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market size of export destinations on  
manufacturing growth**

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# Export Market Size Matters:

## The effect of the market size of export destinations on manufacturing growth

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### *Abstract*

*Literature contends that the manufacturing sector is crucial for economic development, and it is conventional wisdom that exports drive manufacturing growth. However, it has not yet been established empirically whether the market size of export destinations is an important factor to explain diverging regional and sectorial manufacturing growth patterns. This article argues that accessing large external markets reduces transaction costs, increases expectations of economies of scale and fosters capital formation. To test this hypothesis, we construct a novel Relative Export Market Size (REMS) index that measures whether the share of sectoral exports that are destined to large economies in one region is higher than in other regions. Using a PVAR model, we verify the impact of the REMS index on value added, employment and capital accumulation of 129 manufacturing sectors in 23 regions in Colombia during the period 1992-2017. The obtained results show that exporting to larger markets has a positive impact on employment, capital formation and value added per capita of manufacturing sectors at a regional level. This finding indicates that exporting to the largest market of the world helps to develop competitive manufacturing sectors.*

**Keywords:** Export market size; manufacturing exports; trade; manufacturing growth; regional growth; industrialization

**JEL codes:** F14; O14; R11

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## INTRODUCTION

Economic literature argues that it is disadvantageous for countries to mainly concentrate on the extraction of raw materials or to focus prematurely on the production of services without having developed a solid manufacturing sector beforehand. That is because the productivity growth rates of the manufacturing sector tend to be larger than that of other sectors and because it produces tradable goods that do not face domestic demand constraints (Rosenstein-Rodan, 1943; Prebisch, 1950; Hirschman, 1958; Kaldor, 1967; Thirlwall, 1983; Wade, 1990; Rodrik, 2016; Haraguchi, 2017).

Likewise, it has been shown that economic growth is balance of payment constrained (Thirlwall, 1979; Spinola, 2020), and that export intensity is an important determinant of manufacturing growth (Chenery, 1980; Melitz & Trefler, 2012) and explains diverging sub-national industrial developments (Leichenko, 2000; Gao, 2003). Moreover, the New Economic Geography (NEG) literature argues that countries that are located close to countries with high income levels experience higher GDP per capita growth, given that they can take advantage of the large external markets (Head & Mayer, 2011); and previous studies show that export market heterogeneity matters because firms that export to countries with a higher level of development tend to have larger productivity gains from exports (De Loecker, 2007; Crinò & Epifani, 2012). However, to the best of our knowledge, it has not yet been established if the market size of export destinations also plays a role in explaining diverging regional and sectorial manufacturing growth patterns within a country.

This article argues that those manufacturing sectors and regions that sell their products to large external markets experience more beneficial effects from exporting than those that sell their products to small markets. This is because exporting to few large markets implies lower transaction costs than exporting to many small markets. The higher profitability of exports to countries with higher demand levels means that fixed costs are more likely to be recovered, which fosters innovation and physical capital formation and has positive effects on manufacturing value added and employment. Moreover, exporting to large economies can enable industries to better circumvent potential lack of demand problems and increases their expectations of economies of scale.

To test this hypothesis, we use Colombia as a case study. The country is an interesting and useful case study for our purpose for three main reasons. First, it has very good data availability with census-like annual manufacturing data at the state level. Second, the country demonstrates important heterogeneity between manufacturing sub-sectors and regions – for example, the best performing state has a value added per capita that is 90 times higher than the worst performing state. Third, Colombia has suffered from the phenomenon of premature deindustrialization: its manufacturing value added declined from approximately 18% of GDP in 1990 to 11% in 2017 (World Bank, 2020). This decline in value added might solely reflect the fact that the country’s comparative advantage in manufacturing is low or that the country suffered from Dutch Disease issues (on the latter see Goda & Torres, 2015). However, in accordance with our hypothesis, an additional reason might be the circumstance that the country’s incurrence in large exports markets declined substantially: in 1990 nearly 50% of Colombia’s manufacturing exports were sold to the USA, Western Europe and East Asia and Pacific (which together represent approximately 75% of global demand), whereas this figure dropped to 27% in 2017.

