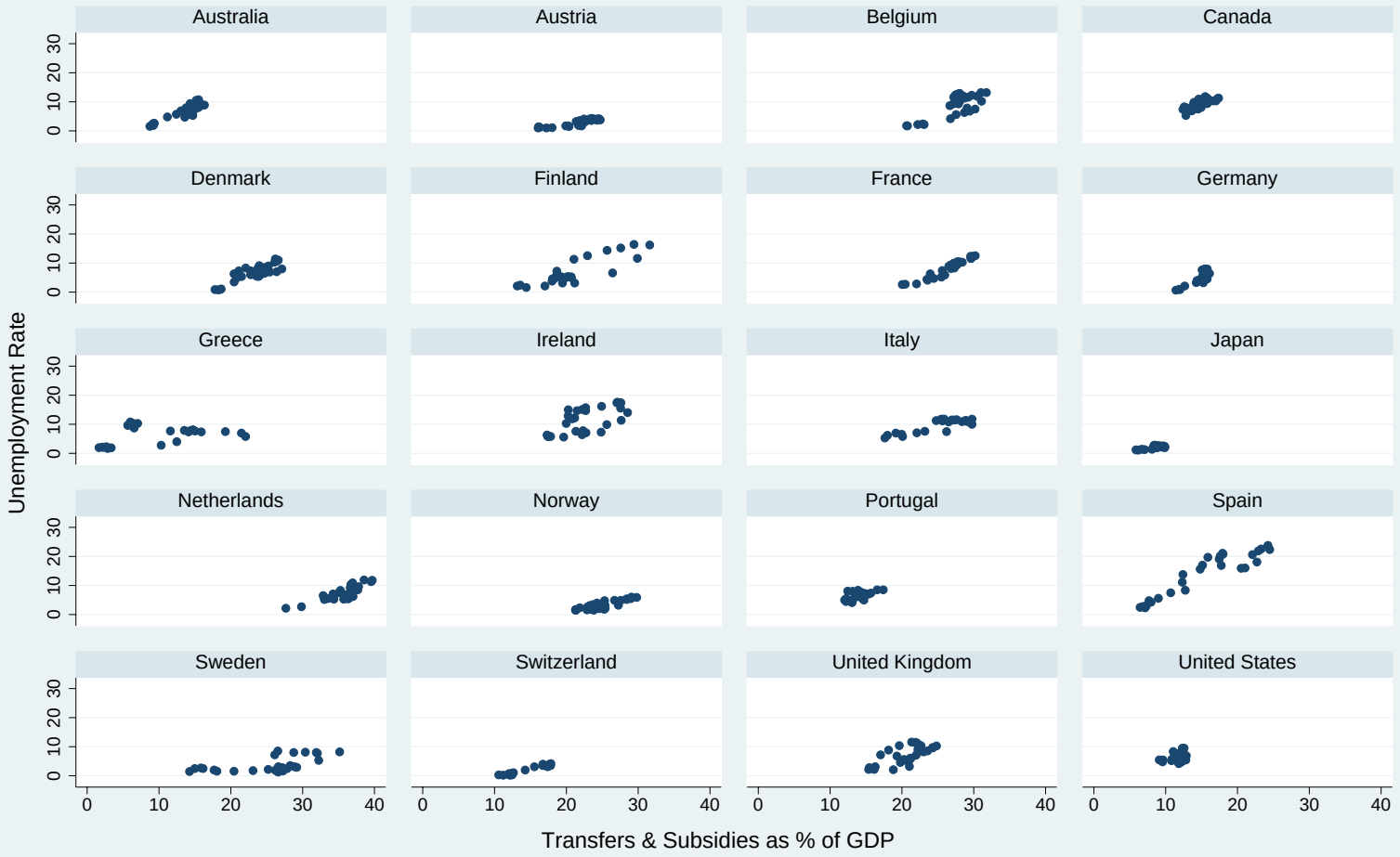


Figure 6: Unemployment Rate vs. Transfers & Subsidies in OECD Countries (1970−1999)

