The Effect of Government Size on the Steady-State Unemployment Rate: An Error Correction Model

Siyan Wang*
wangs@lerner.udel.edu

And

Burton A. Abrams
abramsb@lerner.udel.edu

Department of Economics
University of Delaware
Newark, DE 19716
Tel: (302) 831-1924
Fax: (302) 831-6968

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***Corresponding author**

Abstract

The relationship between government size and the unemployment rate is investigated using an 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.

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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 makes 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). 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 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 (5-year average) and its government size (total government outlays as a percent of GDP). His pooled OLS estimation, however, is unable to control for the unobserved country characteristics. 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.[1] It is important to note that the results from Abrams (1999) and Feldmann (2006) are subject to potential simultaneity bias because they treated all regressors, including government size measures, as strictly exogenous while in fact

[1] 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).

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, the estimated positive effect of government size on the unemployment rate could simply be an artifact of reverse causality. Using period-averaged data (Abrams, 1999), which is intended to take out the effects of business cycles, are likely to aggravate the simultaneity problem.[2]

Christopoulos and Tsionas (2002) took a time series approach by estimating a bivariate VAR model of the unemployment rate and government size (total government expenditures as a percentage of GDP) for ten OECD countries. They found unidirectional causality running from government size to the unemployment rate. Although free of the reverse causality problem, their study examined only the short-run interactions between government size and 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. Their econometric analysis is, however, seriously flawed because 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 any other variable in the system, including government size, is used as the dependent variable. The inconsistent test results should be interpreted as a lack of

[2] 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.

cointegration (long-run relationship) between government size and the unemployment rate rather than unidirectional causality.

We seek to further test the relationship between government size and the unemployment rate by developing an error-correction model, which describes both the short-run dynamics and long-run determination of the unemployment rate. We hypothesize that the steady-state unemployment rate is determined by government size and various institutional factors while short-run fluctuations in the unemployment rate are affected by growth and inflation shocks. Our estimation method allows for the unobserved country characteristics and explicitly controls for simultaneity bias. The empirical study is based on a panel of twenty OECD countries from 1970 to 1999.[3] 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.

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. Empirical results are discussed in Section 5. Sensitivity analysis is summarized in Section 6. Section 7 concludes the paper.

[3] 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.

2. Linking Government Size to Unemployment

The steady-state unemployment rate (U^*) depends upon a finding rate (*f*) and a separation rate (*s*) according to the well-know relationship:[4]

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

Any increase in the separation rate or decrease in the finding rate raises 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 consumption 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,

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

especially when taking into account possible crowding-out effects on private investment spending. Some government capital purchases have also been known to be wasteful.[5]

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 provides country graphs of unemployment rates between 1970 and 1999 for twenty OECD countries.[6] Generally speaking, unemployment rates have increased

[5] A recent and well publicized $250 million "bridge to nowhere" in Alaska is one example.

over the period 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 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. 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

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[6] 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.

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 Econometric Model

Our empirical analysis of the unemployment dynamics starts with an error-correction model:

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

and

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

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 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.[7] 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, reflected by the real GDP growth rate, $GRO_{i,t}$;[8]

[7] 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 lack of time series data for the period 1970-1999.

[8] Theoretically, lagged real GDP growth should be used in equation (3) to reflect the business cycle effect as movements in unemployment rate tend to lag the real GDP growth. However, since our sample consists

and (iii) inflation shock, $\Delta INF_{i,t}$, which captures the short-run (expectation-adjusted) "Phillips curve" effect. 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.[9] In equation (3), λ should lie between 0 and 1, with larger value of λ suggesting faster speed of adjustment to unemployment disequilibrium. Unobserved country-specific characteristics, such as cultural, demographic, religious and legal factors, and time-invariant labor-market institutions, are captured by the country fixed effects ν_i and η_i. 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 the steady-state unemployment rate (Abrams, 1999), our approach is to first estimate the reduced-form model

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

with $u_i = \lambda \nu_i + \eta_i$ representing the country fixed effects, and $\xi_{i,t} = \lambda \varepsilon_{i,t} + \varpi_{i,t}$ the i.i.d. error term. The parameters in the error-correction model of equations (2) and (3) can then be recovered using the following relationships:

$$\beta = \frac{\phi}{1-\rho_1}, \gamma = \frac{\rho_2}{1-\rho_1}, \ \lambda = 1-\rho_1, \ \delta = \rho_3, \text{ and } \theta = \rho_4. \qquad (5)$$

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

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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.

