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Determinants of manufacturing industry exports in European Union member states: a panel data analysis

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This paper aims to provide analysis on the determinants of export performance on the extensive data-set of the 27 European Union member states' total manufacturing and high tech manufacturing industry. Hence, this paper adds to the existing empirical work by specifying an export performance equation not only as a function of income and price, as is traditionally done, but also industrial production and labour cost. For that purpose, dynamic panel data models are estimated by utilising the system GMM estimator for the period from 2000 to 2011. The obtained results indicate that both industrial production and domestic demand have a positive and statistically significant impact on total and high tech manufacturing exports. On the other hand, it is proven that foreign demand also has an impact on total manufacturing exports. Thus, the paper's contribution is reflected in the acknowledgement that a stable macroeconomic environment (contained in the significance of a dummy variable for the economic crisis in both models), boosting production capacity and domestic demand, is essential for better export performance and the competitiveness of the manufacturing industry in an increasingly competitive global economic climate. Finally, from the perspective of policy-making, the paper concludes that recovery in the manufacturing industry could be the much needed push from crisis to economic development.

Keywords: manufacturing industry; exports; European Union; dynamic panel data analysis; economic crisis; competitiveness

JEL classification: C33, E23, F41

1. Introduction

The financial crisis has had a serious impact on the EU manufacturing sector (European Commission, 2012b). Production is lower than pre-crisis level with over 3 million industrial jobs having beening lost and deteriorating industrial investment. Moreover, the recovery is long and varies between the EU member states. There is general consensus that Europe needs a strong industrial base: manufacturing industries employ over 40 million European workers, underpin economic growth and wealth creation, are a source of innovation and technological progress (industry represents 81% of private sector R&D in Europe), create solutions for societal problems ensuring a better quality of life

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for all and sustainable development, contribute substantially to the equilibrium of Europe's trade balance (industrial goods represent three quarters of Europe's exports), provide employment-multipliers and drive demand for industry-related services (every industrial job creates 2 two extra jobs in the service sectors)[1]. Although in advanced economies manufacturing may no longer be a dependable source of large-scale job growth (McKinsey Global Institute, 2012), it is seen as a powerhouse of the EU economy (European Commission, 2012b).

Therefore, the objective of this paper is to analyse the determinants of European manufacturing industry exports'. More precisely, the paper investigates the effects of domestic and foreign demand, real effective exchange rate, industrial production, labour cost and economic crisis on the export of the total manufacturing and high tech manufacturing industry in European Union countries using the panel data analysis.

Although there is a large body of literature studying the export demand equations; the approach used in this paper expands existing knowledge on the export competitiveness in European Union economies in several ways. First, we include all EU member states in the analysis during the period between 2000 and 2011. Previous empirical studies have been based either on euro area (Bayoumi, Harmsen, & Turunen, 2011; European Commission, 2010b) or a selected group of European Union countries (Allard et al., 2005; European Commission, 2010a). Next, we do not analyse the total export of goods and services, but manufacturing industry exports, highlighting the significance of export performance on sectorial level. Moreover, as opposed to most of the research modelling real exports mostly on foreign income and relative export prices, we also include the variables of industrial production and labour cost in order to capture production capacity and labour market effects. Additionally, in line with some previous literature (Esteves & Rua, 2013), this paper considers domestic demand as an additional explanatory variable.[2] Furthermore, we also analyse the effects of the economic crisis on manufacturing industry exports. To the best of the authors' knowledge, this study presents the first attempt to address an export performance equation in such a framework. Finally, the empirical analysis in this paper also differs from the aspect of the applied methodology. While previous research focused on time series analysis and the estimated error correction model for each country of interest, several recent analyses used panel methodology, which considers simultaneously time and cross-section components, gives more informative data, more variability and is less sensitive to outliers and multicollinearity among independent variables (Baltagi, 2008). In this paper, we consider two models by using the system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). To ensure robustness of results we perform two additional estimators (Least Squares Dummy Variables, LSDV, and LSDVc, bias-corrected Least Squares Dummy Variables) proposed by Kiviet (1995). He results are almost identical regardless of the estimator.

