Unemployment in the Eurozone: Economic Integration and Monetary Union

Economics 312

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Abstract

We use panel data from 10 countries, 9 in Europe and the United States, and 31 years total from 1980 to 2011 to observe changes in European unemployment. We look to estimate the changes of unemployment following European integration, in addition to looking at traditional determinants of unemployment. We find that unemployment has, for these select nations, increased following their entrance to the EMU, but we lack confidence that this result is robust. We also find statistically significant results for the effects of trade, union density, population, lagged GDP, and labor tax (which counterintuitively is shown as correlated with a decrease in unemployment as we discuss in Conclusions).

Introduction

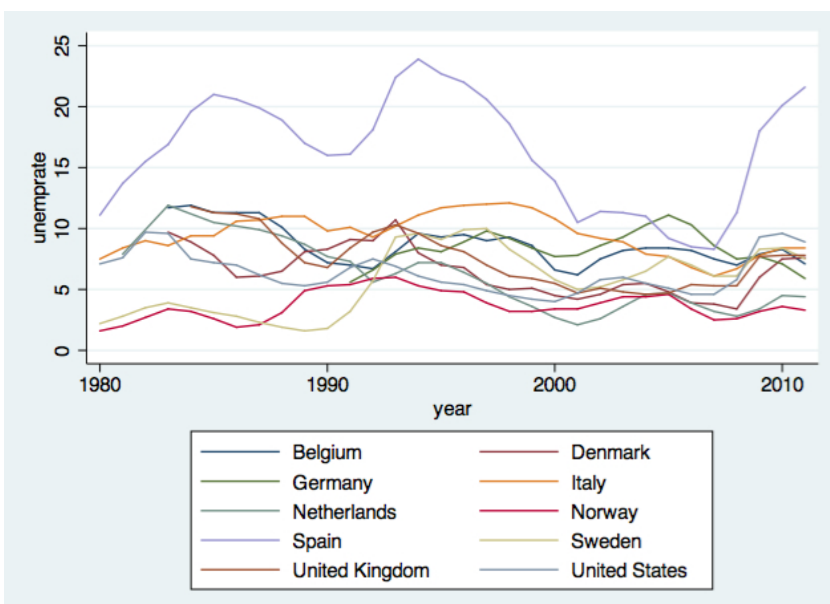

Figure 1: Unemployment by Country from 1980 to 2011

Europe, more than any other geographical region, has both an incredible density of strong economies and a great deal of structural unemployment. This structural unemployment is traditionally explained through a combination of high unemployment benefits, presence of minimum wages, taxes on labor, and legal roadblocks preventing firms from firing employees. These combined effects increase friction in the labor market, making it difficult for firms to find an efficient labor stock and for workers to find placement matching their talents.

We are especially interested in how unions, and hence unemployment rates, react to monetary union, with this change encapsulating both a shared monetary policy and an increased level of economic integration. We expect these effects to be opposite in sign. The shared monetary policy presumably would drive nominal wages up, resulting in higher unemployment, while increased economic integration, or levels of trade, will likely increase labor mobility, resulting in lower unemployment.

We seek to examine whether or not the increased economic integration in the Eurozone has, primarily through the channel of labor mobility, interacted with traditional factors of structural unemployment and the effects of a shared monetary policy. This paper aims to examine the factors impacting unemployment and to explain unemployment rate in terms of theoretically plausible roots in macroeconomic, labor, and migration patterns.

Theory

The presence of labor market rigidities can cause employers to hire less, creating more unemployment. For example, if employers know that they cannot lay off workers in downtimes they will be reluctant to hire those workers in the first place even when the profit maximizing level of labor would otherwise motivate hiring more. Additionally, unemployment benefits can lead to market rigidities because if unemployment benefits exceed the expected wage and the cost of finding a job, there will be more unemployment because people will be less inclined to look for a job. This phenomenon is known as the Welfare or Unemployment Trap. Unions can compound these problems by increasing the equilibrium wage through market manipulation (negotiations, strikes and threats thereof) providing fewer better jobs as opposed to the free market equilibrium. Thus, it becomes harder for workers to find a job, increasing their dependence on government benefits.

We expect increased levels of economic integration, or trade, to decrease labor market rigidities through two primary pathways: the first and, and likely greater component, is increased labor mobility. With a shared currency and a shared passport, European citizens can easily relocate to another country in the EU to take up more beneficial employment than they could otherwise obtain in their home country.

