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Do labor market rigidities matter for business cycles? Yes they do

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Abstract

We study whether labor market institutions affect the volatility and correlations of macroeconomic variables for a sample of 20 OECD countries. Labor market rigidities are characterized with a number of indicators; volatilities and correlations are computed in several ways. Union coverage and replacement ratios in the first year of unemployment are the labor market rigidities that most significantly affect business cycle statistics. Active labor market policies are effective in reducing unemployment volatility in countries with heavily regulated labor markets.

JEL classification numbers: E32, E6, J01, J08

Key words: Labor market institutions, Business cycles, OECD countries, rank sum test, active labor market policies

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1 Introduction

This paper studies how labor market institutions affect the macroeconomy using data from 20 OECD countries for the period 1975-2007. We look at the volatility and the cross-correlations of the main macroeconomic variables and we investigate whether and how labor market institutions shape those business cycle statistics. We find that institutions do matter.

A rapidly growing strand of theoretical literature attributes a crucial role to labor market institutions in explaining the behavior of macro variables over the cycle. Business Cycle models have been recently augmented with labor market frictions in order to match important empirical facts. Two broad categories of rigidities have been considered: on the one hand, frictions limiting flows in and out of unemployment, such as hiring costs, labor hoarding and matching technology, employment protection legislation, wage bargaining institutions, unemployment benefits and tax wedges; on the other hand, rigidities preventing the adjustment of real wages to economic fluctuations. Many economists have argued that institutional rigidities affect the short run movements of macro variables in response to macroeconomic shocks, because of imperfect adjustments of employment and the real wage[1]. Yet the empirical literature on the topic is rather scant. Very few Business Cycle models relate labor market institutions indicators, structural parameters and the volatility of macro variables[2]. Our study intends to cover this gap.

We use the CEP-OECD Institutions Data Set (Nickell (2005)) to construct labor market institutions indicators for the OECD countries in our sample. The data covers a sufficiently long span of time to include both expansionary and recessionary periods. We have information about employment protection legislation, union density, union coverage, coordination and centralization of the wage bargaining process, replacement rates, employment benefit duration and tax wedges. These are the usual suspects for institutional rigidities set out in Oswald´s (1997) quote: benefits, trade union power, taxes and wage "inflexibility." We divide the countries into two groups, "strictly" versus "loosely" regulated, according to their position relative to the mean (or the median) of the various labor market indices and non-parametrically test whether the two samples of observations have similar distributional features. We control for a number of variables that could potentially

[1] Among them, a sample includes Walsh (2005), Trigari (2006), Campolmi and Faia (2006), Krause and Lubik (2007), Blanchard and Gali (2008) and Gali and van Rens (2008).

[2] With a focus on inflation volatility, Tomas and Zanetti (2008) and Krause, Lopez-Salido and Lubik (2008) structurally estimate a NK model with labor market matching frictions for the Euro Area and the Unites States, respectively and find that hiring and firing costs are not quantitatively relevant for inflation dynamics. Christoffel, Kuester and Linzert (2006) structurally estimate a NK model with labor market frictions and real wage rigidities with German data and provide evidence that both efficiency in the matching process and real wage rigidity matter.

affect business cycle statistics other than labor market institutions, such as the size of the government, the degree of openness of the economies, the monetary policy stance and the exchange rate regime. We also study whether the "Great Moderation" episode changes the relationship between business cycle statistics and labor market institutions by splitting the sample at the beginning of the 1980s.

We find that business cycle statistics are affected by the degree of the labor market regulations. Differences between loosely and strictly regulated labor markets are statistically significant and, often, economically important. Our results hold regardless of how we define "loose" or "strict", or the way we construct business cycle statistics and, to a large extent, the sample we consider. We conclude that the macroeconomic consequences of labor market institutions have been generally underemphasized.

Union coverage and replacement rates are the labor market indices that affect most business cycle statistics. In countries where the number of workers covered by collective agreements is relatively higher, the volatility of the real wage is lower, while the volatility of unemployment is higher. Union coverage also affects the structure of economic relationships. In fact, the correlation of employment with labor productivity is negative and further decreases in countries where the fraction of contracts negotiated through collective wage bargaining is higher than average, while the correlation of output with inflation switches from positive to negative when labor market regulations get tighter.

High replacement ratios make employment more volatile and increase the correlation of the real wage with labor productivity. In addition, countries with generous benefits display stronger positive co-movements of output and inflation. Interestingly, employment protection and unemployment benefits´ duration are the labor market indicators which least impact on macroeconomic performance. Employment protection only reduces the correlation of employment with labor productivity while duration appears to have no cyclical effects.

We find that active labor market policies make little difference for the volatility of macro variables for the full sample of countries. However, we document that conditional on labor market rigidities, active policies are effective in countries characterized by relatively strict labor market institutions. Thus, the assessment of labor market policies cannot abstract from institutions.

Many empirical studies build on the seminal papers by Layard, Nickell and Jackman (1991) and Nickell and Layard (1999) on institutions and labor market performance[3]. All these papers

[3] See for instance Blanchard and Wolfers (2000), Nickell, Nunziata and Ochel (2005) and Costain and Reiter (2008).

study the effect of institutions and their interaction with shocks on unemployment. None of them systematically investigates the impact of institutions on the volatility and the cross-correlations of the major macroeconomic variables. Exceptions are Nunziata (2003), who studies the effect of labor market institutions on cyclical adjustment of employment and hours worked, Nunziata and Bowdler (2005), who analyze the effects of institutions on inflation dynamics, Fonseca et al. (2007) who look at how international comovements relate to institutions and Rumler and Scharler (2009) who use fixed-effect panel regressions for a sample of 20 OECD countries to assess the importance of institutions for the variability of the output gap and inflation.

The rest of the paper is organized as follows. The next section presents the indicators capturing labor market institutions and describes how they are constructed. Section 3 presents the data and highlights some methodological issues. Section 4 presents the results. Section 5 investigates the role of active labor market policies and section 6 concludes.

