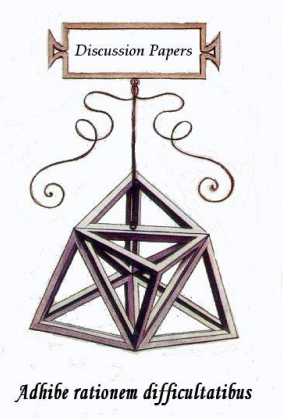
Discussion Papers
Collana di
E-papers del Dipartimento di Economia e Management – Università di Pisa



Roberto Martino - Phu Nguyen-Van

Labour market regulation and fiscal parameters: a structural model for European regions

Discussion Paper n. 200

2015

Discussion Paper n. 200, presentato: **July 2015**

Indirizzo degli Autori:
Dipartimento di Economia e Management, via Ridolfi 10, 56100 PISA – Italy
BETA, CNRS & Universite de Strasbourg, 61 avenue de la Foret Noire, F-67085 Strasbourg Cedex - France

Si prega di citare così:
Martino R., Nguyen-Van P., (2015), "Labour market regulation and fiscal parameters: a structural model for European regions", Discussion Papers del Dipartimento di Economia e Management – Università di Pisa, n. 200 (http:// http://www.dse.ec.unipi.it/index.php?id=52).

Discussion Paper
n. 200

Roberto Martino - Phu Nguyen-Van

Labour market regulation and fiscal parameters: a structural model for European regions

Abstract

Deregulation of the labour market and public budget balance are usually considered a fundamental requirement for economic performance. This study analyses the long term relationship between these indicators and gross value added (GVA) for a panel of European regions from 1995 to 2008. Following Olley and Pakes (1996), Levinsohn and Petrin (2003) and Ackerberg et al. (2006), a structural equation is estimated using a two stages semi-parametric procedure. Results suggest no univocal evidence of a detrimental effect of labour protection on long term GVA, while public deficit spending is positively associated with higher output. A negative relationship with debt arises only for economies with very high debt/GDP ratios.

Classificazione JEL: C20; E23; O47; R11
Keywords: Labour protection; convergence criteria; production function; European Union

1 Introduction

Starting from the Eighties of the last century, economic receipts have been suggesting that a market oriented environment sets up the right conditions for successful economic activities. Liberalization, privatization and less State intervention have been invoked as a prerequisite for the appropriate functioning of markets. In particular, the State should just guarantee free competition and avoid any potentially distorting intervention. This implies more abstentions than active policies. Consequently, balanced budget has been proposed as the main policy target, to be achieved by reduced public spending rather than by increasing taxation. Deregulation is intended to remove frictions affecting markets' functioning in favour of free competition. Similarly, the rationale for privatization is the belief that private industry performs better than State enterprise because of the more direct incentives to managers (Williamson, 1990).

Originally catalysed by the experience of Latin America in the Eighties, this set of reforms has been adopted as main conditioning receipt by the Bretton Woods institutions for their Structural Adjustment programs, mainly in Africa and Latin America. It is known as the Washington Consensus after Williamson (1990). However, its main principles have been recently adopted in the European Union (EU), in particular during the last crisis. Indeed, despite no direct reference has been made to the Washington Consensus itself, the ingredients are the same, with more emphasis on fiscal consolidation and less on privatization.

Two main domains assume relevance in the current EU scenario. First, liberalization and deregulation have been advocated as the main means to make markets as close as possible to perfect competition. Indeed, regulation is traditionally seen as a source of both unemployment and unsatisfactory economic performance.[1] In particular, labour markets should be made more flexible, while employment protection should be reduced since it discourages firms to hire and invest because of firing restrictions.

Second, budget imbalances are usually invoked to explain the difficulties of some countries of the EU to get out of the crisis. Despite the crisis was not born as a debt crisis, it is argued that public debt must be addressed in order to help Europe to recover.[2] Moreover, the two Maastricht parameters concerning public finance state that the debt/GDP ratio should be lower than 60%, while the deficit/GDP ratio should not exceed 3%. On this basis, a conservative pro-cyclical response package has been adopted throughout Europe, mainly by cutting public expenditure.

As already happened for the original Consensus, the soundness of such polices has been heavily questioned. Theoretically, it can be argued that the relationship between public debt and economic performance is negative. For instance, high debt may cause uncertainty and generate expectations of future financial repressions, as well as it may increase sovereign risk (Cochrane, 2011; Codogno et al., 2003). Also, excessive debt burden may constrain the capacity of fiscal authority to engage in traditional countercyclical stabilization policies (Cecchetti et al., 2011). However, it is also true that as long as public debt is cumulated as a result of expansionary fiscal policies, it can be positively related to economic performance (Cecchetti et al., 2011; Panizza and Presbitero, 2014). The

[1] For the relationship between labour market institutions and employment see for instance Blanchard and Wolfers (2000) and Bassanini and Duval (2007).

[2] Reinhart and Rogoff (2010) is probably the most influential paper which gives support to the hypothesis that high debt hampers economic growth.

last point brings to the discussion on the role of contractionary fiscal policies and public deficit. Critics of the post-crisis policy package have pointed out how contractionary policies during a recession could worsen it, instead than favouring a recovery. Therefore, countercyclical interventions should be preferred.[3] Moreover, the Maastricht fiscal parameters have been criticized for being neither theoretically grounded nor supported by empirical evidence.[4] More generally, context conditions, such as the overall status of the economy, future prospects of growth, access to credit, etc. should be accounted for when considering budget deficit targets (Stiglitz, 1998). Empirical findings are not univocal as well. Some authors report evidence of a negative nonlinear relationship between public debt and growth, with turning point around a debt/GDP ratio above 80-90% (Cecchetti et al., 2011; Reinhart and Rogoff, 2010). Others find either weak or no association, also when the level of debt becomes high (Égert, 2015; Panizza and Presbitero, 2014; Pescatori et al., 2014). For what concerns deregulation and liberalization policies, Stiglitz (1998) already pointed out that they do not necessarily imply increased competition.[5] This can be true for the current deregulation of the labour market, if either the overall economic conditions do not allow for actual competitive markets or globalization opportunities (and threats) do exist. Moreover, deregulation could have perverse effects in terms of unemployment, especially for the youth (O'Higgins, 2012).

The present paper sets in this framework by analysing the relationship between labour market deregulation, fiscal parameters and Gross Value Added (GVA). We use several institutional indicators for the labour market, debt and deficit shares on GDP. We also consider the Maastricht thresholds to investigate their empirical relevance. The main scope of this study is to assess the existence of a long-run relationship between the variables considered, GVA being the main dependent variable. Hence, we estimate an augmented *structural equation*, drawing the methodology from the firm-level literature on production functions. In particular, we adapt the estimation procedure originally proposed by Olley and Pakes (1996) and reviewed by Levinsohn and Petrin (2003) and Ackerberg et al. (2006). This allows to approximate nonparametrically any unobserved factor influencing likely endogenous regressors. This in turn yields consistent estimates of the coefficients. Our structural model implies the estimation of am augmented production function in which capital, employment and the additional variables are included as regressors. Of course, our additional regressors are potentially correlated with the two "inputs", in particular with employment, since we consider labour market institutions. Therefore, their inclusion corresponds to the need to explain the residual term which accounts the most in explaining differences in productivity among economies (Easterly and Levine, 2001). In particular, we want to assess whether the fiscal parameters and labour market deregulation contribute to explain productivity and if their contribution is positive, as implied by the rationale of their application in the EU[6].

[3]See Blinder (1997) and Barba (2001) for an assessment of the depressive and the expansionary hypothesis of fiscal retrenchments.

[4]See Pasinetti (1998) for a critique of the 3% deficit/GDP criterion, Herndon et al. (2014) for a reassessment of the debt/GDP results of Reinhart and Rogoff (2010).

[5]With respect to the financial markets, the support for deregulation comes from the assumptions that free-market capitalism works better without the constraints imposed by State control. For a critical assessment on this regard, with a specific focus on the causes of the last crisis, see Soros (2009) and Varoufakis (2013). It is worth noting how such two different perspectives converge to the role of financial deregulation in favouring the crisis.

[6]Adapting the words of (Bresson et al., 2014, p. 1), we want to "ascertain the importance of these

Our findings show no univocal evidence of a detrimental effect of labour markets regulation on GVA. Furthermore, deficit spending beyond the 3% criterion is associated with higher output, while public debt is found to be detrimental for economic performance only when its share on GDP becomes large.

The paper proceeds as follows. Section 2 introduces the methodological background on estimation of production functions. Section 3 describes the estimation procedure. The data are presented in Section 4. Results are discussed in Section 5. In Section 6 we present some specification tests to verify the appropriateness of our assumptions. Section 7 concludes.