To test our hypothesis that potential export market size to some extent explains diverging manufacturing growth patterns, we first construct a novel Relative Export Market Size (REMS) index that measures whether the share of sectoral exports that are destined to large economies in one region is higher than in other regions. In a second step, we verify the impact of the REMS on per capita value added, employment, physical capital accumulation of 129 manufacturing sectors in 23 regions in Colombia during the period 1992-2017 using a Panel Vector Autoregressive (PVAR) model. This model is suitable for our purpose because it allows the inclusion of a variable of interest that is endogenous and depends on the lags of its own value and the values of other macroeconomic variables.

The descriptive statistics show that approximately 30% of Colombia’s regional sectors have access to relatively large markets (i.e., their REMS index is above 0)<sup>1</sup>. The data moreover reveals that, on average, these regional sectors have higher per capita value added, capital stock and employment. In line with this indicative evidence, the PVAR regression results indicate that export market size has a statistically significant impact on the growth of manufacturing sectors and regions. The impulse responses show that, when the REMS index increases permanently by 0.1

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<sup>1</sup> The REMS index ranges from -1 to 1.

points, long-term manufacturing employment, capital stock and value-added per capita rise by 1.3%, 1.4% and 1.6%, respectively. These results are not driven by export intensity (i.e., REMS values are not correlated with export to sales ratios) and are robust when non-exporters are excluded from the sample.

The remainder of this article is structured as follows: Section two outlines the theoretical framework for our hypothesis that the potential export market size matters for the growth performance of manufacturing sectors and regions; section three discusses the methodology and data used to derive the REMS index and to estimate the PVAR regressions; section four gives an overview of the descriptive statistics; section five presents the empirical results; and section six concludes.

## **THE EFFECT OF EXPORT MARKET SIZE ON MANUFACTURING GROWTH**

The positive relationship between exports and manufacturing sectors' performance is well documented. It has been shown that the promotion of exports, together with other industrial policies such as the substitution of imports and public investment in education and R&D, has been a key component of the development process of manufacturing sectors in East Asian countries (see e.g., Bruton 1998; Chang, 2002; Palma, 2009). Moreover, empirical evidence indicates that exporting in general has beneficial effects on manufacturing productivity, value added and employment at the firm and aggregate level (see e.g., Lileeva, 2008; Lileeva & Trefler, 2010; Melitz & Trefler, 2012; Munch & Schaur, 2018; Doan & Long, 2019; Kacou et al., 2022).

With regard to exports and industrial growth at the sub-national level, Erickson (1989) finds significant correlations between export intensity and manufacturing employment and value-added growth in US states. Similarly, Leichenko's (2000) results show a significant positive relationship between exports and manufacturing production in US states (with some differences between regions). In contrast to previous research, he uses a VAR analysis and establishes that US export growth causes regional manufacturing value added growth (and vice versa). Similar results have been reported for China. Gao (2004) finds that the substantial variations in industrial output that are observed between Chinese regions can be explained to a large extent by diverging export intensity; Yao (2006) shows that exports have a strong and significant positive effect on Chinese

regional economic growth; and Jin et al.'s (2008) results indicate that exports as a percentage of regional GDP is the most robust variable to explain regional growth in China during the period 1988 to 2003.

From a theoretical point of view, Melitz (2003) and Helpman et al. (2008) argue that exports are beneficial for the aggregate productivity of the manufacturing sector because they foster the reallocation of labour and capital from low- to high-productivity firms. The reason for this reallocation effect is that “better-performing firms thrive and expand into foreign markets, while worse performing firms contract and even shut down in the face of foreign competition” (Melitz and Trefler, 2012: 92). Moreover, it has been shown that exports induce innovation at the firm-level. This is because, on the one hand, firms learn from exporting, especially those in developing countries. The adoption of new technology and innovation, in turn, is seen as vital for exporters as it enables them to raise their productivity and to compete successfully in international markets. On the other hand, only those firms that have access to sufficiently large markets will find it profitable to cover the up-front fixed costs that are related with innovation like physical capital formation and technology adoption (Grossman & Helpman, 1990; 1991; Hallward-Driemeier et al., 2002; Barlock & Gertler, 2004; Lileeva & Trefler, 2010).