2 Characterizing labor market rigidities

We rank countries looking at 9 indicators capturing different aspects of labor market rigidities. They are: (i) EPL, the strictness of employment protection legislation; (ii) RR_S, the replacement rate, defined as the ratio of disposable income when unemployed to expected disposable income, if beginning to work during the first year of unemployment; (iii) RR_L, the replacement rate as the average across the first five years of unemployment; (iv) DU, the duration of unemployment benefits; (v) UD, union density, measured as the percentage of workers affiliated to a union; (vi) UC, union coverage, measured as the percentage of contracts negotiated by unions, (vii) COOD, the degree of coordination in the bargaining process, both on workers' and firms' side; (viii) CEN, the degree of bargaining centralization; (ix) TAX, the tax wedge. Centralization refers to the predominant level where bargaining takes place (e.g. firm level, industry level and nation wide). Coordination, as defined by Kenworthy (2001), refers to the degree to which minor bargaining units follow along with major players' decisions, where major players may include union confederations (Norway, Netherlands and Italy), leading unions and its employer counterpart (such as IG Metall in Germany) and confederations of large firms as in Japan. Indices of coordination take into account the presence of coordinating activity by the major players. Examples of those activities, in addition to confederations of firms and of unions, are state-sponsored or state-imposed coordination.

Employment protection, replacement rates and benefit duration are typically regarded as important determinants of the incentives driving job creation and job destruction and, as a consequence,

of labor market adjustments. Density, coverage, coordination and centralization affect the power of unions and their importance in wage adjustment. Tax wedges may also have an impact on the responsiveness of the real wage to changes in macroeconomic conditions.

We group countries into two groups according to the tightness of the indices. The time series for the indicators run from 1960 to 2004. However, we restrict our analysis to the period starting in 1975 due to unavailability of macroeconomic series for some countries earlier to that date. The average value of the index is assigned to each country and grouping is performed according to the country´s position relative to the cross-country mean (and/or the median). Since the temporal coverage of these data differs across series and countries and there are more than one series for some indicators, grouping countries according to their position relative to the mean results in a robust classification. Also, the absence of considerable time variations in the indicators´ series rationalizes our choice of using the mean value, rather than trying to take advantage of the time series dimension of the indicators.

The indicators we use come from the CEP-OECD Institutions Data Set. For employment protection legislation we use the series constructed by the OECD. Replacement ratios are from the OECD and we have one observation every two years for each country. For both replacement rates series, RR_S and RR_L, the data are averaged over three family situations and two earnings levels and the benefits are measured as a percentage of average before tax earnings. Duration is an index capturing the level of benefits available in the later years of unemployment spells, relatively to the first year. Our rankings of union coverage coincide for the two available indices, the one produced by the OECD and the one of Ochel (2001). Tax wedges are constructed as the sum of employment, direct and indirect tax rates.

Table 1 summarizes the information we have available. A score of 1 is given to countries with an index higher than the cross-country average and 0 to countries with index below the cross-sectional average. In general, the nine indicators have a great deal of overlap. For example, countries with high degree of coordination in the bargaining process, also have a high degree of centralization (the exception is Japan). Also, the degree of coordination is related to the percentage of union covered employment: the two indicators differ only for Italy, Ireland and Japan. The US features the most unrestricted labor market, it is classified as "loose" along all the dimensions we consider. On the other hand, Finland and Norway, are always ranked as "strict", independently of the index used. All European countries are highly rigid, with the exception of Switzerland, Ireland and the UK.

Table 1: Labor market Characteristics of OECD countries

COUNTRY	EPL	RR_S	RR_L	DU	UD	UC	COOD	CEN	TAX
Australia	0	0	0	1	1	1	1	1	0
Austria	1	0	1	1	1	1	1	1	1
Belgium	1	0	1	1	1	1	1	1	1
Canada	0	1	0	0	0	0	0	0	0
Denmark	0	1	1	1	1	1	1	0	1
Finland	1	1	1	1	1	1	1	1	1
France	1	1	1	0	0	1	0	0	1
Germany	1	0	0	1	0	1	1	1	1
Ireland	0	0	1	1	0	0	1	1	0
Italy	1	0	0	0	0	1	0	0	1
Japan	0	0	0	0	0	0	1	0	0
Netherlands	1	1	1	1	0	1	1	1	1
Norway	1	1	1	1	1	1	1	1	1
New Zealand	0	0	0	1	0	0	0	0	0
Portugal	1	1	0	0	0	1	1	1	0
Spain	1	1	1	0	0	1	1	1	0
Sweden	1	1	0	0	1	1	0	1	1
Switzerland	0	1	0	0	0	1	1	0	0
UK	0	0	0	1	1	0	0	0	0
US	0	0	0	0	0	0	0	0	0

3 The macroeconomic data and the methodology

We use quarterly data in the exercise. The source is the OECD and the International Financial Statistics (IFS) of the IMF. The sample covers the period 1975:1-2007:4. The countries in the sample are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States. Gross domestic product (GDP) is measured in constant 2000 prices. Employment measures total full and part time employment in thousands, while the unemployment rate measures average yearly rates. For real wages we use both the series on the relative unit labor costs and adjusted for the real exchange rate, or the hourly earnings series divided by the GDP deflator[4]. Labor productivity is computed as the ratio between output and total employment and the GDP deflator is used to construct the inflation series.

We measure volatilities and correlations in a number of ways. In the business cycle literature, it is common to filter out long and short frequencies fluctuations and concentrate on fluctuations which, on average, last between 2 to 6 years. In cross country studies, however, one has to worry

[4]We use two types of real wages series, since it is impossible to collect comparable series for all the countries in the sample.

about the fact that cycles may have different length in different units, or that trends may not be common. For that reason, in cross sectional comparisons, it is more typical to compute statistics using growth rates of the variables, or scaling variables by appropriate averages. As a benchmark, we compute statistics obtained by forth differencing the log of the raw data. We check the robustness of our conclusions by using three alternative ways of eliminating trends: Hodrick-Prescott filtering, Band pass (BP) filtering and VAR filtering.