Gruner & Hefeker (1999) show that, when Unions across nations have identical preferences and the ECB follows a conservative monetary policy(not unreasonable given the level of German influence in modern monetary decision), the adoption of monetary union will increase nominal wages, inflation, and unemployment. This results follows from the monetary union forcing labor unions to a lower utility level.

Economic integration is a movement towards freer markets. As economic integration increases, tariffs, duties, and other market imperfections fade out of existence within the context of those countries being integrated. Our trade variable acts as a proxy for this economic integration. Feasibly, as trade takes up a higher percentage of GDP of a country, that country is more economically integrated with other countries i.e. increased trade points strongly to lower trade restrictions. Due to comparative advantage, this should result in a more wealthy populace, higher GDP, and lower unemployment.

Keynesian economics tells us that we should expect that GDP below the optimal amount should cause unemployment and that more inflation should be an indicator that GDP is at or above that optimal amount. A higher interest rate should theoretically lead to higher unemployment though this effect will likely be lagged. Also, a higher union density should have a positive effect on unemployment, while population should not have a very large effect on unemployment. We expect foreign population to proxy for economic integration which should decrease unemployment through labor mobility and through the efficiency of free markets.

Our complete linear model then looks something like:

$$(1)\ Unemp = \alpha_{it} + \beta_1 pop_{it} + \beta_2 uniondens_{it} + \beta_3 EU_{it} + \beta_4 trade_{it} + \beta_5 intrate_{it} + \beta_6 forpop_{it} + \beta_7 pubspend_{it} + \beta_8 inf_{it} + \beta_9 labtax_{it} + \varepsilon_{it}$$

Where $i \in \{1, 2, ..., n\}$ is our panel index with each i representing a nation, and t is our time index.

We do not necessarily expect all of these variables to have a linear effect on unemployment. It could be argued that Public spending on unemployment, for example, has a non-linear effect on the unemployment rate, decreasing it up to threshold and then increasing it once an agent has to make a welfare trap decision. Given strong theoretical backing for a simple quadratic labor market rigidity model however, we simply analyze the linear case.

Data

Our data consist of the following variables:

year	the year in which the observation took place	a priori
unemprate	the harmonised unemployment rate	Eurostat
countrycode	the country of the observation coded as a variable. The countries are: Belgium, U.S, U.K, Denmark, Germany, Italy, Netherlands, Norway, Spain, and Sweden.	a priori
gdp	the GDP per capita	World Bank online database
EU	dummy variable for country moving to the Euro	Europa (Website of The European Commission)
ForPop	foreign population as percent of total country population	Migration Policy Institute Data Hub
forpopp	The percent change in foreign population	Migration Policy Institute Data Hub
pop	the population size in thousands	Eurostat
uniondens	a measure of the density of trade unions	OECD statistics database
inflation	the level of inflation	OECD statistics database
intrate	the real interest rate	Eurostat
pubspend	public spending on unemployment benefits as % of GDP	OECD statistics database
trade	a measure of the net difference between exports and imports divided by GDP	OECD statistics database
labtax	tax rate on labor	Eurostat

Table 1: Variable description and source

Variable	Obs	Mean	Std. Dev.	Min	Max
unemprate	295	7.863051	4.148718	1.6	23.9
gdp	320	26717.14	15005.21	4353.972	98080.91
pop	320	54364.12	76115.64	4078.9	311943
uniondens	311	41.8256	22.35491	8.342174	83.89023
intrate	282	5.560894	3.303201	-5.81162	16.75101
ForPop	175	5.6129	2.938456	.6	12.41522
forpopp	162	.124109	.3123286	-1.1	1.5
pubspend	120	1.386533	1.023166	.2	3.7
EU	320	.203125	.4029549	0	1
trade	320	58.90497	35.77001	13.55947	184.9007
inflation	299	3.79069	3.332792	-.6994754	21.2766
lpop	320	10.11507	1.269837	8.313582	12.65058
lunion	311	3.567567	.6065908	2.121324	4.429509
labtax	153	22.97582	5.800556	12.5	34.2

Table 2: Summary statistics for our variables

```
. xtdescribe

countrycode:  1, 2, ..., 10                                  n =        10
       year:  1980, 1981, ..., 2011                          T =        32
              Delta(year) = 1 unit
              Span(year)  = 32 periods
              (countrycode*year uniquely identifies each observation)

Distribution of T_i:   min      5%     25%       50%       75%     95%     max
                        32      32      32        32        32      32      32

     Freq.  Percent    Cum. |  Pattern
 ---------------------------+----------------------------------
       10    100.00  100.00 |  11111111111111111111111111111111
 ---------------------------+----------------------------------
       10    100.00         |  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

As can be clearly seen in the above table of summary statistics, nearly all of our variables are not balanced, that is we have missing data from certain years of certain panels. Several of our variables, such as public spending on unemployment, are inconsistent in presence across both time and panel. Others, such as tax rate on labor, are consistent across panels, but only accessible for a limited continuous set of years. Additionally, many of the variables we were interested in, including but not limited to Union Density, taxes on labor, and public spending on unemployment benefits, were unavailable(in any obvious location) for many nations in the eurozone. The below table of variable correlations shows that none of the variables are extremely correlated.

