

## II. The determinants of export quality in the euro area

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*Export quality is an important component of external competitiveness on the non-cost side. First of all, quality significantly affects the global patterns of trade. Moreover, increasing the quality of existing products can strengthen existing comparative advantages while boosting export revenues. Furthermore, products with more potential for quality improvement are less exposed to low-wage competition. In this section, we analyse the determinants of export quality in the euro area. Using sectoral data on manufacturing exports for euro area countries over the period 2005-2015, we confirm the finding of a growing literature suggesting that a prime determinant of export quality is the level of income of the exporting country. Higher incomes mean domestic demand for high-quality product and go together with higher skills of the labour force and higher supply of capital. In addition, however, our results looking more in-depth at supply side channels show that the use of a higher share of high-tech inputs (both services and manufacturing products), as well as better institutions are positively related to export quality. These results are especially true for sectors with higher technological intensity, and where the potential for quality improvements is also higher. Policies to increase efficiency in product markets and to strengthen institutions therefore matter for fostering export quality and improving resilience of the economies. <sup>(91)</sup>*

### II.1. Introduction

The economic literature has shown that the type of export specialisation, and in particular increasing the quality of exports, is important for economic growth and competitiveness. For example, exporting products similar to the ones produced by high-income countries is associated with higher growth. <sup>(92)</sup> Moreover, product quality is a key determinant of the direction of trade between countries: exporting higher-quality varieties of existing products can thus contribute to boost export revenues and productivity. <sup>(93)</sup> At the same time, however, the potential for quality improvement is different across products, and it is higher for manufacturing goods than in agriculture and natural resources. <sup>(94)</sup>

Quality upgrading is not the same as increasing the technological content of exports. While low-income countries seem to have increased the level of the latter for their products, in many cases, as argued by Hwang (2007), they tend to remain in the low end of the quality distribution within those industries; nevertheless, for quality to contribute to growth, countries should export not only more complex products but also products with higher

potential for quality improvements, i.e. with "longer quality ladders". <sup>(95)</sup>

In addition to being important for growth and competitiveness, quality upgrading matters because it can shelter, at least in part, from price competition. In this respect, the literature has shown that countries that export products for which the potential for quality improvement and diversification is higher tend to be better off in those sectors, while countries specialising in products with shorter "quality ladders" have been shown to be more exposed to employment and output declines resulting from low-wage competition. <sup>(96)</sup>

Given the just outlined relevance of product quality and quality improvements, this section aims at shedding light on the determinants of export quality in euro area countries, using the indicator for quality developed by di Comite et al. (2014) and Vandenbussche (2014). <sup>(97)</sup> The analysis is performed using sectoral data. The value added of using sectoral data instead of aggregate data is that they allow us to shed light on sectoral differences on the factors affecting export quality.

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<sup>(91)</sup> The section was prepared by Gaetano D'Adamo. The author wishes to thank Elizaveta Archanskaia, Erik Canton and Jorge Durán Laguna for useful comments.

<sup>(92)</sup> Hausmann, R., Hwang, J., and D. Rodrik (2007), 'What you export matters', *Journal of Economic Growth* Vol.12, pp.1-25.

<sup>(93)</sup> Hallack, J.C. (2006), 'Product quality and the direction of trade', *Journal of International Economics* Vol. 68, pp. 238-265.

<sup>(94)</sup> Khandelwal, A. (2010), 'The long and short (of) quality ladders', *Review of Economic Studies* Vol. 77, pp.1450-1476.

<sup>(95)</sup> Hwang, J. (2007), 'Introduction of new goods, convergence and growth', *Harvard University, mimeo* and Rodrick, D. (2007) "Unconditional convergence exists after all!", [http://rodrik.typepad.com/dani\\_rodriks\\_weblog/2007/04/unconditional\\_c.html](http://rodrik.typepad.com/dani_rodriks_weblog/2007/04/unconditional_c.html).

<sup>(96)</sup> Khandelwal, A. (2010), *op. cit.*

<sup>(97)</sup> Di Comite, F.; Thisse, J.F., and H. Vandenbussche (2014), 'Vertical differentiation in export markets', *Journal of International Economics* 93(1), pp. 50-66; Vandenbussche, H. (2014) *op. cit.* and H. Vandenbussche (2014), 'Quality in exports', *European Economy – Economic Papers* 528, *European Commission*.

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Our focus is on manufacturing exports, thus leaving aside services. While it cannot be denied that services also represent an important share of international trade, the measurement of quality in services is even more problematic than in manufacturing and, to our knowledge, available indicators of export quality do not cover services. Nevertheless, as we will point out, services matter also for the quality of manufacturing exports.

This Section is structured as follows. Sub-section II.2 reviews the related literature on the measurement of export quality. Sub-section II.3 focuses on the determinants of export quality and shows descriptively the relationship between our indicator and the key determinants identified by the literature. Sub-section II.4 discusses the empirical approach and the data and Sub-section II.5 reports the regression results. Sub-section II.6 concludes.