The paper is structured into six sections, including the introduction and closing remarks. In the introductory section, both the research area and the problem of research are defined. The positioning of the manufacturing industry in European Union member states is explained in more detail in the second section. The third section presents the literature review while Section 4 encompasses a description of the used data and the methodology as well as the rationale behind the choice of a linear dynamic panel model. Section 5 presents the results of the econometric analysis and their interpretation. Finally, in the conclusion, we summarise the most important results and their implications for policy-making.

2.   Theoretical background

We begin the analysis by examining the trade patterns in the European Union's manufacturing industry with special emphasis on the period of economic and financial crisis. It has been recognised that at a time when financial problems still persist, Europe needs its real economy more than ever to underpin the recovery of economic growth and jobs, especially being the world-leader in many strategic sectors such as automotive, aeronautics, engineering, space, chemicals and pharmaceutics (European Commission, 2012a). Hence, industrial policy, although essentially concerned with internal issues, also has broader international implications (Dicken, 1998). Namely, European industry still accounts for 4/5 of Europe's exports, and 80% of private sector R&D investment comes from manufacturing (European Commission, 2012a). Furthermore, the EU-27 constitutes a large share of world trade in manufactured goods: exports originating in EU-27 countries, including intra EU-27 trade, accounted for 40.8% of total world exports in 2009 (European Commission, 2011).

The continuing economic crisis has put Europe's industry under pressure: consumer and business confidence is low, problems in the banking sector make it difficult to access finance and investments are held back while factories are under pressure to close (European Commission, 2012a). However, some countries run considerable trade deficits while others run consistent trade surpluses and the EU as a whole currently runs a trade deficit (WIFO, 2012). Therefore, the impact of the crisis on industrial sectors has delayed the process of long-term adjustment and created short-term stressful conditions for small and medium-sized (SME) enterprises that are perfectly competitive in the long-term (European Commission, 2012b). Moreover, this is happening at a time when the speed of innovation and technological development has put the world on the edge of an industrial break-through (European Commission, 2012b) and when the European economies are under strong pressure from the fast rise of emerging economies such as China, India, or Brazil which, due to their combination of low factor costs and increasing quality of human resources and infrastructure, are attracting an increasing share of world industrial production and therefore undermining the industrial base of the European economies (WIFO, 2012).

Despite the fact that industrial production has only partially recovered since its minimal value in 2009 (according to the Eurostat data), it can be concluded that the EU remains the dominant trade actor in a large number of industrial sectors (such as C11, C12, C16, C17, C18, C19, C22, C23, C28, C29 and C31 – bold in Table 1). These data indicate that, despite all of the problems, the significance of the manufacturing sector in the EU has not diminished (Table 1). However, the main issues is that these dominant industrial sectors fall in the group of medium-low and low-tech industries.

3.   Literature review

There is little consensus in the literature regarding the 'ideal indicator' for measuring a country's international cost and price competitiveness (ECB, 2007). The Goldstein and Khan (1985) model, which has been used as the initial model analysing the impact of the macroeconomic environment on the real exports in various studies (e.g. Bayoumi et al., 2011; ECB, 2003, 2005, 2007), represents the starting point for research performed in this paper.

However, in order to quantify the role of various determinants, different equations were estimated for the volumes of exports for different groups of countries so far.

Table 1. EU exports of manufactured goods 2009 by industry affiliation (%).

Nace	Commodity description	EU-27	Nace	Commodity description	EU-27
C10	Food	46.8	C22	**Rubber & plastics**	**65.5**
C11	**Beverages**	**69.0**	C23	**Non-metallic mineral prod.**	**50.2**
C12	**Tobacco**	**68.3**	C24	Basic metals	35.0
C13	Textiles	29.5	C25	Metal products	49.3
C14	Clothing	32.5	C26	Computers, elec. & optical	24.3
C15	Leather & footwear	38.6	C27	Electrical equipment	41.7
C16	**Wood & wood products**	**50.1**	C28	**Machinery n.e.c.**	**50.3**
C17	**Paper**	**57.1**	C29	**Motor vehicles**	**55.5**
C18	**Printing**	**57.2**	C30	Other transport eq.	49.0
C19	**Refined petroleum**	**76.0**	C31	**Furniture**	**50.9**
C20	Chemicals	32.8	C32	Other manufacturing	32.0
C21	Pharmaceuticals	49.5			

Source: European Commission (2011).