2 Methodological background

We adopt the approach used in the *structural* literature, following Ackerberg et al. (2006), which focuses on the computation of total factor productivity (TFP) at the firm level by estimating a general production function, usually assumed as a Cobb-Douglas technology. The approach explained below works also with any different assumption about the form of the production function (Ackerberg et al., 2006; Levinsohn and Petrin, 2003; Olley and Pakes, 1996). The use of the Cobb-Douglas is just a convenient approximation which, in the case of the present study, helps also understanding the link between the adopted approach and the widely used growth regressions.[7] Olley and Pakes (1996) and Levinsohn and Petrin (2003) develop a method to estimate a production function providing more consistent results with respect to OLS and fixed effects estimators. The approach accounts for the simultaneity problem arising from the acknowledgement that any productivity shock known to the firm, but unknown to the analyst, could affect the choice of inputs. This in turn causes OLS estimates to be inconsistent. Similarly, fixed effect techniques make sense as long as the unobserved effect is assumed to be constant overtime. This is a strong assumption not likely to hold if we consider shocks (Ackerberg et al., 2006). Moreover, within estimators eliminate between-firm variation which is likely to contain relevant information for the estimates (Levinsohn and Petrin, 2003). Differently, the methodology we use builds on the use of a 'proxy' variable to solve the simultaneity problem, as well as any potential collinearity issue (Ackerberg et al., 2006). Therefore, such a solution should also be much more informative than traditional alternatives (Griliches and Mairesse, 1995).

The present paper differs in two ways from the previous literature on the topic. Firstly, the unit of observation is not the firm, but the regional economies of the European Union as defined by the Eurostat classification (NUTS2 level). This has some relevant implications in terms of the economic interpretation of the results. Indeed, the unobserved term cannot be merely referred to as a pure productivity shock, since at such a level of aggregation other factors affect economic activity and its output. After the pioneering study by Solow (1956), the literature has focused on the identification of the components of the TFP residual. For instance, Mankiw et al. (1992) augment the original model by adding human capital. In general, the approach proceeds by endogenizing those factors that originally were taken as exogenous. For what concerns practical applications, the empirical growth literature uses to adopt a generic representation of the implied equation

explanations of the residual" and their "contribution to productivity in different countries".

[7] See below for a discussion and Del Gatto et al. (2011) for a survey on production functions estimation.

of the Solow's model, by adding additional explanatory variables, depending on the specific focus of the study. The resulting equations are usually known as Barro regressions in growth econometrics (Barro, 1991; Caselli et al., 1996; Durlauf et al., 2005; Durlauf and Quah, 1999). In the present paper, the main interest concerns the long-run relationship between labour market deregulation, public finance constraints, and economic performance. Therefore, we *augment* the standard structural model by adding these explanatory variables and some additional controls to account for the structural composition of the economy.

Secondly, we are not directly interested in obtaining a measure of TFP, but in explaining which factors account for the heterogeneity in GVA and, therefore, labour productivity. However, it may still be that some other unobserved factors may affect economic choices, i.e. how much capital to use and how much employment to hire. Take for instance political factors, external economic shocks, non measurable innovations causing pure productivity increases. Hence, we think that the structural approach suits the goal of obtaining consistent estimates of the parameters. The TFP term can still be properly computed to understand how much variability in the dependent variable is left unexplained.

Our augmented specification is equivalent to the *canonical augmented* growth regression but with the dependent variable is in levels, instead of in growth rate, and steady-state implications are not considered. In other terms, the focus is on the *long-run* behaviour of the economy. In the following section, we can see that our approach appears to be theoretically grounded as well as suitable for a proper estimation of the parameters of a GVA equation. An equivalent application, with a different estimating procedure, is performed in Bresson et al. (2014). The use of the Olley and Pakes (1996) approach helps to obtain consistent estimates of the coefficients of interest, especially when there is reason to suspect simultaneity issues. As long as this is true, the point of such an estimation methodology applies fairly generally (Wooldridge, 2009).

3 Specification and estimation procedure

We begin by assuming a standard Cobb-Douglas production technology for the economy with two traditional inputs, capital stock and labour. We *augment* it by adding further explanatory variables leading to the following specification:

$$Y_{it} = A_{it} K_{it}^{\beta_k} L_{it}^{\beta_l}$$

with

$$A_{it} = A_0 e^{Z'_{it}\vartheta + \omega_{it}}$$

where K_{it} and L_{it} are capital stock and employment in the economy, respectively. Note that no specific restriction is imposed on the parameters. Additional factors affecting output are considered by specifying the composition of the technological level (or total factor productivity), A_{it}. A_0 is the initial technological level, whereas Z_{it} includes two sets of variables in which we are mainly interested, i.e. *fiscal parameters* and *labour market institutional indicators*. Unobserved factors (or shocks) likely to affect the choice of inputs, i.e. capital and employment, are included in ω_{it}. It follows that A_{it} is allowed to be varying over time and heterogeneous between observations. Taking the logs of the above production function we get

$$y_{it} = \beta_0 + z'_{it}\vartheta + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it} \tag{1}$$

where lowercase letters indicate variables in log, $\beta_0 = \ln A_0$, ϵ_{it} is the standard i.i.d. disturbance. The presence of ω_{it} causes the the *simultaneity* issue. For a non-firm approach as in our case, we may think at any kind of macroeconomic perturbation, as well as pure technological drifts, political events or international factors which shape the economic environment. The intuition is still that such a perturbation is not observed (or measurable) by the analyst, still it may be known to the economic actors, therefore shaping their decisions.

In order to address the simultaneity issue, we follow the estimation procedure as proposed by Ackerberg et al. (2006), which draw on Olley and Pakes (1996) and Levinsohn and Petrin (2003). The approach requires a suitable proxy variable being *monotonically* related to ω_{it}. We use investment s_{it}, as originally proposed by Olley and Pakes (1996). This turns out to be an adequate proxy as long as we believe that investment reacts monotonically to ω_{it}. In other terms, we are just assuming that investment increases whenever the overall conditions become more favourable to economic activity.[8] The next step consists in specifying a function for s_{it}. Following Ackerberg et al. (2006), a resonable time schedule implies that k_{it} is chosen in $t-1$, l_{it} in $t-b$ with $0 < b < 1$, and finally investment decisions are taken in t. Therefore employment is treated as a flexible variable, while capital depends on investment decisions in $t-1$, while investment in t determines the level of capital stock in $t+1$ and depends on the information set available in t. The time schedule allows to express investment as function of capital stock, employment and overall unobserved economic factors (including any kind of shock)[9]. Therefore, we have

$$s_{it} = f(\omega_{it}, k_{it}, l_{it}). \tag{2}$$

where s_{it} is investment. We also assume that ω_{it} follows a first-order Markov process

$$\omega_{it} = E[\omega_{it}|\Omega_{it-1}] + \xi_{it} = E[\omega_{it}|\omega_{it-1}] + \xi_{it} \tag{3}$$

where ξ_{it} is a random disturbance. If monotonicity holds, it is possible to invert equation (2) as

$$\omega_{it} = f^{-1}(s_{it}, k_{it}, l_{it}). \tag{4}$$

Therefore, the equation to be estimated is the following

$$y_{it} = \beta_0 + z'_{it}\vartheta + \beta_l l_{it} + \beta_k k_{it} + f^{-1}(s_{it}, k_{it}, l_{it}) + \epsilon_{it}. \tag{5}$$

We also observe that β_0 is not separately identified from f^{-1} as the latter is a nonparametric function.

We use the two-stage estimation procedure given by Ackerberg et al. (2006) to obtain consistent estimates of the coefficients of the model. A step-by-step guide to the estimation

[8] Levinsohn and Petrin (2003) rise some doubts on the strict monotonicity assumption regarding investment. They argue that empirically investment is very lump, due to adjustment costs which reduce its responsiveness to the transmitted shocks. Therefore investment may not adequately capture the variation in inputs' usage due to productivity shocks. Although this sounds reasonable at the firm level, at the aggregate level, investment measures the overall increase in capital stock in response to depreciation *and* improved economic conditions. Moreover, considering macroeconomic data excludes cases in which investment is zero for some observations, as it may happen when using microdata.

