Economic Determinants and Analysis of the European Union Wood Industry SMEs Employment

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Wood-based industries are an important part of the European Union (EU) manufacturing sector because their growth can help in achieving EU's industrial policy goal of raising manufacturing's gross domestic product (GDP) to 20% by 2020. In this paper, special emphasis is placed on the influence of macro-economic factors on small and medium enterprises (SMEs) employment in the wood industry. The research objective was to test whether traditional macroeconomic indicators of economic growth are significant determinates of SMEs employment dynamics. For estimation of employment dynamics, a two-step Arellano-Bover/Blundell-Bond (a system generalized method of moments) estimator with robust standard errors was used. The model contained the following independent variables: real GDP growth rate; industrial production of wood processing industry; the number of wood processing enterprises; and exporting of manufactured goods of wood processing. The findings confirmed that the increase in GDP growth rate, the industrial production of wood processing, and exporting of manufactured goods of wood processing had statistically significant and positive impacts on SMEs employment. It was also found that the existence of a high number of enterprises had a positive impact on employment.

Keywords: Wood industry; Small and medium enterprises (SMEs); Panel analysis; European Union (EU)

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INTRODUCTION

Europe's 2020 growth strategy (EC 2010), which started in 2010 with the priorities of delivering smart, sustainable, and inclusive growth, urged national economies' policy makers and industry leaders to take action to launch economic growth and restore job creation. Consequently, the economic performance of the EU has improved in 2016 relative to previous years. However, growth rates remain low, and it will take time to reduce high unemployment (that has been falling but remains at a historically high level) and combat low production levels in some member states (EC 2015a). In addition, EU exports have been growing above the world trade index since the crisis (EC 2015b). According to the European commission (EC) (2016), in 2015 at the member state level, employment growth was strongly related to growth in the number of enterprises. This means that a 1% increase in the number of enterprises translated into a 0.8% increase in employment on average overall EU member countries. Additionally, all member states either experienced stable employment or saw an increase in employment between 2014 and 2015, with growth ranging from 0.1% in France up to 4.8% in Malta.

The term "SMEs" or small and medium enterprises has many different definitions, but according to the EC (2015c), SMEs are defined as enterprises having less than 250 employees and an annual turnover of up to 50 million Euro (EUR) or a balance sheet total of no more than EUR 43 million. However, in determining whether or not an enterprise is an SME, the enterprise's size (employees, turnover, and balance sheet total) is not the only factor that should be taken into account, because an enterprise can be very small in these terms but if it has access to additional resources (*e.g.*, because it is owned by, linked to, or partnered with a larger enterprise) it might not be eligible for SME status (EC 2015c). These definitions are important when assessing which enterprises may benefit from EU funding programmes aimed at promoting SMEs and in relation to certain policies such as SME-specific competition rules (Eurostat 2015). According to recent available data, in 2015, SMEs accounted for 99.8% (a little under 23 million SMEs) of all enterprises in the non-financial business sector in the European union (EU28) member states (NFB EU 28), generated 3.9 trillion EUR in value added (58% of total NFB EU 28), and employed 90 million people (67% of NFB EU 28) (EC 2016). Furthermore, EU28 SMEs finally appear to have escaped the fallout of the economic crisis of late 2008 and 2009, experiencing 3.8% growth in value added in 2014 and 5.7% growth in value added in 2015, respectively. Additionally, for the first time since the recession (it was a period from 2008 to 2013), SMEs' employment grew by 1.1% in 2014 and by 1.5% in 2015. According to the EC (2016), SMEs had a good year in 2015 in almost all member states, achieving increases in value added in all but two member states (*e.g.*, Estonia and Greece), and increases in employment in 27 of the 28 member states (Finland experienced a relatively small decrease in employment at -0.3%). Additionally, in the non-financial business sector, one of the five most important SME sectors in terms of value added and employment in the EU28 was the manufacturing sector, contributing 44% of total value added and 59% of the total number of employees (EC 2016). However, 1.7 million jobs still need to be recovered in the EU manufacturing sector to restore the sector to its 2009 status (EC 2015b). From a sectorial perspective, after several difficult years at the start of the century, EU manufacturing output expanded rapidly from 2003 to 2008, when it peaked (EC 2015b). It then fell by almost 20% in 2008 and 2009 as the full force of the recession required manufacturers to close down or downsize to survive (EC 2015b). From its lowest point in 2009, manufacturing has recovered more than half the output lost in 2008 and 2009 but remains lower than pre-recession peak production in most member states (EC 2015b).