## II.2. Measuring export quality: a challenging task

The quality of exports is one of the factors affecting export performance on the non-price side, together with institutions, integration in Global Value Chains, infrastructures, etc.

Quality is crucial to determine whether consumers will purchase a product, and perhaps it is the key non-price characteristic. Measuring quality is a very complex task: each product has its specific features concerning e.g. reliability, brand, design, performance and safety of a product. Moreover, the level of quality of one product should be defined by reference to the quality levels of other comparable products, i.e. in relative terms.

Since the quality of exports cannot be directly observed, it needs to be estimated. The simplest way to define quality could be unit values, which are directly observable. From this point of view, a product with higher unit value would have higher quality. However, the "pure" product unit value is, at best, a noisy proxy for quality, since it may reflect differences in export composition, production costs, pricing strategies, or even in quality-adjusted prices resulting from shocks to supply or demand. <sup>(98)</sup>

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<sup>(98)</sup> Henn, C., Papageorgiou, C. and N. Spatafora (2013), 'Export quality in developing countries', IMF Working Paper No. 13/108.

Different approaches to the estimation of exports quality have been developed in the literature. These approaches generally model demand, or, in some cases, supply, using microeconomic foundations. Some measures are based on unit values, under the assumption that higher-quality products (once controlling for other factors) should sell at higher prices. <sup>(99)</sup> Alternative measures focus on demand shifters, and thus are based on the assumption that a product is of higher quality if, conditional on price, it has a higher market share. <sup>(100)</sup> In this sense, quality represents a parallel and outward shift in the demand curve, which results in a higher willingness-to-pay for the higher-quality goods than for the lower-quality goods. Feenstra and Romalis (2014) add to this demand-side intuition the fact that goods of higher quality are shipped longer distances (the "Washington apples effect"). <sup>(101)</sup> <sup>(102)</sup>

The perception of quality by the consumer also involves some subjective elements, and therefore, some features might be very valuable for one customer and not as much for another. The taste of a consumer should thus be taken into account as well and, as a result, the ranking of a product might differ according to the different destination markets. In other words, one should take into account also the factors that affect the slope of the demand curve, where these "slope shifters" would account for taste differences. That is the approach to measure quality developed by di Comite et al. (2014) and applied by Vandebussche (2014) and on which the "quality indicator" used in this section to express export quality is based. <sup>(103)</sup>

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<sup>(99)</sup> Hallack, J.C. (2006), *op. cit.*; Baldwin, R. and J. Harrigan, (2011) 'Zeros, quality and space: trade theory and trade evidence', *American Economic Journal: Microeconomics* Vol 3(2), pp. 60-88.

<sup>(100)</sup> Khandelwal, A. (2010), *op. cit.*; Hummels, D. and P.J. Klenow (2005), 'The variety and quality of a nation's exports', *American Economic Review* Vol. 95(3), pp. 704-723.

<sup>(101)</sup> The "Washington apples effect" or Alchian–Allen effect implies that when the price of two goods of different quality is increased by the same, fixed, amount (e.g. a transportation cost or a lump-sum tax), demand will shift towards the higher-quality good. In this framework, therefore, since it is more expensive to ship at longer distance, goods that travel further away are considered of higher quality.

<sup>(102)</sup> Feenstra, R. C. and J. Romalis (2014), 'International prices and endogenous quality', *The Quarterly Journal of Economics* Vol. 129 (2), pp. 477-527.

<sup>(103)</sup> Di Comite, F.; Thisse, J.F. and H. Vandebussche (2014), *op.cit.*

### Box II.1: A measure of export quality

The calculation of the indicators of export quality used in this section is based on the theoretical background and empirical approach described in di Comite et al. (2014) and Vandebussche (2014). In short, this approach moves beyond only considering (unit) prices for computing quality, and instead focuses on prices, variable costs and competition effects.

The model assumes that the demand for variety  $s$  belonging to the product market  $S$  in destination  $i$  is linear, stemming from a quadratic utility function, and takes the form:

$$p_{s,i} = \alpha_s - \beta_{s,i} \cdot q_{s,i} - \gamma \cdot Q_{s,i}$$

where  $p$  is the unit value,  $q$  is quantity consumed of variety  $s$  in destination  $i$ ,  $\alpha$  is the willingness to pay for the first unit of  $s$  in that destination,  $\beta$  is the slope of the demand, which varies by product and destination market,  $\gamma$  is a parameter indicating the substitutability between varieties in  $S$  and  $Q$  is the total quantity consumed of all other varieties. In the model,  $\alpha_s$  is therefore what identifies the product's quality.

Vandebussche (2014) shows that, after solving the firm's maximization problem, the "relative quality of an exported product  $s$ " (with respect to another variety  $r$ ), can be calculated as:

$$(\alpha_s - \alpha_r) = (2p_{s,i}^* - c_s) - (2p_{r,i}^* - c_r),$$

where the  $p^*$  are equilibrium prices and  $c_s$ ,  $c_r$  are marginal costs. Therefore, to calculate the indicator, the data series that are needed are: (i) export prices at product level of the exporting country to a destination market by year; (ii) export quantities at the firm-product level to the same destination market by year and (iii) cost of production of the product in the market from where it is shipped.