[9] The estimation procedure is also consistent with the assumption that l_{it} is set in $t-1$ ($b = 1$). What is relevant here is the possibility to express investment as a function of both capital stock and employment, as it solves any collinearity issue which could arise in the procedure of Levinsohn and Petrin (2003). See (Ackerberg et al., 2006, p. 10)

is presented in their paper, and also in Olley and Pakes (1996), Levinsohn and Petrin (2003) and Yasar et al. (2008). Differences are due to the assumptions about the time schedule and the proxy, which lead to changes in the first step (see Van Beveren (2012) for a review). Alternatively, one may adopt the one step estimation as in Wooldridge (2009). Equation (5) can be rewritten as

$$y_{it} = z'_{it}\vartheta + \phi(s_{it}, k_{it}, l_{it}) + \epsilon_{it}. \tag{6}$$

where

$$\phi(s_{it}, k_{it}, l_{it}) = \beta_k k_{it} + \beta_l l_{it} + f^{-1}(s_{it}, k_{it}, l_{it}). \tag{7}$$

In the first stage, equation (6) is estimated by using an estimator which is linear in l_{it} and nonlinear in ϕ. One can use OLS and a polynomial expansion in s_{it}, k_{it} and l_{it}, to approximate $\phi(s_{it}, k_{it}, l_{it})$ as in Olley and Pakes (1996). Alternatively, a semi-parametric regression as in Robinson (1988) can serve the scope as well. This is the option we follow. Therefore f^{-1} is treated non parametrically and it is identified up to a constant, hence β_0 is not separately identified. More precisely, we use the Epanechnikov kernel and the Silverman (1986) rule-of-thumb for the bandwidth parameter. Results do not change when a normal kernel or different bandwidths are set (see also Racine (2008)). As a result, the first stage yields a consistent estimate of ϑ whereas β_k and β_l cannot be estimated at this step as capital stock and employment enter ϕ more than once. Therefore, their respective coefficients must be estimated at the second stage, solving any collinearity issue which could arise in the approach by Olley and Pakes (1996) and Levinsohn and Petrin (2003).

Note that the additional variables z_{it} are not included in (2). The rationale for this assumption is twofold. Firstly, as k_{it} is a *state* variable that gathers all informations available in previous periods, i.e. investment decisions and other factors from time $t-1$ to time t, the inclusion of z_{it} in (2) would have a little additional value because z_{it} do not vary a lot between two successive years. Secondly, despite the previous argument, if we want to include z_{it} in equation (2) such as $s_{it} = f(\omega_{it}, z_{it}, k_{it}, l_{it})$, then the nonparametric estimation of $\phi(s_{it}, z_{it}, k_{it}, l_{it})$ will encounter the *curse of dimensionality* because of a high number of arguments in ϕ. A plausible way to include z_{it} is then to assume $s_{it} = f(\omega_{it} - z'_{it}\eta, k_{it}, l_{it})$ which gives $\omega_{it} = f^{-1}(s_{it}, k_{it}, l_{it}) + z'_{it}\eta$. However, in this case, the coefficient associated to z_{it} in equation (5) becomes $\vartheta + \eta$, the rest of the equation remaining unchanged, showing that η is not separately identified from ϑ. Thus, the model as described in (5) still applies here.

In the second stage, we firstly approximate non-parametrically $\phi(s_{it}, k_{it})$ from equation (6):

$$\hat{\phi}(s_{it}, k_{it}, l_{it}) = E[y_{it} - z'_{it}\hat{\vartheta}|s_{it}, k_{it}, l_{it}]. \tag{8}$$

Then, we can exploit equation (7) to compute an approximation for $\omega_{it} = f^{-1}(s_{it}, k_{it})$. For doing this we need a value for β_k to plug in the equation. We follow Levinsohn and Petrin (2003) and we estimate equation (1) by standard OLS for obtaining *candidates* β_k^0 and β_l^0. Hence, ω_{it} is approximated by

$$\tilde{\omega}_{it} = \hat{\phi}(s_{it}, k_{it}, l_{it}) - \beta_k^0 k_{it} - \beta_l^0 l_{it}. \tag{9}$$

Therefore, the Markov chain assumption leads to a nonparametric estimate of $\hat{\omega}_{it}$[10],

$$\hat{\omega}_{it} = E[\tilde{\omega}_{it}|\tilde{\omega}_{i,t-1}]. \tag{10}$$

[10]The bandwidth for the non parametric estimation of $\hat{\omega}_{it}$ has been obtained by cross-validation. See Silverman (1986).

Finally, we have all the elements needed to compute the residuals of equation (5). Using coefficients $\hat{\vartheta}$ and $\hat{\beta}_l$ from the first stage, and the fact that the non-parametric estimate $\hat{\omega}_{it}$, under the Markov-Chain assumption, implies the innovation $\xi_{it} = \tilde{\omega}_{it} - E[\tilde{\omega}_{it}|\tilde{\omega}_{it-1}]$, equation (5) can be rewritten as (remark that β_0 is not separately identified from $\hat{\omega}_{it}$)

$$y_{it} = z'_{it}\hat{\vartheta} + \hat{\beta}_l l_{it} + \beta_k k_{it} + \hat{\omega}_{it} + \xi_{it} + \epsilon_{it}. \tag{11}$$

Hence, the new residuals correspond to $\xi_{it} + \epsilon_{it}$. Since, by construction, the residuals are cleaned of the unobserved shock and therefore are uncorrelated with k_{it}, β_k and β_l can be estimated by GMM using the following moment conditions:

$$E[\widetilde{\xi_{it}}|k_{it}, l_{it-1}] = 0. \tag{12}$$

Finally, we use bootstrap to compute standard errors of our estimates in order to obtain consistent results.[11]

4 Data

The study uses data for the NUTS-2 sub-national territorial units, as classified by Eurostat. Overall, we have informations about regional economies for 20 European countries from 1995 to 2008. The countries are Austria (AT), Belgium (BE), Czech Republic (CZ), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), Hungary (HU), Italy (IT), Netherlands (NL), Poland (PL), Portugal (PT), Sweden (SE), Slovakia (SK) and the United Kingdom (UK). In particular, we draw gross value added (GVA), employment, capital stock, investment from the Cambridge Econometrics database. We then compute the sector shares as the ratios on aggregate GVA. The focus is on manufacturing, financial services and other market services, since they are the sectors which contribute the most to productivity growth in Europe.[12]

Additional variables included in the augmented model are taken from different sources and they are indicators at the national level.[13] The *implicit tax on labour* is defined as the ratio of (direct and indirect) taxes and social security contributions on employed labour income to total compensation of employees. The *implicit tax on capital* is the ratio between revenue from all capital taxes, and all (in principle) potentially taxable capital and business income in the economy. Both of them are drawn from Eurostat.

[11] Equation (12) can be replaced by the moment conditions in Levinsohn and Petrin (2003), i.e.

$$E[(\widetilde{\xi_{it} + \epsilon_{it}})|k_{it}, l_{it-1}] = 0$$

where $\widetilde{\xi_{it} + \epsilon_{it}} = y_{it} - z'_{it}\hat{\vartheta} - \beta_l l_{it} - \beta_k k_{it} - \hat{\omega}_{it}$. Furthermore, overidentification conditions can be added, changing the equation in

$$E[\widetilde{\xi_{it} + \epsilon_{it}}|W_{it}] = 0$$

where W_{it} is the vector of instruments, for instance $W_{it} = \{k_{it}, k_{it-1}, l_{it-1}, ...\}$. However, in our case the above alternatives provide similar results. See also Petrin et al. (2004) and Wooldridge (2001) and Wooldridge (2010).

[12] See for instance Van Ark et al. (2008), OMahony et al. (2010) for a sectoral analysis on productivity in Europe. See Rodrik (2013) for an investigation of the role of manufacturing in cross-country convergence. See Martino (2014) for the role of sectoral composition in determining labour productivity dynamics in the European Union.

[13] A summary of variables definition is reported in Appendix A.

The *public budgetary position* is taken from the World Bank and it is computed as the ratio of deficit/surplus over GDP. We will refer to it as *budget balance*. Note that positive values for the variable imply a surplus in public budget for the year. A negative sign for the coefficient implies a *positive* correlation between deficit spending (i.e. increased deficit) and GVA.

The remaining indicators are drawn from the OECD database. The *Employment Protection Legislation* (EPL) indicators refer to the regulation concerning hiring and firing workers and it is expressed in scale 0-6. It is decomposed in EPL for *individual* and *temporary* contracts. It is argued that excessive regulation (i.e., higher values of the indicator) may disincentive firms to employ workers, since firing costs increase. On the contrary, arguments in favour of employment protection concern macroeconomic stability against adverse shocks, as well as job security as a factor favouring human capital investment and productivity (see Cazes and Nesporova (2003) and OECD (2013)). The *unit labour cost* (ULC) measures the average cost of labour per unit of output and it is given by the labour compensation share on total GDP it refers to (i.e. the wage share). It should not be interpreted as a comprehensive measure of competitiveness, but as a reflection of cost competitiveness. Indeed it deals exclusively with the cost of labour and should be considered in relation to changes in the cost of capital, especially in advanced economies. *Trade union density* corresponds to the ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners. The *(youth) temporary employment* indicates the share of (15-24 aged) temporary workers for all dependent employees. The *debt/GDP ratio* and the *nominal interest rate* conclude the list.