The literature also shows that it is not enough to export just any product, but that the types of products exported, and their variety, is a crucial determinant of economic growth. More precisely, it has been shown that sub-national regions that export a higher variety of products have higher value-added growth (Boschma & Iammarino, 2009; Boschma et al., 2012). Moreover, there exists ample evidence that countries and regions that have a comparative advantage in complex technology-intensive products tend to grow faster (see e.g., Hausman et al., 2007; Hidalgo et al., 2007; Lee, 2010; Jarreau & Poncet, 2012; Hartmann et al., 2021). An important rationale behind the latter finding is the elastic demand for higher productivity goods in world markets.

The importance of market size is also stressed by the NEG literature (Martin & Sunley, 1996). The first generation of NEG models shows that countries specialise in those industries for which they have a large domestic market (given that transaction costs are relatively low), and that the resulting agglomeration and increasing returns to scale effects mean that each country will become more productive and “a net exporter in the industry for whose products it has the relatively larger [domestic] demand” (Krugman, 1980: 955). The second generation of NEG models shows that it

is also important to consider the external market potential. Essentially, the potential of external markets depends on the purchasing power of the respective export destination (Redding & Venables, 2004; Hanson, 2005; Head & Mayer, 2011). Accordingly, Lawless & Whelan (2014: 1028) provide empirical evidence that “distance and GDP, do an excellent job of capturing the systematic factors explaining how many firms will choose a particular destination”.

This focus of NEG on market size effects is closely related to the Big Push literature of industrialization, given that larger markets help industries to reduce the risk of investment and to exploit the benefits of economies of scale (Martin & Sunley, 1996). Especially in developing countries, domestic demand is often not large enough to enable firms and industries to reach sufficiently large scales – even more so when the manufacturing sector does not represent a significant proportion of GDP because then the agricultural and service sector surplus must be large enough to be capable of demanding manufactured goods.

Moreover, in line with Verdoorn’s (1949) law, it can be expected that productivity growth tends to be low when (external) demand is not high enough. This potential lack of demand problem can be circumvented by insertion into external markets (Murphy et al., 1989). Van Biesebroeck (2005), for example, finds empirical evidence that exporters exhaust scale economies, whereas non-exporters produce at a point on the production frontier that leaves significant potential for increasing returns to scale. Evidently, the larger the external market size, the more capable firms are to saturate their economies of scale (Melitz & Trefler, 2012).

In principle, high exports can be achieved by exporting to many small- and medium-sized economies or by exporting to few large economies. The second alternative can be seen as superior to the first one. Expansion into new markets entails up-front fixed costs and transaction costs, which means that entering into few large economies is more efficient than entering into many small- and medium-sized economies. Moreover, large economies have a larger market potential than small- and medium-sized ones. Hence, theoretical trade models assume that “the profitability of exports varies by destination; it is higher for exports to countries with higher demand levels...” (Helpman et al., 2008: 443), so that exporting firms first enter into the largest destination (Melitz, 2003).

When assuming that the profitability of exports to destinations with a high purchasing power is higher, it can also be hypothesized that those firms/sectors/regions that export to larger economies

tend to invest and grow more than those that do not. If this hypothesis is correct, exporting to countries with a high GDP should affect positively the valued added, employment and capital stock of manufacturing sectors and regions within a country. The intention of the remainder of this article is to verify empirically the existence of such a relationship.

## METHODOLOGY

### *Calculation of the Relative Export Market Size (REMS) index*

To test the hypothesis that those sectors and regions that export to large markets perform better than those that export to small- and medium-sized markets, we first construct a new index to measure whether the share of sectoral exports that are destined to large economies in one region are higher than in other regions. This index, which we call the  $REMS^N$  index, is similar to a relative trade intensity index, with the main difference that the percentage of exports that is going to a partner country is interacted with the GDP of this destination (i.e., with the country's market size):

$$REMS_{dst}^N = \frac{\sum_p \frac{X_{dspt}}{X_{dst}} * Y_{pt}}{\sum_p \frac{X_{spt}}{X_{st}} * Y_{pt}} \quad (1)$$

where  $t$  is time,  $s$  denotes manufacturing sector,  $d$  refers to region,  $p$  denotes commercial partner countries,  $X$  is export values in real USD and  $Y$  is real GDP in USD.