```
. corr unemprate lunion intrate trade EU inflation labtax pubspend gdp ForPop lpop
(obs=48)
```

	unempr~e	lunion	intrate	trade	EU	inflat~n	labtax	pubspend	gdp	ForPop	lpop
unemprate	1.0000										
lunion	-0.4005	1.0000									
intrate	0.0292	0.2995	1.0000								
trade	-0.1818	0.1970	0.0421	1.0000							
EU	0.3149	-0.4562	-0.0877	0.3758	1.0000						
inflation	-0.0487	-0.2582	-0.4567	0.1078	0.4011	1.0000					
labtax	-0.6317	0.7575	0.1444	0.1157	-0.4637	0.0521	1.0000				
pubspend	-0.0043	-0.0616	0.1713	-0.0173	-0.0102	-0.1093	0.0445	1.0000			
gdp	-0.6993	0.5802	0.1296	0.0140	-0.5003	-0.1849	0.6576	0.0886	1.0000		
ForPop	-0.1841	0.2444	0.4177	0.5804	0.1275	-0.3664	0.0601	0.0585	0.1797	1.0000	
lpop	0.4645	-0.7301	-0.0456	-0.4154	0.2917	-0.1694	-0.8820	0.0214	-0.5135	-0.1144	1.0000

Table 3: Correlation across variables

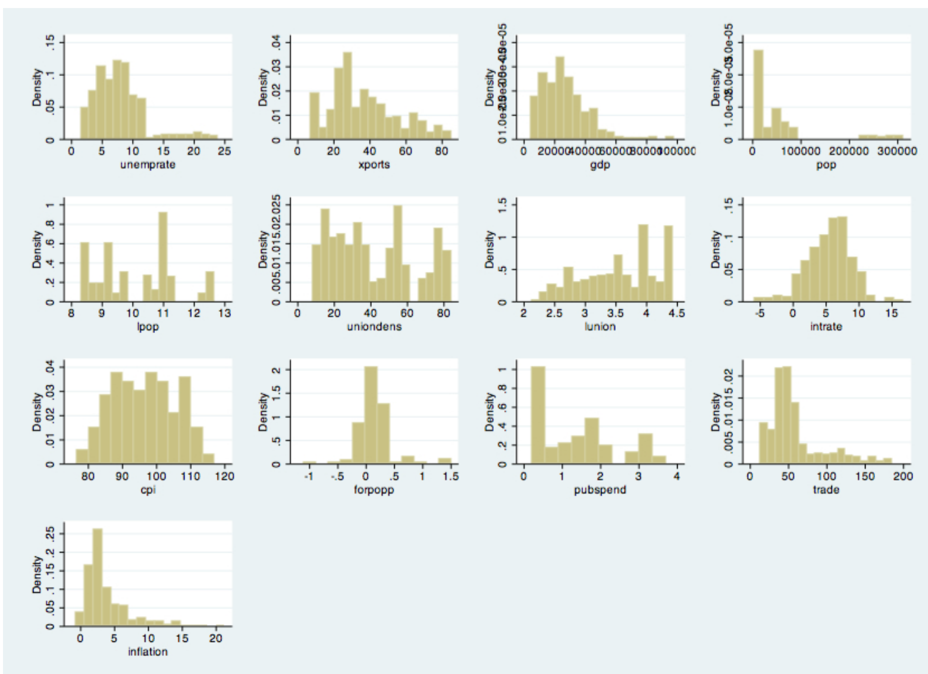

Figure 2: Histograms of our variables with log transformed Union Density and Population. The variable xports (exports as %of GDP) data came from the OECD, but wasn't included in any regressions.

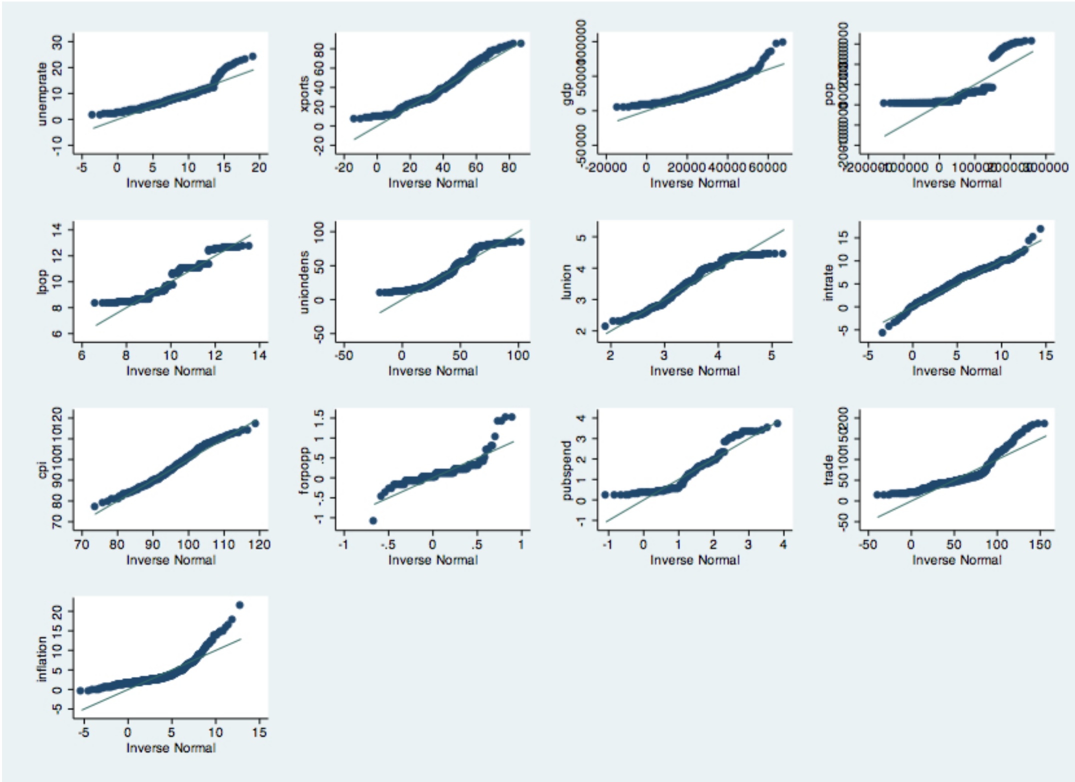

Figure 3: qnorm plots of variables used- This compares quantiles of the variable against the quantiles of the normal distribution.

The histograms and qnorm plots of the variables show that the distributions of the variables deviate from the normal distribution to some extent.

Results

The results of several models that seemed reasonable to us are presented in the following outreg tables:

unemprate
-0.065
(4.05)***
5.384
(5.05)***
-0.444
(1.25)
2.637
(1.49)
-0.322
(2.01)**
0.243
(0.84)
-1.405
(2.28)**
-0.257
(0.76)
0.073
(0.48)
0.000
(0.76)
-0.000
(1.63)
24.142
(2.01)**
0.77

	unemprate	unemprate	unemprate	unemprate	unemprate	unemprate
uniondens	0.057					
	(0.82)					
intrate	0.079	0.078	0.084	0.153	0.331	-0.035
	(1.78)*	(1.76)*	(0.88)	(0.95)	(1.29)	(1.36)
trade	0.015	0.016	0.012	0.002	-0.046	0.009
	(0.83)	(0.95)	(0.77)	(0.09)	(2.66)***	(0.47)
EU	-3.227	-3.285	-3.317	-0.960	0.715	-2.360
