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WORKING PAPER

Unemployment in the OECD since the 1960s. Do we really know?

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Unemployment in the OECD since the 1960s. Do we really know? *

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Abstract

Nickell, Nunziata and Ochel [Economic Journal, 2005] argue that unemployment rates cointegrate with labour market institutions in a panel of OECD countries. This paper reproduces their Maddala-Wu panel cointegration test and shows that this test is only valid when (i) the number of countries tends to infinity and (ii) the underlying country-specific cointegration tests are independent. Their finding of cointegration does not survive when small sample properties and heterogeneous cross-sectional dependencies are taken into account. This suggests that the estimated impact of institutions on unemployment is spurious.

JEL Classification: C15, C33, E24

Keywords: unemployment, panel cointegration, bootstrapping

1 Replication results

Using a panel of yearly data for 20 OECD countries ranging from 1960 to 1995, Nickell, Nunziata, and Ochel (2005), NNO henceforth, estimate a reduced form unemployment equation including labour market institutions, interactions among these institutions and macroeconomic shocks. Using the Maddala and Wu (1999), MW henceforth, panel unit root test, calculated from Dickey-Fuller (DF) tests for the individual countries, NNO find that the unit root hypothesis cannot be rejected for unemployment and for most of the explanatory variables. As such, NNO test for cointegration using the MW panel cointegration test. Their MW test statistic of 75.89[1] can be replicated by (i) estimating a static version of the model[2], i.e. dropping the lagged unemployment rate, (ii) calculating p-values for the country-by-country Engle-Granger (EG) cointegration tests from the standard DF unit root distribution and (iii) combining these country-specific p-values into the MW panel test statistic. Comparing this test statistic with the 5% critical value of 55.76

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[1]See NNO, Table 5, note (d).

[2]As in NNO we estimate a fixed effects panel data model including time dummies and country-specific trends using iterated GLS allowing for heteroscedastic errors across countries and country-specific first order serial correlation.

from the χ^2_{40} distribution led NNO to conclude that there is a cointegrating relationship between unemployment and institutions.

We challenge this result for two reasons. First, the MW panel cointegration test has a χ^2 distribution only if the underlying country-specific cointegration tests are independent. As both unemployment rates and labour market institutions are highly correlated over countries[3], this assumption is clearly not satisfied. NNO acknowledge that there are cross-country dependencies but argue that the problem is solved by including time dummies in the empirical specification. As highlighted by MW these time dummies are only adequate in the presence of common time-specific effects, i.e homogeneous correlation, but not in the presence of heterogeneous correlation. MW further argue that the latter is probably a more adequate description of cross-country dependencies in most practical settings. Using Monte Carlo simulations Strauss and Yigit (2003) show that using the χ^2 distribution under heterogeneous correlation induces a strong size bias in the MW panel unit root test. Second, calculating the p-values for the country-by-country EG cointegration tests from the standard DF unit root distribution relies on the assumption that the estimated residuals can be treated as 'raw' data. In a pure time series context this assumption is clearly violated as the estimated residuals are obtained from minimising the sum of their squares. The appropriate distributions for an EG cointegration test are provided by Mackinnon (1996).[4] In a homogenous panel data context, the estimated residuals can be treated as 'raw' data asymptotically, i.e. for the number of countries tending to ∞, as in this case the impact of an individual country on the estimated coefficients, and therefore on the estimated residuals, becomes infinitely small. The panel data set used in NNO only includes 20 (highly correlated) countries, though.[5]

Taking stock, the distribution of both the country-by-country EG cointegration test and the MW panel cointegration test should be simulated taking into account the properties of the panel data set, i.e. the number of countries included and the observed cross-country correlation. For this purpose, we set up a bootstrap procedure in the next section.

2 A bootstrap approach

Under the null of no cointegration, we assume that the data generating process (DGP) for the unemployment rate U_{it} is given by

$$U_{it} = 100\left(1+\exp(-U'_{it})\right)^{-1}, \quad i=1,\ldots,N; \quad t=3,\ldots,T \tag{1}$$

$$U'_{it} = \beta U'_{it-1} + (1-\beta)U'_{it-2} + \mu_{it}, \tag{2}$$

[3]The cross-country correlation for changes in the unemployment rate for instance ranges from -0.35 to 0.84.

[4]For 30 time series observations, the 5% critical value of a standard DF unit root test including a constant and a trend is -3.58. For a unit root test on the residuals estimated from a regression including a constant, a trend and 20 explanatory variables (which is about the number of explanatory variables in NNO), this critical value drops to -10.03.

[5]A small Monte Carlo experiment shows that for a panel of 20 countries including 30 time series observations, the 5% critical value of a unit root test on the residuals estimated from a homogeneous regression including country-specific constants and trends, time dummies and 20 explanatory variables equals -3.89. Adding heterogeneous cross-country correlation of about the magnitude observed in unemployment rates, this critical value drops to -4.23.

where N is the number of countries, T is the number of time series observations and μ_{it} is a mean zero disturbance term, for which we assume

$$E[\mu_t \mu_t'] = \Omega \quad \forall t, \qquad E[\mu_t \mu_s'] = 0 \quad \forall s \neq t, \tag{3}$$

where $\mu_t = [\mu_{1t}, \ldots, \mu_{Nt}]'$ and the variance-covariance matrix Ω is, besides positive definiteness, left unrestricted to allow for (i) heteroscedasticity across countries and (ii) heterogeneous cross-country correlation.