Finally, we also consider the relationship between fiscal consolidations and GVA in the long run. We use the dataset developed by Devries et al. (2011), which focuses on discretionary changes in *taxes* and *government spending* motivated by budget deficit reduction. The main scope of the database is to provide data which are independent of the status of the economy. It is argued that fiscal retrenchments may have positive effects on the economy (Barba, 2001; Blinder, 1997). The fiscal policies in the EU following the last crisis, as well as the Maastricht criteria, respond to such an hypothesis. We use these data to verify if regions belonging to countries which adopted fiscal consolidation measures perform better in the long run.

Table 1 reports descriptive statistics for the main variables. Mean and standard deviation are in the second and third columns, while minimum and maximum values are in columns 4 and 5. The region with the highest levels of GVA, employment and capital is Ile de France, which includes Paris. The minimum value for capital stock is registered in the Spanish region of Melilla, while Aland (FI) has the lowest value of both employment and GVA. However, the latter is found to be the best performer in terms of labour productivity, defined as the share GVA/employment. Since the labour force is measured in terms of employees, this implies that Aland produces the highest level of GVA per worker. This can be due either to labour being more efficient or to specialization in more productive industries. To account for the latter, in the next Section we control for GVA shares in manufacturing, financial and business-related market services, since they are respectively the most growing and productive sectors in Europe. Specialization also contributes to explain why the lowest productive region is located in Eastern Europe. The Implicit taxes on labour and capital have the highest variation, as the standard deviation suggests. Nordic countries have the maximum values for both, while the lowest are in

Table 1: Descriptive statistics

	Mean	Std.Dev.	Min	Max
GVA*	10.10	0.97	6.43[a]	12.94[b]
Employment*	6.42	0.83	2.73[a]	8.63[b]
Capital stock*	11.39	0.93	7.51[c]	14.30[b]
Labour productivity*	1.58	0.12	1.29[d]	2.40[a]
Temporary empl. share	12.64	6.43	4.50 (SK)	34.04 (ES)
Temporary empl. youth share	35.75	16.13	10.98 (UK)	68.60 (ES)
EPL individual	2.53	0.76	1.03 (UK)	4.58 (PT)
EPL temporary	1.79	1.12	0.25 (UK)	4.75 (IT)
Trade Union Density	35.34	21.39	7.54 (FR)	80.63 (SE)
ULC*	-0.50	0.13	-1.06 (HU)	-0.31 (UK)
Tax on labour	37.05	6.47	21.60 (PT)	48.50 (SE)
Tax on capital	28.62	7.82	13.90 (SI)	49.90 (DK)
Debt/GDP	53.17	23.68	9.22 (CZ)	113.76 (BE)
Budget Balance	-1.57	2.80	-9.23 (NL)	6.79 (FI)

Note: * indicates that variables are in logs. [a] is the region of Aland (FI), [b] is Ile de France (FR), [c] is Ciudad de Melilla (ES), [d] is Lubelskie (PL)

Portugal and Slovenia for labour and capital respectively. EPL statistics are representative of the different labour market systems in Europe: Mediterranean countries (Italy and Portugal) have the highest levels of protection, while the United Kingdom has the lowest. The Continental regions are in between. Statistics on temporary employment reveal that the share of workers with temporary contracts is dramatically higher for people in age 16-24. In particular, the recent deregulation of labour markets had a significant impact on Spain, in which 3 young workers out of 4 have a temporary job, while the European mean is 1/3. The ratio of wage and salary earners that are trade union members varies considerably, ranging from 7.54 % (France) to 83.14% (Sweden). Public finance statistics are characterized by high standard deviation. Therefore, even though average Debt/GDP is 53%, some countries have a ratio larger than 1, such as Belgium and Italy, others have very low ratio, such as Czech Republic. Finally, governments are on average deficit spenders. Finland and Netherlands register respectively the highest surplus and deficit.

5 Estimation results

5.1 The base case

We proceed by estimating our model as described above. Standard errors are obtained by bootstrap procedure using resampling with replacement, as suggested by Levinsohn and Petrin (2003).[14] The focus is on two sets of variables. The first set describes the degree of regulation of the labour market. It includes the two indexes of employment protection and the measure of trade union density. The second set represents the budget status of the central government. It is composed by the ratio of debt and deficit

[14]For comparison purposes, estimations of the basic production function with just capital stock and employment as inputs are presented in Appendix B. Some results for robustness check are discussed in Appendix C.

on GDP. Additional variables are used as controls. Manufacturing and services sector shares account for the structural composition of the economy, which heavily affects the level of output. The increasing deregulation of the labour market during the last decades has changed the composition of employment, with a rise in the adoption of temporary contracts. This is especially true in the countries in which the level of employment protection was higher, as in Spain and in Southern Europe (O'Higgins, 2012). Therefore, we include the share of temporary employment for the whole labour force, as well for the youth. The implicit tax on capital and labour, and the unit labour cost (ULC) are used as indicators of competitiveness. However, both the ULC and the tax on labour include social contributions for employees. Therefore, in what follows we use them alternatively in two different sets of estimates. The nominal interest rate is also included.

Table 2 reports the results. All the variables are in logs, excluding the two indexes of employment protection, the budget balance and the implicit taxes on capital and labour, whose coefficients can be interpreted as semi-elasticities. In Model (1) ULC is included among the regressors. The coefficient on employment is 0.555, while the estimated elasticity of GVA with respect to capital is lower (0.240). Beginning with the labour market indicators, the coefficient on EPL is negative and significant, while EPL for temporary workers has no significant effect. On the opposite, the density of trade unions is positively associated with higher levels of GVA. The coefficients for temporary employment shares indicate that the relationship between GVA and temporary contracts is different according to age. Indeed, the higher the share of non-permanent workers in the labour force the lower total GVA is. However, the relationship has a negative sign when the share of young temporary workers is considered. These findings suggest an incentive-disincentive mechanism depending on age: temporary employment is positevely related to productivity for the youth joining the labour market, however insecure contracts all along the life cycle tend to hinder productivity[15]. For what concerns the competitiveness variables, ULC has no explanatory power, while the tax on capital has no economic relevance, even though it is statistically significant. Interesting results are obtained for the budgetary variables. Finally, both the debt/GDP and the deficit/GDP ratios are not significant[16]. In Model (2) we substitute ULC for the implicit tax on labour. The related coefficient is negative and significant, suggesting that implicit taxation on labour compensation hinders GVA, even though its magnitude is hardly economically significant. The shares of (total and young) temporary employment are still statistically significant, being their coefficients higher. The coefficient on EPL for temporary workers is now positive and significant, even though its magnitude is low, consistently with the above interpretation of the relationship between GVA and temporary contracts. The coefficient on indiviual EPL is more than doubled with respect to Model (1). Finally, the debt/GDP share is now positive and significantly related to GVA.

Overall, the results suggest that the deregulation of labour markets is not univocally associated with higher levels of GVA. For instance, even though employment protection

[15]Some caution must be used for what concerns the temporary share of youth workers. Indeed, countries differ in the kind of temporary contracts and in the rules for their application and renewal, as well as for the kind of activities which make use of them. The difference between the dual apprentice system in Germany and the temporary contracts in Italy and Spain is an example (see O'Higgins (2012) for an analysis on the topic).

[16]Recall that positive values of budget balance indicate budget surplus. Therefore, a negative value of the coefficient indicates a positive relationship between deficit spending and GVA. However, results in this and the following sections do not reveal a significant relationship.

Table 2: Estimation results: the base case

	Model 1	Model 2
Capital stock	0.240^{***}	$0.0.321^{***}$
	(0.049)	(0.096)
Employment	0.555^{***}	0.473^{***}
	(0.044)	(0.097)
Manufacturing share	0.079^{***}	0.078^{***}
	(0.026)	(0.022)
Financial share	0.254^{***}	0.260^{***}
	(0.031)	(0.029)
Trans. share	-0.122^{*}	-0.165^{***}
	(0.065)	(0.059)
ULC	0.032	–
	(0.098)	
Tax on labour	–	-0.007^{***}
		(0.002)
Tax on capital	0.004^{***}	0.004^{***}
	(0.001)	(0.001)
EPL individual	-0.084^{***}	-0.076^{***}
	(0.016)	(0.015)
EPL temporary	0.005	0.016^{*}
	(0.009)	(0.008)
Temp. empl. share	-0.138^{***}	-0.221^{***}
	(0.042)	(0.041)
Temp. empl. youth share	0.151^{***}	0.239^{***}
	(0.043)	(0.042)
Trade union density	0.031^{*}	0.051^{***}
	(0.017)	(0.018)
Debt/GDP	0.031	0.042^{**}
	(0.021)	(0.019)
Budget balance	−0.005	−0.003
	(0.004)	(0.003)
Interest rate	0.006	0.007^{**}
	(0.004)	(0.003)
Number of obs.	2885	2885

Notes. Bootstrap standard errors are in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

has a negative effect on total output, regulation of temporary contracts has either no or positive effect on economic performance. Similarly, the diffusion of more *flexible* temporary employment is likely to produce a negative feedback if temporary contracts are widely (structurally) adopted. For what concerns budget policies, the estimates show no evidence of a detrimental effect of public debt on economic performance. If any, a positive association is in place, especially for debt/GDP.