Against this background, quality indicators used in this Section are constructed using data coming from two sources. First, we used Comext (EUROSTAT) trade flows at product (CN8) level to obtain unit values as a proxy for prices. Second, we use information of the firm-level dataset ORBIS to obtain a proxy for country-product costs. The destination market considered is the EU-28.

In the empirical analysis, all the CN8 products exported by each European member state as well as China, US and Japan to the EU28, for which we have sufficient information on the cost side, are considered. This results in 31 countries of origin whose export products we can compare within the same product market, on average about 6000 exported products for each of the EU Member States and its main world competitors i.e. US, Japan, China.

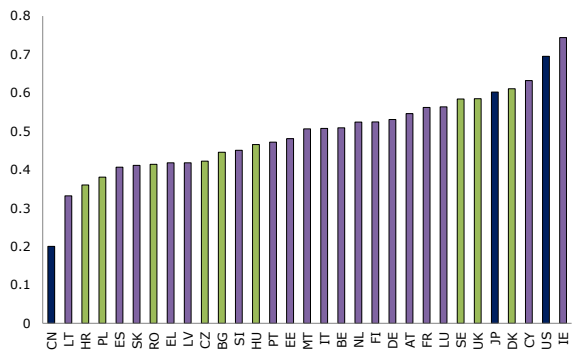
To obtain a country-product cost measure, we first match the 4-digit Nace Rev. 2 primary Industry classification of ORBIS for firms in the country of origin with the CN8 product classification (via CPA codes) to which a particular product belongs, in order to have an idea of the cost of each exported product. Cost data are variable costs, consisting of both wage costs and material costs. Due to different accounting practices and data availability, for some countries, instead of wage costs and material costs, we used cost of goods sold. This was the case for China, Cyprus, Denmark, United Kingdom, Greece, Ireland, Japan, Lithuania, Malta, United States, Latvia and Netherlands.

One caveat is that ORBIS does not report all the very small firms and thus has a bias towards larger firms. However, since exporters tend to be larger firms, we expect variable costs estimates coming from this data to be a good proxy. To take this potential bias into account, we consider the variable cost of the median firm in the sector as a proxy for the costs of all the CN8 products that map into this industry classification. Arguably, the median is less influenced by outliers than the average.

Thus, for each country in the sample (all EU countries, US, China and Japan) and for each 4-digit NACE Rev. 2 manufacturing sector in which CN8 products map, we take the cost level of the median firm for that country-sector to be a proxy for the marginal cost of a country-product variety exported by that particular country.

Finally, to construct the quality indicator, for each product exported by a country to the destination market we compute the normalized quality rank as in Vandebussche (2014): in each narrowly-defined product category (CN8), we compare exports of 31 countries of origin (EU MS, US, China, Japan) exporting to the EU. A quality rank of 1 reflects the highest quality in the EU market for a particular "country of origin-product", while a rank of 0 is the lowest quality rank. It is important to note that, in assigning a quality rank to a product, we take into account the number of other countries also exporting the same product to the EU market.

Graph II.1: Average export quality rank in manufacturing, 2005-2016



(1) See Box II.1 for details on the construction of the indicator. (2) Purple bars identify euro area countries.  
**Source:** European Commission services calculations from Orbis and ComExt

Box II.1 explains the procedure and the data used to obtain this measure of quality. Previous work has shown that quality, measured using this indicator, is positively related to export performance, once taking demand effects due to product and geographical composition into account.<sup>(104)</sup> This section goes beyond, by showing the drivers of export quality and hence, indirectly, of export performance.

As explained in Box II.1, the quality indicator used here is an ordinal measure of export quality, and therefore, for each product, it ranks countries from the highest quality (the value of the indicator being 1) to the lowest (i.e. the indicator is equal to zero). In other words, quality is defined in relative terms.

Graph II.1 shows the weighted average ranking of euro area countries' exports in 2015 as well as the EU, China, US and Japan using this indicator.

Considering, as a caveat, that values for smaller economies (e.g. Luxembourg, Cyprus and Malta) might be affected by statistical issues (due to the limited size of manufacturing exports), using this indicator, it appears that the highest-quality exports in the euro area come from Ireland, France and Austria. We will come back to this point in sub-section II.5.

<sup>(104)</sup> 'Assessing the price and non-price competitiveness of the euro area' *Quarterly Report on the Euro Area (QREA)*, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission, vol. 16(1), pages 37-47, March.

### II.3. What determines export quality? A descriptive view

Since we have discussed how export quality matters, how can we explain differences across countries in the quality of their products?