The  $REMS^N$  index reaches high (low) values when the exports of sector  $s$  in region  $d$  are mainly destined for relatively large (small) economies ( $p$ ). Given that it is a relative index, its values are not affected when the real GDP of all partner countries grows at the same rate, or the export values to each partner country change in equal proportions. Moreover, the index is not dependent on the export intensity of a sector, i.e., sectors that have a high exports-to-sales ratio but mainly export their products to small economies have a low  $REMS^N$  value, vice versa.

The  $REMS^N$  index is asymmetric with values between 0 (no exports of  $s$  in  $d$ ) to infinite. To make it symmetric and to simplify its interpretation, we follow Brasili et al. (2000) and apply the following monotonic transformation:

$$REMS_{dst} = \frac{REMS_{dst}^N - 1}{REMS_{dst}^N + 1} \quad (2)$$



This adjustment is similar to a logarithmic transformation, in the sense that it reduces the standard deviation and the weight of extreme observations; but it has the advantage that it can be used along the entire rank of numbers (including zero values). The adjusted *REMS* index takes values between -1 and 1, and numbers above 0 imply that the GDP of the commercial partners from sector  $s$  in region  $d$  is larger than the sector's national average.

### ***Empirical model***

To verify whether manufacturing sectors with higher *REMS* index value grow faster, we consider three commonly used variables: employment ( $e$ ), fixed capital stock ( $k$ ), and value added ( $va$ ). All of these variables are log transformed and normalized by the population size of each region to make the data better comparable and to account for sectorial specialization patterns between industries.

To estimate the causal relationship between the *REMS* index and the three variables, a PVAR model is used. PVAR estimates consider short-run dynamics and long-run equilibrium relationships, presume error correlation and allow the use of variables that have bi-directional impacts. In contrast to univariate dynamic panel regressions, autoregressive PVAR regressions explicitly allow the inclusion of a variable of interest that is endogenous and depends on the lags of its own value and the values of other macroeconomic variables (Koop & Korobilis, 2016). This elimination of endogeneity concerns is particularly useful in our case, given that it can be assumed that all of the variables considered are to some extent endogenous. Theoretical trade models suppose, for example, an entry hierarchy into export markets: all exporting firms first enter into the largest destination, whereas only the most productive firms are able to cover the additional costs involved when entering smaller ones (Melitz, 2003; Helpman et al., 2008).<sup>2</sup>

The general specification of the model is as follows:

$$W_{dst} = \theta * W_{dst-1} + \Delta_d + \Omega_s + \vartheta_{dst} \quad (3)$$

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<sup>2</sup> Although empirical studies back this hierarchy theory to some extent, their results rather suggest that the most popular destinations for exporting firms are not the largest markets but the closest ones. Eaton et al. (2011: Table 1), for example, report that for French firms Belgium/Luxembourg, Germany and Switzerland are the most popular export destinations, while the USA is only placed at rank seven; and Lawless (2009: Table 6) finds that the UK is by far the most popular market for Irish firms.

where

$$W_{dst} = \begin{bmatrix} w_{dst} \\ w_{dst-1} \\ \vdots \\ w_{dst-l} \end{bmatrix}; \theta = \begin{bmatrix} \theta_1 & \theta_2 & \cdots & \theta_{l-1} & \theta_l \\ I_n & 0 & \cdots & 0 & 0 \\ 0 & I_n & & 0 & 0 \\ \vdots & & \ddots & \vdots & \vdots \\ 0 & 0 & \cdots & I_n & 0 \end{bmatrix}; \Delta_d = \begin{bmatrix} \delta_d \\ 0 \\ \vdots \\ 0 \end{bmatrix}; \Omega_s = \begin{bmatrix} \omega_s \\ 0 \\ \vdots \\ 0 \end{bmatrix}; \vartheta_{dst} = \begin{bmatrix} v_{dst} \\ 0 \\ \vdots \\ 0 \end{bmatrix};$$