Table 2. The recent literature review of the determinants of export performance.

Authors	Region/ Country	Period	Dependent variable	Independent variables	Methodology
Allard et al. (2005)	France, Germany, Italy, Spain	late 1970s or early 1980s-2004	export of manufactured goods, export of goods/ services	foreign/ domestic demand, rel. prices, reer, capacity util. rate	error correction model
Allard (2009)	Czech R., Hungary, Poland, Slovakia,	2002–2007	export	world demand, FDI stock, price competitiveness	error correction model
European Commission (2010a)	Austria, Germany, Spain, France, Italy	1980–2008, except France 1980–2000	real export of goods and services	foreign demand, reer	Johansen (1991, 1995) maximum likelihood method
European Commission (2010b)	euro area	1989–2009	extra euro area export	foreign income, reer, intermediate imports	Dynamic Ordinary Least Square estimator
Bayoumi, Harmsen, and Turunen (2011)	euro area	1995–009	total export volumes	foreign demand, reer, EMU (dummy variable)	fixed effect model

Source: Author's compilation.

Table 2 summarises various research papers on the European Union member states export performance.

For example, Allard et al. (2005) showed that the REER appreciation during the 2001–2004 period had adversely affected exports of goods and services in euro area countries, broadly in proportion with the degree of appreciation (however, with some notable variations between countries reflecting different estimated elasticities). On the other side, while global demand contributed positively to exports in all cases, domestic demand played a key role only on the import side. Performing the analysis for Hungary,

Poland, Czech Republic and Slovakia; Allard (2009) shows that the behaviour of volume variables explains most of the recent behaviour of trade flows, especially since EU accession. Therefore, the acceleration in global demand accounts for the bulk of export buoyancy over 2002–2007 (with the strongest impact in the Czech Republic and Slovakia). However, this is not related to an exposure to more dynamic trade partners but to the ability of the smaller countries to expand their market share more systematically since transition, which is mirrored in higher elasticities to world demand. The results also showed that an increase in FDI investments contributes to export growth over the observed period. Next, the results of the research performed by European Commission (2010a, 2010b) show that the real exchange rates and foreign demand explain, to a large extent, changes in exports for euro area countries with real exports being positively related to external demand and negatively to an appreciation of the real effective exchange rate. Finally, Bayoumi, Harmsen, and Turunen (2011) have examined the link between exports and trends in competitiveness across euro area countries for the period between 1995 and 2009. The results from export equations suggest that intra-euro area trade is at least two times more sensitive to changes in relative prices than extra-euro area trade (especially since the inception of EMU).

In addition, most recent research on export performance extends the theoretical models rooted in Krugman's new trade theory towards highlighting the differences across markets, firms and products even within the same sector (European Commission, 2012c).[3] In particular, from the aspect of high-tech exports, Tebaldi (2011) provides evidence that human capital, inflows of foreign direct investments and openness to international trade are the main factors influencing the performance of a country's high-tech technology exports. In addition, Zhang (2007) shows that inflow of FDI and infrastructure have significant and positive effects on high-tech exports, while Srholec (2007) points to enrolment in higher education, granted patents and access to computers as significant factors that positively affect high-tech exports. Moreover, Faruq (2010) argues that the export of high quality differentiated goods is associated with R&D activities and FDI.

4. Econometric analysis

In this part of the paper, we examine the impact of income and price elasticity (approximated through foreign demand and the real exchange rate) on the total manufacturing and high tech manufacturing industry's real exports using the panel data analysis. The analysis is performed for 27[4] European Union countries in the period from 2000 to 2011.

4.1. Model

Our paper builds on the work by Goldstein and Khan (1985). The rationale behind the choice of this model stems from the fact that Goldstein and Khan (1985) emphasised that the appropriate imports and exports behavioural model depends, among other things, on the type of goods traded (perfectly homogeneous primary goods or highly differentiated manufactured goods), on the end use for which the traded good is intended (final consumption or an input in production), the institutional framework under which it is traded (within an economy where resources are allocated by relative prices or within an economy in which the administrative controls have a dominant role), on the purpose of modelling (forecasting or hypothesis testing) and sometimes even on the availability of data.