In a study like ours, besides spurious trend effects, one should also worry about the presence of measurement error. As long as this error is uncorrelated with labor market rigidities, no systematic bias should be present. However, measurement error may artificially increase the volatility of macro variables and reduce the power of our tests. While there is little in principle one can do to take care of this problem, comparing alternative detrending procedures should help to quantify the importance of measurement error. In fact, while HP or BP filtering are likely to leave the importance of high frequency measurement errors unchanged, taking growth rates magnifies its importance. Hence, considering a number of filtering methods should help us to assess the robustness of our conclusions.

We analyze the relevance of labor market institutions for the business cycle characteristics by testing differences in the average moments of filtered data in strictly versus loosely regulated countries, for each of the indicators we consider. To detect differences, we use the Mann–Whitney U-test, a nonparametric rank sum test. A non-parametric methodology has several advantages.

First, while the t-test is the standard method for testing the difference between population means in two non-paired samples, it is not valid for populations that are non-normal, particularly for small samples. Our test can be applied when distributional assumptions are suspect. When the cross section is large our test is equivalent to an F-test used to assess the significance of the β coefficient in the regression $x_i = \alpha + \beta D_i + e_i$, where x_i are estimated business cycle moments and D_i one of our labor market indicators, once standard errors are adjusted to take into account the fact that x_i are estimated. In addition, the test examines the entire cross sectional distribution instead of its first moments only. Thus, it provides a more reliable picture of the statistical significance of the differences. Second, our non-parametric approach does not suffer from error-in-variable problems which make standard regression analysis unreliable. In fact, failing to correct for the fact that business cycle moments are estimated may give a biased view of the importance of the restrictions and artificially produce significant effects even when the "true" ones are negligible. Finally, the U-test is a small sample test. This is particularly important, since for some classifications we have

groups with very few countries and small sample biases may be severe. With our approach, such biases are of no concern, as critical values of the test have been tabulated for groups with as little as three units (see e.g. Hoel (1993)).

4 The results

In this section we examine whether basic business cycle statistics are affected by the presence of labor market institutions. We summarize cyclical information with 16 measures, 8 volatilities and 8 correlations: the volatility of the annual growth rate of real GDP, Y, real GDP per capita, y, employment, N, employment per capita, n, real wages, w, labor productivity, y/n, annual unemployment and inflation rates, u and π; the correlations of GDP (and GDP per capita) with employment, inflation and labor productivity and the correlations of employment (and employment per capita) and the real wage with labor productivity.

Table 2 reports the p-values of the nonparametric rank sum test. Since we have nine indicators capturing labor market restrictions, different rows report the results obtained with different classifications [5]. In boldface are the p-values smaller than 0.05.

Certain institutional restrictions in the labor market matter for business cycle fluctuations in output, employment and the real wage, for example, the short run replacement ratios and union coverage. However, other indicators such as union density, employment protection and the duration of unemployment benefits seem to make very little difference for business cycle statistics. Overall, volatilities are typically insignificantly different across all groups, except when countries are grouped using the short run replacement ratio, union coverage and coordination. Correlations differ more often across groups and the correlation which looks most unstable is the one between employment and labor productivity.

[5] Results obtained when ranking countries according to their position relative to the cross-sectional median rather the mean are identical.

Table 2: Business Cycle statistics, forth differences

Index	EPL	RR_S	RR_L	DU	UD	UC	COOD	CEN	TAX
Var(Y)	0.15	0.10	0.59	0.82	0.64	0.94	0.13	0.70	0.88
Var(y)	0.82	**0.01**	0.32	0.98	0.08	0.48	0.11	0.32	0.94
Var(N)	0.08	0.20	0.70	0.94	0.22	0.87	0.69	0.72	0.88
Var(n)	0.65	**0.00**	0.25	0.08	0.94	0.53	0.69	0.15	0.11
Var(u)	0.59	0.17	0.11	0.94	0.54	**0.01**	0.43	0.70	0.60
Var(w)	0.83	0.55	0.76	0.49	0.59	**0.01**	0.18	0.29	0.20
Var(y/n)	0.11	**0.01**	0.75	0.88	0.44	0.27	**0.03**	0.45	0.42
Var(π)	0.99	0.54	0.70	0.36	0.53	0.10	0.08	0.59	0.41
cor(y,n)	0.45	0.65	0.49	0.45	0.64	0.87	0.75	0.36	**0.01**
cor(Y,N)	0.88	0.99	0.22	0.20	0.35	0.75	0.15	0.22	0.76
cor(Y,y/n)	0.40	0.36	**0.02**	0.25	0.11	0.08	0.53	0.76	0.76
cor(N,y/n)	**0.02**	**0.00**	0.22	**0.03**	0.54	**0.00**	0.43	0.54	0.82
cor(w,y/n)	0.59	**0.00**	0.65	0.94	0.28	0.48	0.38	0.54	**0.01**
cor(y,y/n)	0.40	0.45	0.76	0.36	0.70	0.87	**0.01**	**0.02**	0.74
cor(n,y/n)	0.13	0.29	0.20	0.15	0.28	0.10	0.30	**0.05**	0.11
cor(y,π)	0.88	0.76	**0.04**	0.70	0.32	**0.00**	0.69	0.94	0.82

P-values are useful summary statistics but may hide important information. To give some visual content to the numbers presented in table 2, we plot the values of the estimated statistics that appear to be different across groups. A vertical bar in each graph cuts off the countries with loose labor market institutions (an index equal to zero) from those with strict ones (an index equal to one).

a. Employment protection

Employement protection affects significantly only the correlation of employment with labor productivity.

Gali (1999) documents a striking empirical regularity in industrialized economies: a permanent increase in total factor productivity reduces employment; and a temporary increase in aggregate demand increases both employment and labor productivity. In other words, following permanent technology shocks employment is negatively correlated with labor productivity, and following transitory shocks to demand employment is positively correlated with labor productivity.