The first theory of quality specialization in international trade was proposed by Linder (1961). He suggested that high-income countries tend to export higher-quality products because profitably selling such type of products requires robust demand in the home market.<sup>(105)</sup> In other words, the strength of the home-market demand is a key determinant of export specialization. The "Linder hypothesis" was then formalized by Fajgelbaum et al. (2011).<sup>(106)</sup>

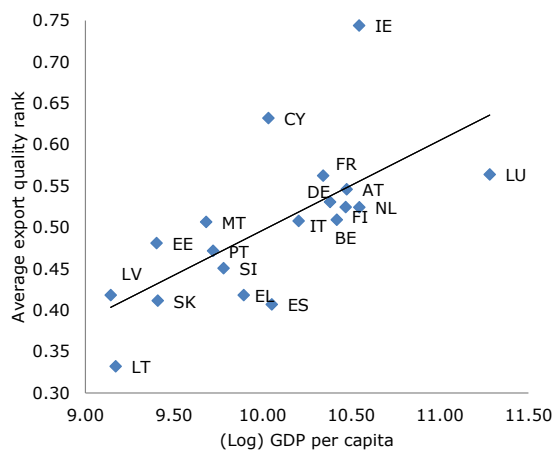
The positive relationship between income per capita and quality is also true on the imports side: higher-quality products tend to be sold more in high-income destinations, because the relative demand is higher there.<sup>(107)</sup>

The factor-abundance theory suggests, instead, that countries should export goods which use intensively the factors that are relatively abundant in those countries. Since high-income countries have higher supply of skilled labour and capital, to the extent that quality is skill-intensive, high-income countries should have comparative advantage in exporting high-quality products.<sup>(108)</sup>

According to both the Linder hypothesis and the factor-abundance theory of comparative advantage, we should thus observe a positive correlation between income per capita and export quality. This is indeed the case for euro area countries, as shown, in a purely descriptive fashion, in Graph II.2, where export quality is defined using the indicator introduced above and outlined in Box II.1.<sup>(109)</sup>

<sup>(105)</sup> Linder, S. (1961), *An essay on trade and transformation*. Almqvist & Wiksell, Stockholm.  
<sup>(106)</sup> Fajgelbaum, P., Grossman, G. M., and E. Helpman (2011), 'Income Distribution, Product Quality, and International Trade', *Journal of Political Economy* Vol. 119(4), pp. 721-765.  
<sup>(107)</sup> Bastos, P., Silva, J. and E. Verhoogen (2017), 'Export destinations and input prices', *American Economic Review*, forthcoming.  
<sup>(108)</sup> Dingel, J. I. (2016), 'The determinants of quality specialization', *Review of Economic Studies* 2016-01, pp. 1-35.  
<sup>(109)</sup> Crinò, R. and P. Epifani (2012), 'Productivity, quality and export behavior', *The Economic Journal* Vol. 122, pp. 1206-1243.

**Graph II.2: GDP per capita and export quality in euro area countries, 2005-2015**



**Source:** Eurostat and author's calculations

Hausmann et al. (2007) discuss that if what countries produce and export (also in terms of the inner quality) was determined only by their endowments of production factors as well as natural resources, policies that aim at reshaping production beyond these fundamentals would be sub-optimal and asking what determined export quality would not be relevant from a policy perspective.<sup>(110)</sup> However, the authors show that this is not the case. In addition, since not all goods have the same implications for export performance and producing goods with higher implied productivity is associated to higher economic growth, there is indeed room for policy to have a positive impact on the production structure of the economy.<sup>(111)</sup> In other words, whilst the determinants of quality specialization are slow-moving, and in this sense akin to endowments, they are mainly man-made and policy may therefore have a role to play.

Institutions have been shown to be as important as human and physical capital endowments in this respect. In particular, Hausmann et al. (2007) show that, in a setting in which there are costs associated to discovery and innovation (while positive externalities are also present), the economy is more likely to get closer to its productivity frontier if the government is able to engage a sufficiently large number of entrepreneurs in cost discovery in the modern sectors of the economy.<sup>(112)</sup> In a similar way, the literature suggests that a country's ability

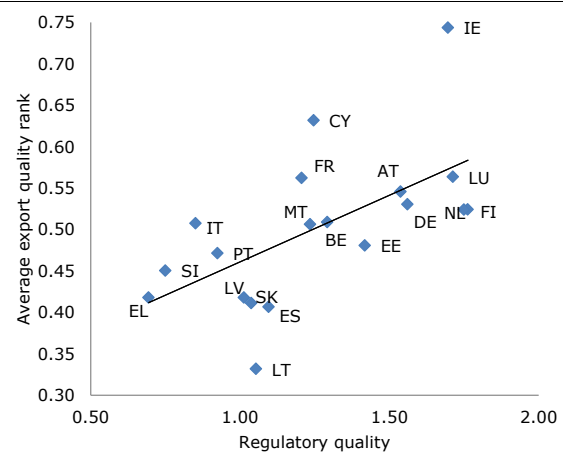
<sup>(110)</sup> Hausmann et al. (2007), *op. cit.*

<sup>(111)</sup> Hausmann et al. (2007), *ibid.*

<sup>(112)</sup> Hausmann et al. (2007), *op. cit.*

to enforce contracts (Nunn, 2007) and, more generally, the quality of its institutions and level of human capital (Costinot, 2009) are key determinants of comparative advantage.<sup>(113)</sup> To provide an intuition of this, Graph II.3 plots average export quality for euro area countries against the World Bank indicator of regulatory quality, showing indeed a positive relationship between the two, with a correlation of 0.64. A more formal econometric analysis is presented in the following sub-section.