[9] Phelps (1994, p.326) used the same variable as a proxy for demand shocks.

GMM estimators in general, is often the obvious estimator of choice because it is consistent under a variety of conditions.[10] In applying the Arellano-Bond estimator to equation (4), we notice that unemployment, growth, inflation and government size are likely to be jointly determined. Therefore, to control for simultaneity bias, we shall treat $\Delta INF_{i,t}$ and $GRO_{i,t}$ as endogenous, $U_{i,t-1}$ and $GOV_{i,t-1}$ as predetermined, and the labor market institutions as strictly exogenous.[11]

Several important hypotheses can be tested based on the estimation results of the error-correction model. A positive and significant estimate of γ 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 θ would point to the short-run Phillips curve tradeoff between inflation and unemployment rate. Business cycle theory suggests that δ <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.[12]

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[10] The Arellano-Bond estimator (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 than random-effect models in macroeconomic analysis, 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.

[11] 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) and institutions in equation (4) appear in lagged form, the Arellano-Bond estimator would remain consistent as long as $E(X_{i,t}\xi_{i,t}) = 0$, even if institutions depend on lagged values of unemployment rate. Since our analysis is based on annual data and changes in institutions take time, the exogeneity assumption of the labor market institutions should be harmless.

[12] Okun (1962) regressed the first difference in unemployment rate on a constant and the real GNP growth rate (Method 1). The coefficient on the real GNP growth rate was found to be -0.3. Our study differs from Okun's 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.

5. Empirical Results

In this section, we discuss the estimation results of the reduced-form model of equation (4), and more importantly, of the error-correction model of equations (2) and (3). Our results are based on a sample of 449 observations from twenty OECD countries for the period 1970 to 1999. Thus, our data set covers the three decades leading up to the introduction of the euro.

To obtain accurate parameter estimates, it is important that our sample display enough variations. Table 1 reports some descriptive statistics of the pooled data, including the mean, standard deviation, minimum and maximum. 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 present the country graphs of unemployment rates against government size variables for the period 1970-1999 (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 estimate five model specifications. Specification 1, our baseline specification, uses GO as an overall measure of the government size and assumes that the steady-state 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 (3) to capture any different effects these outlays might have on the unemployment rate.[13] 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.

[13] 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).[14] 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.[15]

Table 4 reports the estimation results of the error-correction model of equations (2) and (3), which are obtained from the parameter estimates of equation (4) and the relationships in equation (5). The five columns again correspond to the five specifications. All five specifications yield similar coefficient estimates on the labor-market institutions, lagged unemployment disequilibrium, real GDP growth rate and inflation shock. However, the results on government outlays vary substantially. Details are discussed next in terms of specifications 1 and 2.

As for the short-run dynamics, both the real GDP growth and the unexpected inflation tend to lower the unemployment rate as expected. 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 Okun's estimate of 0.3 (Okun, 1962). In contrast, the impact of unexpected inflation is much smaller although statistically significant. 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 disequilibrium (λ) is

[14] 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).
[15] 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 ($\Delta\xi_{i,t}$).

estimated to be 0.12 for specification 1 and 0.14 for specification 2, and the half-life to convergence[16] takes 4.7~5.4 years.

As for the long run, increases in government outlays tend to raise the steady-state unemployment rate.[17] In specification 1, we find that government size has 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) can lead 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, but 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) can lead 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.[18] 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 re-estimate the model by dropping the labor institutions, the results on the remaining variables hardly change (specifications 3 and 4).

[16] 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 $-\ln(2)/\ln(1-\lambda)$.

[17] 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.

[18] 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 re-estimate the model by dropping the government size variable, 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).[19]

6. Sensitivity Analysis

In this section, we examine the robustness of the findings reported in section 5 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 are copied into column (a) in

[19] Collective bargaining coverage (the percentage of employees covered by collective 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.