Furthermore, there are two complementary models that dominate the empirical literature: the model of imperfect substitutes and the model of perfect substitutes, where the model of imperfect substitutes assumes that neither imports nor exports are perfect substitutes for domestic goods. Hence, the general form of the export demand equation is commonly based on the imperfect substitutes model of international trade presented in Goldstein and Khan (1985). Under this approach, the export demand equation is specified as a function of the relative price of exports and the rest of the world's real income. However, the paper uses the real effective exchange rate instead of the relative price of export because the exchange rate directly affects the prices of exportable goods. Symbolically, the baseline model is specified as follows:

$$\ln x_t = \beta_0 + \beta_1 \ln y_t^* + \beta_2 \ln reer_t + e_t \tag{1}$$

where t indexes time, x_t signifies real exports, y_t^* denotes foreign income, $reer_t$ denotes the real effective exchange rate and e_t is the disturbance.

According to this, a rise in foreign demand and a rise in cost and price competitiveness (reflecting a depreciation of the domestic currency in real terms) should be associated with an increase in real exports (ECB, 2007, p. 13).

Further, according to Goldstein and Khan (1985) the main characteristics of the imperfect substitutes model can be summarised as follows. In accordance with conventional demand theory, the consumer is postulated to maximise utility subject to a budget constraint. The resulting demand functions for imports and exports thus represent the quantity demanded as a function of the level of (money) income in the importing region, the imported good's own price, and the price of domestic substitutes (Goldstein & Khan, 1985). However, it has been recently broadly recognised that such most commonly used traditional determinants are far from being able to entirely explain export behaviour (see, for example, di Mauro and Forster (2008), European Commission (2010b), ECB (2012)). Such evidence reinforces the need to search for other factors that may influence exports dynamics. Hence, stressing the need to take a broader view on manufacturing competitiveness measures, the paper also introduces a more elaborate framework that takes into account the labour cost, industrial production performance and economic crisis as an additional explanatory variable:

$$x_t = f(y_t^*, \ reer_t, \ indpro_t, \ lab\cos t_t, \ dd_t, \ econcrisis_t) \tag{2}$$

where $indpro_t$ denotes industrial production, $lab\cos t_t$ denotes labour cost, dd_t denotes domestic demand and $econcrisis_t$ denotes economic crisis. For this purpose we adopt the standard specification of export demand as explained in Goldstein and Khan (1985), although we introduce some modifications.

4.2. Data

The export data for all 27 EU member states were originally obtained using the UNCTAD database, which classifies products according to the Standard International Trade Classification of the United Nations, managed by the United Nations (SITC 5 to 8, excluding 667 and 68). The annual values of exports were deflated by the consumer prices of the individual member in order to exclude the effects of price changes. In addition, all the data used in the analysis (except industry employment growth) are expressed in indices (2000 = 100).

The domestic demand for manufacturing industry for all member states was approximated using the GDP at market prices, with all values being translated into indices

(2000 = 100). On the other hand, the foreign demand was approximated using the average GDP of the EU member states. Furthermore, the analysis employed values of the real exchange rate, deflated on the basis of the consumer price index.

Finally, since the research in this paper focuses on the analysis of export performance in the context of the economic crisis, we need to define the term 'crisis'. Therefore, we explored one possible definition of a crisis (for annual data) within which a period of crisis is defined as the year characterised by a negative percentage change in growth relative to the previous period (gross domestic product expressed at market prices). A dummy variable representing the economic crisis takes the value 1 in the crisis year and value 0 in all others.