The SMEs play a vital role in the global economy and are considered the backbone of industrial development in the EU and all of its 28 country members.

In the EU, manufacturing subsectors are very diverse, combining activities with relatively low apparent labor productivity and average personnel costs. Some of these subsectors are the manufacturing of wood, the manufacturing of products of wood and cork, and furniture production (Eurostat 2016). Further, the EU's forest-based industries are an important part of manufacturing, and their growth helps achieve the goals of the EU's industrial policy, including the goal of raising manufacturing's contribution to the GDP in the EU from 15.3% in 2012 to 20% by 2020, referred to as the "reindustrialization of Europe" (for more details about the diversity of the SMEs wood processing industry (NACE C16) sector within EU member states regarding information on number of employed people; number of enterprises; and industrial production in 2008 and in 2016, see Figs. 1 and 2 in Appendix). Through their value chains, the forest-based industries extend upstream into an increasing EU forest resource and downstream into an array of industrial and consumer applications for their products meaning that wood, as a natural, renewable, re-usable and recyclable material, is having enormous potential to contribute positively to a low-carbon economy, such as to provide a high standard of living from lower levels of energy input and resource consumption (Eurostat 2017). Also, the use of wood may aid in the development of a sustainable economy (Klarić *et al.* 2016). The most important sub-sector of the forest-based industries in Europe is the woodworking industry. The woodworking industry includes sawmilling (15%), wood construction products (37%), and furniture manufacturing (48%), and had a turnover of over EUR 180 billion and 2.4 million employees across 365,000 SMEs in 2009 (Forest Based Sector Technology Platform 2013).

The EC (2016) noted that on average the EU28 SME employment growth by enterprise size of wood processing industry sector, which according to statistical classification of economic activities in the European community (NACE Rev. 2) presents the section of the manufacture of wood and of products of wood and cork (NACE C16) was 2.3% between 2013 and 2015. In 2015 the share of NACE C16 SME employment in the total SME employment was 1%. Additionally, the export intensity level of wood processing industry sector (NACE C16) was low, meaning that export over total sales was between 5% and 10%. According to the most recent data from the EC (2016), at the member state level, the low-tech (or traditional) sector, which according to Maskell (1998) and Shefer and Frenkel (2005) includes the wood industry sector, has had a great deal of employment growth. The highest rate of low-tech SME employment growth (6%) was achieved in Bulgaria and Greece, followed by Estonia (5%) and Ireland (5%). However, declines in the employment of low-tech SMEs were noted in Belgium (-3%), Croatia (-2%), and France (-2%). Low technology sectors have the lowest innovation expenditure and tend to have many job losses in Europe. In contrast, high technology sectors combine greater innovative efforts with the possibility of employment growth. In contrast, Barčić *et al.* (2016) noted that the management activities of wood industry companies play an important role in human resource innovation.

The aim of this work was to present the impact of the traditional macroeconomic indicators of economic growth (real GDP growth rate, industrial production of wood processing industry sector, the number of enterprises of wood processing industry sector, and exporting of manufactured goods of wood processing industry sector) on SMEs employment dynamics of European Union wood processing industry.

THEORETICAL BACKGROUND – AN EMPLOYMENT AS A DEPENDENT VARIABLE

Table 1 summarizes various research papers on employment in EU member states regarding manufacturing industries. Some studies regarding employment in the United States manufacturing industries were additionally analyzed. For example, Greenaway *et al.* (1999) found that increases in trade volume caused reductions in the level of derived labor demand in 167 manufacturing industries in the UK from the 1970s to the 1990s. Additionally, Sapir and Schumacher (1985) showed that a balanced expansion of European Community trade with other OECD countries would have only minor effects on employment. They found a small increase in employment in Italy, while a small decline in employment was identified in Germany, the Netherlands, and Belgium. Additionally, no changes were found in the UK and France. Also, Greenaway *et al.* (1999) highlighted that an OECD study, conducted in 1992, has shown that trade between 1970 and 1985 was a net source of employment gain in Denmark, France, Germany, and the Netherlands, but a source of employment loss in the UK. For France, Messerlin (1995) observed a modest and mostly positive effect on employment from foreign trade between 1980 and 1992 (+ 0.8% per year on average), though the effect was negative during the economic expansion from 1988 to 1991.