**Graph II.3: Institutions and export quality in euro area countries, 2005-2015**



**Source:** World Bank and author's calculations

#### II.4. Taking the theory to the data

As mentioned in sub-section II.3, the "Linder hypothesis", as well as previous empirical analysis, suggests that richer countries spend a larger proportion of their income on high-quality goods. Moreover, since closeness to demand is a source of comparative advantage, richer countries would have a comparative advantage in the production of high-quality goods. In other terms, quality and GDP per capita should be significantly and positively related.

Moreover, the quality of institutions (including the regulatory environment), apart from affecting some of these factors, should also affect export quality

<sup>(113)</sup> Nunn, N. (2007), 'Relationship-specificity, incomplete contracts, and the patterns of trade', *The Quarterly Journal of Economics* Vol. 122(2), pp. 569-600. Costinot, A. (2009), 'On the origins of comparative advantage', *Journal of International Economics* Vol. 77(2), pp.255-264.

directly, as discussed in the previous section.<sup>(114)</sup> It cannot be denied, however, that institutional quality tends to be correlated with GDP per capita. Therefore, by controlling for the latter we can pin down the role of institutions in determining export quality.

Other things equal, higher quality should be associated with the use of relatively more sophisticated or "high-quality" inputs as well as research and development (R&D) activity, and recent empirical literature has confirmed that indeed the complexity of inputs is related to firms' ability to upgrade their output. <sup>(115)</sup>

As mentioned above, export quality has also been shown to be related to the income in destination markets. <sup>(116)</sup> However, since the quality indicator used here is constructed using a common destination market (i.e. the EU28, see Box II.1), we do not investigate this channel.

In our empirical setting, export quality is therefore expressed as a function of country-specific and sector-specific factors: country-specific factors, following the discussion above, are GDP per capita, skills level and institutional variables. Sector-specific variables are related to the endowment of inputs that are relevant to the production in the sectors, i.e. technology, research etc.

More precisely, "inputs" in this context are (i) the share of high-tech knowledge-intensive services sectors in the value added of a sector's exports (*kibs*) and (ii) STEM-industries (where STEM stands for Science, Technology, Engineering and Mathematics) value added shares of gross exports of a given sector (*stem*). <sup>(117)(118)</sup> These two variables are our proxies for "high-quality inputs".

*patent* is the sectoral patent intensity, measured as the number of patents divided by the number of employees. This is preferred to R&D intensity as a measure of research activity due to better coverage in our data. The skills are proxied by the share of working population with a tertiary degree (*sh\_tertiary*).

Finally, at country level, exports quality should also be affected by the quality of institutions. We measure the quality of institutions using the World Bank's (i) regulatory quality indicator and (ii) government efficiency indicator.

Based on the above, the regression run is the following:

$$\widetilde{qual}_{ijt} = \alpha + \beta_1 gdppc_{it} + \beta_2 X_{ijt} + \beta_3 Z_{it} + \varepsilon_{ijt}$$

where  $X_{ijt}$  is the vector of sector-specific determinants of quality, i.e. the variables previously defined *kibs*, *stem* and *patent* while  $Z_{it}$  is the vector of country-specific determinants apart from GDP per capita. The  $i$  stands for the country while  $j$  indicates the sector. Since quality is not directly observable, but estimated with the approach outlined in Box II.1, it is indicated with a tilde.

Since institutional variables do not vary much during the period, they are close to being fixed effects. Including all of them would create multicollinearity problems. Therefore, in what follows, we report the results of the pooled OLS regressions and include some of the variables one at the time. Moreover, given the construction of the quality indicator, there is no need to include sector-specific fixed effects.

To test which factors explain export quality differences within the euro area, we use data for the 19 euro area countries over the period 2005-

<sup>(114)</sup> Thum-Thysen, A. Voigt, P., Bilbao-Osorio, B., Maier, C., and D. Ognyanova (2017), 'Unlocking Investment in Intangible Assets', *European Economy Discussion Paper* 047.

<sup>(115)</sup> Kugler, M. and E. Verhoogen (2012), 'Prices, plant size, and product quality', *Review of Economic Studies* 79, 307-339.

<sup>(116)</sup> Bastos, P. et al. (2017), *op.cit.*

<sup>(117)</sup> *kibs* services are: Motion picture, video and television programme production, sound recording and music publishing activities; Programming and broadcasting activities; Telecommunications; Computer programming, consultancy and related activities; Information service activities; Scientific research and development.