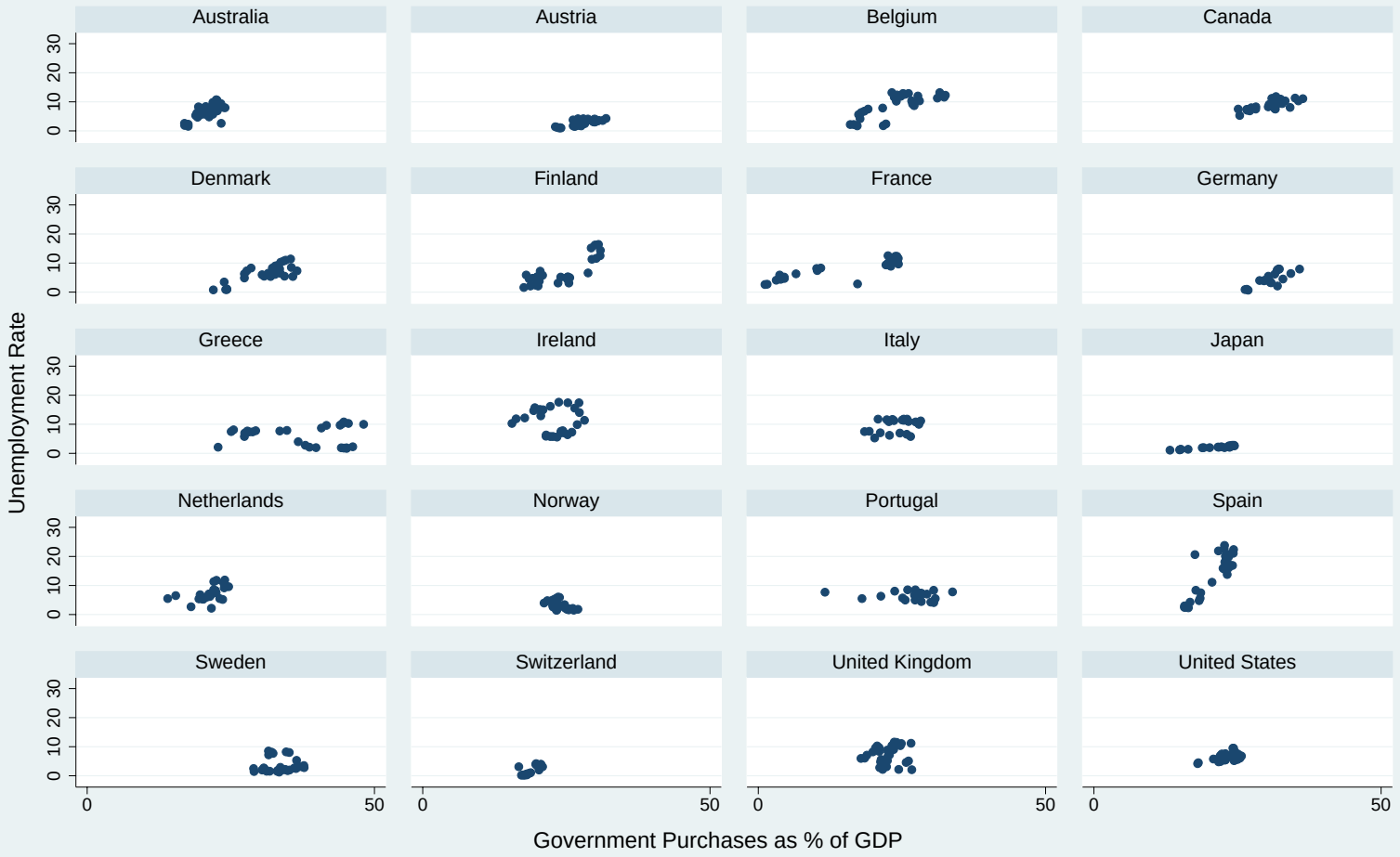


Figure 7: Unemployment Rate vs. Government Purchases in OECD Countries (1970−1999)