Table 1. Literature Review of the Determinants of Employment Performance

Authors	Region/Country	Sample/ Industry/ Period	Independent variables
Sapir and Sumacher (1985) and Greenaway *et al.* (1999)	United Kingdom	Hundred-sixty-seven companies /manufacturing (1971-1991)	Trade volumes – export and import
Saget (2000)	Bulgaria, Czech Republic, Hungary, Poland, Russia, Slovakia, Romania, Slovenia, Latvia, Estonia, and Ukraine	Industry (1990 – 1999)	GDP growth
Acs and Armington (2004)	US	Manufacturing industry (1991 – 1996)	Company establishment
Möller (2010)	Germany	Manufacturing industries (1975 – 2009)	Real GDP growth
Brownlees (2012)	US	Manufacturing industry (2005-2010)	Industrial production

Typically, the cyclical component of employment changes followed that of real GDP growth with a lag (Tregenna 2008). In addition, the cyclical and the trend components of real GDP and employment growth moved together very closely. Saget (2000) found that, from 1990 to 1999, employment positively responded to GDP growth in several European countries (*e.g*., Hungary, Poland, Slovenia, the Czech Republic, Estonia, Latvia, Slovakia, and Russia). In contrast, GDP growth has not been estimated to be a significant determinant of employment in Bulgaria and Ukraine. However, in Romania, the GDP growth was estimated to have a small, negative impact on employment. Boeri and Garibaldi (2006) showed that in the aftermath of 1996, recessions led to significant job destruction, and subsequent expansions in the GDP did not lead to statistically significant job creation in the ten Central and Eastern European countries (CEEC). Izyumov and Vahaly (2002), found a low Okun's coefficient of -0.526 for the effect of GDP growth on the change in unemployment in the ten CEECs in the post-recession era of 1995 to 2000. By comparison, the coefficient for the EU15 was -0.799. Möller (2010) established that the real GDP and the employment rate of the manufacturing industry in Germany from 1975 to 2008 were positively correlated. Additionally, the correlation coefficients for the trend component and the cyclical component were 0.47 and 0.74, respectively. In addition, Möller (2010) noted that in 2008, Spain experienced a below-average decline in real GDP but had a tremendous increase (18%) in the unemployment rate. Germany exhibited the other extreme in that the German unemployment rate showed almost no reaction in 2008 despite the decline in real GDP.

Another of the macroeconomic determinants that usually has an impact on the number of employees in an industry (or a country as a whole) is industrial production.

According to Boyd *et al*. (2005), rising unemployment is often followed by a much greater reduction in the index of industrial production. Brownlees and Gallo (2009), based on US manufacturing industry data from 2005 to 2009, offered a model that explained when an economy is in distress, the financial system will stop functioning properly, impairing industrial production. Furthermore, impaired industrial production will promote other consequences such as increased unemployment.

Acs and Armington (2004), in examining the US manufacturing industry from 1991 to 1996, noted that new firms play an important role in job creation. They also stated that both new firms and new secondary-location establishments (firms) contribute new employment opportunities, and these patterns are consistent across sectors and form types. This was in a line with Bhide (2000), who noted that the majority of new jobs are created by a relatively small number of rapidly growing establishments. Additionally, numerous academic studies by Reynolds *et al.* (1995), Feldman (1996), and Cooke and Wills (1999) have argued that new and small enterprises function as the locomotive of employment creation.

OBJECTIVE AND HYPOTHESIS

The research objective was to test weather traditional macroeconomic indicators of economic growth (real GDP growth rate, industrial production of wood processing industry, the number of wood processing enterprises, and exporting of manufactured of wood processing) are significant determinates of SMEs employment dynamics. Based on the previously cited literature, the relationship between four traditional macroeconomic indicators of economic growth and the SME's employment were hypothesized as follows:

H_1: There is a positive impact of industrial production on SMEs employment;

H_2: There is a positive impact of real GDP growth rate on SMEs employment;

H_3: There is a positive impact of number of enterprises on SMEs employment;

H_4: There is a positive impact of export of manufactured goods on SMEs employment.