5.2 Maastricht parameters

Maastricht parameters have been established as a prerequisite to join the Euro area. They are referred to as *convergence criteria* and presented as the conditions a country must respect to safely join the Euro area. In particular, soundness and sustainability of public finances are required, through limits on government borrowing and national debt. Soundness is defined through a threshold of 3% on public deficit relative to GDP. Sustainability requires the ratio Debt/GDP to be lower than 60%. The sustainability threshold finds its confirmation in Reinhart and Rogoff (2010) empirical study. However, the latter has been shown to be flawed by selective exclusion of available data, coding errors and inappropriate weighting of summary statistics (Herndon et al., 2014). The soundness criterion has not be criticized *per se*, but because of being imposed independently of context considerations. The sustainable deficit should be based on circumstances, including the cyclical state of the economy, prospects for future growth, the level of national savings and investment (Stiglitz, 1998, p. 16). In this section we proceed by testing the validity of the criteria using our structural model.

In Table 3 we substitute the budgetary variables of Table 2 with the Maastricht parameters. In particular, $Def/GDP > 3\%$ is a binary variable which takes value 1 if deficit spending is larger than 3% of GDP, i.e. if the *Budget Balance* variable is lower than -3. Similarly, $Debt/GDP > 60\%$ is a binary variable which is equal to 1 if $Debt/GDP$ is larger than 60%. The two thresholds are introduced in the first two columns of Table 3, in Model 3 and Model 4. Results are consistent with findings in Model 1 and Model 2. In particular ULC and Tax on Labour are not associated with GVA, while the not univocal conclusions on labour market regulation are confirmed. Findings support the sustainability criterion: economies with a Debt/GDP ratio higher than 60% have lower GVA. However, we find no evidence confirming the soundness criterion: on the opposite deficit spending beyond 3% is positevely related to GVA. Similar conclusions can be drawn for Model 1a and Model 2a. Moreover, allowing for a quadratic term in debt/GDP reveals that higher ratios are associated with higher GVA until a turning point, after which debt/GDP and GVA are negatively associated. In particular, the turning point corresponds to 46.5% and 47.7% in Model 1a and Model 2a respectively, which is lower than the 60% critical level of the sustainability criterion.[17]

Summing up, findings in Table 3 suggests that what matters is a sustainable financial position, while deficit spending beyond 3% is beneficial for economic performance on the long run. Therefore, even though Stiglitz (1998)'s argument should be kept in mind when considering the case for deficit spending, the above results reject the soundness of the 3% threshold.

5.3 Fiscal consolidations

The analysis above shows that deficit spending and debt are not associated with lower levels of GVA. On the opposite, a reversed argument could be told. A further interesting piece of the story would be to understand if regions belonging to countries which undertake budget balancing policies are likely to have higher GVA levels on the long run. Note that

[17]Note that the standard result in the literature reveals nonlinearity with the growth rate of GDP as dependent variable, while here we are using GVA in levels. See for instance Reinhart and Rogoff (2010) and Cecchetti et al. (2011).

Table 3: Estimation results: Maastricht parameters

	Model 3	Model 4	Model 1a	Model 2a
Capital stock	0.276***	0.265*	0.303***	0.285***
	(0.101)	(0.151)	(0.048)	(0.044)
Employment	0.507***	0.534***	0.475***	0.524***
	(0.069)	(0.192)	(0.049)	(0.046)
Manufacturing share	0.071***	0.072***	0.081***	0.083***
	(0.030)	(0.029)	(0.023)	(0.023)
Financial share	0.276***	0.269***	0.277***	0.276***
	(0.016)	(0.015)	(0.029)	(0.029)
Trans. share	−0.118*	−0.152**	−0.125**	−0.140**
	(0.064)	(0.063)	(0.060)	(0.060)
ULC	−0.010	–	−0.050	–
	(0.092)		(0.094)	
Tax on labour	–	−0.004*	–	−0.002
		(0.002)		(0.002)
Tax on capital	0.004***	0.006***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
EPL individual	−0.077***	−0.072***	−0.056***	−0.054***
	(0.016)	(0.016)	(0.016)	(0.015)
EPL temporary	0.016*	0.024***	0.027***	0.030***
	(0.003)	(0.009)	(0.009)	(0.009)
Temp. empl. share	−0.167***	−0.212***	−0.157**	−0.173***
	(0.041)	(0.044)	(0.040)	(0.045)
Temp. empl. youth share	0.164***	0.215***	0.127***	0.146***
	(0.043)	(0.045)	(0.040)	(0.048)
Trade union density	0.051***	0.066***	0.067***	0.070***
	(0.017)	(0.018)	(0.017)	(0.018)
Debt/GDP > 60%	−0.046**	−0.037*	–	–
	(0.021)	(0.021)		
Debt/GDP	–	–	1.098***	1.005***
			(0.204)	(0.226)
(Debt/GDP)^2	–	–	−0.143***	−0.130***
			(0.027)	(0.030)
Def/GDP > 3%	0.041**	0.039**	–	–
	(0.016)	(0.017)		
Budget balance	–	–	−0.005	−0.004
			(0.003)	(0.003)
Interest rate	0.005	0.006*	0.007**	0.008**
	(0.004)	(0.003)	(0.003)	(0.003)
Number of obs.	2885	2885	2885	2885

Notes. Bootstrap standard errors are in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

this is a different exercise than analysing the short term effects of fiscal consolidations, i.e. the relationship between the growth rate of GDP and fiscal consolidations.[18] We use the dataset developed by Devries et al. (2011), which focuses on discretionary changes in taxes and government spending primarily motivated by a desire to reduce the budget deficit, independently of economic conditions. Contemporaneous policy documents are

[18]The positive effect of fiscal consolidations on economic growth is usually referred to as the non-Kenyesian effect, or expansionary austerity. For some empirical reviews on the topic, see, for instance, Giudice et al. (2007),Guajardo et al. (2014), and Medvedev and Seth (2014).

examined to identify the rationale of the fiscal policy. As a result, the latter are unlikely to be systematically correlated with other developments affecting output, and are thus valid for estimation purpose (Devries et al., 2011). The variable is given by the size of the deficit reduction over GDP. Note that the side effect of such a selection criterion is that the variable takes mostly values equal to zero, since countries adopt such a kind of polices only in few years in the preiod considered. Therefore, given the structural nature of our model, the following results must be interpreted with caution.

Results are reported in Table 4. In Model 5 and 6 fiscal consolidations are represented by the variable *Total contractionary*, given by the size of the sum tax increases and expenditure cuts over GDP in one year. We also allow for the interaction between contractionary policies and the debt/GDP ratio, in order to assess whether the relationship with GVA changes at higher levels of debt. There is no evidence of neither a beneficial nor a detrimental effect on economic performance, since the coefficient is not statistically significant. The coefficients on the other variables confirm the findings of the previous sections, both in terms of significance and magnitude. In Model 7 and Model 8 we distinguish between contractionary.

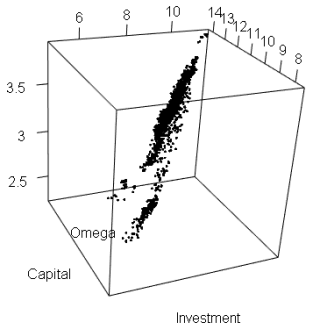
6 Specification test

The model we estimate rests on the assumptions about the proxy for the unobserved term. In particular, our stimates are consistent only if the investment proxy can be expressed as a monotonically increasing function of ω_{it}, capital stock and employment. As long as this is true, then $s_{it} = (\omega_{it}, k_{it}, l_{it})$ can be inverted with respect to ω_{it} and the procedure is valid. However, if this is not the case, then the approach is inappropriate. Therefore, in this section we perform the test proposed by Levinsohn and Petrin (2003). What we do is to visually examine $\omega_{it} = f^{-1}(s_{it}, k_{it}, l_{it})$ by plotting the smoothed function firstly against investment and capital, secondly against investment and employment. Our monotonicity assumption is satisfied if ω_{it} is increasing in both cases. The two top panels of Figure 1 show the plots of ω estimated using Model 1. In the left panel, the estimate of ω_{it} is on the vertical axis, while capital and investment are on the horizontal ones. In the right panel the same plot is shown, with employment in place of capital. In both cases the smoothed function is increasing in investment. The middle and the bottom panels plot the same relationship for for Model 2 and Model 0, the latter being the basic production function, i.e. considering only the inputs capital and employment (estimation results are in Table B1 in Appendix B). Also in this case, ω_{it} is increasing in investment. Therefore, we can conclude that monotonicity holds and that our theoretical assumptions are verified empirically.