likewise,

$$w_{dst} = \begin{bmatrix} REMS_{dst} \\ k_{dst} \\ e_{dst} \\ va_{dst} \end{bmatrix}; \theta_1 = \begin{bmatrix} \theta_{11}^i & \theta_{11}^i & \theta_{11}^i & \theta_{11}^i \\ \theta_{11}^i & \theta_{11}^i & \theta_{11}^i & \theta_{11}^i \\ \theta_{11}^i & \theta_{11}^i & \theta_{11}^i & \theta_{11}^i \\ \theta_{11}^i & \theta_{11}^i & \theta_{11}^i & \theta_{11}^i \end{bmatrix}; \gamma_l = \begin{bmatrix} \gamma_1^l \\ \gamma_2^l \\ \gamma_3^l \\ \gamma_4^l \end{bmatrix}; \delta_d = \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{bmatrix}; \omega_s = \begin{bmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \\ \omega_4 \end{bmatrix};$$

$$v_{dst} = \begin{bmatrix} v_{dst}^1 \\ v_{dst}^2 \\ v_{dst}^3 \\ v_{dst}^4 \end{bmatrix};$$

while the dimensions of the expressed matrices are:

$$W_{dst}: (nl \times 1); \theta: (nl \times nl); \Delta_d: (nl \times 1); \Omega_s: (nl \times 1); \vartheta_{dst}: (nl \times 1);$$

where  $n$  stands for the number of endogenous variables,  $l$  symbolizes the number of lags used in the auto-regressive process, and vectors  $\Delta_d$  and  $\Omega_s$  are regional and sector fixed effects, respectively. The vector  $\vartheta_{dst}$  contains the estimation residuals.

The model is estimated by the generalized method of moments (GMM) methodology in order to obtain the most consistent coefficients. As it is common in VAR models, the lags of the endogenous variables will be utilized as instruments and, as suggested by Holtz-Eakin et al. (1988), the missing lags of the instruments will be treated as zeros in order to gain efficiency of the estimators. Moreover, considering that our sample is slightly unbalanced, we follow Arellano & Bover's (1995) suggestion to use the forward orthogonal deviation to gain efficiency. Impulse response functions are calculated with an 80% confidence interval that is built by 1,000 Monte Carlo simulations.<sup>3</sup>

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<sup>3</sup>To consider an 80% confidence interval is in line with previous studies (e.g., Forni & Gambetti, 2010). Please note that it could be as low as 68% to obtain reliable results (Sims & Zha, 1999).

## *Data*

The real GDP data is retrieved from the World Development Indicators database, the export data from the survey “Estadísticas de Exportaciones de Colombia” (EXPO), and the employment, value added and capital stock data from the survey “Encuesta Anual Manufacturera” (EAM). EXPO contains monthly information of all exports with a disaggregation at a 10-digit level, whereas EAM contains annual data for small, medium and large sized Colombian manufacturing firms of 23 departments, which is reliable at a 4-digit level.<sup>4</sup> Both databases are administered by Colombia’s National Statistical Department (DANE) and response by firms is mandatory, which means that the data is census-like.

The combined data from EXPO and EAM represents annual observations at the 4-digit level for 23 departments (departamentos), 129 manufacturing sectors, and the period 1992 to 2017 in constant Colombian Pesos (COP).<sup>5</sup> The 129 industrial sectors are classified according to the International Standard Industrial Classification of All Economic Activities (ISIC). ISIC’s categorisation changed twice during the sample period (Rev.2 before 2000, Rev.3 from 2000-2012, and Rev.4 from 2012 onwards); in order to make the distinct categories comparable over time, they are all brought to Rev.3. To combine Rev.2 with Rev.3, it is assumed that establishments that existed before 2000 did not change their main sector, i.e., they receive the same classification for the period 1992-1999 than they had in the year 2000 (71% of the sample). The rest is classified in line with correlatives tables from DANE (25%) or excluded from the sample (4%). Similarly, to combine Rev.4 with Rev.3, existing establishments receive the same categorisation during 2012-2017 than they had in 2011 (93%), while the rest is classified according to the correlative tables (6%) or excluded from the sample (1%).

