Labor Market Institutions and Unemployment in the Euro Area

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Abstract

Using a DSGE model with search and matching frictions in both labor and product market, we show that historical differences in labor market performance across four main Euro Area countries are a result of both heterogeneity in structural characteristics of economies and divergent paths of shocks. Structural differences are partly linked to country-specific labor market institutions like unemployment benefits, firing and hiring costs and wage rigidity. In terms of shocks, our model implies that unemployment dynamics is governed mostly by preference shocks, rather than technology innovations. We provide preliminary empirical evidence that shocks to discount factor may be interpreted as a proxy for a wider range of forces affecting households willingness to consume, like asset prices, uncertainty or demographic changes. Finally, we find that variance of the unemployment is mostly dominated by the contribution of frictional unemployment (accounting for frictions in both labor and product markets), with a relatively limited role of nominal rigidities.

1 Introduction

Despite nearly two decades of monetary integration, Euro Area countries still form a club of fairly heterogenous economies differing with respect to the magnitude of business cycle fluctuations and the ability to absorb shocks. The differences were exemplified by the recent experience of Great Recession and its impact on labor markets in member states. For example, while unemployment rate in the main Euro Area economy (Germany)

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dropped from around 10% in 2006 to 5% in 2013, the fourth biggest economy (Spain) experienced a spike of unemployment from 8% to 26% over the same period. Among competing theories to explain the source of heterogeneity in labor market adjustments across Euro Area, a lot of attention is being paid to the importance of cross-country differences in labor market institutions (e.g. Bentolila, Cahuc, Dolado, and Le Barbanchon (2012)). Our aim is to verify to what extent divergent historical dynamics of unemployment rates in four main Eurozone economies (Germany, France, Italy and Spain) results from different instiutional settings, as opposed to different magnitude and timing of shocks hitting each economy. Moreover, we study relevance of product and labor market frictions along with nominal rigidities by decomposing recorded time series of umeployment into three components: Keynesian, classical and frictional unemployment. Decomposition is perfomed through the lenses of a DSGE model featuring search and matching frictions in both labor and product market. "Shopping" frictions in product market reinforce an impact of demand shifts on unemployment dynamics. While we model demand shocks in a simplified manner as innovations to households discount factor we give a preliminary empirical evidence that preference shocks maybe intepreted as a proxy for other forces affecting household willingness to consume, e.g. asset prices or uncertainty.

In the next section we discuss the literature related to our research. Third section outlines setup of the model, calibration / estimation approach and basic results of the simulations. Fourth section discusses unemployment decompositions, while in fifth section we study importance of shocks and labor market institutions to unemployment dynamics in our sample of Euro Area economies. Final section concludes.

1.1 Literature review

Our work blends two strands of literature. First, it is related to works concerning the problem of unemployment in European economies and the related articles on the role of labor market institutions. Second, it is associated with works investigating the unemployment structure in an explicit way.

Unemployment in Europe. There is a vast literature concerning the unemployment in Europe and its main determinants. A detailed empirical overview of this issue was made by Nickell and Layard (1999) who studied the impact of labor market institutions on unemployment and growth in a wide group of European economies and several other developed countries (US, Japan, Australia, New Zealand and Canada). They find that institutions on which policy should concentrate are: social security systems and unions. Nickell and Layard indicate that negative influence of those institutions on unemployment and growth can be neutralized by: i) active labor market policies in case of social security system and i) encouraging product market competition in case of unions. Their results show that employment protection and minimum wages are of less importance for unemployment and growth. The finding that concerns the role of employment protection was challenged by Bentolila, Cahuc, Dolado, and Le Barbanchon (2012) who studied the role of observed differences in employment protection in France and Spain in explaining the differential in unemployment rates observed during the Global Financial Crisis. More precisely, they argue that the larger gap between firing costs associated with temporary and permanent contracts and a more common use of the former in Spain explains about 45% of the difference in unemployment rates that amounted to 24% in Spain and 10% in France (and were almost equal at the onset of the crisis). Putting it in a more formal way, larger fraction of temporary workers and higher level of the firing cost gap, that characterized Spanish labor market before the Great Recession, imply that the joint surplus of a match is lower in this country which makes unemployment very responsive to adverse macroeconomic shocks.

The role of security system (more specifically: the generosity of unemployment insurance) in affecting the level of employment in European economies was studied in the seminal work by Ljungqvist and Sargent (1998). Their main point is that higher replacement rate of unemployment benefits in welfare states across Europe (in comparison to other OECD economies) is not a sufficient explanation for the relatively high unemployment rates that characterized these countries over last decades. They argue, that in the 1960s and 1970s, employment in Europe was comparable (or even higher) than its average value across the OECD despite the generous safety net that was present in European economies. In contrast, unemployment rates in those countries diverged from the OECD average at the beginning of 1980s and this process was not accompanied by any significant changes in the generosity of unemployment insurance in Europe. Ljungqvist and Sargent suggest that this divergence was associated with globalization, increasing competition from emerging economies and internationalization of production that led to a rise in idiosyncratic turbulence of labor income faced by workers in developed economies. This coupled with higher replacement rates of unemployment benefits in European countries decreased the incentives to exert search effort by jobless people. More specifically, higher idiosyncratic turbulence, faced by the unemployed, implied a deterioration of future labor income prospects which in turn disincentivized them from the active search for new jobs as, at the same time, they were entitled to generous unemployment benefits.

Asymmetry in labor market institutions in the context of the EMU is studied by Abbritti and Mueller (2013). To explore this issue, they construct a DSGE model of a currency union with monopolistic competition, sticky prices, labor market frictions and real wage rigidities. They distinguish between two types of labor market rigidities: real wage rigidities (capturing the degree to which wages are influenced by the level of the so-called wage norm which is time invariant) and unemployment rigidities (measured by the level of job-finding and separation rates). They found that unemployment rigidities have a positive impact on volatility of differences in inflation rates between members of a currency union and affects negatively the analogous object associated with unemployment. The opposite is true for real wage rigidities that increase the volatility of unemployment differential and have a negligible impact on the volatility of inflation differential. All this means, that asymmetries of labor market institutions across the EMU states are key for the conduct of monetary policy in a common currency area.

The contribution of our work to this part of literature is twofold. First, we explore the structure of unemployment in several European countries by distinguishing between classical, Keynesian and frictional unemployment. Second, not only do we investigate how various labor market institutions affect the total unemployment level but also we show how they influence its main components.

Unemployment decomposition. It seems that the closest paper to ours is the work by Michaillat (2012) which extends the standard Diamond-Mortensen-Pissarides along two dimensions. First, he incorporates real wage rigidities. Second, he assumes a concave production technology. The interplay of those two ingredients gives rise to rationing in labor market (i.e., employment becomes demand driven) in adverse macroeconomic conditions. All this means, that pool of unemployed workers can be divided into two subgroups: frictional unemployment and rationing unemployment. Michaillat shows that the former exhibits a procyclical pattern.

Our paper can be seen as a DSGE version of the work by Michaillat. To this end, we introduce risk-averse households to the model. Next, to be able to capture the impact of labor market institutions, we assume that there is both endogenous and exogenous firing (in contrast to Michaillat who assumes only exogenous separations). Since production technology is assumed to be linear in our case, there is no job rationing in our model. More precisely, we distinguish between three types of unemployment: Keynesian, classical and frictional that are associated with presence of price rigidities, nominal wage rigidities and labor market frictions, respectively.