EXPERIMENTAL

Materials

Data selection and description

Macroeconomic variables for which yearly time series data for EU countries were available from the Eurostat and UNECE statistical databases by applying dynamic panel data analysis were used in the study for the 2008 to 2016 period. Hence, the analysis involved 23 of the 28 EU member states (Cyprus, Luxembourg, Malta, Slovenia, and Slovakia were exempt due to the lack of disaggregated sectorial data) during and following the period of economic recession.

Wood processing industry according to statistical classification of economic activities in the European community (NACE Rev. 2) presents the manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (NACE C16).

The dependent variable was the number of persons employed in SMEs in the wood processing industry sector (later in text NACE C16) in the 23 EU countries. The values were taken from the Eurostat database (SME performance review 2015/2016) over the period from 2008 to 2016 and transformed in 2010=100 indices (meaning that the year 2010 is set on 100 and presents a basic index). Namely, the year 2010 was taken as a base year, because Eurostat database also use this year as a bases.

The first independent variable, industrial production of NACE C16, was expressed as percentage change of volume index production to the previous year.

The second independent variable, the real GDP growth rate, was expressed as percentage change of GDP at market prices in percentage to the previous year.
The data of these two variables were also captured and obtained from Eurostat data base.

The third independent variable, the number of SMEs in NACE C16, was expressed in total number of SMEs enterprises of wood processing industry sector (NACE C 16) and was also taken from the Eurostat database (SME performance review 2015/2016).

The last, fourth independent variable was export of manufactured goods of the sub-group 63 (Code 63), which according to Standard International Trade Classification (SITC, Rev. 3) refers to Cork, and wood manufactures (excluding furniture). The data for 23 EU member states were originally obtained using the United Nations conference on trade and development (UNCTAD) data base, managed by the United Nations, which classifies products according to the SITC, Rev 3 into *Manufactured good* (SITC 5 to 8 less 667 and 68) which include sub-group 63. Data were originally expressed in thousands of United States (US) dollars but were transformed into indices (2010=100).

Variables SMEs employment in NACE C16 and export of manufactured goods of Code 63 were logarithmically transformed.

The lagged value (one-period lag) of the dependent variable was used as an instrumental variable. Finally, an unbalanced panel data was analyzed, which refers to the fact that there is no available data for all countries and for all years and variables of interest. Table 2 provides a description of the variables and their sources.

Table 2. Data Description and Sources

Variable	Data Description	Source
SMEs employment in NACE C16	Number of people employed in NACE C16 SMEs; data transformed to indices; (2010=100)	EUROSTAT database
Industrial production in NACE C16	Volume index of production; percentage change on previous year	EUROSTAT database
Real GDP growth rate	Percentage change to previous year	EUROSTAT database
Number of NACE C16 enterprises	Number of enterprises	EUROSTAT database
Export of manufactured goods of Code 63	Export in US dollars; data transformed to indices (2010=100)	UNCTAD statistics

Methods

Employment model

Dynamic panel data models estimated using the generalized method of moments (GMM) have become an important instrument in macro econometric analysis with a large number of individual units and a relatively short time series. For estimation, a two-step Arellano-Bover/Blundell-Bond (a system GMM) estimator with robust standard errors was used. The estimator was developed by Arellano and Bover (1995) and Blundell and Bond (1998) and is an enhanced version of the Arellano and Bond (1991) GMM estimator. It was the most convenient choice due to the characteristics of the data (according to Roodman 2009). Arellano and Bond sought to solve the problem of weak instruments by estimating a system of equations. The equation in the first difference, instrumented by a lagged value of regressors in level, is estimated simultaneously with the equation in level, and is symmetrically instrumented by the regressors in the first difference. To check the robustness of estimates, the authors implemented the Arellano and Bover (1995) estimator. More precisely, two-step estimators use a weighting matrix that makes the two-step GMM asymptotically efficient (Roodman 2009). Historically, researchers often reported one-step results in addition to two-step results because of the downward bias in the computed standard errors in two-step results (Roodman 2009). However, when the Windmeijer (2005) correction became available, the problem was greatly reduced (Roodman 2009).