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<sup>4</sup> EAM is based on firm-level data. However, it is not advisable to use microdata or highly disaggregated data, given that at levels above 4-digits DANE distorts the data to ensure anonymity. Similarly, the data from ten departments and that of the sectors 1600, 2414, 2430, 2729, 2922, 2927, 3000, 3210, 3220, 3230, 3312, 3330, 3511, 3512, 3530, 3692 cannot be used due to statistical reservations.

<sup>5</sup> All values are brought to constant 2014 COP by using the industrial Producer Price Index at ISIC’s two digit-level. Exports are reported as FOB in USD, while EAM data is reported in COP. To make the data comparable, we transform the USD values into COP with exchange rate data reported by the Colombian Central Bank.

## DESCRIPTIVE STATISTICS

Table 1 summarizes the descriptive statistics of the data used in the PVAR regressions, i.e., the REMS index, the log of capital stock per capita ( $k$ ), the log of employment per 100,000 habitants ( $e$ ) and the log of value added per capita ( $va$ ). The panel contains a maximum of 16,923 total observations, with a yearly average of 651 observations. The REMS index of Colombia reaches its theoretical possible minimum value of -1 and is very close to its possible maximum value of +1 (with a standard deviation of 0.53). The minimum and maximum values of  $k$ ,  $e$  and  $va$  indicate that some manufacturing sectors are not important at all for the economy of some regions, while some others are very important for some regions. The variable with the highest standard deviation is  $k$ , which suggests that Colombia's manufacturing sectors and regions are especially divergent regarding their capital intensity.

< Table 1 >

In terms of changes over time, Colombia's per capita manufacturing sector value added shows a clear upward trend at the national level between 1992 and 2007 (except for the years 1998-99 when the country experienced contagion effects from the Asian crisis and a financial crisis), but then becomes relatively stagnant and even has a clear declining tendency after 2013 (Figure 1). The latter is surprising considering the 40% depreciation of Colombian Pesos (COP) in 2014, which was not reversed until the end of the period under study.

< Figure 1 >

Similarly, the mean of the REMS index increases between 1996 and 2007 but then declines sharply and becomes stagnant in the last years (Figure 2a). Another feature of Colombia's REMS index is that it is negative throughout the whole period. The negative mean implies that that few sectors/regions export most of their exports to relatively large export markets, while most sectors/regions mainly export to relatively small export markets (and some do not export at all). The latter finding is confirmed by Figure 2b, which shows that approximately 22% of the observations do not export at all, that most observations have a REMS value of  $<0$ , and that less than one-third of the observations have a REMS index value of  $>0.5$ . It is important to note that our main findings are robust when only those sectors/regions are considered that are exporters.

< *Figure 2* >

In 2017 the weighted mean of regional manufacturing value added was approximately US\$ 550 per capita, but stark differences existed between regions (Figure 3a). The relative standard deviation was about 60%, with only 7 out of the 23 departments having a value added per capita above the mean. The most industrialized region (Cundinamarca) produced a yearly manufacturing value added of approximately US\$ 1,350 per capita, while the figure for the least industrialized region (Nariño) was only US\$ 15. Most importantly, Figure 3b shows that manufacturing value added per capita and the REMS index are highly correlated among Colombian regions. The correlation of 0.63 between these two figures at the regional level (which is significant at the 1%-level, according to Pearson's correlation test) is indicative that the (non)incurrence in large export markets might partly explain regional differences in manufacturing value added in Colombia.

< *Figure 3* >

Next, we check if the REMS index is correlated with export intensity (i.e., the ratio of export sales to total sales). When the REMS values would be positively correlated with export intensity one could argue that our results are not driven by differences in the market size of export destinations but that we just provide more evidence on the well documented fact that export intensity has positive effects on manufacturing sector and regional growth. According to Figure 4 such a concern is unfounded though. The scatter plot shows that the REMS index values are not correlated with each observation's export sales to total sales ratios (the correlation coefficient between the two variables is 0.02).