2 Model

2.1 Setup

In order to analyze factors shaping dynamics of European unemployment we use DSGE model with search and matching frictions on both labor and product markets (i.e. shopping frictions). The model was developed in the accompanying paper Borys, Doligalski, and Kopiec (2017), where we discuss both our specific modeling assumptions and rationale behind incorporating shopping frictions into DSGE framework. Thus, aim of this section is not to present model specification at full, but rather give a brief introduction and define relevant variables.

As typical in DSGE literature, our model assumes existence of a representative infinitely-lived household choosing consumption plan that maximizes his / her utility, subject to budget constraint with income derived from wages and unemployment benefits. Additionally, in order to purchase consumption goods household has to exert shopping effort which involves disutility (cost modeled in a linear fashion with coefficient $-\kappa_G$). Final amount of consumption available depends not only on the effort by the household but also on goods supply by companies, as both aggregates are combined within aggregate matching function. Matching function is specified as in Haan, Ramey, and Watson (2000) with its shape governed by a single parameter α_G.

Firms maximize profits with production being a linear function of a single input - labor. As labor market is characterized by search and matching friction, increasing employment is costly and requires posting vacancies (cost captured by κ_L). Matching function is symmetric to the product market, except for a different parametrization (parameter α_L for labor market). Firm can adjust employment not only by vacancy posting but also by dismissing least productive workers (with productivity having both aggregate and idiosyncratic components) at the cost of a firing tax (ϕ). Finally, amount of goods sold by a company depends not only on inputs and technology but also on product market frictions captured by market tightness (x_G) defined as a ratio between a measure of consumers search effort (v_G) and firms supply (t) that may be also interpreted as capacity. Tightness on the labor market (x_L) is defined symmetrically.

Basic model captures the presence of nominal rigidities, both in terms of prices and wages. Wages are set as an weighted average of a bargained wage (with weight ξ_w) and previous period wage. Bargaining follows standard Nash protocol with worker's outside option affected by unemployment benefits (b) and non-monetary benefits from unemployment (ζ, introduced in a simplified manner as in Zanetti (2011)). Price of final goods is defined as an weighted average of previous period price (weight $1 - \xi_p$) and a price that would guarantee optimal reaction of consumers to dynamics of product market frictions (value derived from social planer problem, weight ξ_p). Price level is also indirectly affected by monetary policy set accordingly to simplified version of inflation stabilization rule with Φ_p governing the reaction of interest rates on bonds to price dynamics.

2.2 Parametrization

To quantify relevance of factors shaping differences in labor market performance across Euro Area economies in our sample, we need to pin down values of structural parameters for each country. We follow the approach presented in the accompanying paper Borys, Doligalski, and Kopiec (2017), where we discussed properties of the model parametrized for the US. Parameters relevant for steady state allocation are calibrated individually for each country so that their choice reflects specific characteristics of the economy.

However, in several instances we were forced to resort to values of parameters implied by studies that do not account for their possible cross-country variation. This is the case for discount factor (β), worker bargaining factor (λ), parameter governing shape of labor market matching function (α_L) and ratio between recruitment costs and wages (for more detail see Borys, Doligalski, and Kopiec (2017)). While these parameters are constant across countries, others are allowed to vary. Replacement rates of unemployment benefits ν, defined as a ratio between level of benefits and steady state wages (so $b = \nu w^{ss}$), are calculated with country specific OECD data. Exogenous job destruction rate (σ), firing costs (ϕ) and non-monetary benefits to unemployment (ζ) are set to match the data on long term average unemployment rate, flow rate out of unemployment and country specific estimates of ratio between exogenous and endogenous job destruction from Bukowski, Kowal, and Lewandowski (2011). Finally, we calibrate the parameter of the product market matching function (α_G) to match European Commission's data on average capacity utilization in each country.[1] The other parameter relevant for product market frictions, κ_G is normalized to one.[2]

There are seven parameters not affecting the steady state of the economy and we estimate their values using Bayesian methods. Estimated parameters relate to characteristics of stochastic processes (ρ_z, ρ_d, σ_z, σ_d), wage and price rigidities (ξ_w and ξ_p) and response of interest rates to inflation dynamics (Φ_p). Capacity utilization and unemployment rate are the two measured signals used in the estimation process. For each country we use quarterly data ending in 2016, while starting points differ across sample - in Germany and France it is 1991, in Italy - 1985 and in Spain - 1987. For a reference, we also show the results for the US obtained in Borys, Doligalski, and Kopiec (2017). Priors for the parameters governing shocks properties and interest rate responsiveness to inflation are set symmetrically across countries, mostly as in Smets and Wouters (2003). For parameters characterizing nominal rigidities priors are based on country specific estimates. In case of Spain, Italy and France we resort to survey data on frequency of price and wage changes (see Knell (2013)), while for Germany we use estimates by Hristov (2016).

Values of parameters for each country model are presented in tables ?? and ??. While looking at institutions directly constraining employment adjustment by firms one can see that both firing (ϕ) and recruitment (κ_L) costs are relatively high in Germany, France and Italy. In Spain firing and hiring workers is less costly, moreover firms face high exogenous rate of workers outflow (σ). Across our sample of Euro Area countries, unemployment benefits are the most generous in Germany and France, and the least - in Italy. Based on the literature results, high benefits could limit volatility of wages at the cost of higher employment volatility. However, we see that in Germany this effect

[1] Data from Business Climate Indicator survey.

[2] Instead of normalizing κ_G, we could set steady-state product market tightness θ_G to one and calculate κ_G using equilibrium conditions as in Duras (2016). We verified that results are mostly robust to the choice of approach.

Table 1: Values of calibrated parameters

Parameter	β	λ	σ	α_L	α_G	ϕ	κ_L	ζ	ν
DE	0.99	0.5	0.006	1.27	5.95	0.94	0.042	0.22	0.72
FR	0.99	0.5	0.009	1.27	5.20	0.94	0.040	0.23	0.73
IT	0.99	0.5	0.007	1.27	2.84	0.94	0.042	0.23	0.65
ES	0.99	0.5	0.205	1.27	2.8	0,91	0.039	0.23	0.68
US	0.99	0.5	0.019	1.27	4.7	0,92	0.027	0.33	0.55

Table 2: Values of estimated parameters

Parameter		Φ_p	ξ_p	ξ_w	ρ_z	σ_z	ρ_d	σ_d
DE	Posterior	0.75	0.52	0.33	0.83	0.04	0.92	0.005
	Prior	1.7	0.3	0.33	0.85	0.01	0.85	0.01
FR	Posterior	0.71	0.45	0.23	0.81	0.03	0.90	0.005
	Prior	1.7	0.27	0.23	0.85	0.01	0.85	0.01
IT	Posterior	0.5	0.44	0.13	0.84	0.03	0.91	0.006
	Prior	1.7	0.28	0.14	0.85	0.01	0.85	0.01
ES	Posterior	0.45	0.28	0.23	0.84	0.03	0.93	0.016
	Prior	1.7	0.28	0.23	0.85	0.01	0.85	0.01
US	Posterior	0.58	0.31	0.29	0.80	0.004	0.89	0.01
	Prior	1.13	0.33	0.3	0.5	0.07	0.5	0.07
Prior distribution		Normal	Beta	Beta	Beta	Inverse Gamma	Beta	Inverse Gamma

may be outweighed by high elasticity of wages (ξ_w) , which may be a function of other institutions affecting wage negotiations (e.g. trade unions). The opposite situation is observed in Italy where relatively low unemployment benefits go in a pair with highly rigid wages. Finally, in most of the considered areas, labor market in the US seems to be more flexible compared to Euro Area countries.