To investigate the determinants of SMEs employment in wood processing industry, the authors used the following model,

$$y_{it} = \beta_0 + \eta y_{it\ 1} + \sum_{k=1}^{K} \beta_k x_{kit} + u_{it} \tag{1}$$

where y_{it} is employment in SMEs in wood processing industry, $y_{it\ 1}$ is the lagged dependent variable, *k = 1, 2, 3, ..., K* is the number of independent variables, and *i = 1, 2, 3, …, N* is the number of different individuals or panels in the sample observed (23 EU members) at *t = 1, 2, 3, …, T* time points. Finally, x_{kit} is any of the explanatory or exogenous variables whose lags are included in the model (real GDP growth rate, industrial production in of wood processing industry, export of manufactured goods in of wood processing industry, and number of enterprises in of wood processing industry), and u_{it} is the error term.

Statistical analyses were performed using Microsoft Excel (Microsoft EMEA, Issy-les-Moulinex, France) and by using Stata 12 (Stata Corp LLC, Texas, USA).

RESULTS AND DISCUSSION

Table 2 shows the results of the estimated impact of the determinants on the employment performance of SMEs in the wood processing industry in the 23 EU member states and the diagnostic tests of the dynamic panel data analysis. In addition to the obtained coefficients, the results of the diagnostic tests (*e.g.*, Arellano-Bond tests for autocorrelation of first and second order) are shown. There was no autocorrelation between the residuals of the first (AR1) and second (AR2) order in either system GMM model, meaning that the model was valid.

The validity of the instruments selected for the evaluation of the model was tested with a Sargan test. The Sargan test for over-identifying restrictions in both models did not reject the null hypothesis, which indicated that the instrumental variables were valid. In other words, the test suggested that the models were well specified. Estimation results for the employment of SMEs in the of wood processing industry equation were in line with expectations. Further, considering the empirical results presented in Table 2, it was evident that all of the independent variables had a significant impact on sectoral employment, as all variables were statistically significant at the $\alpha = 0.05$ significance level (excluding export of manufactured goods in model 2 as it was significant at the $\alpha = 0.1$ significance level). More specifically, the real GDP growth rate had a significant positive impact on the employment of SMEs in the wood processing industry, meaning that a higher GDP growth led to higher SMEs employment in the wood processing sector. This was in line with results reported by Möller (2010), who noted that a 1% change in the cyclical component of GDP entailed a change in the employment of approximately the same magnitude.

The higher level of industrial production in the wood processing sector, and the growth in the number of enterprises also had statistically significant, positive effects on the SMEs' employment in the wood processing industry. In addition, the estimation results showed that a 1% growth in the level of the wood processing sector's industrial production would stimulate SMEs' employment in the wood processing sector for 0.243%. Further, a 1% growth in the number of wood sector enterprises would stimulate the SMEs' employment in the sector for 0.138%.

Table 2. GMM Models for Estimation of EU's SMEs Employment in NACE C16

Variable	System GMM - Model 1		System GMM -Model 2	
	Coefficients	p	Coefficients	p
Lagged dependent variable	0.791	0.0001***	0.674	0.0001***
Real GDP growth rate/ Export of manufactured goods Code 63	0.008	0.008***	0.55	0.083*
Industrial production (NACE C 16)	0.243	0.011**	0.426	0.0001***
Number of enterprises (NACE C 16)	0.138	0.0001***	0.175	0.0001***
Constant term	-0.179	0.734	-1.147	0.132
Sargan test of over identifying restrictions (p-value)	0.5177		0.3207	
Arellano-bond test for ar1 in differences (p-value)	0.1383		0.1653	
Arellano-bond test for ar2 in differences (p-value)	0.4461		0.3342	
Number of observations	175		161	
Number of groups	23		23	
Number of instruments	18		16	

Note: (1) ***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively; (2) A two-step system GMM estimator with robust standard errors was applied; (3) The Sargan test is a Sargan-Hansen test of over identifying restrictions and the null hypothesis states that the instruments used are not correlated with the residuals; (4) AR1 and AR2 are tests for first and second-order serial correlation in the first-differenced residuals. The null hypothesis for the second-order serial correlation test states that the errors in the first-differenced regression do not show second-order serial correlation.

To check the robustness of the dynamic model, the GDP growth rate variable was replaced with the export of manufactured goods (Model 2). As shown in Table 2, both models had the same important result. More concretely, boosting manufacturing exports was positively and significantly related to the dependent variable and was also a driver of SMEs' employment in the wood industry, meaning a 1% increase in the exportation of manufactured goods would stimulate SMEs' employment in the wood industry approximately 0.055%. Hence, the authors' results confirmed the significance of macroeconomic performance and emphasized the need for a stronger focus on employment and SMEs performance.