Table 5 and column (a) in Table 6, respectively. We shall refer to these results as the "benchmark".

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).[20] 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). This is not surprising since the sample average of GO is 1.3 times that of GE. 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 by the first difference of the percentage change in nominal oil prices. In estimating equation (4), lagged real interest rate is treated as predetermined and oil price shock as strictly exogenous. The results are reported in columns (c) in Tables 5 and 6. The real interest rate is found to have a positive and significant effect while the effect of the oil price shock is

[20] 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 GE (e.g., Christopoulos and Tsionas, 2002, and Christopoulos, et al., 2005). Definitions for these variables are provided in the Appendix.

insignificant. There is no significant change in the coefficient estimates on unemployment disequilibrium, real GDP growth or inflation shock, or the estimated half-life to convergence. The effect of total government outlays is also 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.

Stability of parameter estimates

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 (Figures 2-4). 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. Spain's unemployment rate rose dramatically while Japan's increased little. To see if the results 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.[21] The results based on sub-sample

[21] It would be 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.

1970-1989 differ slightly from the benchmark (columns (f) of Tables 5 and 6). The effects of real GDP growth on the short-run unemployment dynamics are 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 out to be significant at 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 in section 5 seem robust to changes in the estimation sample.

Heteroskedastic error terms

Results in Tables 3-4 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 inflation shock remain significant at the 1% level, while government purchases and the labor-market institutions remain insignificant.

Choice of instrument sets

Results in Tables 3-4 are obtained using the "optimal" instrument set.[22] While theoretically, adding more instruments (or moment conditions) would improve the asymptotic efficiency of Arellano-Bond 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 endogenous and predetermined variables as instruments and instruments dated far into the past would have weak correlation with the endogenous regressors. So we experimented with instrument sets that use a maximum of 4-8 lags of the endogenous and predetermined variables, the results are very close to the benchmark.[23]

7. Concluding Remarks

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. 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. In addition, our findings are not subject to simultaneity bias, a significant improvement over the previous studies, such as Abram (1999) and Feldmann (2006). As noted earlier, unemployment insurance, a transfer program, has been linked directly to increases in the unemployment rate (Feldstein, 1976, 1978). We conjecture that publicly provided health care, provided to all citizens regardless of their employment status or concentrated on the unemployed

[22] 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.
[23] Detailed results are not reported here but available upon request.

as in the case of the U.S. Medicaid program, plays a significant role in reducing the finding rate and raising the separation rate, but empirical evidence to support this must await future work.

Government purchases of goods and services, on the other hand, include capital expenditure outlays to improve roads and infrastructure. These public investment-spending outlays might raise employment as noted by Karras (1993). Overall, however, we find no evidence that government purchases, given the level of aggregation used in this study, affect the steady-state unemployment rate.

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.[24] 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.

[24] 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.