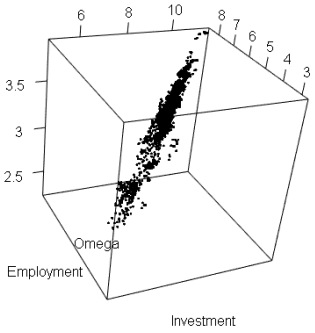
Table 4: Estimation results: Fiscal consolidations

	Model 5	Model 6	Model 7	Model 8
Capital stock	0.238**	0.302***	0.359***	0.368***
	(0.114)	(0.035)	(0.029)	(0.031)
Employment	0.557***	0.512***	0.510***	0.579***
	(0.152)	(0.046)	(0.006)	0.006)
Manufacturing share	0.078***	0.078***	0.129***	0.127***
	(0.016)	(0.022)	(0.016)	(0.015)
Financial share	0.257***	0.262***	0.338***	0.340***
	(0.030)	(0.028)	(0.024)	(0.024)
Trans. share	−0.124**	−0.166***	0.047	0.040
	(0.062)	(0.037)	(0.039)	(0.038)
ULC	0.030	–	−0.135	–
	(0.095)		(0.098)	
Tax on labour	–	−0.006***	–	−0.002
		(0.002)		(0.001)
Tax on capital	0.004***	0.005***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
EPL individual	−0.082***	−0.073***	−0.165***	−0.173***
	(0.016)	(0.014)	(0.012)	(0.011)
EPL temporary	0.006	0.017**	0.006	0.011*
	(0.009)	(0.009)	(0.004)	(0.004)
Temp. empl. share	−0.131***	−0.215***	0.099**	0.068
	(0.043)	(0.041)	(0.037)	(0.036)
Temp. empl. youth share	0.145***	0.232***	0.057	0.084*
	(0.043)	(0.041)	(0.036)	(0.034)
Trade union density	0.030*	0.052***	0.043***	0.042***
	(0.017)	(0.017)	(0.013)	(0.011)
Debt/GDP	0.039*	0.051***	0.033	0.053***
	(0.023)	(0.020)	(0.018)	(0.015)
Budget balance	−0.004	−0.003	−0.011***	−0.011***
	(0.003)	(0.003)	(0.002)	(0.002)
Total contractionary	0.098	0.100	–	–
	(0.096)	(0.092)		
Total contr.×Debt/GDP	−0.022	−0.023	–	–
	(0.022)	(0.021)		
Tax increase	–	–	0.275***	0.291***
			(0.047)	(0.047)
Tax increase×Debt/GDP	–	–	−0.063***	−0.067***
			(0.011)	(0.011)
Exp. cuts	–	–	0.052	0.003
			(0.067)	(0.063)
Exp. cuts×Debt/GDP	–	–	0.005	0.018
			(0.017)	(0.016)
Interest rate	0.006	0.007**	−0.010	−0.006
	(0.004)	(0.003)	(0.014)	(0.014)
Number of obs.	2885	2885	2885	2885

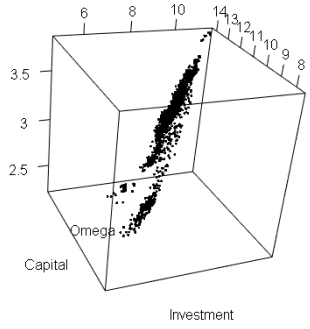
Notes. Bootstrap standard errors are in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.



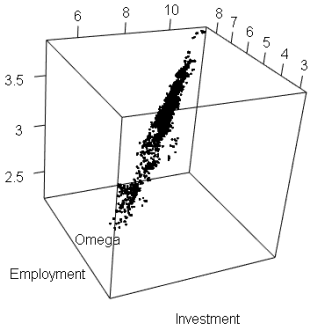
(s, k), Model 1



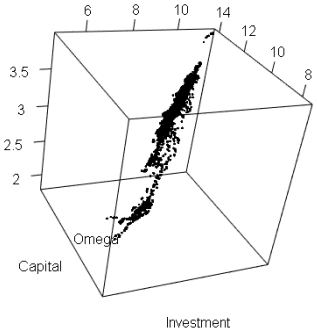
(s, l), Model 1



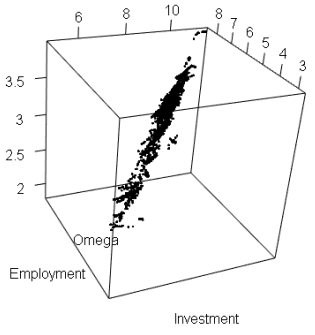
(s, k), Model 2



(s, l), Model 2



(s, k), Model 0



(s, l), Model 0

Figure 1: Monotonicity test for ω_{it}.

7 Conclusions

This study analysed the long-term relationship between indicators of labour market regulation, public finance parameters and GVA. We used the estimation procedure as proposed by the *structural literature*, augmenting the model with the additional variables of our interest (labour market protection and fiscal parameters). Therefore, we obtained consistent estimates of the parameters by approximating nonparametrically any unobserved factor influencing likely endogenous regressors. Moreover, less stringent assumptions were needed about endogeneity, differently from the GMM approach.

Some interesting implications for policy can be drawn. Indeed, we do not find univocal evidence of a detrimental effect of labour protection on the long term performance of regional economies. Even though a negative relationship is found for EPL (individual contracts), regulating hiring and firing for temporary workers is associated with higher GVA. Consistently, even though the share of temporary workers among the youth is positively related to economic performance, the share on the whole labour force negatively affects output. These results suggest that on the job security over the life of workers is associated with a higher long-run GVA, while *tout-court* deregulation is not a prerequisite for a better performance. For what concerns the fiscal indicators, the estimates show that larger debt/GDP and deficit/GDP ratios are associated with a higher output. This is especially true for deficit spending over the 3% threshold established by the convergence criteria. Such an evidence can be interpreted as a support for crowding in and expansionary effects of public expenditure, while debt is found to be detrimental for economic performance only when its share on GDP is really large.

As for future research, the relationship between the structure of the labour market and economic performance can be further investigated by considering additional features. Apprenticeship systems and active policies can facilitate the inclusion in the labour market of the unemployed and avoid the depletion of skills, increasing GVA per worker in the long run. Moreover, as the estimation procedure allows to specify several production functions, it would be interesting to investigate the results obtained with different specifications of the model.

Appendices

A Summary of variables definition

Variable	Definition
GVA	Gross Value Added at 2000 constant prices.
Employment	Number of workers.
Manufacturing share	Share of GVA in manufacturing on total GVA.
Financial serv. share	Share of GVA in financial market services on total GVA.
Business related serv. share	Share of GVA in business-related and other market services on total GVA.
ULC	Unit Labour Costs measure the average cost of labour per unit of output and are calculated as the ratio of total labour costs to real output. ULC should not be interpreted as a comprehensive measure of competitiveness, but as a reflection of cost competitiveness.
Implicit tax on labour	Sum of direct taxes, indirect taxes and compulsory actual social contributions paid by employees and employers on labour employed, divided by compensation of employees increased by wage bill and payroll taxes.
Implicit tax on capital	Ratio between revenue from all capital taxes, and all (in principle) potentially taxable capital and business income in the economy, such as net operating surplus of corporations and non-profit institutions, imputed rents of private households, net mixed income by self-employed, net interest, rents and dividends, insurance property income.
EPL	Indexes of employment protection concerning the legal procedures to fire workers, both individually and collectively. Each index is built using several item which aggregate to the indicator. An index for temporary contracts is also used. All indicators are expressed in scale 0-6.
Temporary employment share	Ratio of temporary employment for dependent employees of all ages.
Temporary employment share for the youth	Ratio of temporary employment for dependent employees in the age 15-24
Trade Union Density	Ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners.
Debt/GDP	Central government debt, divided by Gross Domestic Product.
Budget Balance	Central government deficit (<0) or surplus (>0), divided by Gross Domestic Product.
Fiscal consolidations	Fiscal actions primarily motivated by the desire to reduce the budget deficit and not by a response to prospective economic conditions. Policy makers' intentions and actions are taken from contemporaneous policy documents (Devries et al., 2011).