Second, this study was the first to use a panel analysis (a dynamic panel GMM system estimation) for the purpose of analyzing the determinants of SMEs' employment in the wood industry in EU member countries. For example, Basarac Sertić *et al.* (2015) employed a panel data analysis to analyze the determinants (foreign demand, real effective exchange rate, industrial production, labor cost, and domestic demand) of EU manufacturing industry exports. Furthermore, Lachenmaier and Rottmann (2011) used a dynamic panel GMM system estimation to analyze the effect of innovation on employment at the firm level in German manufacturing industry companies, which was found positive. In a forest-based sector, Sauquet *et al.* (2011) applied a system GMM estimator to identify the robust parameters of a panel data analysis in which they investigated the relationship between French domestic and foreign forest product consumption. More precisely, regarding the wood industry, results of a panel data analysis following a macro econometric approach, showed that a stable macroeconomic environment, improved access to markets, more investment, and lower energy costs had statistically significant and positive impacts on the industrial production of the EU furniture industry (Družić and Basarac Sertić 2015).

Third, the authors' results complement other empirical findings on the effects of the wood industry sector in EU member states. According to the European Commission (2016) in 2015, SME employment growth was 1% on the EU 28 low-tech industry level. The sector was employing 984,000 people in 172,000 companies, most of which were small or medium-sized enterprises. As such, SMEs are a part of the bio-economy that can contribute to the circular economy. Maskell (1998) noted that the European wood industry sector performed better than many high-tech sectors both economically and with regard to its employment record. Additionally, Ayyagari *et al*. (2011) found that SMEs had the largest share in employment, especially in low-income countries, and generated the majority of new jobs.

However, none of these studies, by following a macro econometric approach, used the dynamic panel GMM system estimation to analyze the determinants (GDP growth rate, the industrial production, the number of companies in the wood processing sector, and exports) in the context of SMEs' employment in the wood industry in European Union member countries.

CONCLUSIONS

1. The aim of this paper was to gain a deeper understanding of the SMEs employment creation dynamics in the wood processing industry manufacturing sector of the EU member states by exploring traditional macroeconomic indicators (GDP growth rate, industrial production, number of companies in the wood processing sector, and exports). By employing a dynamic panel data analysis and using a dynamic panel GMM system estimator, the results indicated that all independent variables had a statistically significant impact on sectorial employment.
2. Estimation results for SMEs employment in the wood processing industry equation were in line with expectations in that the real GDP growth rate, a higher level of industrial production, growth in the number of enterprises, and the export of

manufactured goods led to higher employment in SMEs in the wood processing industry sector.

3. Overall, this paper sheds new light on the role of SMEs in the wood industry sector of the European Union. Special emphasis is placed on the influence of macro-economic factors on employment in SMEs in the wood industry, which is very important economically, particularly in terms of jobs creation. As such, SMEs are a part of the bio-economy that can also contribute to the circular economy. As this issue is not only crisis-related, it should help design policy measures and have implications at both the European Union and national level. Besides, there is no voluminous research that supports these robust results and policy options, so additional research in these areas could produce insights useful for policy purposes.