From the aspect of the impact of the real effective exchange rate on the exports, the assumption is that an increase in exchange rate[5] (depreciation) has a positive effect on exports since it makes them cheaper, while at the same time has a negative effect on imports making them more expensive. Next, we expect the estimated coefficients of domestic and foreign demand to be in line with the basic economic principles; i.e. negative and positive coefficient, respectively (for details, see Ball, Eaton, & Steuer, 1966; Rahmaddi & Ichihashi, 2011).[6] Furthermore, we include industrial production in our list of variables to be examined and expect a positive sign of the coefficient with this variable. For the final variable included in the analysis – the labour cost – we measure the sensitivity of an industry's export performance to changes in labour costs and expect a negative sign (in accordance with Carlin, Glyn and Van Reenen).[7] All variables are logarithmically transformed (except dummy variable and labour cost, which is expressed in percentages). Table 3 provides a description of the variables and their sources.

4.3. Methodology

Like most economic relations, export is also a dynamic phenomenon, which means that its current values depend on its past values. Thus, for empirical analysis of export

Table 3. Data description and sources.

Variable	Data description	Source
Manufacturing industry exports	Merchandise trade matrix; manufactured goods (SITC 5 to 8 less 667 and 68)	UNCTAD
High-tech industry exports	Merchandise trade matrix; manufactures with high skill and technology intensity	UNCTAD
Foreign demand	Gross domestic product at market prices; European Union (27 countries)	Eurostat
Real effective exchange rate	Real Effective Exchange Rate (deflator: consumer price indices – 27 trading partners)	Eurostat
Industrial production	Volume index of production; manufacturing; data adjusted by working days	Eurostat
Labour cost	Labour cost index; manufacturing; percentage change on previous period; wages and salaries (total)	Eurostat
Domestic demand	Gross domestic product	WEO
Dummy variable (Econ. crisis)	Gross domestic product per capita, current prices, US dollars	Eurostat

Note: United Nations Economic Commission for Europe (UNECE); World Economic Outlook (WEO).
Source: Specified databases.

performance in the European Union manufacturing industry, we use a dynamic panel model, which can be expressed by the following equation:

$$y_{it} = \mu + \delta y_{i,t-1} + \beta_1 x_{it1} + \beta_2 x_{it2} + ... + \beta_K x_{itK} + v_i + u_{it} \quad i = 1,..., N, t = 1,..., T \tag{3}$$

where N is the number of EU countries, T is the number of periods, y_{it} is value of the dependent variable (in this case, the value of the EU member states' manufacturing industry's real exports – *exp*) of country i in the period t, the parameter μ is the constant, $y_{i,t-1}$ is the lagged (one year lag) dependent variable, δ is the parameter, x_{it1}, ..., x_{itK} are the independent variables (foreign demand, real effective exchange rate, industrial production, labour cost, domestic demand and economic crisis) and K is the number of independent variables in the model while $\beta_1, \beta_2, ..., \beta_K$ are the parameters of exogenous variables. Finally, v_i is the fixed effect or specific error for each country and u_{it} is the remaining part of the error term in the model. It is assumed that all variables x_{it} are strictly exogenous and uncorrelated with any u_{it}. Namely, with inclusion of lagged dependent variable $y_{i,t-1}$ in the model, it becomes correlated with v_i. Due to the observed correlation most commonly used, LSDV (Least Squares Dummy Variables) and GLS (Generalised Least Squares) estimators for panel data are biased and inconsistent. Therefore, the most frequently used estimators in empirical researches are the difference GMM estimator proposed by Arellano and Bond (1991) and the system GMM proposed by Arellano and Bover (1995) and Blundell and Bond (1998). To overcome the correlation between $y_{i,t-1}$ and v_i, Arellano and Bond (1991) proposed taking equation (3) in first differences:

$$y_{it} - y_{i,t-1} = \delta(y_{i,t-1} - y_{i,t-2}) + \beta_1(x_{it1} - x_{i,t-1,1}) + \beta_2(x_{it2} - x_{i,t-1,2}) + ...$$
$$+ \beta_K(x_{itK} - x_{i,t-1,K}) + (u_{it} - u_{i,t-1}); \ i = 1,...N, t = 1,...,T \tag{4}$$

Although in equation (4) v_i is excluded, the problem arises with $y_{i,t-1}$ which is correlated with $u_{i,t-1}$. In order to solve this problem, instrumental variables[8] are included in model. Thus, this estimator outperformed previous estimators in terms of bias, but it showed weaknesses when the dependent variable is highly persistent and in the case when the ratio of the individual effect variance and the remained error variance (σ_v^2/σ_u^2) increases. So, following the work of Arellano and Bover (1995), Blundell and Bond (1998) proposed a new system GMM estimator. System GMM uses equation in first differences (4) and equation in levels (3). To avoid the problem of the correlation between $y_{i,t-1}$ and v_i in equation (3) instrumental variables[9] are introduced. This estimator showed better properties than the Arellano and Bond estimator and all other estimators in numerous researches (Blundell & Bond, 1998, 2000; Bond, 2002; Bun & Windemeijer, 2007; Soto, 2009).