2.3 Dynamic properties of the model

In Borys, Doligalski, and Kopiec (2017) we established that shocks to preferences explain gross of business cycle volatility in the US economy. Here we perform a similar exercise of variance decomposition for a sample of euro area economies. Table 3 shows contribution of preference shocks to variance of nine selected macroeconomic aggregates, i.e. consumption, production capacity in firms, unemployment rate, productivity threshold for firing, vacancies posted by firms, wages, price level and tightness on both labor and product markets. For a reference we also display US results. As there are only two shocks in the model, contribution of technology shocks is a complement of a variance share accounted by preference shifts.

Table 3: Contribution of preference shocks to variance of selected variables (%)

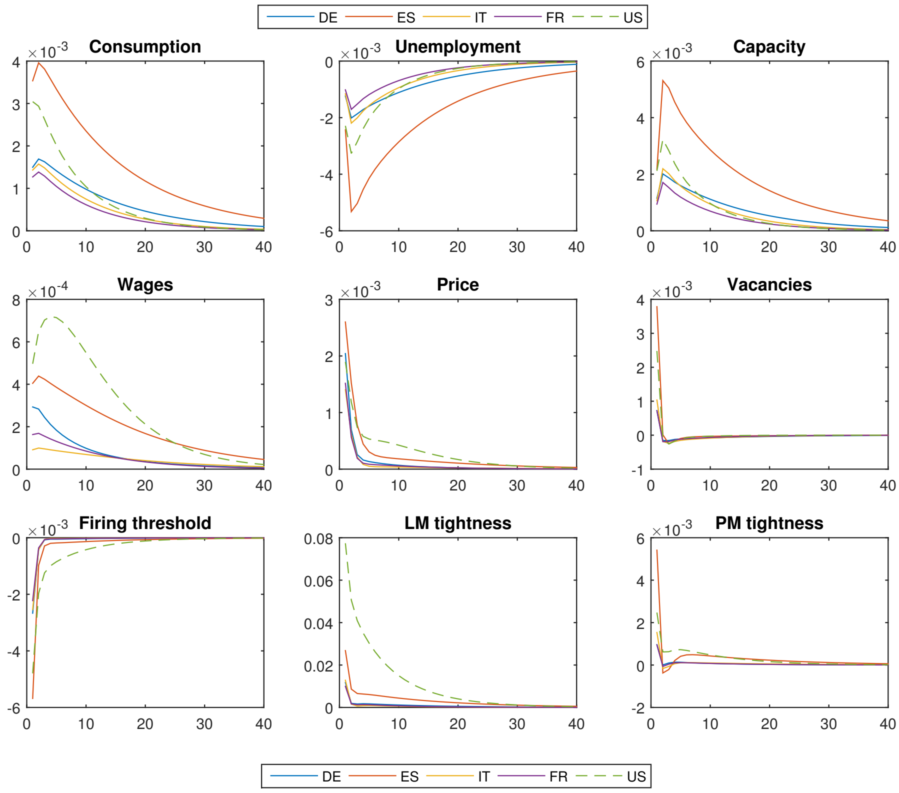
	c	t	u	a	v_L	w	p	θ_L	θ_G
DE	1,8	0,7	90,7	54,5	27	48,8	0,2	44,2	0,1
ES	27,4	10,7	96	58,9	83,8	93,9	1,5	95,3	2,2
FR	2,1	0,8	78,5	60,3	24,8	52,3	0,2	40,5	0,1
IT	3,8	1,2	87	40,6	44,5	83,6	0,3	58,2	0,2
US	89	62,9	99,3	99,6	95,9	99,3	34,3	99,1	50,2

In all studied economies preference shocks seem to be a key determinant of unemployment variation. Similarly, other labor market variables are strongly affected by demand innovations. Technology shocks largely explain variance of prices and θ_G both in the US and Euro Area. However in European economies, as opposed to the US, technology innovations are also the main force driving variation in private consumption and capacity level. Generally, while in the US employment falls after a positive technology shocks, in Euro Area it rises, thus magnifying the positive impact of the disturbance on production capacity. High volatility of capacity induced by technology shocks contributes to volatility of product market tightness which explains a negative correlation between t and θ_G predicted by the model, especially when calibrated to European data. As θ_G determines the probability of a successful purchase by the customer, strong dependence of consumption on technology shocks stems from their impact on θ_G. Partially, the results for the Euro Area hinge on failure by the model to capture a mildly positive correlation between consumption and product market tightness. For the US calibration the correlation predicted by the model is relatively close to the data.

Impulse responses to unitary preference and technology shocks are presented in figures 1 and 2. Similarly as in discussion of variance decomposition, we include results for the US obtained in Borys, Doligalski, and Kopiec (2017) as a reference. In terms of demand shock, positive innovation leads to increased consumption, employment, wages and prices in all studied economies. However magnitude of responses differ across countries. While Spain and the US distinguish themselves with a relatively high responsiveness of main variables, Germany, Italy and France form a fairly homogeneous group characterized by substantial level of immunity to shocks. The main difference between Germany, Italy and France seems to refer to wages dynamics - their initial reaction to shock is strongest in Germany, and the most muted in Italy.

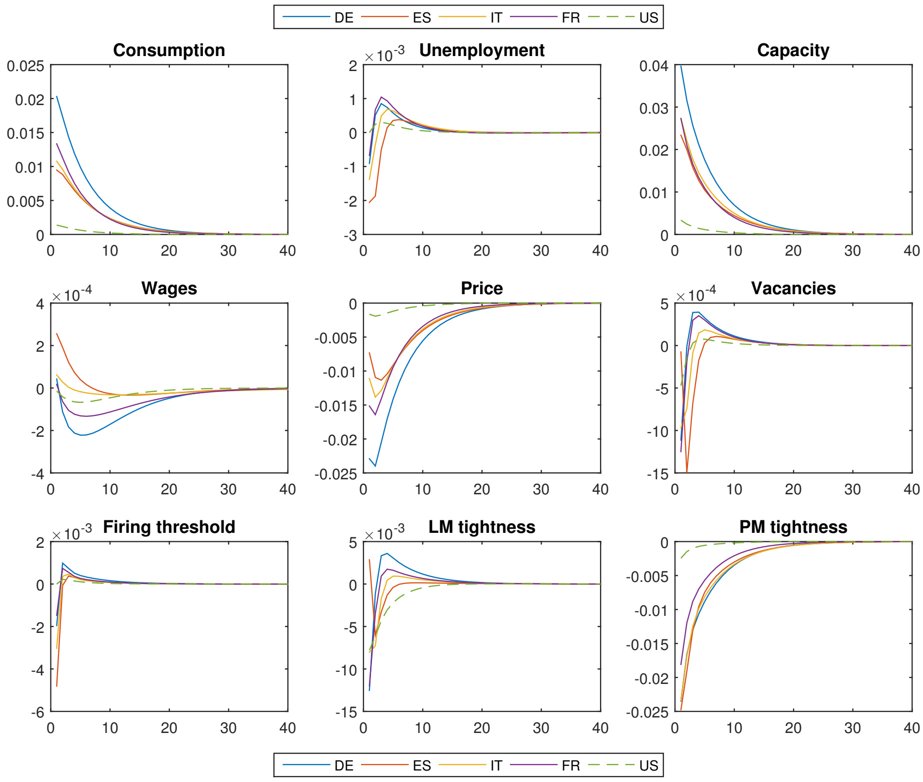
There are certain similarities between consequences of demand shift and technology shocks, involving mainly a positive reaction of consumption and capacity. However, while for the Euro Area economies both shocks predict initial positive response of wages end employment, subsequent dynamics is different. After a negative impact of technology shock on prices reach its trough, employment and wages start to fall and settle

Figure 1: Response of selected variables to a positive preference shock.



below their steady state levels for a few quarters. Cross-country comparisons of impulse responses also yield different results when technology shock is considered, instead of preference innovations. Germany and France shows sharp positive response of consumption and capacity, which is hard to reconcile with the fact that both economies tend to experience the most clear drop in employment and wages over the medium term. Remarkably, responsiveness of studied variables to technology shocks in the US is muted when compared to European economies. It is in line with a minor role played by technology in explaining variance of main aggregates in the US, as discussed before.