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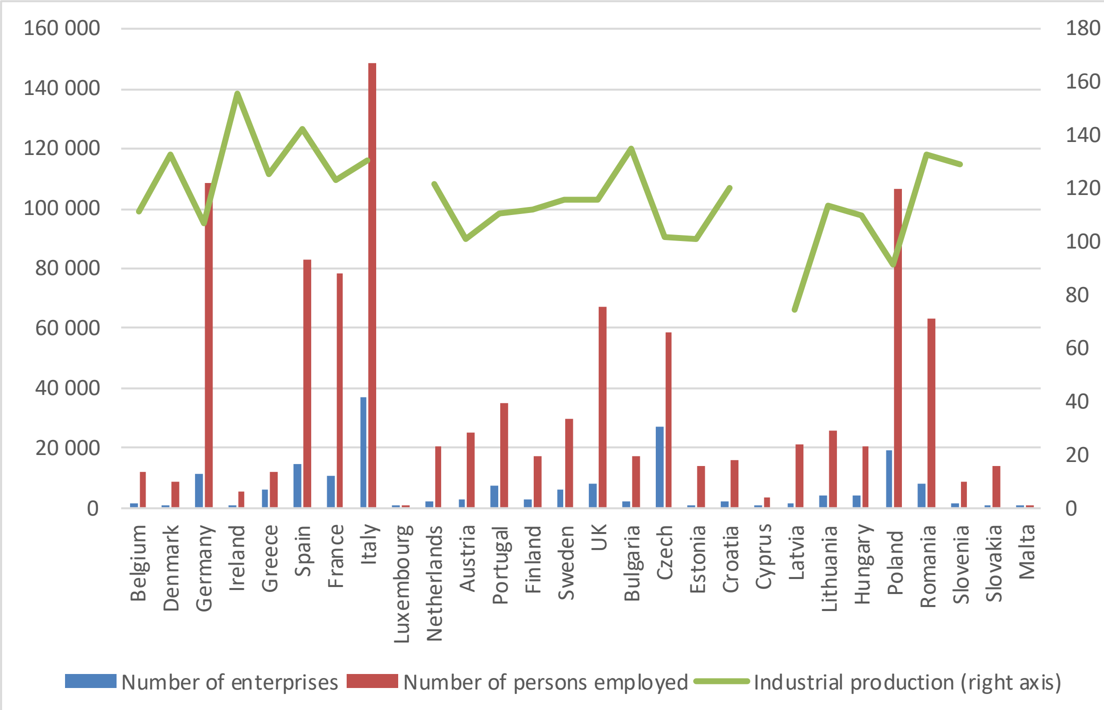
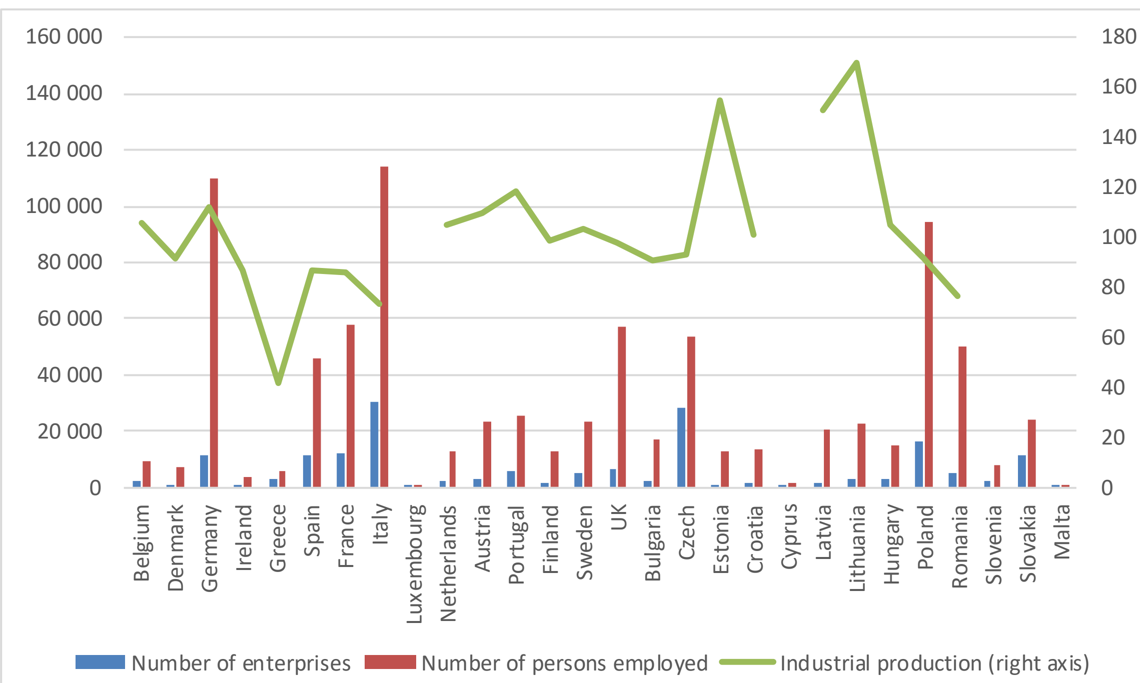
APPENDIX



Source: Eurostat database

Fig. 1. Number of people employed, number of enterprise and industrial production in SMEs wood processing industry in European Union in 2008 (2010=100)



Source: Eurostat database

Fig. 2. Number of people employed, number of enterprise and industrial production in SMEs wood processing industry in European Union in 2016 (2010=100)