	(2.96)***	(3.17)***	(2.77)***	(1.79)*	(0.99)	(3.00)***
inflation	-0.228	-0.218	-0.073	-0.367	0.045	-0.432
	(3.30)***	(3.22)***	(0.37)	(1.07)	(0.10)	(1.95)*
lunion		1.497	-2.714	1.917	1.216	-2.706
		(0.79)	(0.78)	(1.01)	(0.71)	(1.17)
labtax			-0.082	-0.533	-1.004	-0.145
			(0.46)	(4.11)***	(4.10)***	(1.04)
ForPop				-0.560	-0.117	
				(1.82)*	(0.63)	
lpop					-3.608	
					(1.89)*	
pubspend						0.128
						(0.78)
L.pubspend						
L2.pubspend						
L.gdp						
L2.gdp						
_cons	5.710	2.680	19.627	15.845	63.384	21.361
	(1.52)	(0.36)	(1.25)	(1.76)*	(2.03)**	(2.34)**
R2_O	0.06	0.05	0.14	0.45	0.63	0.08

	unemprate	unemprate	unemprate	unemprate	unemprate
uniondens					
intrate	-0.018	-0.017	-0.002	0.197	0.140
	(0.26)	(0.24)	(0.02)	(1.35)	(0.75)
trade	-0.007	-0.015	-0.014	-0.041	-0.067
	(0.69)	(1.28)	(1.28)	(2.27)**	(4.35)***
EU	2.186	2.613	2.384	2.565	3.018
	(1.75)*	(2.03)**	(1.84)*	(1.53)	(3.17)***
inflation	0.092	0.035	0.020	0.145	-0.399
	(0.23)	(0.09)	(0.05)	(0.36)	(1.10)
lunion	2.584	2.463	2.321	3.020	2.187
	(2.55)**	(2.07)**	(1.73)*	(1.67)*	(1.87)*
labtax	-0.376	-0.347	-0.299	0.023	-0.427
	(5.56)***	(4.77)***	(3.72)***	(0.14)	(2.68)***
ForPop				0.050	0.185
				(0.24)	(0.68)
lpop					-3.043
					(6.11)***
pubspend	0.097	-0.051	-0.115	-0.030	0.225
	(0.28)	(0.14)	(0.31)	(0.08)	(0.70)
L.pubspend	-0.107	0.180	0.163	0.026	0.156
	(0.39)	(0.74)	(0.80)	(0.11)	(0.61)
L2.pubspend	0.229				
	(0.52)				
L.gdp			-0.000	0.000	0.000
			(0.36)	(1.06)	(1.15)
L2.gdp			0.000	-0.001	-0.001
			(0.03)	(2.37)**	(3.55)***
_cons	4.156	4.811	5.616	8.459	52.018
	(1.03)	(1.11)	(0.98)	(1.14)	(6.19)***
R2_O	0.61	0.56	0.59	0.81	0.88

As we can see in the above tables, the results of our model varied fairly significantly in certain aspects. As a general rule of thumb, our results were more in line with theory the more inclusive our model was. However, this inclusivity of variables came at the cost of both degrees of freedom and number of observations. For example, all of our regressions including the labor tax variable were limited to the years