Figure 2: Response of selected variables to a positive technology shock.



3 Unemployment decomposition

We use the model to decompose the unemployment time series into four components. Take a sequence of exogenous shocks as given. Denote by $U(\hat{\xi}_w, \hat{\xi}_p)$ the series of unemployment in the model with wage flexibility $\hat{\xi}_w$ and price flexibility $\hat{\xi}_p$. Suppose that ξ_w and ξ_p are the calibrated wage and price flexibility parameters. Recall that they vary from 0 (constant wages / prices) to 1 (fully flexible wages/prices). We decompose the unemployment series into four components

$$U(\xi_w, \xi_p) = U^F + U^K + U^C + U^I, \tag{1}$$

where each component is defined in the following way:

$$\begin{aligned}
\text{frictional unemployment: } & U^F \equiv U(1,1), \\
\text{Keynesian unemployment: } & U^K \equiv U(1,\xi_p) - U^F, \\
\text{classical unemployment: } & U^C \equiv U(\xi_w,1) - U^F, \\
\text{interaction unemployment: } & U^I \equiv U(\xi_w,\xi_p) - U^F - U^K - U^C.
\end{aligned}$$

The frictional unemployment U^F is the unemployment implied by the costly search in the labor and goods markets in the absence of wage or price rigidities. The Keynesian unemployment U^K captures the contribution of the price rigidity. Rigid prices introduce inefficient variation in the goods' market tightness. Hence, this type of unemployment is driven by inefficient volatility in the probability of the firm's to sell the product. The classical unemployment U^C accounts for the impact of wage rigidity on unemployment. When wages are rigid, the firm substitutes the adjustment of wages with an adjustment of employment. Suppose that the economy is hit by a negative demand shock. If wages were flexible, they would drop substantially on impact. Since they are rigid, wages fall less and firms reduce the employment level more than in the flexible case. Finally, interaction unemployment U^I stands for the joint impact of price and wage rigidities on unemployment on top of their individual contributions.

It is worth point out that only the frictional unemployment has a non-zero steady state value. It means that the remaining unemployment components fluctuate around the mean of zero, taking positive or negative value. Hence, given a path of exogenous shocks, any of mean-zero unemployment components can contribute *negatively* to the overall unemployment level.

3.1 Variance decomposition of unemployment

The variance of total unemployment is a sum of all the elements of the covariance matrix of the unemployment components:

$$Var(U) = \sum_i \sum_j Cov(U^i, U^j), \tag{2}$$

where i and j loop over the set of indices $\{F, K, C, I\}$. Consider the sum of the i-th row of the covariance matrix: $\sum_j Cov(U^i, U^j)$. It captures the contribution of unemployment component i to the total unemployment volatility.

Table 6 presents main moments of unemployment: the mean, the variance and the decomposition of variance into the contributions of each component. A few robust facts emerge:

1. The frictional unemployment accounts for more than 90% of total unemployment variance. In Germany and France it contributes more than 100% to the variance of total unemployment.

2. The Keynesian unemployment *stabilizes* the total unemployment. The Keynesian unemployment reduces the variance of total unemployment by 5.3% in Spain up to almost 10% in France. It is due to large negative covariances with other unemployment components.

3. Classical and interaction components contribute positively to volatility of total unemployment, with former accounting for 5.1% in Germany up to 11.8% in Italy and the latter accounting for 0.5% in Spain up to 4.3% in France.

Table 4: Moments of unemployment

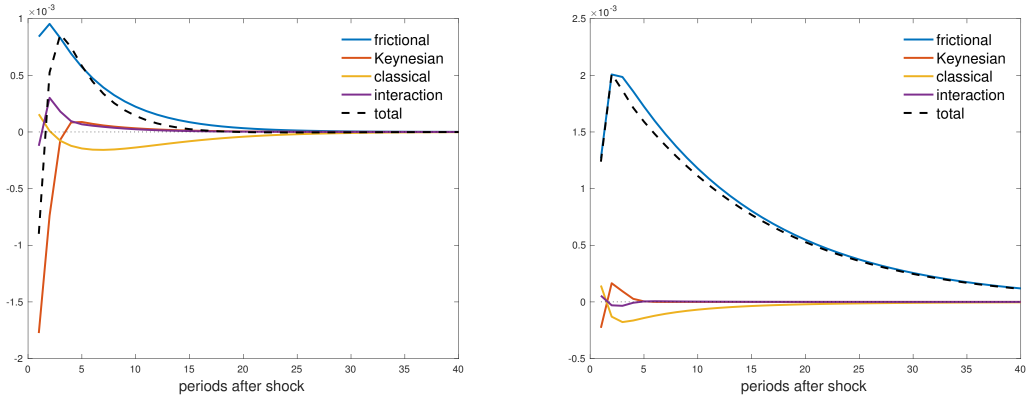
$E(U)$	$Var(U)$	$\sum_j Cov(U^F, U^j)$	$\sum_j Cov(U^K, U^j)$	$\sum_j Cov(U^C, U^j)$	$\sum_j Cov(U^I, U^j)$
GERMANY					
7.758e-02	3.381e-05	3.311e-05	-2.417e-06	1.665e-06	5.551e-07
	share of $Var(U)$:	100.6%	-7.3%	5.1%	1.7%
FRANCE					
9.222e-02	1.953e-05	1.912e-05	-1.873e-06	1.004e-06	8.254e-07
	share of $Var(U)$:	100.2%	-9.8%	5.3%	4.3%
ITALY					
9.388e-02	3.056e-05	2.733e-05	-1.841e-06	3.532e-06	8.361e-07
	share of $Var(U)$:	91.5%	-6.2%	11.8%	2.8%
SPAIN					
1.628e-01	2.156e-04	2.070e-04	-1.112e-05	1.341e-05	1.138e-06
	share of $Var(U)$:	98.4%	-5.3%	6.4%	0.5%

Consider Spain, which in terms of volatility of unemployment dominates other European economies by an order of magnitude. Although the stabilizing force of Keynesian unemployment appears to be the weakest in Spain, the relative contributions of each unemployment components do not differ drastically from their counterparts in other countries. It suggests that the exceptional Spanish volatility may be due to factors which contribute to its high mean unemployment. Recall that non-frictional unemployment components influence the variance of unemployment, but not the mean.

To gain a deeper insight, let's take a look at impulse responses of unemployment components after productivity and demand shocks for Germany (Figure 3). Impulse responses in other countries are qualitatively similar. Notably, frictional unemployment is the most dominant component after each shock. Furthermore, we easily see a negative correlation between Keynesian and other main unemployment components, especially the classical one. The stabilizing impact of the Keynesian component is particularly clear after the productivity shock. In the absence of rigidities, unemployment increases on impact of the positive productivity shock. That is because prices and probability of selling the produced good fall faster than productivity increases. As a result the marginal revenue $A_z f_G p$, which drives the firm's hiring decision, is pulled down on impact. When we introduce price rigidities, initially prices fall less and the marginal revenue goes up, lifting the employment level. Only in the second period prices adjust enough to increase the unemployment level above the steady state value. This delayed response shows the

Figure 3: Impulse responses of unemployment components (Germany).