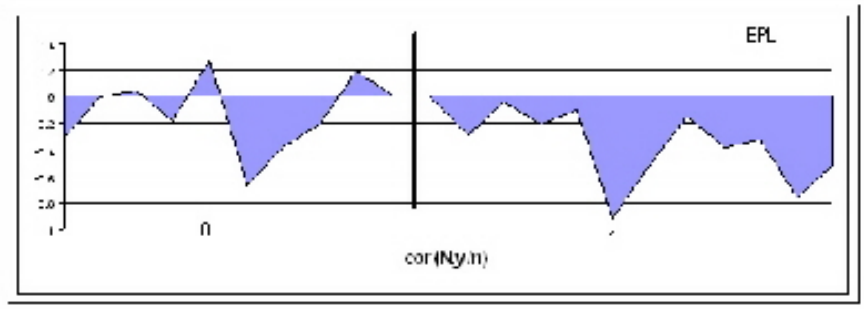

Figure 1: The employment protection legislation index

A bar divides states with loose EPL indices from those with strict EPL indices.

The unconditional correlations between employment and labor productivity in the sample of our countries for the period considered are mostly negative, and in countries with stricter employment protection legislation they are significantly more negative than in countries with looser EPL. If stricter EPL implies higher firing costs and, in turn, higher firing costs make the employment adjustments costlier than the price adjustments, output fluctuations should be damped in response to either supply or demand shocks. Therefore, both the positive comovement between employment and labor productivity in response to transitory shocks and the negative comovement between employment and labor productivity in response to permanent shocks should be dampened. The data suggest that strict EPL results in a more negative correlation between employment and labor productivity and this is difficult to reconcile with any of the existing business cycle models.

b. Replacement rates and duration

Except for the volatility of employment and the correlation of real wages with labor productivity, the differences in the means across groups classified using the RR_S indicator are economically unimportant.

Without a structural model, it is hard to provide an explanation for these movements. However, our findings may be reconciled with a model featuring labor market matching frictions and real wage rigidities. In countries with more generous benefits, workers have a higher threat point in wage negotiations. Hence, profits get smaller on average and more sensitive to productivity changes. Therefore, as in Hall (2005), Shimer (2005), Costain and Reiter (2008) and Hagedorn and Manovskii (2008), hiring and employment become more volatile. On the other hand, the bargaining

set shrinks so that firms are more likely to reward productivity changes to prevent matches from being destroyed. Thus, the correlation of real wages with labor productivity could be higher.

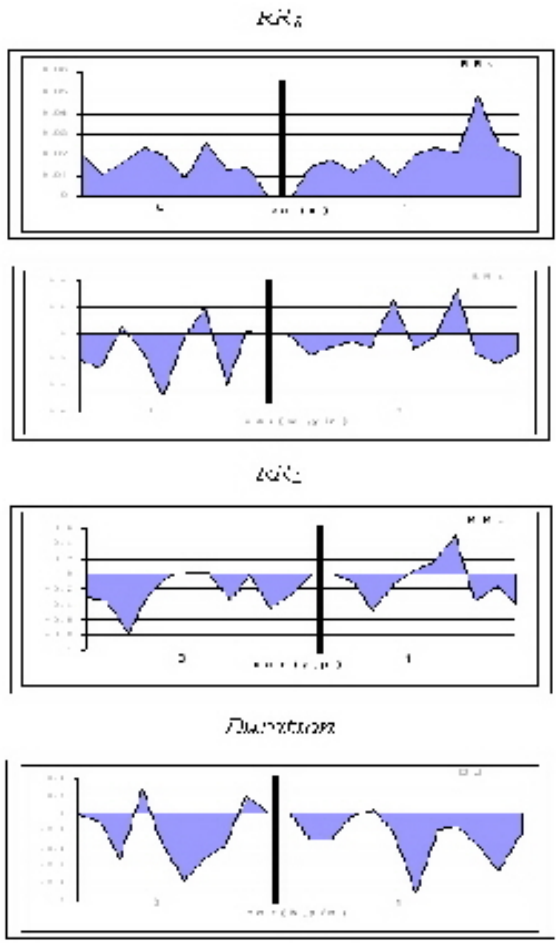

Figure 2: Replacement rates and duration

A bar divides states with low replacement rates from those with high ones.

It is also clear from figure 2 that the distribution of the correlation between output and inflation is higher for countries with higher replacement ratios in the first five years of unemployment. Keeping in mind that the output gap, rather than output per se, is driving monetary policy trade-offs, this finding may indicate a change in the costs and the benefits of inflation stabilization between the two groups of countries. In fact, higher replacement rates in the long-run seem to be

associated with a positive correlation of output and inflation, which is consistent with movements along a positively sloped and stable Phillips curve. Conversely, more flexible labor markets display a negative correlation of output and inflation, suggesting shifts of the curve.

Finally, benefit duration does not significantly affect the mean correlation of employment with labor productivity.

c. The importance of labor unions

When considering the grouping according to the union coverage, our test detects a significant negative relationship between union coverage and real wage volatility. This evidence is consistent with the recent findings by Holden and Wulfsberg (2009) who suggest that unionization increases downward nominal wage rigidity. To the extent that prices are also sticky, countries with more powerful unions should display lower volatility of the real wage. As a consequence, it is reasonable to expect more volatile hiring activity and unemployment in countries where real wages are less flexible. The data partially confirms this intuition, as unemployment volatility is higher in countries with a coverage higher than the average.

The data also suggests that high coverage and wage setting centralization are associated with stronger negative co-movements of labor input and productivity. One can argue that, if coverage and centralization proxy for real wage rigidities, then such institutions make the real wage stickier. As a result, quantities should move more than prices, and employment should adjust to changes in supply or demand, more than wages. In environments with both real wage and nominal rigidities, employment should increase more after a negative shock to productivity in countries where both prices and real wages are sticky.

Labor productivity is on average positively correlated with output per-capita and less so in countries with centralized bargaining systems. When countries are clustered according to coordination, means are not significantly different across groups.

Coordinated bargaining boosts the volatility of productivity. This fact may be regarded as consistent with the recent contribution of Gali and Van Rens (2008). Their model with hiring costs and endogenous labor effort would account for higher volatility of labor productivity in countries where hiring costs are higher. This is because to the extent that labor market frictions prevent the adjustment of employment to productivity shocks, labor productivity has to be more volatile than in a frictionless model. We do not observe in our data a measure of hiring costs. Hence, we cannot directly compare our results with theirs. Still, as long as coordinated wage bargaining correlates

positively with hiring costs, this evidence lends some support to their model.