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*** (3.16)		0.237*** (3.59)		
Government purchases as % of GDP (G)		0.094 (1.44)		0.094 (1.48)	
Transfers & subsidies as % of GDP (TR)		0.574*** (5.10)		0.549*** (5.57)	
Minimum wage	0.003 (0.12)	0.016 (0.66)			0.017 (0.45)
Trade union density rate	0.066 (1.13)	-0.020 (-0.37)			0.114 (1.60)
Unemployment benefits replacement rate	-0.002 (-0.04)	-0.014 (-0.28)			0.074 (1.00)
Short-run parameters --- Equation (3)					
Unemployment disequilibrium ($U^{*}_{i,t-1} - U_{i,t-1}$)	0.120*** (6.18)	0.137*** (7.06)	0.117*** (6.23)	0.136*** (7.18)	0.099*** (5.34)
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)
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*** (3.16)		0.194*** (2.88)	0.227*** (3.04)	0.237*** (3.25)	0.207** (2.32)	0.299*** (3.25)	0.219** (1.99)
Total government expenditures as % of GDP (GE)[b]		0.396*** (4.79)						
Real interest rate			0.325*** (3.31)					
Minimum wage	0.003 (0.12)	0.007 (0.30)	-0.005 (-0.02)	0.010 (0.32)	-0.0007 (-0.01)	-0.018 (-0.50)	-0.035 (-0.77)	0.003 (0.18)
Trade union density rate	0.066 (1.13)	0.050 (0.97)	0.112** (1.97)	0.060 (0.94)	0.063 (1.06)	0.053 (0.52)	0.162** (2.10)	0.066 (0.81)
Unemployment benefits replacement rate	-0.002 (-0.04)	-0.020 (-0.39)	-0.061 (-1.09)	-0.002 (-0.03)	-0.028 (-0.46)	-0.033 (-0.41)	0.167* (1.67)	-0.002 (-0.03)
Short-run parameters --- Equation (3)								
Unemployment disequilibrium ($U^{*}_{i,t-1} - U_{i,t-1}$)	0.120*** (6.18)	0.137*** (6.92)	0.128*** (6.25)	0.113*** (5.56)	0.116*** (5.90)	0.121*** (4.98)	0.141*** (4.47)	0.120*** (6.38)
Real GDP growth rate ($GRO_{i,t}$)	-0.274*** (-17.53)	-0.273*** (-17.85)	-0.293*** (-16.93)	-0.273*** (-16.83)	-0.278*** (-16.73)	-0.226*** (-12.78)	-0.363*** (-15.26)	-0.274*** (-7.18)
Inflation shock ($\Delta INF_{i,t}$)	-0.083*** (-6.94)	-0.079*** (-6.69)	-0.092*** (-6.55)	-0.085*** (-6.62)	-0.081*** (-6.27)	-0.076*** (-6.12)	-0.090*** (-4.10)	-0.083*** (-6.40)
Oil price shock			-0.007 (-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 (1.44)		-0.035 (-0.51)	0.094 (1.37)	0.103 (1.53)	0.084 (1.16)	0.057 (0.58)	0.094 (0.91)
Government purchases as % of GDP (G')[b]		0.079 (0.41)						
Transfers & subsidies as % of GDP (TR)	0.574*** (5.10)	0.548*** (4.41)	0.780*** (6.22)	0.608*** (5.05)	0.603*** (5.20)	0.689*** (4.83)	0.614*** (4.49)	0.574*** (2.58)
Real interest rate			0.278*** (3.68)					
Minimum wage	0.016 (0.66)	0.019 (0.74)	0.010 (0.46)	0.018 (0.71)	0.016 (0.38)	0.007 (0.25)	-0.025 (-0.60)	0.016 (1.20)
Trade union density rate	-0.020 (-0.37)	-0.008 (-0.14)	-0.017 (-0.35)	-0.027 (-0.48)	-0.024 (-0.44)	-0.063 (-0.78)	0.081 (1.10)	-0.020 (-0.35)
Unemployment benefits replacement rate	-0.014 (-0.28)	-0.004 (-0.08)	-0.098** (-2.20)	-0.018 (-0.34)	-0.029 (-0.56)	-0.052 (-0.85)	0.154* (1.77)	-0.014 (-0.24)
Short-run parameters --- Equation (3)								
Unemployment disequilibrium $(U^*_{i,t-1} - U_{i,t-1})$	0.137*** (7.06)	0.133*** (6.82)	0.160*** (7.66)	0.133*** (6.47)	0.135*** (6.84)	0.151*** (6.13)	0.149*** (5.03)	0.137*** (7.32)
Real GDP growth rate ($GRO_{i,t}$)	-0.270*** (-17.61)	-0.273*** (-17.87)	-0.289*** (-17.03)	-0.268*** (-16.88)	-0.272*** (-16.73)	-0.218*** (-12.61)	-0.359*** (-15.50)	-0.270*** (-7.18)
Inflation shock ($\Delta INF_{i,t}$)	-0.079*** (-6.72)	-0.078*** (-6.67)	-0.089*** (-6.47)	-0.080*** (-6.38)	-0.076*** (-6.02)	-0.069*** (-5.60)	-0.099*** (-4.63)	-0.079*** (-6.39)
Oil price shock			-0.018 (-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.