Two aspects of this DGP are worth emphasising. First, although observed unemployment rates are found to exhibit a unit root, we cannot simply generate U_{it} from a random walk process as this would fail to preserve the restriction that it is bounded to lie between 0 and 100%. Therefore we impose this restriction on the DGP by means of a logistic transformation, i.e. equation (1) translates the possible range $[-\infty, \infty]$ for the unit root process U_{it}' into a range $[0, 100]$ for U_{it}.[6] Second, NNO assume that the cross-sectional dependencies in the data are caused by common time-specific effects, i.e. $\mu_{it} = \lambda_t + \varepsilon_{it}$ where ε_{it} is an idiosyncratic random component. In this case, λ_t can be eliminated by including time dummies. Following MW we allow for a more general form of cross-sectional dependence, i.e. Ω is left unrestricted. In this case including time dummies would not control for (all of) the cross-sectional correlation and hence the MW test would not have a χ^2 distribution.

To obtain a bootstrap sample $\widetilde{U}_{it}$ we first estimate equation (2) using OLS to obtain the estimate $\hat{\beta}$ and the estimated (rescaled) residuals $\hat{\mu}_{it}$ for $i = 1, \ldots, N$ and $t = 3, \ldots, T$.[7] Next, we resample $\hat{\mu}_{it}$ to obtain $\widetilde{\mu}_{it}$ for $t = 3, \ldots, T$, and generate $\widetilde{U}_{it}$ from equations (1) and (2) with initialisation $\widetilde{U}_{i1}' = U_{i1}'$ and $\widetilde{U}_{i2}' = U_{i2}'$. With respect to resampling $\hat{\mu}_{it}$ we need to take into account its structure as implied by equation (3). As resampling from the cross-sectional dimension would fail to preserve the cross-country dependencies and heteroscedasticity, we resample from the time series dimension only, keeping the cross-section index fixed, i.e. a bootstrap sample of residuals $\widetilde{\mu}_{it}$ is obtained as

$$\widetilde{\mu}_{it} = \left(\hat{\mu}_{it_3}, \ldots, \hat{\mu}_{it_T}\right)', \qquad i = 1, \ldots, N, , \tag{4}$$

where the $(T-2) \times 1$ vector of indices $(t_3, \ldots, t_T)'$ is obtained by drawing with replacement from the index $(3, \ldots, T)'$.

The bootstrapped unemployment rates are then linked to the observed explanatory variables by estimating the static version of the model, again using the same GLS estimator as in NNO. Next we perform a DF test on the country-specific residuals. After repeating this 10.000 times we obtain country-specific empirical distributions for the EG cointegration test. The panel average 5% critical value of this empirical distribution is -4.61 (compared to the 5% critical value of -3.58 from the standard DF distribution used by NNO). From the obtained country-specific

[6]Using a MW panel unit root test, the null hypothesis that the transformed unemployment rate $U_{it}' = -ln\,(100/U_{it} - 1)$ exhibits a unit root cannot be rejected (p-value = 0.90).

[7]By applying the Baltagi and Li (1995) test the null of an AR(1) or MA(1) structure in the residuals can be rejected at the 10% and 5% level respectively.

empirical distributions we can now calculate the p-values for the country-specific EG cointegration test statistic obtained from the original data and calculate the MW panel cointegration test statistic. Table 1 reports the result. The MW test statistic drops from 75.89 as in NNO to 47.91. For each of the bootstrapped samples we also calculate the MW panel cointegration test. This yields its distribution under the null hypothesis of no cointegration. The 5% critical value from this simulated distribution is 72.21. Comparing the simulated MW panel test statistic with the simulated distribution of this test shows that in contrast to NNO's finding unemployment does not cointegrate with labour market institutions. The same result is obtained when we relax the assumption that the AR coefficient in equation (2) is homogeneous (see bottom line Table 1).

Table 1: Maddala-WU panel cointegration tests

	test statistic	critical value	p-value
Nickell et al. (2005)	75.89	55.76	0.00
Bootstrap approach (a)	47.91	72.21	0.21
Bootstrap approach (b)	48.35	75.26	0.21

Bootstrap approach (a) assumes β in equation (2) to be homogeneous over the panel while (b) allows for country-specific βs.

3 Discussion

The finding of no panel cointegration neither implies that there is no relation between unemployment and labour market institutions nor that the results reported by NNO are invalid. First, economic theory relates the equilibrium rate of unemployment to a large variety of factors, some of them being difficult to measure or even unobservable, e.g. the reservation wage which is a function of, among others, the value of leisure. By inducing a unit root component in the residuals, both missing non-stationary variables and measurement error in non-stationary variables turn an otherwise cointegrating relation into a spurious regression.[8] Second, although panel cointegration is rejected this does not necessarily invalidate the results reported in NNO. Phillips and Moon (1999) show that for a spurious panel regression, different from a pure time series context, the pooled least squares estimator is $\sqrt{N}$-consistent. The intuition behind this result is that the information in independent cross-section data carries a stronger signal compared to the pure time series case. The data set used in NNO includes (highly) correlated data for only 20 countries, though. So large N asymptotics are probably a poor guide to the small sample properties. Therefore, we test in each of our bootstrap iterations over the static model whether the null of no relation between the unemployment rate and the institution variables can be rejected at the 5% level of significance using a standard t-test. Although we set the nominal size equal to 5%, this hypothesis could not

[8] Note that Engel (2000) has shown that in the presence of a permanent component in the residuals, standard cointegration tests have a large size bias, i.e. they find cointegration in too many cases. This suggests that the critical values reported in Table 1 should be seen as upper bounds on the real critical values if there is a relation between unemployment and institutions but there is a permanent component left in the residuals. This further weakens the case of cointegration.

be rejected only in about 60% of the cases.

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