(a) Productivity shock   (b) Demand shock



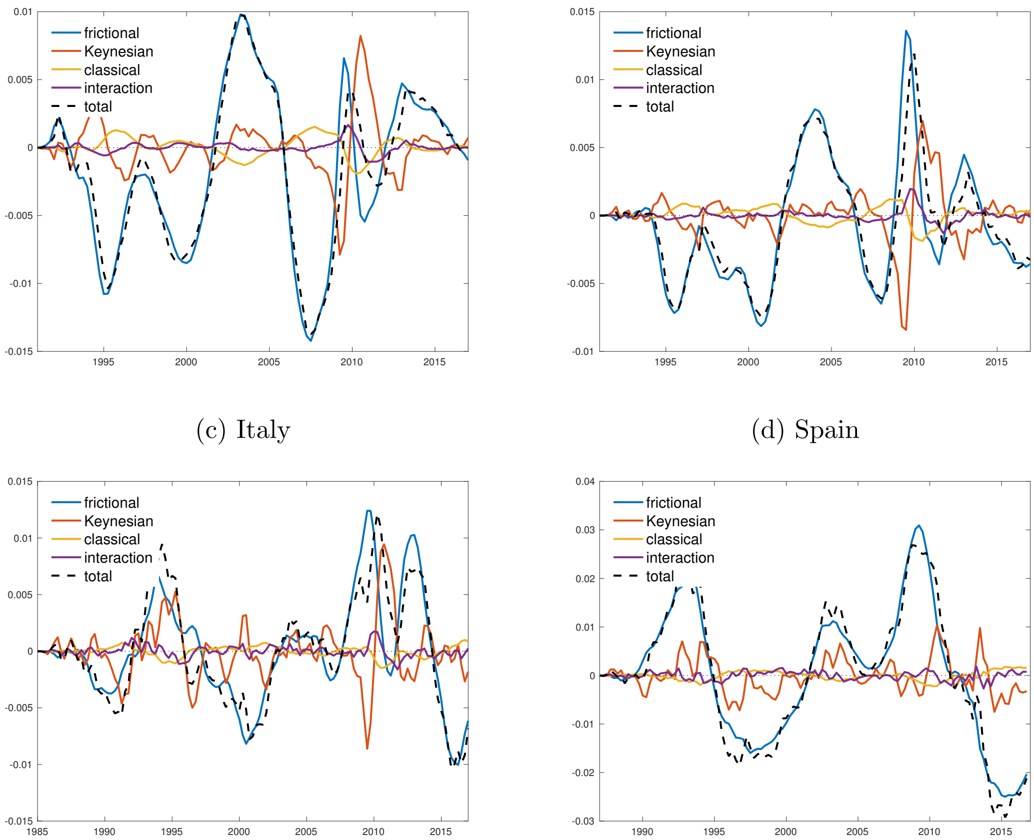
moderating impact of Keynesian unemployment.

We present historical decomposition of unemployment time series in Figure 5. Notice the importance of Keynesian component in explaining unemployment during great recession. As we pointed out before, the stabilizing force of the Keynesian unemployment appears to be the weakest in Spain, perhaps explaining some portion of large Spanish unemployment volatility.

Figure 5: Historical decomposition of unemployment (deviations from steady state).

(a) Germany (b) France

(c) Italy (d) Spain



4 Shocks or institutions?

In this section we evaluate the relative importance of exogenous shocks and institutions in shaping the unemployment dynamics in European economies. First, we decompose the volatility of unemployment into components corresponding to differences in shocks and differences in the structure of the economy. Second, we examine the impact of labor market institutions of dynamic properties of unemployment. Finally, we investigate origins of the preference shocks.

4.1 Decomposition into shocks and structure

The aim of this Section is to decompose the volatility of unemployment rates observed in the studied economies into two components: the one associated with country-specific shocks and the second related to structural properties of economy (including labor market institutions). Our benchmark is Germany - the largest economy in the Eurozone. More formally, the components are isolated in the following way:

$$\underbrace{Std\left(U|params\ x, shocks\ x\right) - Std\left(U|params\ y, shocks\ y\right)}_{total\ difference\ in\ volatility}$$

$$= \underbrace{Std\left(U|params\ x, shocks\ x\right) - Std\left(U|params\ x, shocks\ y\right)}_{contribution\ of\ country-specific\ shocks}$$
$$+ \underbrace{Std\left(U|params\ x, shocks\ y\right) - Std\left(U|params\ y, shocks\ y\right)}_{contribution\ of\ country-specific\ structural\ issues}$$

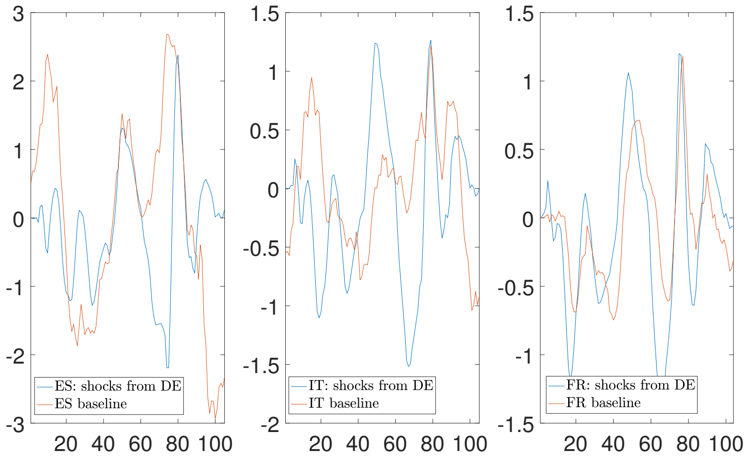
where $Std\left(U|params\ x, shocks\ y\right)$ is standard deviation of unemployment rate in economy characterized with parameters of country x and the path of shocks associated with country y. In our case, y is benchmark economy - Germany and x stands for either Spain, Italy or France. Figures 7 and 8 display paths of unemployment that are used when calculating standard deviations described above. To calculate the hypothetical path of unemployment characterizing Spanish (alternatively: Italian or French) economy that is affected by shocks specific to German economy, we simulate the models estimated for Spain, Italy and France using the path of shocks computed for Germany. Standard deviations based on both empirical observations and counterfactual simulations are presented in Table 5.

Let us briefly discuss these results. Unemployment rate is more volatile in Spain than in Germany - the difference in standard deviation between two countries amounts to almost 0.7%. It turns out, that both components contribute to that difference almost equally: Spanish unemployment is more volatile because shocks affecting this economy exhibit a larger magnitude and because their amplification by the country-specific economic structure is greater. Italian unemployment rate is less volatile than the one observed in Germany (standard deviation of Italian unemployment rate is lower by about 0.13%)

Table 5: Volatility decomposition (standard deviation - percentage points)

	Spain	Italy	France
Total difference in volatility	0.67%	−0.13%	−0.15%
Contribution of country-specific shocks	0.35%	−0.22%	−0.18%
Contribution of country-specific structure	0.32%	0.09%	0.03%

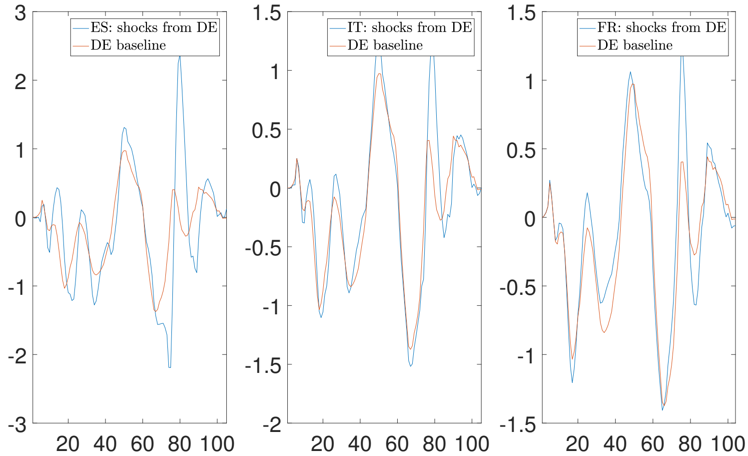
Figure 7: Unemployment decomposition: the role of shocks



and this result is generated by two opposite forces. On the one hand, Italian shocks are less volatile than German ones. On the other hand, however, the structure of Italian economy tends to make unemployment rate more volatile by amplifying exogenous shocks. The former force dominates the latter and hence the difference between volatilities of unemployment in Italy and Germany is negative. The situation is similar in France: overall, unemployment rate is less volatile than in Germany and it is due to lower amplitude of shocks that affect French economy.