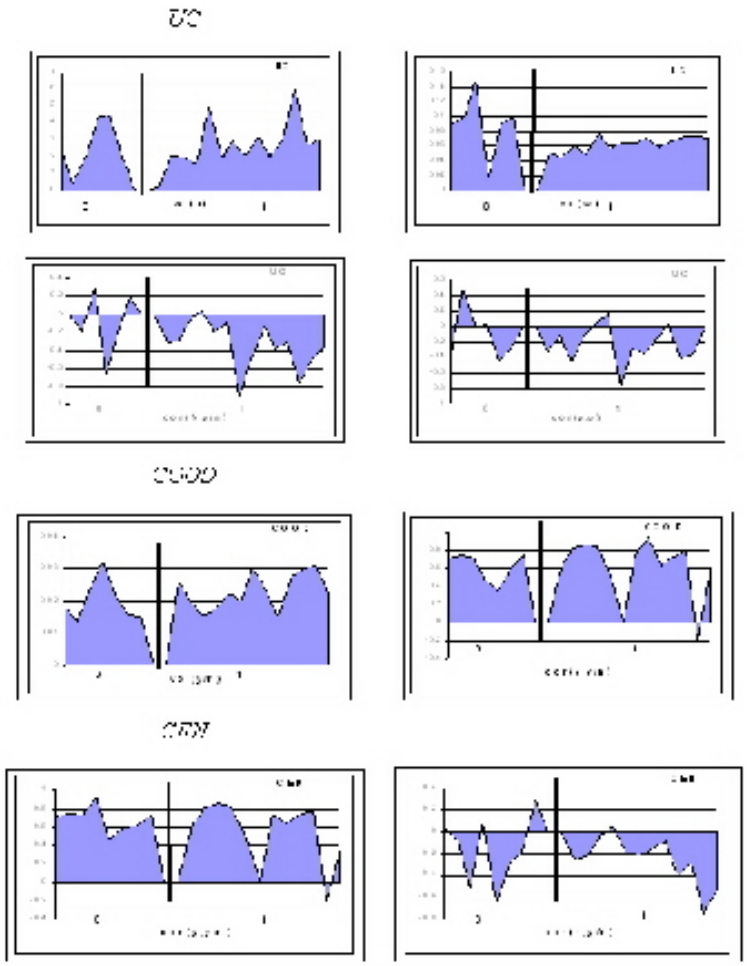

Figure 3: Labor Union indices

A bar divides countries with low indicators from those with high ones.

The labor market structure seems to change monetary policy trade-offs also in this case. In fact, higher coverage reduces the correlation of output and inflation and pushes its mean mean value from –0.09 to –0.22, making harder the joint stabilization of both inflation and output.

d. The tax wedge

Higher tax wedges significantly reduce the correlation between output and employment. Intuitively, given the distortions induced by taxes, firms may want to adjust other available margins, such as effort or capital, in order to respond more efficiently to changes in productivity. On the other hand, the correlation of the real wage and labor productivity does not seem to be significantly affected by the size of the tax wedge.

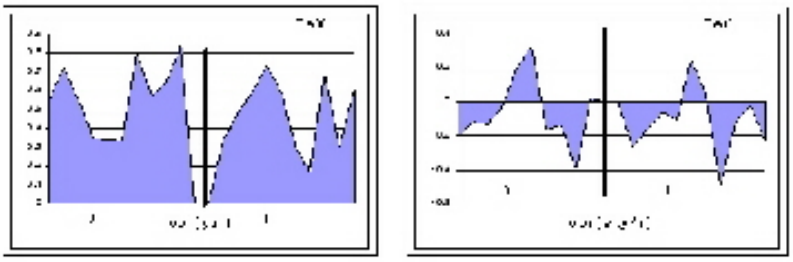

Figure 4: The tax wedge

A bar divides countries with low tax wedges from those with high ones.

Rumler and Scharler (2009) find that union density matters for the volatility of output and that the degree of coordination of the wage bargaining system is important for the volatility of inflation. The p-values for these statistics are both equal to 0.08 in Table 2, which is hardly significant. The main reason for the difference in the significance level is the econometric methodology used: in fact while we use a non-parametric approach, they use a standard two-step regression. The estimated importance of labor market rigidities in two-step regressions might be overstated because the analysis neglects the fact that the left hand side variables of the second regression are estimated and not the true ones. Since estimates of standard errors are downward biased, differences across groups may become artificially significant.

e. Robustness

We first check whether the uncorrect filtering or measurement errors may affect the conclusions we reach. Table 3 reports the p-values of the tests when we detrend the raw data with an HP filter[6]. It is evident that results are broadly unchanged, despite the relative short size of the sample.

[6] Band-Pass and VAR filtering deliver similar results that we do not present here for economy of space.

Table 3: Business Cycle statistics, HP filtered data

Index	EPL	RR_S	RR_L	DU	UD	UC	COOD	CEN	TAX
Var(Y)	0.11	0.10	0.61	0.82	0.64	0.94	0.13	0.70	0.88
Var(y)	0.76	**0.01**	0.32	0.99	0.08	0.48	0.11	0.32	0.94
Var(N)	0.70	0.21	0.70	0.94	0.22	0.87	0.69	0.70	0.88
Var(n)	0.76	**0.01**	0.25	0.08	0.94	0.53	0.69	0.15	0.11
Var(u)	0.20	0.17	0.11	0.94	0.54	**0.01**	0.43	0.70	0.60
Var(w)	0.76	0.54	0.76	0.49	0.59	**0.01**	0.18	0.28	0.20
Var(y/n)	0.65	**0.01**	0.76	0.88	0.44	0.27	**0.03**	0.45	0.41
Var(π)	0.23	0.54	0.70	0.36	0.54	0.10	0.08	0.59	0.41
cor(y,n)	0.22	0.65	0.49	0.45	0.64	0.87	0.75	0.36	**0.01**
cor(Y,N)	**0.03**	0.99	0.22	0.20	0.35	0.75	0.15	0.22	0.76
cor(Y,y/n)	0.25	0.65	**0.02**	0.25	0.10	0.08	0.53	0.76	0.76
cor(N,y/n)	0.87	**0.01**	0.22	**0.03**	0.54	**0.00**	0.43	0.54	0.82
cor(w,y/n)	0.59	**0.01**	0.64	0.94	0.28	0.48	0.38	0.54	**0.01**
cor(y,y/n)	0.60	0.45	0.76	0.36	0.70	0.87	**0.01**	**0.02**	0.76
cor(n,y/n)	0.32	0.29	0.19	0.15	0.28	0.10	0.30	**0.05**	0.11
cor(y,π)	0.40	0.79	**0.05**	0.70	0.32	**0.01**	0.69	0.94	0.82

As we mentioned, measurement error could also be an issue and comparing across filtering methods which emphasize or de-emphasize high frequency measurement error could help us to assess its importance. Comparing tables 2 and 3, one can see that p-values are roughly unchanged. Hence, measurement error does not drive our results.