<sup>(118)</sup> An industry is classified as STEM if more than 13.5% of its labour force has a STEM education. The classification of STEM industries follows Goos, M. et al. (2016). These include Chemicals; Pharmaceuticals; Computer, Electronic and Optical

products; Electrical equipment; Machinery and equipment n.e.c.; Motor Vehicles; Other Transport equipment; Electricity and Gas, Water Collection, Recycling; Postal and courier; Telecommunications; Computer consultancy; Legal and accounting; Architectural and engineering; Research and Development; Advertising and market research; Other scientific activities; Administrative and support services; Human health and social work. The variables *stem* and *kibs* are constructed using data from the world input-output database (WIOD).

2015 spanning 17 manufacturing sectors (NACE-Rev. 2 decomposition at two-digit level). <sup>(119)</sup>

**II.5. Results**

The results of the empirical analysis are reported in Table II.1. As expected, higher GDP per capita is always associated with higher export quality (in other words, the "Linder hypothesis" is confirmed). In particular, a 1% increase in GDP per capita is associated with an increase of 0.05-0.09 pps. in (relative) export quality.

More importantly, the quality or "complexity" of the inputs used in production always has a significant and economically relevant impact on quality. Increasing the share of STEM inputs by 1 pp. is associated with an increase in quality of almost 0.9 pps., while increasing the share of high-tech knowledge-intensive services by 1 pp. raises quality by 3-4 pps. in the full specification.

**Table II.1: Determinants of export quality**

	(1)	(2)	(3)	(4)	(5)	(6)
<i>GDPpc</i>	0.084*** (0.008)	0.047*** (0.008)	0.078*** (0.006)	0.048*** (0.008)	0.053*** (0.007)	0.065*** (0.009)
Skills/R&D						
<i>Patent intensity</i>	0.136*** (0.047)					-0.053 (0.075)
<i>Share of Tertiary</i>	0.195*** (0.061)	-0.06 (0.065)	0.081 (0.058)	-0.069 (0.066)	-0.061 (0.064)	0.02 (0.066)
Inputs						
<i>High-tech serv.</i>	0.284*** (0.085)	0.528*** (0.075)	0.344*** (0.079)	0.433*** (0.083)	0.410*** (0.082)	0.280*** (0.085)
<i>STEM inputs</i>			0.093*** (0.012)	0.089*** (0.012)	0.090*** (0.012)	0.092*** (0.015)
Institutions						
<i>Govvern. Eff.</i>		0.053*** (0.007)		0.051*** (0.007)		
<i>Reg. Quality</i>					0.065*** (0.009)	0.062*** (0.010)
<i>Constant</i>	-0.412*** (0.072)	-0.096 (0.067)	-0.376*** (0.053)	-0.125* (0.070)	-0.189*** (0.062)	-0.307*** (0.081)
Observations	2,036	3,230	3,215	3,215	3,215	2,036
R-squared	0.143	0.151	0.158	0.169	0.171	0.181

Note: OLS regressions. Heteroskedasticity and autocorrelation-robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Source:**

Institutional quality always has a positive and significant impact on export quality, and this is true using both the regulatory quality variable and government efficiency. <sup>(120)</sup> Patent intensity also is

<sup>(119)</sup> We include all manufacturing sectors in the NACE Rev.2 decomposition at two-digit-level except printing and reproduction of recorded media due to lack of data.

<sup>(120)</sup> These variables were inserted separately in the regression due to multicollinearity. As a robustness check, alternative variables proxying the quality of institutions were used, namely (i) control of corruption and (ii) rule of law. The result was confirmed and the impact of institutions was always positive and significant in all cases.

positively related to quality of exports, although this effect is no longer significant in the fully-specified model. The same holds for the share of population with tertiary education.

Since some data and also the export quality indicator might be volatile for smaller countries, including Ireland, due to statistical reasons, as a robustness check we have performed the regressions excluding Ireland, Malta, Cyprus and Luxembourg. All results were confirmed.

One limitation of the specification in Table II.1, which might explain why some coefficient are no longer significant in column (6), is that it imposes a common elasticity of quality to its determinants across sectors (and countries). This may also explain the fact that the R<sup>2</sup> of the full specification is not very high, being just above 0.18. In fact, input "sophistication" and skills may have different impact on export quality in different sectors, in particular depending on the sectors' technological intensity.

Following the OECD ISIC Rev.3 classification, we can identify four groups of sectors by technological intensity: low-tech, medium-low-tech, medium-high-tech and high tech. Table II.2 reports the classification of NACE Rev.2 manufacturing sectors based on the technological intensity.