Observe, that simulation presented in Figure 7 enables us to answer an additional question concerning the correlation of shocks affecting labor markets in four largest economies in the Eurozone. This issue is of great importance for the conduct of monetary policy in a currency union (see, e.g., Mundell (1961)). It can be seen that correlation between the hypothetical paths (based on German shocks) of unemployment calculated for Spain and Italy and their empirical counterparts is relatively weak: it amounts to 0.13 for Spain and 0.14 for Italy. This indicates that European peripheries are not well-synchronized with the largest economy in the EU which poses a great challenge for the conduct of monetary policy. The situation is very different in case of France: it seems that shocks affecting French labor market are not very different from those influencing unemployment in Germany (correlation amounts to 0.67).

Figure 8: Unemployment decomposition: the role of structural features



4.2 Labor market institutions and unemployment fluctuations.

In this section we evaluate the importance of labor market institutions for the cyclical fluctuations of total unemployment and each of the unemployment components. Table 6 reports the elasticities of reported moments of unemployment with respect to policy parameters: the unemployment benefit replacement rate ν, the firing cost ϕ, the vacancy creation cost κ_L and the wage flexibility ξ_w. To gain a more detailed look into the impact of each policy, we compute a cumulative unemployment change for each type of shock and each type of unemployment in two time horizons: a short term (2 quarters) and a long term (40 quarters). We consider a negative demand shock and a positive productivity shock, as after these shocks the unemployment increases. Spain is an exception: there we consider a negative productivity shock, since productivity is negatively related to the long-run Spanish unemployment. The elasticities of the cumulative unemployment changes with respect to policy parameters are reported in Table 7 (Germany and France) and Table 8 (Italy and Spain).

Higher unemployment benefit replacement rate ν always leads to an increase of total unemployment and, with an exception of Spain, to a decrease of total unemployment variance. This effect is driven by a substantial long-term decrease of frictional unemployment response after the productivity shock. Curiously, this results contrasts with a conventional intuition of higher value of being unemployed reducing the volatility of wages and increasing the volatility of employment (see Hagedorn and Manovskii (2008)). Spain stands out, as higher ν magnifies rather than moderates the response to the productivity shock. As a result, higher replacement rate in Spain leads there to more volatile unemployment.

An increase of firing cost ϕ reduces the mean and increases the variance of total unemployment in all economies. Notably, the elasticities have the lowest absolute magnitude in Spain, where the firing costs are the lowest. The firing costs reduce the response of unemployment to the demand shock. However, an increase of the response to the productivity shock is sufficient to raise the overall unemployment volatility.

The vacancy creation cost κ_L influences total unemployment in the same way as the firing cost, although with much lower magnitude. That is intuitive, since both policies act as a tax on flows between employment and unemployment (see Abbritti and Mueller (2013)). The two policy parameters have qualitatively similar impact also on different components of unemployment: they increase the variance contribution of frictional unemployment and reduce volatility due to Keynesian and classical components. Note that, counterintuitively, decreasing the vacancy creation cost *locally* leads to a rise of the mean unemployment level. On the other hand, if the vacancy cost could be reduced all the way to zero, the mean unemployment would also fall to zero. This result highlights the difference between the local, small reform approach followed in this section and non-local, large policy changes.

Wage flexibility ξ_w reduces the unemployment volatility everywhere apart from Germany. More flexible wages generally delay the response of unemployment to shocks. By construction, wage flexibility parameter does not affect frictional nor Keynesian unemployment. Its delaying impact enters though the classical unemployment and is slightly offset by the interaction unemployment component.

To sum up, the sign of elasticities of mean total unemployment with respect to policy parameters agree in all the European economies. It is not the case with variance: increasing the unemployment benefit replacement rate reduces unemployment volatility in Germany, but raises it in Spain. Finally, since the frictional component accounts for more than 90% of variance of total unemployment, it is generally sufficient to track the impact of labor market institutions on this particular unemployment component. The only exception is the wage flexibility parameter ξ_w, which intuitively affects mostly the classical unemployment.

4.3 Behind preference shifts

So far we established that historical differences in labor market performance across main euro area economies can be linked not only to heterogeneity in their structural characteristics but also to different magnitude and timing of country-specific shocks. As suggested by variance decomposition excercise, unemployment dynamics seems to be determined mainly by the path of preference shocks, with a fairly limited impact of technology innovations. According to Huo and Rios-Rull (2013) preference shocks in DSGE model may be interpreted as an approximation for more plausible forces behind business cycle volatility, as shocks to credit access or households wealth. While our model is not rich enough to validate that statement, we take an preliminary attempt to investigate factors behind preference shifts by studing linkages between our shocks

Table 6: Elasticities of moments of unemployment w.r.t. policy parameters

	$E(U)$	$Var(U)$	$\sum_j Cov(U^F, U^j)$	$\sum_j Cov(U^K, U^j)$	$\sum_j Cov(U^C, U^j)$	$\sum_j Cov(U^I, U^j)$
				GERMANY		
ν	51.452	-9.140	-16.337	42.728	142.717	-121.998
ϕ	-24.289	16.401	20.432	-31.166	-66.623	59.175
κ_l	-0.653	0.356	0.448	-0.641	-1.284	0.493
ξ_w	-0.000	0.045	0.021	0.363	0.147	-0.760
				FRANCE		
ν	36.883	-16.173	-22.230	20.458	115.134	-39.399
ϕ	-17.709	15.724	19.307	-19.955	-52.528	21.386
κ_l	-0.369	0.178	0.243	-0.246	-0.754	-0.086
ξ_w	0.000	-0.036	-0.020	-0.129	0.160	-0.323
				ITALY		
ν	34.236	-1.982	-3.795	-8.522	26.373	-30.538
ϕ	-15.662	5.981	7.985	-11.192	-9.644	11.719
κ_l	-0.380	0.118	0.177	-0.381	-0.136	-0.249
ξ_w	0.000	-0.063	-0.031	-0.464	-0.006	-0.171
				SPAIN		
ν	17.438	1.824	1.639	-6.310	14.579	-52.691
ϕ	-7.781	3.117	3.324	-2.089	-3.095	16.357
κ_l	-0.062	0.036	0.046	-0.091	-0.059	-0.111
ξ_w	-0.000	-0.011	-0.002	0.039	-0.036	-1.912