Interest rate	This is the nominal interest rate set by the monetary authority. Therefore we have 1 value for the Euro area plus several values for non Euro countries

Note: Definitions are taken from the respective data source of each variable.

B Estimation of the basic production function

We consider the basic production function with just capital stock and employment as inputs without additional explanatory variables (i.e. $Y_{it} = A_{it}K_{it}^{\beta_k}L_{it}^{\beta_l}$). Data availability allows us to include four countries which were excluded in the estimation of the augmented equation, i.e. Greece (GR), Ireland (IE), Romania (RO) and Slovenia (SI). Results are shown in Table B1 under Model 0. Differently from the augmented specifications, the elasticity of output with respect to capital is higher than with respect to employment, being the coefficients 0.639 and 0.371 respectively. The magnitude of the estimated coefficients is in line with Olley and Pakes (1996) results, while opposite findings are in Levinsohn and Petrin (2003) and Ackerberg et al. (2006). It is interesting to compare the results of this paper with those in Bresson et al. (2014) since they use macro data as we do, differently from the original strand of literature. Even though Bresson et al. (2014) do not follow the structural approach estimation, their non-Bayesian results are comparable to ours. In particular, they obtain higher elasticity of output with respect to capital when estimating the basic production function, while the coefficient for employment is higher when they augment their equation.

Table B1 also compares Model 0 with four different specifications, respectively OLS, Fixed Effect within estimator (FE) and two alternative GMM models. The first GMM model treats employment as endogenous, while the second one treat both capital and employment as endogenous. Excluding OLS, elasticity estimates for capital are slightly lower than in Model 0 and they are rather constants across specifications. Differently, estimated coefficients for employment are lower than in Model 0, ranging from 0.257 in the FE case to 0.090 for OLS. It is worth noting that the coefficient for capital is higher than the coefficient on employment in every model of Table B1.

Table B1: The basic production function

	Model 0	OLS	FE	GMM (1)	GMM (2)
Capital stock	0.639***	0.940***	0.585***	0.601***	0.616***
	(0.090)	(0.006)	(0.008)	(0.012)	(0.013)
Employment	0.371***	0.090***	0.257***	0.191***	0.176***
	(0.084)	(0.008)	(0.019)	(0.029)	(0.032)
Adjusted R^2	—	0.944	0.689	0.721	0.739
Number of obs.	3542	3542	3542	3542	3289

Notes. Bootstrap standard errors are in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Recall that estimates in Table B1 are obtained using a larger sample than for the augmented specifications. This can affect estimation results as long as economies composing the two samples are different in terms of structure of the economy, level of development

and so on. To investigate such an issue we firstly report samples composition in Table B2. In the augmented specification regional economies from some *peripheral* countries are dropped. In particular, Spanish (ES) and Polish (PL) regions are almost halved, while Greek (GR), Irish (IE), Romanian (RO) and Slovenian (SI) regions are completely wiped out. Hence, the smallest sample is somehow more representative of the richest regions of the EU and this may affect the estimation of the basic production function. Therefore, as a further check, we estimate Model 0, the FE, the OLS and the GMM models using the smallest subsample. Results are reported in Table B3. Excluding the OLS case, the elasticity of GVA with respect to employment increases for every estimator, while the coefficient on capital decreases. However, excluding the FE within estimator, the magnitude of the coefficient is still higher for capital. We may interpet this finding as the effect of including economies whose output structure is specialized in labour intensive activities. Therefore, the elasticity of GVA with respect to capital is still higher, while the coefficient on employment increases being GVA measured as the value of output net of intermediate consumption.

Table B2: Samples composition

	AT	BE	CZ	DE	DK	ES	FI	FR	GR	HU
BASIC	126	154	112	546	70	266	70	308	182	98
AUGM.	126	154	112	546	70	171	60	308	0	56
	IE	IT	NL	PL	PT	RO	SE	SI	SK	UK
BASIC	28	294	168	224	70	112	112	28	56	518
AUGM	0	294	168	128	70	0	80	0	24	518

Table B3: The basic model with the smallest subset

	Model 0	OLS	FE	GMM (1)	GMM (2)
Capital stock	0.521^{***}	0.975^{***}	0.463^{***}	0.524^{***}	0.514^{***}
	(0.023)	(0.010)	(0.010)	(0.015)	(0.015)
Employment	0.494^{***}	0.048^{**}	0.483^{***}	0.327^{***}	0.349^{***}
	(0.023)	(0.011)	(0.025)	(0.041)	(0.041)
Adjusted R^2	0.946	0.721	0.753	0.754	
Number of obs.	2919	2919	2691	2691	2919

Notes. Bootstrap standard errors are in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

C Robustness check

The model allows to control for any unobserved factor (or shock) that may cause simultaneity or endogeneity issues. The scope of the procedure is to approximate ω_{it} in order to get consistent estimates of the coefficients. Here, we compare our results of Model 1 and Model 2 with the Fixed Effect within estimator. Results for the OLS estimator are included as a reference. Moreover two alternative GMM models, where endogeneity for

employment and capital is taken into account, have been also estimated. However, results are not reported here as they are not conclusive.

Table C1: Robustness check for the augmented model

	Model 1	Model 2	OLS 1	OLS 2	FE 1	FE 2
Capital stock	0.240^{***}	0.321^{***}	0.651^{***}	0.705^{***}	0.273^{***}	0.298^{***}
	(0.050)	(0.095)	(0.011)	(0.010)	(0.011)	(0.010)
Employment	0.555^{***}	0.473^{***}	0.320^{***}	0.256^{***}	0.496^{***}	0.504^{***}
	(0.044)	(0.097)	(0.011)	(0.009)	(0.020)	(0.020)
Manufacturing share	0.079^{***}	0.078^{***}	0.007	0.019^{**}	-0.094^{***}	-0.101^{***}
	(0.026)	(0.022)	(0.010)	(0.008)	(0.011)	(0.011)
Financial share	0.254^{***}	0.260^{***}	0.331^{***}	0.327^{***}	0.117^{***}	0.106^{***}
	(0.031)	(0.028)	(0.013)	(0.011)	(0.010)	(0.010)
Trans. share	-0.122^{*}	-0.165^{*}	-0.036	-0.209^{***}	-0.110^{***}	-0.121^{***}
	(0.065)	(0.059)	(0.025)	(0.022)	(0.021)	(0.021)
ULC	0.032	—	0.409^{***}	—	0.093^{***}	—
	(0.098)	—	(0.041)	—	(0.018)	—
Tax on labour	—	-0.007^{***}	—	-0.025^{***}	—	-0.001^{*}
	—	(0.002)	—	(0.001)	—	(0.001)
Tax on capital	0.004^{***}	0.004^{***}	0.012^{***}	0.010^{***}	-0.003^{***}	-0.002^{***}
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
EPL individual	-0.084^{***}	-0.076^{***}	-0.052^{***}	-0.048^{***}	0.035^{***}	0.027^{***}
	(0.017)	(0.015)	(0.006)	(0.005)	(0.010)	(0.010)
EPL temporary	0.005	0.016^{*}	0.045^{***}	0.078^{***}	0.040^{***}	0.042^{***}
	(0.009)	(0.008)	(0.004)	(0.003)	(0.002)	(0.002)
Temp. empl. share	-0.138^{***}	-0.221^{***}	-0.012	-0.372^{***}	0.087^{***}	0.065^{***}
	(0.042)	(0.041)	(0.018)	(0.017)	(0.011)	(0.010)
Temp. empl. youth share	0.151^{***}	0.239^{***}	0.088^{***}	0.428^{***}	-0.027^{**}	-0.004
	(0.043)	(0.042)	(0.018)	(0.015)	(0.011)	(0.011)
Trade Union density	0.031^{*}	0.051^{***}	0.107^{***}	0.156^{***}	-0.199^{***}	-0.231^{***}
	(0.017)	(0.018)	(0.007)	(0.006)	(0.011)	(0.009)
Debt/GDP	0.031		0.042^{***}	0.048^{***}	-0.028^{***}	-0.038^{***}
	(0.021)	(0.019)	(0.009)	(0.007)	(0.005)	(0.005)
Budget Balance	-0.005	-0.003	-0.008^{***}	-0.001	0.003^{***}	0.003^{***}
	(0.004)	(0.003)	(0.002)	(0.001)	(0.000)	(0.000)
Interest rate	0.006	0.007^{**}	-0.002	0.003^{*}	-0.001^{**}	-0.002^{***}
	(0.004)	(0.003)	(0.002)	(0.002)	(0.000)	(0.000)
(Intercept)	—	—	0.385^{***}	0.116	—	—
	—	—	(0.110)	(0.087)	—	—
R^2	—	—	0.974	0.981	0.884	0.883
Adj. R^2	—	—	0.973	0.980	0.810	0.809
Num. obs.	2885	2885	2885	2885	2885	2885

Notes. Bootstrap standard errors are in parentheses. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table C1 reports the results for the two augmented models. The OLS results report coefficients on capital which are more than twice the magnitude in our models and the FE specifications. Even though the elasticities with respect to capital and employment are similar, comparing the FE models and our structural equations reveal different findings for the additional regressors than in Model 1 and Model 2. In particular, the FE estimations suggest that temporary employment is associated with higher GVA, while the opposite holds for the share of temporary contracts among the youth. Also, employment protection is found to be positively related to GVA, while Trade Unions membership has a negatively

coefficient. For what concerns the fiscal parameters, the FE models show a negative relationship between Debt ratios and GVA, while having a positive budget balance (i.e. a surplus) is associated with higher economic output, even though the magnitude is not economically signifiant. A similar reasoning applies to the tax on capital and the interest rate. As remarked by Levinsohn and Petrin (2003), a within estimator eliminates *between* variation which can be relevant for obtaining consistent estimates of the coefficients. This is likely to affect the results.