1990 to 2011. The data constraint became a glaring issue at this point in our analysis. Were we to sacrifice identification and omitted variable bias for a larger sample size, or were we to abandon the road to asymptopia and use the more complete models. Ultimately, though we present the results of all the models we ran, we chose to use the more complete models, as extreme omitted variable bias seemed to skew our results more than a small time sample. We also used the precedent of Nickell(1997), who made inferences uses regressions with a sub 50 sample size.

For our inclusive models we used for variables trade, EU dummy variable, inflation, labor tax, lagged(past two periods) gdp, foreign population, lagged(zero and one period) public spending on unemployment benefits, log of union density and log of population. We also included the real interest rate in several models. Population and Union density were log transformed so that they would be more normally distributed. Both the untransformed union density and population variables had little variance within a panel(labor policy is relatively inelastic and population in developed countries does not vary a great deal over small time periods). Public spending on unemployment was lagged to account for agents making an unemployment trap decision. We felt that it was likely(given government inefficiencies) the money spent by the public on unemployment benefits would not reach the unemployed until some time past the first period, and as such the change in benefits would not play into the utility function of those on the welfare trap borderline until some later point. We chose to be conservative with lag, but more would have been theoretically sound. Gdp was lagged to account primarily for endogeneity concerns, as we worry about present period unemployment having an effect on current period GDP.

We chose to run our more rigorous analyses on the following model:

```
xtreg unemprate lunion intrate trade EU inflation labtax L(0/1)pubspend L(1/2)gdp ForPop
lpop , vce(robust)
```

This regression gave us significant coefficients on trade, EU, union density, tax on labor and second lag of gdp. The signs of the effects were somewhat expected, with trade being negative, EU being positive, union density being positive, population being negative and lagged gdp being negative. We were surpirsed and confused however, by the consistent(across models) significant negative effect of labor tax on unemployment. One would think that a firm being taxed on labor would cause more friction in the labor market, increasing unemployment rather than lowering it. We discuss this oddity later in the paper.

The first test on this page tests for first-order autocorrelation (essentially serial correlation in this case) of the variables in the panel dataset. The lagged variables are not included since the command xtserial command does not allow for time operators. In performing this test, Stata looks at the first difference regression of the variables listed and examines the lagged residuals in order to determine whether there is serial correlation.

The second test (Hausman) compares the fixed and random panel models for xtreg. The null hypothesis is that the difference in the coefficients between the two models is not significant, which is shown to not to be the case. Of course, since the fixed effects model omits the EU dummy variable, this is not very surprising, and this test is not necessarily valid.

```
. xtserial unemprate lunion intrate trade EU inflation labtax pubspend gdp ForPop lpop

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       7) =     18.361
           Prob > F =      0.0036


. hausman fixed random

Note: the rank of the differenced variance matrix (9) does not equal the number of coefficients being tested (11); be s
        what you expect, or there may be problems computing the test.  Examine the output of your estimators for anythi
        and possibly consider scaling your variables so that the coefficients are on a similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
      lunion |    3.281252     2.187275        1.093976        6.448456
     intrate |    .0010159     .1399121       -.1388962               .
       trade |   -.0226496    -.0665821        .0439325        .0310847
   inflation |   -.6234387    -.3994956       -.2239432               .
      labtax |    .6173293    -.4266893        1.044019        .4013372
    pubspend |     .240381     .2249888        .0153923               .
  L.pubspend |    .0915195     .1562704       -.0647509               .
       L.gdp |    .0001339     .0001844       -.0000504               .
      L2.gdp |   -.0001254    -.0006409        .0005156               .
      ForPop |   -1.313294     .1852597       -1.498554        .4131599
        lpop |    8.799764    -3.042855        11.84262        39.46471
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =      332.35
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

```
. xtreg unemprate lunion intrate trade EU inflation labtax L(0/1)pubspend L(1/2)gdp ForPop lpop, fe
note: EU omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =        35
Group variable: countrycode                     Number of groups   =         9

R-sq:  within  = 0.8479                         Obs per group: min =         2
       between = 0.1113                                        avg =       3.9
       overall = 0.0684                                        max =         7

                                                F(11,15)           =      7.60
corr(u_i, Xb)  = -0.8923                        Prob > F           =    0.0003

------------------------------------------------------------------------------
   unemprate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lunion |   3.281252   6.524485     0.50   0.622    -10.62536    17.18786
     intrate |   .0010159   .0675894     0.02   0.988    -.1430474    .1450792
       trade |  -.0226496   .0338577    -0.67   0.514    -.0948156    .0495164
          EU |          0  (omitted)
   inflation |  -.6234387   .2630856    -2.37   0.032    -1.184193   -.0626849
      labtax |   .6173293   .4370944     1.41   0.178    -.3143154    1.548974
             |
    pubspend |
         --. |    .240381   .1528477     1.57   0.137    -.0854061    .5661682
         L1. |   .0915195   .1327698     0.69   0.501    -.1914726    .3745117
             |
         gdp |
         L1. |   .0001339    .000096     1.39   0.183    -.0000707    .0003386
         L2. |  -.0001254   .0001719    -0.73   0.477    -.0004918     .000241
             |
      ForPop |  -1.313294   .4632995    -2.83   0.013    -2.300794   -.3257946
        lpop |   8.799764   39.47392     0.22   0.827    -75.33691    92.93644
       _cons |  -98.27191   406.9789    -0.24   0.812     -965.727    769.1832
-------------+----------------------------------------------------------------
     sigma_u |    6.62765
     sigma_e |   .5810253
         rho |  .99237314   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(8, 15) =    20.64             Prob > F = 0.0000

. estimates store fixed
```

This regression has very close to no significance on the independent variable scale. While the regression as a whole is significant, it has very little to no predictive value. In addition, there is the mystery of EU being colinear. Although we could not test correlation with any of the lagged terms, in the table below it is clear that EU is not fatally correlated with any of the non lagged terms. Another explanation: that the panels of EU are collinear with each other; doesn't hold water as only some of the panel countries are in the Eurozone.

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (9)  =    97877.99
Prob>chi2 =      0.0000
```

Due to the largest chi-squared value the authors have ever seen, it is appropriate to state that the above model suffers from heteroskedasticity. However, for the preferred test we use robust standard errors so this is not an issue. This test is done after running the fixed effect model, and the null hypothesis is that there is homoskedasticity where the test involves examining variances across cross sections. According to the Stata help menu, this modified test statistic is valid even if the errors are not normally distributed, at least asymptotically, and will work for unbalanced panel data sets.

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        unemprate[countrycode,t] = Xb + u[countrycode] + e[countrycode,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
               unemprate |   10.82232       3.289729
                       e |   .3375904       .5810253
                       u |          0              0

        Test:   Var(u) = 0
                             chibar2(01) =     0.00
                          Prob > chibar2 =   1.0000
```

Here, we fail to reject the null hypothesis that we should not use random effects. Hence, we look into using the fixed effects model below. For this test the null hypothesis is that there are no significant differences between panels (variance between panels is zero), in which case random effects would not be the appropriate model to use.