Second, we want to make sure that our results are not driven by omitted variables that may correlate with labor market institutions. In fact, conditioning on factors such as size, openness, population density, etc., labor market restrictions may not matter for business cycles, even though they are significant unconditionally. The above variables are typically thought to have an impact on business cycle fluctuations. Some of them may also correlate with labor market institutions. For example, consider openness. More open countries are likely to be more prone to external shocks, therefore they tend to be more volatile. However, they may also develop less rigid institutions, through competition with foreign countries on goods markets, or more rigid institutions if unions get more aggressive so as to better insure workers against unemployment fluctuations. We want to avoid that our statistics capture such effects, rather than the direct effect of institutions on economic fluctuations. Hence, we investigate whether our conclusions hold, once we control for these potentially relevant cross sectional variables.

In table 4 we report p-values of the test for the equality of selected macroeconomic statistics when we condition on a) the degree of openness, grouping the countries by the share of exports or

imports to GDP; b) the size of the countries in the sample, grouping the countries by their real GDP; c) the size of the government, measured as the share of government expenditure to GDP; d) the exchange rate regime, grouping countries according to the number of years they are subject to some fixed or semi-fixed exchange rate arrangement and e) population density. For the sake of space we only present results referring to replacement ratios and union coverage, since they are the ones that matter the most in Table 2.

Table 4: P-values Rank Sum Test: forth differences

Variable	vol(y)	vol(n)	vol(y/n)	vol(w)	vol(u)	corr(N,y/n)	corr(w,y/n)	corr(π, y)
Unconditional								
RR_S	**0.01**	**0.00**	**0.01**	0.55	0.17	**0.00**	**0.00**	0.76
UC	0.48	0.53	0.27	**0.01**	**0.01**	**0.00**	0.48	**0.00**
Openness								
RR_S	**0.03**	0.51	0.32	0.03	0.0	**0.03**	**0.09**	0.00
UC	0.98	0.72	0.17	0.60	0.86	**0.09**	0.30	**0.09**
Size								
RR_S	0.36	0.95	0.99	0.13	0.36	**0.03**	0.36	0.09
UC	0.37	0.23	0.36	**0.03**	**0.03**	**0.03**	0.37	**0.03**
Government size								
RR_S	**0.02**	**0.09**	0.68	0.98	0.41	0.54	0.99	0.68
UC	0.85	0.36	0.27	**0.06**	**0.09**	0.27	0.71	**0.04**
Fix exchange rate regime								
RR_S	**0.08**	**0.00**	**0.08**	0.00	0.00	**0.00**	**0.08**	0.00
UC	0.14	0.85	0.46	0.36	0.86	**0.09**	0.46	0.58
Population density								
RR_S	**0.08**	**0.01**	**0.08**	0.83	0.20	**0.01**	**0.09**	0.83
UC	0.52	0.03	0.53	**0.09**	0.83	0.39	0.39	**0.03**
Before 1980								
RR_S	**0.01**	**0.08**	**0.09**	0.25	0.00	0.15	**0.09**	0.00
UC	0.02	0.96	0.05	0.97	**0.00**	0.65	0.30	**0.04**
After 1980								
RR_S	**0.01**	**0.00**	**0.00**	0.54	0.17	**0.00**	**0.00**	0.76
UC	0.47	0.53	0.26	**0.01**	**0.01**	**0.00**	0.48	**0.01**

Table 4 makes clear that labor market institutions that matter unconditionally also matter conditionally. For example, the exchange rate regime and the population density do not affect the importance of replacement ratios. Similarly, conditioning on country size does not affect the significance of union coverage. In general, while the p-values change relative to table 2 the main message of our analysis is unchanged: labor market institutions are important for business cycle statistics. Replacement ratios robustly matter for the volatility of output per capita and the

correlations of employment and the real wage with labor productivity, while union coverage makes a difference for the volatility of the real wage and the correlation of output with inflation.

Our results appear to be robust also to the presence of potential structural breaks. In Table 5 we report the p-values for the tests when we repeat our analysis for each of the two subsamples 1975-1980 and 1981-2007. Results hardly change across samples. There are two exceptions to the rule however: the union coverage index is not significant for explaining differences in the correlation between employment with labor productivity and the volatility of the real wage before 1980.

Table 5: P-values Rank Sum Test: forth differences

Variable	vol(y)	vol(n)	vol(y/n)	vol(w)	vol(u)	corr(N,y/n)	corr(w,y/n)	corr(π, y)
Full sample								
RR_S	**0.01**	**0.00**	**0.01**	0.55	0.17	**0.00**	**0.00**	0.76
UC	0.48	0.53	0.27	**0.01**	**0.01**	**0.00**	0.48	**0.00**
Before 1980								
RR_S	**0.01**	**0.08**	**0.09**	0.25	0.00	0.15	**0.09**	0.00
UC	0.02	0.96	0.05	0.97	**0.00**	0.65	0.30	**0.04**
After 1980								
RR_S	**0.01**	**0.00**	**0.00**	0.54	0.17	**0.00**	**0.00**	0.76
UC	0.47	0.53	0.26	**0.01**	**0.01**	**0.00**	0.48	**0.01**

Not only our results on the importance of replacement ratios and union coverage do not change conditionally, but other labor market indicators become significant when we condition our analysis. In Table 6 we present the p-values for these indicators. In particular, conditionally on openness, replacement rates in the first five years of unemployment become significant in explaining differences in the variability of output, employment per capita and the real wage, as well as in the correlation of output and employment with labor productivity between the two groups of countries. Also, union density becomes significant for explaining differences in the variability of output per capita and unemployment and the correlation of real wages with labor productivity, as well as the correlation of output with inflation. Conditionally on size, coordination appears to be significant and if we condition on government size, duration gains importance too. Thus, controlling for possibly relevant omitted variables makes our point even stronger.