On the other hand, Kiviet (1995)[10] noted the efficiency of the LSDV estimator, so he derived a bias approximation formula. For the calculation of bias he used one of consistent dynamic panel data estimators: estimator proposed by Anderson and Hsiao (1981), the difference GMM or system GMM. This estimator showed good properties in simulation studies when the number of individuals is small (Bruno, 2005a; Judson & Owen, 1999) but only in the case when all independent variables are strictly exogenous. This assumption is very strong for any macroeconomic research, so for this reason we choose LSDVc for robustness check. We perform a one-step system GMM estimator with robust standard error[11] to estimate equation (1).

5. Estimation results

Tables 4 and 5 show the results of the estimated impact of the determinants of export performance in the 27 European Union member states' manufacturing and high tech industries as well as the diagnostic tests of dynamic panel data analysis. In both system GMM models there was no autocorrelation between the residuals of the first (m_1) and second (m_2) order.[12]

The validity of the instruments selected for the evaluation of the model is tested using the Sargan test.[13] The Sargan test for over-identifying restrictions in both models does not reject the null hypothesis, indicating that instrumental variables are valid. Furthermore, in order to keep the number of instruments under control, only one lag of the dependent variable is used for an instrument. From Tables 4 and 5 it is evident that the number of instruments does not exceed the number of cross-sections so the properties of the system GMM estimator are not endangered. To ensure robustness of results LSDV and LSDVc estimators are performed for the estimation of both models.

The unit root tests for the stationarity of the dependent and independent variables are not employed because the time period is relatively short. Hence, the problem of non-stationarity is not an issue (Blackburne & Frank, 2007).

The estimated coefficient of the lagged dependent variable is statistically significant at the 1% level in both models, and not close to unity, which indicates the absence of potential misspecification or the unit roots in the series. Additionally, the dependent lagged variable was statistically significant and had a positive algebraic sign in both models, which could be interpreted as a result of a rather slow growth adjustment to changes in the right-hand side variables. Furthermore, the obtained results of the first model (Table 4) are in line with expected outcomes and point to the statistically significant effects of domestic and foreign demand, industrial production as well as of the

Table 4. Results of the dynamic panel models; dependent variable: manufacturing industry exports.

Variable	System GMM	LSDVc	LSDV
Lagged dependent variable	0.207*** (0.0648)	0.443*** (0.0482)	0.383*** (0.0432)
Foreign demand	0.663*** (0.199)	0.787*** (0.155)	0.841*** (0.149)
Real effective exchange rate	0.137 (0.194)	−0.0308 (0.111)	−0.00803 (0.107)
Industrial production	1.019*** (0.0696)	0.528*** (0.0736)	0.579*** (0.0685)
Labour cost	−0.00126 (0.0014)	−0.000947 (0.00131)	−0.000679 (0.00126)
Domestic demand	0.219** (0.0865)	0.113** (0.0557)	0.130** (0.0508)
Dummy variable (econ.crisis)	−0.101*** (0.0241)	−0.135*** (0.0217)	−0.122*** (0.0189)
C	−5.696*** (1.285)		−4.219*** (0.793)
Number of observations	293	293	293
Number of countries	27	27	27
Number of instruments	27		
m1 test (*p*-value)	0.2415		
m2 test (*p*-value)	0.1351		
Sargan test (*p*-value)	0.1486		
R^2			0.913

Source: Authors' calculation.
Note: *, **, *** indicate statistical significance at levels of 10, 5 and 1%; standard errors are in brackets; for system GMM robust standard errors are in brackets.