(Note: the regression directly below turns out to be our preferred regression)

```
. xtreg unemprate lunion intrate trade EU inflation labtax L(0/1)pubspend L(1/2)gdp ForPop lpop, re

Random-effects GLS regression                   Number of obs      =        35
Group variable: countrycode                     Number of groups   =         9

R-sq:  within  = 0.1665                         Obs per group: min =         2
       between = 0.9601                                        avg =       3.9
       overall = 0.8770                                        max =         7

                                                Wald chi2(12)      =    156.90
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

unemprate	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lunion	2.187275	.9931387	2.20	0.028	.2407593	4.133791
intrate	.1399121	.1219036	1.15	0.251	-.0990145	.3788386
trade	-.0665821	.0134196	-4.96	0.000	-.0928841	-.0402801
EU	3.017544	1.097371	2.75	0.006	.8667365	5.168351
inflation	-.3994956	.4612485	-0.87	0.386	-1.303526	.5045349
labtax	-.4266893	.1731473	-2.46	0.014	-.7660517	-.0873269
pubspend						
--.	.2249888	.330769	0.68	0.496	-.4233065	.873284
L1.	.1562704	.3029007	0.52	0.606	-.4374042	.7499449
gdp						
L1.	.0001844	.0001384	1.33	0.183	-.0000868	.0004555
L2.	-.0006409	.0002001	-3.20	0.001	-.0010331	-.0002488
ForPop	.1852597	.2096315	0.88	0.377	-.2256105	.5961299
lpop	-3.042855	.852804	-3.57	0.000	-4.71432	-1.37139
_cons	52.01826	12.63859	4.12	0.000	27.24708	76.78944
sigma_u	0					
sigma_e	.5810253					
rho	0	(fraction of variance due to u_i)				

Stationarity Concerns:

One concern with our panel data is that many of the variables being used are probably not stationary. For instance gdp is probably not stationary. To test for whether our gdp time series data are stationary the xtunitroot fisher test was run with gdp being the variable tested. The reason that the xtunitroot fisher test was not used and not one of the many other options is because the fisher version allows for unbalanced panel data and for missing data in the individual panels, while the other versions don't. The dfuller option was used for xtunitroot fisher test in order to specify that augmented Dickey-Fuller tests be done for gdp in each panel. The cumulative Dickey-Fuller tests are testing whether all the panels contain unit roots (cointegration, non-stationarity). The following tests are the results when variable=gdp and lags(#)=2.

```
. xtunitroot fisher gdp, dfuller lags(2)
(247 missing values generated)

Fisher-type unit-root test for gdp
Based on augmented Dickey-Fuller tests
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =     10
Ha: At least one panel is stationary        Number of periods =     32

AR parameter: Panel-specific                Asymptotics: T -> Infinity
Panel means:  Included
Time trend:   Not included
Drift term:   Not included                  ADF regressions: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(20)   P         0.8470       1.0000
 Inverse normal            Z         5.9808       1.0000
 Inverse logit t(54)       L*        6.2941       1.0000
 Modified inv. chi-squared Pm       -3.0284       0.9988
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

Based on this test, it seems that there are issues with stationarity for gdp since the null hypothesis that all panels contain unit roots can not be rejected. Of course, even if one could reject the null hypothesis, the alternative is only that “at least one panel is stationary”, which is not necessarily helpful.