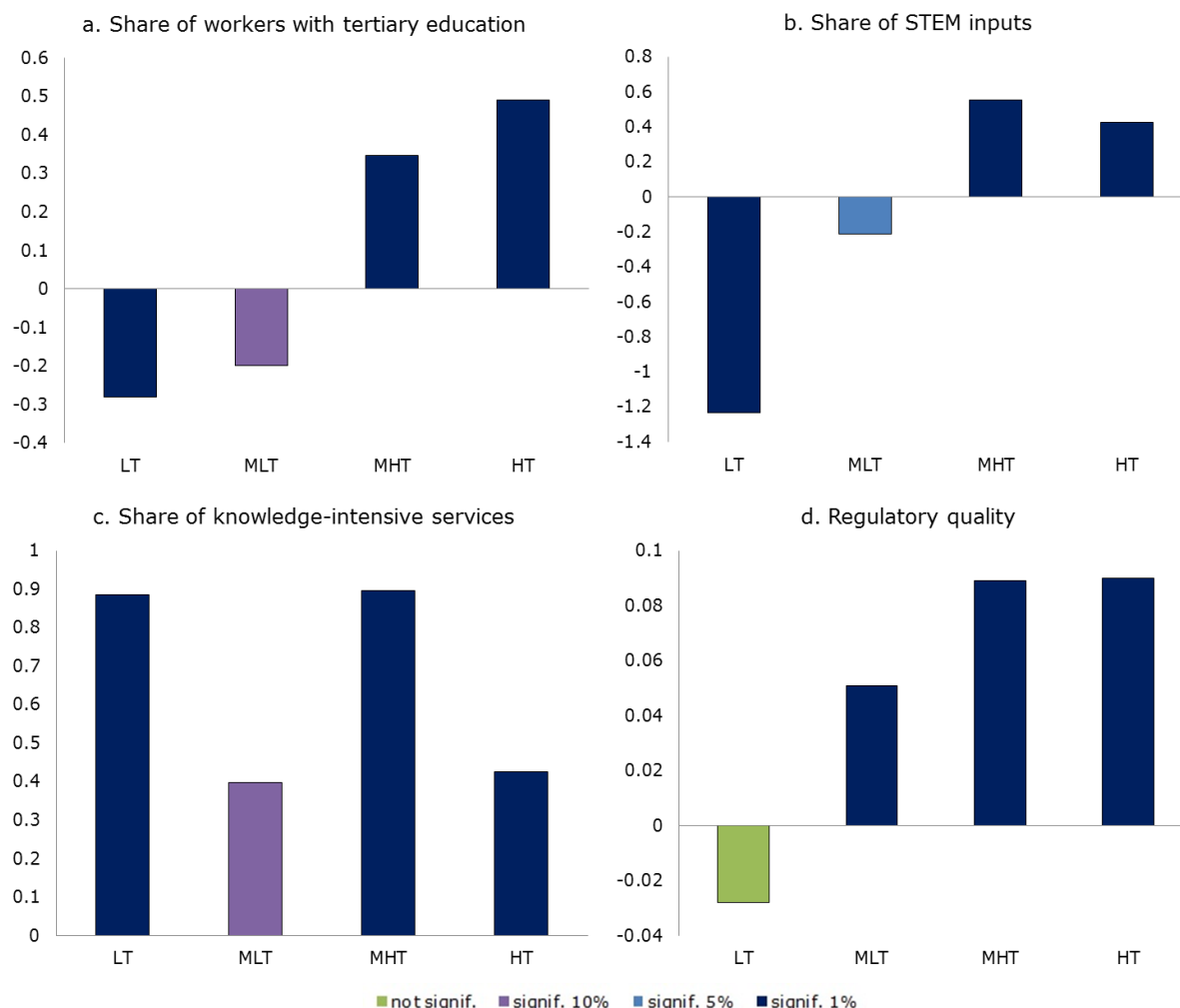
**Table II.2: Sectors' technological intensity**

Tech. Intens.	NACE	Description
	C10-C12	Food Products; Beverages; Tobacco
	C13-C15	Textiles, Wearing Apparel, Leather And Related Products
Low-Tech	C16	Wood and products of wood and cork, except furniture; Articles of straw and plaiting materials
	C17	Paper And Paper Products
	C31-C32	Furniture, Other Manufacturing
	C22	Rubber And Plastic Products
	C23	Other Non-Metallic Mineral Products
Medium-Low Tech	C24	Basic Metals
	C25	Fabricated Metal Products, Except Machinery And Equipment
	C19	Coke And Refined Petroleum Products
	C20	Chemicals And Chemical Products
Medium-High Tech	C27	Electrical Equipment
	C28	Machinery And Equipment N.E.C.
	C29	Motor Vehicles, Trailers And Semi-Trailers
	C30	Other Transport Equipment
High-Tech	C21	Basic Pharmaceutical Products and Pharmaceutical Preparations
	C26	Computer, Electronic And Optical Products

Note: Technological intensity is based on the OECD ISIC Rev.3 classification.

**Source:** Eurostat

Graph II.4: **Export quality and its determinants for goods with different technological intensity**



(1) LT = low-tech; MLT = medium-low tech; MHT = medium-high tech; HT = high-tech. The bars represent the regression coefficients from equation (2) performed separately for sectors with different technological intensity. Different colours represent different significance levels as indicated in the legend.