< *Figure 4* >

Finally, Table 2 presents the differences that exist between those regional sectors that export to relatively large markets (REMS index >0) and those that do not (REMS index <0). Regional sectors with a REMS index above zero, on average, report higher per capita value added, capital stock and exports (X) and higher employment (with all the mean differences being statistically significant at the 1%-level). All these figures are in favour of our hypothesis that larger export markets have a positive impact on the growth of manufacturing sectors and regions. The presented data are only indicative though, given that they only show correlations and that one can expect bi-directional

effects. To establish if export market size indeed matters for the growth of manufacturing sectors in different regions, we will proceed with the PVAR regressions in the next section.

< Table 2 >

## **REGRESSION RESULTS**

### ***Stability***

Table 3 reports the stability examination for the inverse normal Z statistic using 2 lags for both Dickey-Fuller and Phillips-Perron tests. The reason for reporting only the inverse normal statistic is because it offers the best trade-off between size and power according to Choi (2001). Please note that all tests (namely, the inverse chi-squared, modified inverse chi-squared and inverse logit) strongly reject the null hypothesis that all panels contain unit root for all the endogenous variables presented. It evidences stability of the variables in the panels besides the fact that the aggregate values of the variables are not stable.

< Table 3 >

### ***Model specification***

The model specification is chosen according to Andrews and Lu's (2001) criteria.<sup>6</sup> Accordingly, the first four lags of the endogenous variables are used as instruments for the estimation and the lag order of the auto-regressive process is two. The model is stable since all the roots lie inside the unit circle (see Figure 1A in the Appendix). Table 4 summarizes the estimated coefficients of the panel-VAR and their respective *p*-value. The results indicate a negative impact on capital stock shocks to employment after one period (suggesting a substitution effect of employment by capital) and, most importantly for our purposes, a positive impact from the REMS index on its own value, value added and employment. The latter suggests a positive impact of export market size on the performance of manufacturing sectors.

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<sup>6</sup> These criteria are analog to various commonly used maximum likelihood-based model-selection criteria; namely, Bayesian Information Criteria, Akaike Information Criteria and Hannan–Quinn Information Criteria.

< Table 4 >

### ***Granger Causality Tests***

Table 5 presents the Granger causality test. This test gives some statistical support for the order of causality used in the orthogonalized impulse response analysis. Note that both the capital formation and value added only Granger-cause significantly one other variable and are significantly Granger-caused by the set of variables, suggesting that they are more endogenous than employment. On the contrary, we will treat the REMS index as the least endogenous variable. The reason for this decision is twofold: first, it is not part of the production function; second, Lawless & Whelan (2014) find that firm participation in export markets has a high degree of unpredictable idiosyncratic variation, reflecting randomly varying country-specific trade costs. It is important to note that the results are robust when the ordering is made differently (e.g., when the REMS index is treated as the most endogenous variable).

< Table 5 >

### ***Impulse response functions***

Figure 5 presents the orthogonalized impulse response function of the PVAR model. All responses over the main diagonal start at zero because in the orthogonalized shock there is no contemporaneous pass on to a less endogenous variable. The first row indicates that value added per capita does not have a significant impact on capital formation or employment; but that it has a positive and significant impact on the REMS index. The latter is expected, given that it can be assumed that the larger a sector becomes, the better its capabilities to incur in contested markets (due to economies of scale). Capital formation, on the contrary, seems to impact negatively employment and positively value added and the REMS index (second row), while employment impacts positively and significantly all other variables, with the exception of the REMS index (third row).

< Figure 5 >

The positive impact of employment and capital formation on value added is expected given that larger firms typically have larger value added. The ambiguous relationship between employment and capital formation suggests that in the Colombian context new labour requires capital but that

new capital substitutes existing labour. Moreover, the positive impact of capital formation on the REMS index suggests that capital-intensive sectors are better able to enter into large external markets. This latter result is in line with previous findings that especially those firms that invest in physical capital formation and technology adoption thrive and are better able to exploit market potentials.

Most importantly, the last row of Figure 5 supports our hypothesis that export market size is important for manufacturing growth. To be more precise, the impulse responses show that the REMS index has a significant and positive impact on per capita value added, capital and employment of manufacturing sectors and regions in Colombia. In line with the theoretical framework, these results suggest that manufacturing sectors that have access to sufficiently large markets will find it more profitable to cover the up-front fixed costs related to capital formation, and that accessing large external markets also helps to foster employment and value-added growth by improving economies of scale. Having said that, to disentangle the precise theoretical effects that explain the empirical results is beyond the scope of this paper.