Additionally, in order for this test to not be biased by cross panel dependence, the option demean can be used for this test. This option subtracts the mean of the series for all panels and subtracts this mean from the series. The results when this option is used are shown below. Again, one sees that the null hypothesis that all panels contain unit roots can not be be rejected. Given that there is almost certainly a problem with non-stationarity the best solution would probably be to look at the first difference model and possibly the second difference model in order to not have non-stationarity. Part of the problem with doing this is the limited number of observations available to do these procedures.

```
. xtunitroot fisher gdp, dfuller lags(2) demean

Fisher-type unit-root test for gdp
Based on augmented Dickey-Fuller tests
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =     10
Ha: At least one panel is stationary        Number of periods =     32

AR parameter: Panel-specific                Asymptotics: T -> Infinity
Panel means:  Included
Time trend:   Not included                  Cross-sectional means removed
Drift term:   Not included                  ADF regressions: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(20)   P        10.1789       0.9648
 Inverse normal            Z         3.0730       0.9989
 Inverse logit t(54)       L*        3.4034       0.9994
 Modified inv. chi-squared Pm       -1.5528       0.9398
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

Conclusions

We see that the nations in our sample have exhibited higher unemployment rates following their joining the EMU at a significant level with non-trivial coefficients. However, we are wary to call this definitive proof that joining the EMU has a positive effect on the unemployment rate. We worry especially about our lack of data accounting for financial crises, as we may be getting omitted bias, confounding the true effect of joining the EMU.

We should also emphasize the fact that, even if we take the EMU coefficient as valid and true causality, it is nearly impossible to isolate the effects of monetary policy union from increased integration and labor mobility in the absence of good migration data. Theory tells us that the shared monetary policy should have a positive effect on unemployment rate, while the increased economic integration should be negative, but we should be wary of taking this as evidence that the positive EMU coefficient is a result of monetary union. Given our data constraints, we cannot confidently reject that this result is due to omitted variables.

An interesting (and surprisingly robust) result is that higher labor tax rate (more taxes on businesses correlate to lower unemployment rates). This superficially contradicts theory, specifically we would normally expect higher tax rates to correlate with lower unemployment. However, labor tax rates are relatively static per individual country. We propose labor tax rates then are largely proxying government spending. So a country with a higher labor tax rate will spend more money in turn increasing the economic activity within that country and lowering unemployment rate.

Validity Concerns: We have Them

The data is far from ideal. Largely, we have a lack of tenable observations. This stems from the use of many variables in which there was only incomplete data. Labtax is a great example of this. Although regressions using it seem to have benefitted from its inclusion, the data only goes back to 1995. This is compounded by other variables of the same completeness (ForPop and pubspend). Given this lack of observations, it is difficult to claim external validity for our results.

In addition, there is concern that these organizations are not keeping trustworthy data collection, retention, and distribution policies and procedures. One example that comes to mind was a typo in the labtax data. There was a zero for one observation (year 2011) in Norway when the other observations were around 30%. This observation was replaced from data obtained from PKF resulting in an observation of 28%. The data in many areas are spotty at best with some datasets claiming to go back to the 1960s but lacking data anywhere but for a 10 year run. Overall, it is difficult to believe that there are not other mistakes lurking in the data.

Further Research

Though much of our issues with this project have to do with inaccessible or unobservable data, there are some areas where further possible research would be helpful. We feel that percentage of population foreign is an especially weak proxy for measuring levels of working immigration. However it seems especially difficult to estimate statistically, as nations do not seem to document intra-EU migration very well since the adoption of the EMU. Assuming that this data does exist somewhere, we could have taken the difference of migratory workers from emigrant workers and used the resultant statistic as a proxy for labor integration.

Additionally, we could have spent more time looking for data on labor market rigidities, to look at the relationships presented in Nickell (1997). The results from that paper likely did not encapsulate all the lagged effects of nations joining the EMU, and hence should be updated with more modern observations.

One could collect unemployment data from the counties or provinces of a country and estimate the spatial spread of unemployment from neighboring counties. Especially with regard to migration patterns in from the border regions of that country. Given trends of unemployment in the United States, it would be reasonable to expect unemployment to be greater in rural rather than urban areas so one conducting this type of study should at the least include some measure of population density to avoid unnecessarily skewed results. Of special interest are the changes of time in the spatial distribution of unemployment. Has the EMU allowed struggling manufacturing regions near borders to thrive under a monetary union? Has it suffocated manufacturing regions located in areas more isolated from neighboring countries, thus reducing their trade advantage? These are interesting and answerable questions if the prospective researcher is willing to comb through regional unemployment data.

Further analysis can be done in differencing the data to adjust for non-stationarity which we did not explore many solutions to. Despite problems identifying valid tests to identify stationarity problems, a priori and the tests that we did run point to non-stationarity that needs to be accounted for or corrected for in some manner. However, during our brief exploration we discovered that to take full advantage of differencing, more observations are needed.

Another area for further research would be to collect data for the public's expected inflation (what rise in prices the general public expects) to regress using the expectation-augmented phillips curve which should presumably result in a more accurate or at least a more theoretically coherent estimate of the relationship between unemployment and inflation. Additionally, we could have made run separate regressions on short term and long-term unemployment, as theory suggests unions and unemployment benefits have a different effects under hysteresis than in short-term changes.

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