Table 5. Results of the dynamic panel models; dependent variable: high-tech manufacturing industry exports.

Variable	System GMM	LSDVc	LSDV
Lagged dependent variable	0.557*** (0.0943)	0.678*** (0.0449)	0.598*** (0.0407)
Foreign demand	−0.306 (0.573)	0.156 (0.232)	0.266 (0.231)
Real effective exchange rate	0.495 (0.327)	0.0980 (0.175)	0.178 (0.176)
Industrial production	0.870*** (0.195)	0.426*** (0.104)	0.488*** (0.100)
Labour cost	−0.00497* (0.00280)	−0.00280 (0.00195)	−0.00259 (0.00198)
Domestic demand	0.361** (0.174)	0.213** (0.0839)	0.232*** (0.0804)
Dummy variable (econ.crisis)	−0.141*** (0.0366)	−0.140*** (0.0297)	−0.123*** (0.0277)
C	−4.349 (2.762)		−3.404*** (1.284)
Number of observations	293	293	293
Number of countries	27	27	27
Number of instruments	27		
m1 test (*p*-value)	0.0266		
m2 test (*p*-value)	0.3103		
Sargan test (*p*-value)	0.1119		
R^2			0.881

Source: Authors' calculation.
Note: *, **, *** indicate statistical significance at levels of 10%, 5% and 1%; for system GMM robust standard errors are in brackets.

dummy variable for the economic crisis. Therefore, an increase in domestic and foreign demand and industrial production have a statistically significant impact on stimulating the growth of exports of the manufacturing industry. More precisely, the estimation results show that a 1% growth in industrial production would tend to stimulate exports by about 1.019%. Next, a 1% increase in foreign or domestic demand would tend to stimulate exports by nearly 0.663 or 0.219%. Additionally, in a year of economic crisis, exports will diminish by 0.101%. On the other hand, labour costs and the real effective exchange rate variables are not statistically significant. In the second system GMM model (Table 5), the results of the empirical analysis show that a statistically significant effect on high-tech industry exports comes from the industrial production, which is in line with the assumption suggesting that production capacity has an indirect impact on policy outcomes. However, the labour cost variable is significant only in the system GMM model, but it is not robust to different estimators and of any change in the dependent variable. Furthermore, the dummy variable and domestic demand are statistically significant. More precisely, in a year of economic crisis, exports will decrease by 0.141%. The estimation results also indicate that a 1% growth in domestic demand would tend to stimulate exports by about 0.361%. Nevertheless, foreign demand and real exchange rate are not statistically significant in the second model.

Furthermore, we also perform two additional estimators – LSDVc and LSDV – and the results are the same (columns, three and four in Tables 4 and 5).

6. Concluding remarks

A strong industrial base is essential for achieving long-term sustainable economic growth and export competitiveness, especially in the circumstances when the consequences of the economic crisis are still being felt. In that sense, manufacturing remains a significant contributor to exports in the European Union. But its role and its influence vary between economies and change over time and economic cycles. Hence, this paper

takes a closer look at various drivers of the export performance of the total and high-tech manufacturing industry in the 27 European Union member states.

By adding additional explanatory variables – industrial production and labour cost – to a 'standard' export performance model our paper provides some new empirical evidence. Namely, according to the estimated parameters, the analysis shows that both industrial production and domestic demand are statistically significant and have a positive effect on the manufacturing and high tech manufacturing exports. Additionally, an increase in foreign demand also has a statistically significant impact on stimulating the growth of exports of the manufacturing industry. On the other hand, labour cost and the real effective exchange rate variables are not statistically significant. At the same time, it is obvious that the price and income are not the only key determinants affecting the exports, a fact often highlighted in public debates. Hence, the aforementioned econometric results provide further insights into the specificities of the European Union manufacturing industry. Finally, the results obtained from panel data analysis for European Union countries point to the fact that the role of the manufacturing industry in production is significant, despite the fact that manufacturing's share of production is changing.