**Source:**

We therefore performed the regression with the "full specification" (i.e. as in column (6) of Table II.1), which gave the best fit and is in line with our prior (theoretical) discussion, separately by sector according to technological intensity. The regressions performed by sector presented a better fit, being on average 0.27.<sup>(121)</sup> As shown in Graph II.4, the coefficients of the key variables tend to be higher for sectors which are more high-tech. In other words, the higher the technological intensity of the industry, the more relative quality

depends on "good" institutions and "good" or "sophisticated" inputs.<sup>(122)</sup>

For low-tech goods, instead, these factors appear less important or even negatively related to quality. In Graph II.4, the negative sign of the coefficient of some variables on the quality of low-tech exports may look puzzling at first sight. However, it may be explained by the fact that other factors, not included in our specification, actually affect relative quality, and the ones we included would

<sup>(121)</sup> Detailed results are available upon requests.

<sup>(122)</sup> All coefficients are significant at 1%, except the coefficient of regulatory quality for medium-low-tech industries which is significant at 5%.



not be a good substitute for such factors. <sup>(123)</sup> <sup>(124)</sup> Moreover, higher-technology sectors are typically characterised by longer quality ladders, and thus the potential for quality improvement is higher there, which explains why elasticities should be higher.

Our results in Table II.1 and Graph II.4 also show the importance of services for competitiveness, as a higher share of high-tech knowledge-intensive business services is associated with higher export quality, regardless of the technological intensity of the sector considered. Thus, different aspects of non-cost competitiveness also affect and reinforce each other. <sup>(125)</sup>

Previous empirical work has shown that reforms liberalizing the services sectors have a large potential in terms of improvements in efficiency and reduction of mark-ups, and ultimately on trade balances. <sup>(126)</sup> To the extent that reforms liberalizing services boost the demand of those services, our results go in a similar direction, since they suggest that a higher use of "sophisticated" services may have important effects on non-cost competitiveness.

Finally, in our regressions "good" institutions and inputs "trump" the effect of patents. This does not imply, however, that they are substitutes for R&D. On the one hand, by definition, STEM industries and knowledge-intensive services have a higher technological content, and thus might already capture the effect of R&D (patent intensity). As far as institutions are concerned, the result might mean that the same underlying factors that lead to better institutions in a country also increase R&D. This

interpretation is supported by recent studies that showed that institutions foster investment in intangible goods, including R&D (see Thum Thysen et al., 2017, *op.cit.*).

## II.6. Conclusions

This section has discussed the determinants of sectoral quality of exports in euro area countries. Quality is an important component of competitiveness on the non-cost side, but it is not easy to measure and there are a number of competing approaches to the measurement of quality provided by the literature.

The empirical analysis has shown some of the determinants of quality in exports for euro area countries. The positive relationship between export quality and exporter income per capita is well-known based on the Linder hypothesis. The main added value of this work has been to investigate the supply-side determinants of quality, while controlling for the demand side (i.e. GDP per capita), with a specific focus on the sectoral dimension.

While it is difficult, or perhaps impossible, to have a complete picture of what fosters quality improvements, we could identify three categories of factors (in addition to the level of GDP per capita) which can have important implications for the non-cost competitiveness of the euro area. These factors are institutions, skills and input composition. Their relevance seems to increase with the technological intensity of the goods exported, supporting the view that the potential for quality improvement in high-tech sectors is higher (i.e. there are longer "quality ladders").

Further work might explore the impact of competitive pressure, including international competition, on export quality, although defining a good measure for competitive pressure at a product or sector level in this framework may be challenging.

Higher-quality exports, as discussed in this Section, have been previously shown in the economic literature to be less affected by price competition, and improvements in quality are associated with economic growth. The results reported in this Section also suggest that policy has a potential for fostering quality improvements, as the export composition does not seem to be solely affected by economic fundamentals.

<sup>(123)</sup> For example, for what concerns the exports of food, beverages and tobacco products (NACE sectors C10-12, low-tech) other factors including a well-developed primary sector, natural resources and even climate might be relevant in defining relative export quality. This would apply also to the fact that regulatory quality (and also control of corruption) seems not to affect significantly the quality of low-tech products.

<sup>(124)</sup> The coefficient of patent intensity and GDP per capita did not change significantly across sectors.

<sup>(125)</sup> See also Nordås, H. and Y. Kim (2013), 'The Role of Services for Competitiveness in Manufacturing', OECD Trade Policy Papers, No. 148, OECD Publishing, Paris, the Section 'The euro area services sector', Quarterly Report of the Euro Area, Vol.14, n.2 (2015), and the Section 'A closer look at some drivers of trade performance at Member State level', Quarterly Report of the Euro Area, Vol.11, n.2 (2012).

<sup>(126)</sup> Canton, E. Ciniaci, D. and I. Solera (2014), 'The economic impact of Professional Services Liberalization', *European Economy Economic Papers* 533; Varga, J. and J. in't Veld (2014), 'The potential growth impact of structural reforms in the EU - A benchmarking exercise', *European Economy Economic Papers* 541.