Table 6: Conditional analysis				
Factor	openness		Size	G/Y
Index	RR_L	UD	COOD	DU
Rank sum test				
Var(Y)	0.19	0.87	0.25	0.86
Var(N)	0.62	0.25	0.56	0.72
var(y)	**0.04**	**0.07**	0.25	0.58
Var(n)	**0.03**	0.86	0.56	0.46
Var(w)	**0.06**	0.51	**0.02**	**0.04**
Var(u)	0.62	**0.00**	**0.02**	0.09
Var(y/n)	0.10	0.19	0.99	0.14
Var(π)	0.74	0.41	0.97	0.47
cor(y,n)	0.51	0.87	0.25	0.58
cor(Y,N)	0.25	0.25	0.56	0.97
cor(Y,y/n)	**0.00**	0.41	0.98	**0.05**
cor(N,y/n)	**0.00**	0.51	**0.02**	**0.00**
cor(w,y/n)	0.19	**0.05**	0.25	0.85
cor(y,y/n)	0.62	0.86	0.56	0.71
cor(n,y/n)	0.64	0.19	0.99	0.47
cor(y,π)	0.06	**0.00**	**0.02**	**0.04**

In sum, all the evidence we have collected indicates that business cycle statistics are significantly affected by the presence of labor markets rigidities. Replacement ratios and union coverage appear to be the indicators that affect macroeconomic outcomes the most. The conclusions are robust to country classification, to the procedure used to calculate business cycle statistics, to the presence of conditioning variables and, to a large extent, to the sample.

5 Active labor market policies

Active labor market policies have evolved significantly since the early 1960s and cover a range of objectives and programmes both of economic and of social nature. In most of OECD countries, a sizeable fraction of government expenditure is allocated to those programs, that are expected to generate a variety of economic and social consequences. In particular, active labor market policies might exert a stabilizing role in the economy. We explore whether this is true in the data.

We measure active labor market policies as the ratio of expenditure devoted to those policies to the unemployment rate. This can be rewritten as expenditure per unemployed individual, normalized on GDP per member of the labor force.

Following the same methodology used to study the role of labor market institutions, we assess whether active labor market policies significantly alter business cycle statistics. Interestingly, they

do not appear to matter when looking unconditionally at the data, neither for the variability of output and employment, nor for the variability of unemployment. However, when we condition our analysis on labor market institutions, we find that active labor market policies are effective in stabilizing unemployment in countries with heavily regulated labor markets. This is an interesting result showing that the assessment of labor market policies cannot abstract from institutions.

To illustrate this point, we present in Figure 5 scatter plots of active labor market policies against unemployment and employment volatility when countries are grouped according to replacement ratios, union coverage and employment protection. Forth differences are used to filter the data before variabilities and correlations are computed. Countries without labor market restrictions appear with a triangle; countries with labor market restrictions with a square.

Take, for example, the relationship between the variability of employment and the size of active labor market policies when the replacement rates are used to classify the countries. For the whole sample the slope of the relationship is negligible (0.08); for the sample of countries with relatively strict labor market institutions the slope is -0.32 and for the sample of countries with loose restrictions it is 0.54. The slopes for the two different groups of countries are significantly different from zero and significantly different from each other. This is also true if we classify the countries using the UC, UD, DEN, COOD, or DU classifications, but it is not so when we look at the remaining indicators. For example, when we condition the analysis using the EPL classification the effect of active labor market programs is negative but hardly significant (the slope equals -0.10) for the full sample of countries and similar in the two groups.