Table 7: Elasticities of cumulative unemployment change w.r.t. policy parameters

GERMANY			Total	Frictional	Keynesian	Classical	Interaction
ν	demand shock (-)	short term	1.478	3.751	92.532	-745.830	-1.902
		long term	4.750	3.640	72.656	12.935	-4.716
	productivity shock (+)	short term	-671.303	-154.456	9.087	21.173	-1.730
		long term	-304.568	-170.540	2.236	24.415	30.263
ϕ	demand shock (-)	short term	2.580	2.831	-28.616	23.325	-2.496
		long term	3.223	3.070	-5.787	0.704	-3.238
	productivity shock (+)	short term	341.693	79.421	-4.316	-27.732	4.128
		long term	160.100	88.084	0.893	-11.544	-11.385
κ_l	demand shock (-)	short term	0.065	0.082	-1.784	1.171	-0.059
		long term	0.132	0.129	-0.283	-0.022	-0.133
	productivity shock (+)	short term	5.755	1.409	-0.164	0.103	0.113
		long term	2.461	1.510	-0.139	-0.393	-0.548
ξ_w	demand shock (-)	short term	-0.067	0.000	0.000	-13.713	0.064
		long term	0.051	0.000	0.000	0.994	-0.052
	productivity shock (+)	short term	-0.603	0.000	0.000	-1.750	0.354
		long term	0.357	0.000	0.000	1.028	-0.982

FRANCE			Total	Frictional	Keynesian	Classical	Interaction
ν	demand shock (-)	short term	0.027	2.348	56.425	-103.436	-0.460
		long term	3.866	2.526	65.825	7.874	-3.808
	productivity shock (+)	short term	-7076.006	-60.678	6.210	-19.932	-6.277
		long term	-92.168	-63.962	2.415	14.638	19.622
ϕ	demand shock (-)	short term	2.009	2.204	-16.946	5.407	-1.925
		long term	2.494	2.277	-6.216	0.770	-2.517
	productivity shock (+)	short term	3752.816	33.155	-3.020	-5.380	6.711
		long term	53.401	35.214	0.738	-6.602	-6.004
κ_l	demand shock (-)	short term	0.032	0.048	-1.110	0.204	-0.026
		long term	0.091	0.086	-0.289	0.007	-0.092
	productivity shock (+)	short term	32.975	0.321	-0.089	0.350	0.132
		long term	0.337	0.329	-0.118	-0.184	-0.282
ξ_w	demand shock (-)	short term	-0.072	0.000	0.000	-2.213	0.071
		long term	0.063	0.000	0.000	0.706	-0.065
	productivity shock (+)	short term	-9.780	0.000	0.000	-1.311	0.724
		long term	0.174	0.000	0.000	0.725	-0.716

Table 8: Elasticities of cumulative unemployment change w.r.t. policy parameters

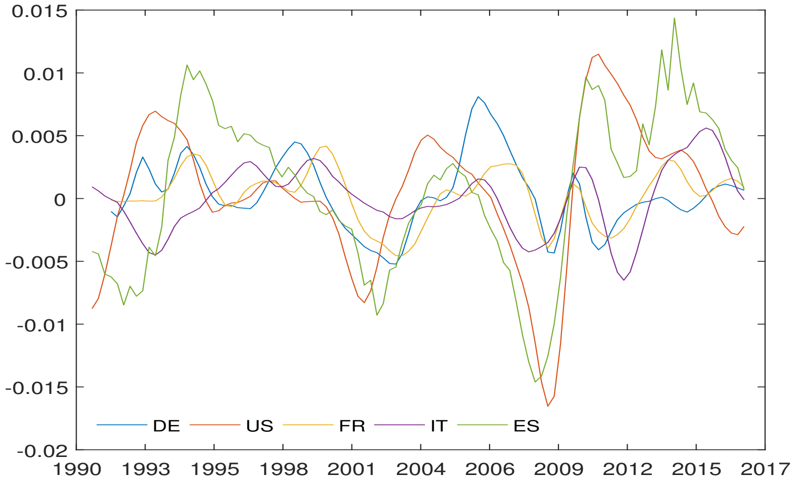
ITALY

			Total	Frictional	Keynesian	Classical	Interaction
ν	demand shock (-)	short term	-1.065	1.203	47.601	-39.358	0.548
		long term	1.627	0.598	38.416	6.436	-1.551
	productivity shock (+)	short term	-34.802	-55.479	3.285	-18.649	-3.053
		long term	-100.549	-60.145	3.226	12.049	15.455
ϕ	demand shock (-)	short term	1.772	2.411	-11.867	-2.511	-1.696
		long term	3.076	2.795	1.471	0.944	-3.106
	productivity shock (+)	short term	17.316	29.635	-2.099	-0.526	105.903
		long term	59.887	32.362	-0.133	-4.507	-4.217
κ_l	demand shock (-)	short term	0.024	0.047	-1.003	0.046	-0.015
		long term	0.104	0.100	-0.060	-0.001	-0.106
	productivity shock (+)	short term	0.180	0.293	-0.043	0.243	2.473
		long term	0.203	0.299	-0.103	-0.154	-0.289
ξ_w	demand shock (-)	short term	-0.056	0.000	0.000	-0.709	0.057
		long term	0.018	0.000	0.000	0.224	-0.019
	productivity shock (+)	short term	-0.008	0.000	0.000	-0.582	9.084
		long term	-0.086	0.000	0.000	0.182	-0.302

SPAIN

			Total	Frictional	Keynesian	Classical	Interaction
ν	demand shock (-)	short term	-1.008	0.430	16.974	-29.911	0.651
		long term	1.189	0.593	41.132	6.063	-1.176
	productivity shock (-)	short term	10.776	92.667	-0.887	16.349	-11.461
		long term	118.837	105.920	0.483	-14.259	-76.060
ϕ	demand shock (-)	short term	1.568	1.731	-4.557	1.555	-1.534
		long term	1.796	1.717	-0.652	-0.011	-1.804
	productivity shock (-)	short term	-4.880	-45.564	1.116	-2.155	4.913
		long term	-60.670	-52.495	-0.445	5.728	38.690
κ_l	demand shock (-)	short term	-0.010	0.001	-0.408	0.144	0.016
		long term	0.028	0.029	-0.168	-0.017	-0.028
	productivity shock (-)	short term	0.010	0.440	-0.057	-0.265	0.003
		long term	0.947	0.615	0.024	0.136	-0.583
ξ_w	demand shock (-)	short term	-0.081	0.000	0.000	-1.107	0.078
		long term	0.033	0.000	0.000	0.652	-0.037
	productivity shock (-)	short term	-0.039	0.000	0.000	0.813	0.004
		long term	0.331	0.000	0.000	-0.728	0.033

Figure 9: Historical paths of preference shocks



and a range of variables not included in the model. The approach is to extract paths of preference shocks obtained during the estimation of the model for each country and then to study correlations between shocks and variables of our interest, using panel-data regressions. To extend the sample we use not only data for the main euro area countries, but also for the US.

Historical paths of quarterly preference shocks for each country after the year 1990 is presented in 9 . Focusing on recent years, we see an interesting pattern. On the one hand, both US and Spain were strongly affected by the initial shock of Great Recession, however in the subsequent years both economies experienced relatively fast recovery of demand. On the other hand, while Italy, France and Germany recorded relatively modest negative demand shock in period 2008-2009, it was followed by another drop in households willingness to consume in years 2010-2012. Overall, variance of the shocks in US and Spain is visibly higher compared to the rest of our sample.