Hence, according to the obtained results and taking into consideration the fact that the dynamics of manufacturing exports varies between Member States, EU countries must create a macroeconomic environment conducive to enhancement of manufacturing technologies, which has been recognised as one of the key priorities for achieving long-term improvement in economic performance. Industrial policy could have a major role in achieving this goal. The key is, however, to develop strategies that would combine policies focused both on price and non-price factors of competitiveness of the manufacturing industry. In addition, the focus should turn to high-technology manufacturing trade since many researchers have found a positive correlation between high-tech exports and countries' economic performance.

Finally, with the still-persistent negative effects of the global economic crisis, more attention should be directed to the shifting role of the manufacturing industry and its potential contribution to overall export performance. The findings of this paper are also important for Croatia and could serve as a basis for its industrial policy development.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. Joint EMCEF/EMF/ETUF:TCL project (2010). Available underat: http://www.industrialpolicy.eu/EMF/What-future-for-European-manufacturing-workers.
2. Namely, Esteves and Rua (2013) found that besides external demand and real exchange rate, the domestic demand behaviour also appears highly significant and relevant for modelling the short-run dynamics of Portuguese exports.
3. For example, DiPietro and Anoruo (2006) found a positive relationship between a country's export performance and a country's creative activity. In particular, the results of the cross-country regression analysis show that a country's creativity, innovation, state of technology, amount of technological transfer from other countries and the extent of business start-ups are all positively correlated with the value of a country's exports. Méon and Sekkat (2006) present evidence that exports of manufactured goods are positively affected by the quality of institutions, especially the control of corruption, the rule of law, government effectiveness and the lack of political violence.

4.   All member states except Croatia (Austria, Germany, Italy, the Netherlands, United Kingdom, Sweden, Finland, Denmark, Belgium, Spain, Greece, Portugal, Ireland, France Malta, Cyprus, Slovenia, the Czech Republic, Slovakia, Hungary, Poland, Lithuania, Latvia and Estonia).

5.   Since according to the Eurostat methodology the growth of the real effective exchange rate indicates the decline in competitiveness, the negative algebraic sign is in accordance with the economic theory and expectations, where the index drop leads to an increase in exports and competitiveness.

6.   However, the expected overall effect of domestic income on exports is ambiguous since, when the economy grows, both domestic supply and domestic demand change (see Yishak, 2009).

7.   Namely, Carlin, Glyn, and Van Reenen (2001) find that relative unit labour cost terms are jointly highly significant and yield a highly significant and negative long-run elasticity within OECD countries over a period of more than 20 years.

8.   Valid instruments for $\left(y_{i,t-1} - y_{i,t-2}\right)$ are lagged values of dependent variable in level $(y_{i,t-2}, ..., y_{i2}, y_{i1})$. Further, if some of x_{itk}, $k = 1, 2, ..., K$ is endogenous in the sense that $E(x_{itk}\varepsilon_{is}) = 0$ for $s > t$ and $E(x_{itk}\varepsilon_{is}) \neq 0$ otherwise, lagged values of independent variable $(x_{i,t-2,k}, ..., x_{i2\ k}, x_{i1\ k})$ are a valid instrument for $(x_{itk} - x_{i,t-1,k})$.

9.   The valid instrument for lagged dependent variable $y_{i,t-1}$ in equation (1) is the lagged value of dependent variable in first differences $\Delta y_{i,t-1}$. Also, in the case of endogenous independent variable x_{itk}, $k = 1, 2, ..., K$, $\Delta x_{i,t-1,k}$ is a valid instrument for this variable.

10. LSDVc estimator proposed by Kiviet (1995) was suitable only for balanced panel data while Bruno (2005b) upgrades this estimator for unbalanced panel data.

11. Standard errors of two-step estimator underestimate variability of this estimator in small samples (Baltagi, 2008; Bond, 2002).

12. The null hypothesis of the m_1 test assumes the absence of a first-order autocorrelation between differenced residuals, and the null hypothesis of the m_2 test assumes the absence of a second-order autocorrelation between differenced residuals.

13. The Sargan test for over-identification of the restrictions in the statistical model (i.e. the validity of instrumental variables) is based on the assumption that the residuals should be uncorrelated with a set of exogenous variables if the instruments are exogenous. Specifically, the Sargan test has the null hypothesis that the instrumental variables are uncorrelated with the residuals.

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