References

Ackerberg, D., K. Caves, and G. Frazer (2006): "Structural identification of production functions," *Small Business Economics*, 30, 85–100.

Barba, A. (2001): "Rethinking expansionary fiscal retrenchments," *Contributions to political economy*, 20, 57–86.

Barro, R. J. (1991): "Economic Growth in a Cross Section of Countries," *Quarterly Journal of Economics*, 106, 407–443.

Bassanini, A. and R. Duval (2007): "The determinants of unemployment across OECD countries," *OECD Economic Studies*, 2006, 7–86.

Blanchard, O. and J. Wolfers (2000): "The role of shocks and institutions in the rise of European unemployment: the aggregate evidence," *The Economic Journal*, 110, 1–33.

Blinder, A. S. (1997): "Is there a core of practical macroeconomics that we should all believe?" *The American Economic Review*, 240–243.

Bresson, G., J.-M. Etienne, and P. A. Mohnen (2014): *How Important is Innovation?: A Bayesian Factor-augmented Productivity Model on Panel Data*, Maastricht Economic and social Research Institute on Innovation and Technology (UNU-MERIT) & Maastricht Graduate School of Governance (MGSoG).

Caselli, F., G. Esquivel, and F. Lefort (1996): "Reopening the convergence debate: a new look at cross-country growth empirics," *Journal of economic growth*, 1, 363–389.

Cazes, S. and A. Nesporova (2003): "Employment protection legislation (EPL) and its effects on labour market performance," in *ILO Conference Paper*.

Cecchetti, S., M. Mohanty, and F. Zampolli (2011): "Achieving growth amid fiscal imbalances: the real effects of debt," in *Economic Symposium Conference Proceedings. Federal Reserve Bank of Kansas City*, 145–196.

Cochrane, J. H. (2011): "Understanding policy in the great recession: Some unpleasant fiscal arithmetic," *European Economic Review*, 55, 2–30.

Codogno, L., C. Favero, and A. Missale (2003): "Yield spreads on EMU government bonds," *Economic Policy*, 18, 503–532.

Del Gatto, M., A. Di Liberto, and C. Petraglia (2011): "Measuring productivity," *Journal of Economic Surveys*, 25, 952–1008.

Devries, P., J. Guajardo, D. Leigh, and A. Pescatori (2011): "A new action-based dataset of fiscal consolidation," *IMF Working Papers*, 1–90.

Durlauf, S. N., P. A. Johnson, and J. R. Temple (2005): "Growth econometrics," *Handbook of economic growth*, 1, 555–677.

Durlauf, S. N. and D. T. Quah (1999): "The new empirics of economic growth," *Handbook of macroeconomics*, 1, 235–308.

Easterly, W. and R. Levine (2001): "What have we learned from a decade of empirical research on growth? It's Not Factor Accumulation: Stylized Facts and Growth Models," *The world bank economic review*, 15, 177–219.

Égert, B. (2015): "Public debt, economic growth and nonlinear effects: myth or reality?" *Journal of Macroeconomics*, 43, 226–238.

Giudice, G., A. Turrini, et al. (2007): "Non-Keynesian fiscal adjustments? A close look at expansionary fiscal consolidations in the EU," *Open Economies Review*, 18, 613–630.

Griliches, Z. and J. Mairesse (1995): "Production functions: the search for identification," .

Guajardo, J., D. Leigh, and A. Pescatori (2014): "Expansionary Austerity? International Evidence," *Journal of the European Economic Association*, 12, 949–968.

Herndon, T., M. Ash, and R. Pollin (2014): "Does high public debt consistently stifle economic growth? A critique of Reinhart and Rogoff," *Cambridge Journal of Economics*, 38, 257–279.

Levinsohn, J. and A. Petrin (2003): "Estimating production functions using inputs to control for unobservables," *The Review of Economic Studies*, 70, 317–341.

Mankiw, N. G., D. Romer, and D. N. Weil (1992): "A contribution to the empirics of economic growth," *Quarterly Journal of Economics*, 107, 407–448.

Martino, R. (2014): "Convergence and growth. Labour productivity dynamics in the European Union," *Working Papers of the Bureau d'Economie Théorique et Appliquée, UDS, Strasbourg*, 18.

Medvedev, D. and S. Seth (2014): "Austerity, Growth, and Public Policy," in *Global Cooperation Among G20 Countries*, Springer, 281–285.

OECD (2013): "OECD Employment Outlook," Tech. rep., OECD, Paris.

O'Higgins, N. (2012): "This Time It's Different. Youth Labour Markets during The Great Recession," *Comparative Economic Studies*, 54, 395–412.

Olley, G. S. and A. Pakes (1996): "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica*, 64, 1263–1297.

OMahony, M., A. Rincón-Aznar, and C. Robinson (2010): "Productivity Growth in Europe and the US: a Sectoral Study," *Review of Economics and Institutions*, 1.

Panizza, U. and A. F. Presbitero (2014): "Public debt and economic growth: is there a causal effect?" *Journal of Macroeconomics*, 41, 21–41.

Pasinetti, L. L. (1998): "The myth (or folly) of the 3% deficit/GDP Maastricht parameter," *Cambridge journal of Economics*, 22, 103–116.

Pescatori, A., D. Sandri, and J. Simon (2014): *Debt and growth: is there a magic threshold?*, 14-34, International Monetary Fund.

Petrin, A., B. P. Poi, and J. Levinsohn (2004): "Production function estimation in Stata using inputs to control for unobservables," *Stata journal*, 4, 113–123.

Racine, J. S. (2008): *Nonparametric econometrics: A primer*, Now Publishers Inc.

Reinhart, C. M. and K. S. Rogoff (2010): "Growth in a Time of Debt," *American Economic Review*, 100, 573–578.

Robinson, P. M. (1988): "Root-N-consistent semiparametric regression," *Econometrica*, 56, 931–954.

Rodrik, D. (2013): "Unconditional Convergence in Manufacturing," *Quarterly Journal of Economics*, 128.

Silverman, B. W. (1986): *Density estimation for statistics and data analysis*, Chapman and Hall.

Solow, R. M. (1956): "A contribution to the theory of economic growth," *Quarterly Journal of Economics*, 70, 65–94.

Soros, G. (2009): *The Crash of 2008 and What it Means: The New Paradigm for Financial Markets*, Public Affairs.

Stiglitz, J. E. (1998): *More instruments and broader goals: moving toward the post-Washington consensus*, UNU/WIDER Helsinki.

Van Ark, B., M. O'Mahony, and M. P. Timmer (2008): "The productivity gap between Europe and the United States: trends and causes," *The Journal of Economic Perspectives*, 22, 25–44.

Van Beveren, I. (2012): "Total factor productivity estimation: A practical review," *Journal of Economic Surveys*, 26, 98–128.

Varoufakis, Y. (2013): *The Global Minotaur: America, Europe and the Future of the Global Economy*, Zed Books.

Williamson, J. (1990): "What Washington means by policy reform," *Latin American adjustment: How much has happened*, 7, 7–20.

Wooldridge, J. M. (2001): "Applications of generalized method of moments estimation," *Journal of Economic Perspectives*, 15, 87–100.

——— (2009): "On estimating firm-level production functions using proxy variables to control for unobservables," *Economics Letters*, 104, 112–114.

——— (2010): *Econometric analysis of cross section and panel data*, MIT press.

Yasar, M., R. Raciborski, B. Poi, et al. (2008): "Production function estimation in Stata using the Olley and Pakes method," *Stata Journal*, 8, 221.

Discussion Papers
Collana del Dipartimento di Economia e Management, Università di Pisa (ISSN: 2039-1854)

Email della redazione: luciano.fanti@unipi.it