As preference shocks in our model are in fact temporary innovations to the value of households discount factor, they tend to induce consumers to shift consumption into the future when a negative shocks is considered, or to increase current expenditure in case of a positive shock. In a model with meaningful saving decisions this would translate into changes to saving rate. Thus, we look up to studies explaining dynamics of households propensity to save in order to establish a set of possible variables whose dynamics could be potentialy captured by our estimated preference shocks. Based on the literature review in Hüfner and Koske (2010), we focus on variables standing for changes in households wealth, credit, fiscal policy stance, uncertainty, terms of trade and demographics. Potential effects of wealth are proxied by the data on housing prices and headline stock market indices for each country [3]. While we have no access to cross-

[3]For Germany - DAX 30, Spain - IBEX 35, Italy - FTSE MIB, France - CAC 40, US - S&P 500.

country data on credit availability, short-term interest rates are used as a measure of borrowing costs.[4] To account for potential impact of ricardian equivalence we include data on public debt ratio to GDP. Indices of economic policy uertainty are used to study relevance of precautionary motives to consumption decisions. The remaining two variables of interest are terms of trade and dependency ratios (ratio of people younger than 15 or older than 64 to the working-age population, ie. those aged 15-64). While typically changes to population structure are seen as a factor affecting aggregate saving ratio over the long term, here we verify their relevance for short-term fluctiations.

To investigate factors behind preference shocks we run a panel data linear regressions with shocks as an explanatory variable and variables discussed in a previous paragraph set as regressors. We resort to standard fixed and random effect estimators, using a sample of 363 observations. Stationary variables are modeled in levels, while non stationary in log differences. Results are presented in 9. Firstly, while asset prices display positive correlation with preference shocks, effect are statistically significant only in case of financial assets. Lack of relation between households consumption time-preferences and housing prices may result from the fact that while for some households increase in housing prices contributes to wealth, for others it mainly rises cost of housing services likely leading to lower consumption through income effect. Secondly, both in terms of interest rates and uncertainty, correlations are in line with the expectations. Higher interest rates or higher level of uncertainty tend to be accompanied by lower willingness of households to consume. Thirdly, in line with life-cycle hypothesis increase in share of non-working population leads higher average propensity to consume. Finally, dynamics of public debt and terms-of-trade seem to be uncorrelated with preference shocks, once controled for other factors. The result for public debt is robust to changes in the measure of fiscal policy like separating changes in government expenditures and taxes or focusing on structural fiscal balance to isolate discretionary changes in policy stance.[5] Our findings does not depend on the estimator choice.

While presented results are in line with expectations and related literature, our approach suffers from a drawback. Obtained estimates are indicative only for correlations and not causal relationships. While in principle we were interested in factors (i) having similar impact on consumers behaviour like preference shifts or (ii) causing preference shifts, presence of reverse causality could bias the estimates. For example, on the one hand, changes to wealth may affect households willingness to consume, but on the other hand, shifts in time preferences may have impact on assets valuation. Accounting for that would either require using quasi-experimental data to estimate causual effects or building a structural model with a broader set of shocks and richer environment (eg.

[4] While our DSGE model accounts for the monetary policy, it does so in a simplified manner, for example not allowing for monetary shocks. Thus unexpected changes of interest rates affecting consumption dynamics, may manifest themselves as a preference shocks in our model.

[5] We use data on structural balance published by the IMF. As the data is avaiable only on annual basis, we extrapolate it to obtain quarterly series.

including financial assets). In turn, our result can be seen rather as a hint of possibly relevant channels to investigate in the future research.

Table 9: Panel data regressions with preference shocks as an explanatory variable.

Estimator	(FE)	(RE)
House prices	0.013	0.012
	(0.018)	(0.018)
Stocks indices	0.830***	0.860***
	(0.250)	(0.240)
Interest rates	−0.110***	−0.110***
	(0.016)	(0.016)
Uncertainty	−0.002***	−0.002***
	(0.001)	(0.001)
Public debt	−0.020	−0.018
	(0.017)	(0.017)
Dependency ratio	1.500***	1.400***
	(0.300)	(0.290)
Terms of trade	−2.100	−2.100
	(1.500)	(1.500)
Intercept		0.400***
		(0.110)
Observations	363	363
R^2	0.290	0.280
Adjusted R^2	0.270	0.270
F Statistic	20.000*** (df = 7; 351)	20.000*** (df = 7; 355)
Note:		*p<0.1; **p<0.05; ***p<0.01

5 Conclusions

The motivation of our work was twofold. Firstly, we took a step to formally verify to what extent differences in historical unemployment dynamics in four main Euro Area countries stemmed from different structural characteristics of the economies as opposed to divergent paths of country-specific shocks. Secondly, we analyzed a composition of unemployment in each country, decomposing its level into three components - frictional, Keynesian (related to price rigidity) and classical (determined by the presence of wage rigidity). The study is an extension of Borys, Doligalski, and Kopiec (2017), where we developed a DSGE model with search and matching frictions in both labor and product markets. While the model was originally calibrated to the US data, here we use it to interpret developments in the labor markets of main Euro Area economies.

Results of unemployment decomposition suggest that its dynamics tends to be dominated by the volatility of frictional component across all studied countries. It is worth recalling that frictional unemployment in our model captures not only the effects of the labor market frictions but also frictions in the product market. As opposed to Michaillat and Saez (2015), our setup allows shopping frictions to affect dynamics of unemployment even when prices are fully flexible. In their study, only under the assumption of rigid prices and wages model is able to generate meaningful volatility in product market tightness. This leads to a risk of confusing consequences of nominal rigidities with effects of shopping frictions. As we introduce a looser relation between prices and product market tightness, the model imply more limited impact of nominal rigidities on unemployment dynamics, compared to Michaillat and Saez (2015). In fact presence of price rigidity, giving rise to Keynesian unemployment, tend to limit variance of the total unemployment. Stabilizing effects of Keynesian factors are the most visible in France, while being the weakest in Spain. As opposed to price rigidity, wage inertia contributes positively to variance of the unemployment, in line with results from related literature. Among the studied Euro Area economies, volatility of the unemployment component related to wage rigidity (i.e. classical) is the highest in Italy and the lowest in Germany.

Despite a fairly homogeneous structure of the unemployment across studied countries, its historical dynamics shows significant cross-country variation. We establish that differences in variance of unemployment rates among selected Euro Area countries are a result of both heterogeneity in structural characteristics of economies and divergent paths of shocks. While we are able to link magnitude of employment adjustments to a range of labor market institutions, we are not willing to draw policy recommendations as the result are partly non-linear (i.e. country dependent) and to some extent contradicting conclusions of other related studies. While typically in the literature high unemployment benefits are claimed to contribute positively to variance of the unemployment, we reach an opposite result for all countries, except for Spain. Similarly, our simulations show positive impact of firing costs on unemployment volatility, which again contradicts findings in other studies and our results established for the US in the accompanying paper Borys, Doligalski, and Kopiec (2017). Finally, higher wage rigidity leads to prolonged and muted response of the employment to shocks in all countries, but Germany. As dynamics of total unemployment mostly coincides with dynamics of its frictional component, we see that effects of labor market institutions on unemployment operate mainly through that component. Wage rigidity is an exception, as by definition it affects only classical component and interactions term.

In line with findings in Borys, Doligalski, and Kopiec (2017) for the US, our model implies that preference shocks are an important source of unemployment volatility in main Euro Area economies.While one may question plausibility of the claim is that variation in households discount factor contributes that strongly to unemployment dynamics, there are studies suggesting that preference shocks can be interpreted as an short-cut for a range of other shocks affecting households propensity to consume. We find support for that claim, by pointing to statistically significant correlations between preference shocks, as extracted by Kalman filter during the estimation of country-specific models, and macroeconomic variables like interest rates, uncertainty, stock exchange valuations and changes to demographic structure of the population.

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