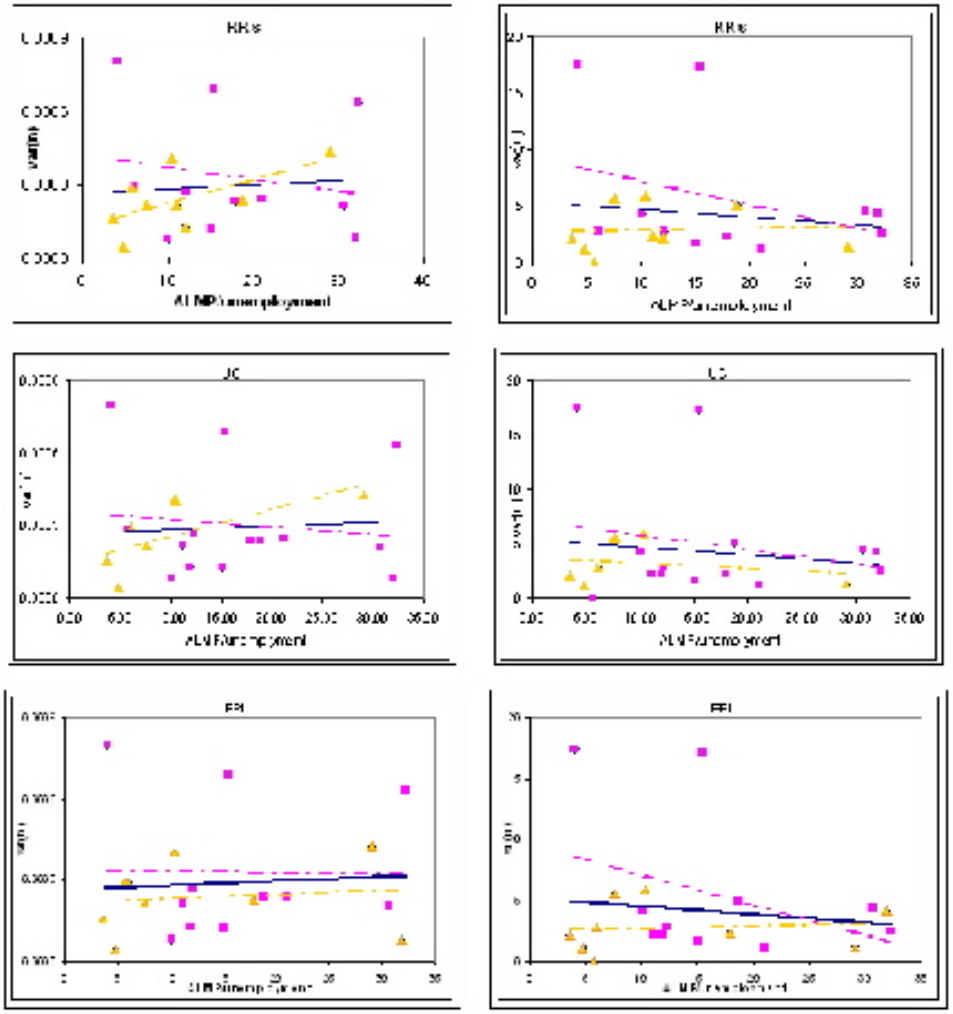

Figure 5: Active labor market policies and labor market institutions

6 Conclusions

This paper analyzed whether labor market rigidities affect the macroeconomic performance of 20 OECD countries.

Our conclusion is that the macroeconomic consequences of labor market institutions have been underemphasized. In particular, union coverage and replacement rates have a significant impact on volatilities and cross correlations of macro variables.

In addition, we show that active labor market policies are effective in reducing unemployment fluctuations in countries featuring rigid labor markets.

Our conclusions have important implications for the recent macroeconomic literature. Many papers, in fact, made a strong theoretical case for the role of labor market rigidities in explaining macroeconomics fluctuations. However, the empirical evidence in this respect is still scant. This paper shows that indeed labor markets institutions are important for economic fluctuations and that union coverage and unemployment insurance are the most important rigidities shaping business cycles in the real world.

7 References

Blanchard, O. and Gali, J., (2008). "Labor markets and monetary policy: a New-Keynesian model with unemployment", mimeo.

Blanchard, O. and Wolfers, J., (2000). "The role of shocks and institutions in the rise of European unemployment: The aggregate evidence", Economic Journal 110 (462), C1–33.

Campolmi, A. and Faia, E., (2006). "Cyclical inflation divergence and different labor market institutions in the EMU", Working Paper Series 619, European Central Bank, available at http://ideas.repec.org/p/ecb/ecbwps/20060619.html.

Christoffel, K. P., Kuester, K. and Linzert, T., (2006). "Identifying the role of labor markets for monetary policy in an estimated DSGE model", Working Paper Series 635, European Central Bank, available at http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp635.pdf.

Costain, J and Reiter, M., (2008). "Business cycles, unemployment insurance, and the calibration of matching models", Journal of Economic Dynamics and Controls, 32, 4.

Fonseca, R., Patureau, L. and Sopraseuth, T., (2007). "Business cycle comovement and labor market institutions: an empirical investigation", Working Paper WR-511, RAND, available at http://ssrn.com/paper=1010248.

Gali, J., (1999). "Technology, employment and the business cycle: do technology shocks explain aggregate fluctuations?", American Economic Review, 89 (1).

Gali, J. and van Rens, T., (2008). "The vanishing procyclicality of labor productivity", mimeo.

Hagedorn, M. and Manovskii, I., (2008). "The cyclical behavior of unemployment and vacancies revisited", American Economic Review, 98 (4), 1692–1706.

Hall, R. E., (2005). "Employment fluctuations with equilibrium wage stickiness", American Economic Review, 95 (1), 50–65.

Hoel, P., (1993) *Introduction to Mathematical Statistics*, Wiley & Sons.

Holden, S. and Wulfsberg, F., (2009). "Wage rigidity, institutions and inflation", mimeo.

Kenworthy, L., (2001). "Wage-setting measures. A survey and assessment", World Politics 54, 57–98.

Krause, M., Lopez-Salido, J. D. and Lubik, T., (2008). "Inflation dynamics with search frictions: a structural econometric analysis", CEPR Discussion Paper, 6810.

Krause, M. and Lubik, T., (2007). "The (ir)relevance of real wage rigidities in the New-Keynesian model with search Frictions", Journal of Monetary Economics, 54.

Layard, R., Nickell, S. and Jackman, R., (1991). "Unemployment, macroeconomic performance and the labour Market", Oxford University Press, Oxford.

Nickell, S. and Layard, R., (1999). "Labor market institutions and economic performance", Handbook of Labor Economics, Vol. 3c, North-Holland, Amsterdam.

Nickell, S., Nunziata L. and Ochel, W., (2005). "Unemployment in the OECD since the 1960s: what do we know?", The Economic Journal, 115 (1).

Nunziata, L., (2003). "Labour market institutions and the cyclical dynamics of employment", Labour Economics 10 (1), 31–53.

Nunziata, L. and Bowdler, C., (2007). "Inflation adjustment and labour market structures: evidence from a multi-country study", Scandinavian Journal of Economics, 109 (3),619–642.

Ochel, W., (2001). "Collective bargaining coverage in the OECD from the 1960s to the 1990s", CESifo Forum (2) 4, 62-65.

Rumler, F. and Scharler, J., (2009). "Labor market institutions and macroeconomic volatility in a panel of OECD countries", ECB Working Paper Series, No. 1005, available at http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1005.pdf

Scarpetta, S., (1996). "Assessing the Role of Labour Market Policies and Institutional Settings on Unemployment: A Cross Country Study", OECD Economic Studies, 26.

Shimer, R., (2005). "The cyclical behavior of equilibrium unemployment and vacancies", American Economic Review, 95 (1), 25–49.

Tomas, C. y Zanetti, F., (2008). "Labor Market Reform and Price Stability: an Application to the Euro Area", mimeo.

Trigari, A., (2006). "The Role of Search Frictions and Bargaining of Inflation Dynamics", mimeo.

Walsh, C. E., (2005). "Labor market search, sticky prices, and interest rate policies", Review of Economic Dynamics 8 (4), 829–849.