The impulse response results from above present a one-period shock; namely, that a specific sector in a specific region increases its REMS index value for only one period and then the index returns to its initial value. This scenario seems unrealistic though because commercial relations tend to be relatively stable over time. Figure 6 shows the results of the more realistic case that the change of the REMS index value is permanent with cumulative long-run effects. The main results of this exercise are in line with the one-period shock model. That is, an increase in the REMS index value has a positive and significant impact on the growth of the three manufacturing sector variables. It is important to stress that this finding is robust when non-exporting sectors are excluded from the sample (see Figures A2 and A3 in the Appendix).

To assess the economic significance of the results we consider the sample's average year-on-year change of the REMS index in absolute values. In a typical year, the REMS index mean value changed by 0.25 points and the median value by 0.10 points. According to the cumulative impulse responses, when an industry/region manages to increase its presence in large markets to such an extent that its REMS index rises permanently by 0.10 points, its employment, capital stock and value-added per capita rises by 1.3%, 1.4% and 1.6%, respectively. When the REMS index instead permanently increases in the magnitude of the observed mean change, employment rises by 3.3%,



capital formation by 3.5% and value added per capita by 4.2%. All of these values are reasonable and economically meaningful. In 2017, for example, the aggregate value added of the Colombian manufacturing sector declined by -1.1% (DANE, 2018).

< Figure 6 >

## CONCLUSIONS

To capture existing differences in the size of export markets, we constructed a novel REMS index, which measures the whether the share of sectoral exports that are destined to economies with a large market in one region is higher than in other regions. In a second step, we verified the impact of the REMS index on the growth of 129 manufacturing sectors in 23 regions in Colombia during the period 1992-2017. To the best of our knowledge, we are the first to study the effect of export market size on regional manufacturing growth empirically.

We show that per capita manufacturing value added, and the REMS index are highly correlated among Colombian regions. Most importantly, the regression results indicate that REMS index changes have a substantial impact on manufacturing employment, capital formation and value added per capita. These results are not driven by export intensity and are robust when non-exporters are excluded from the sample. Accordingly, the main finding of this paper is that for regional manufacturing growth it is not only important how much or what kind of products a country exports (as established by previous literature) but also the size of its destination markets. This finding implies that exporting to the largest economies of the world would be important for regions/countries that want to experience rapid manufacturing growth, and lead to the straightforward policy recommendation to implement policies that promote exports to the largest economies in the world. Examples for fast-growing countries that have exported their manufacturing products mainly to large economies are China, Indonesia, Singapore, South Korea, Taiwan and Vietnam.

The theoretical rationale for this recommendation is that the expansion into new markets entails up-front fixed costs and transaction costs, which means that entering few large economies is more efficient than entering many small- and medium-sized economies. Moreover, large economies have a larger market potential, which reduces the risk of investment and increases the possibility to avoid

potential lack of demand problems and to benefit from economies of scale. Thus, firms that have access to large economies will find it more profitable to cover the up-front fixed costs that are related with innovation like physical capital formation and technology adoption.

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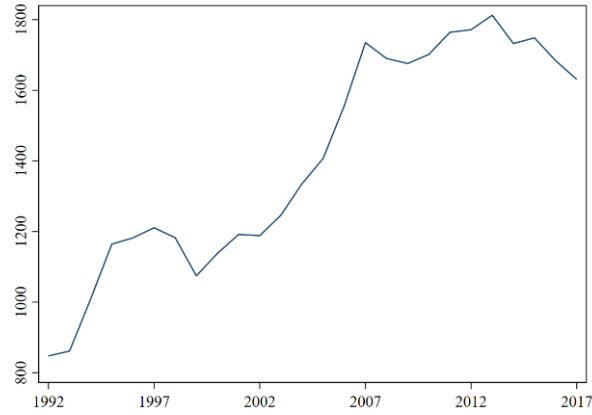
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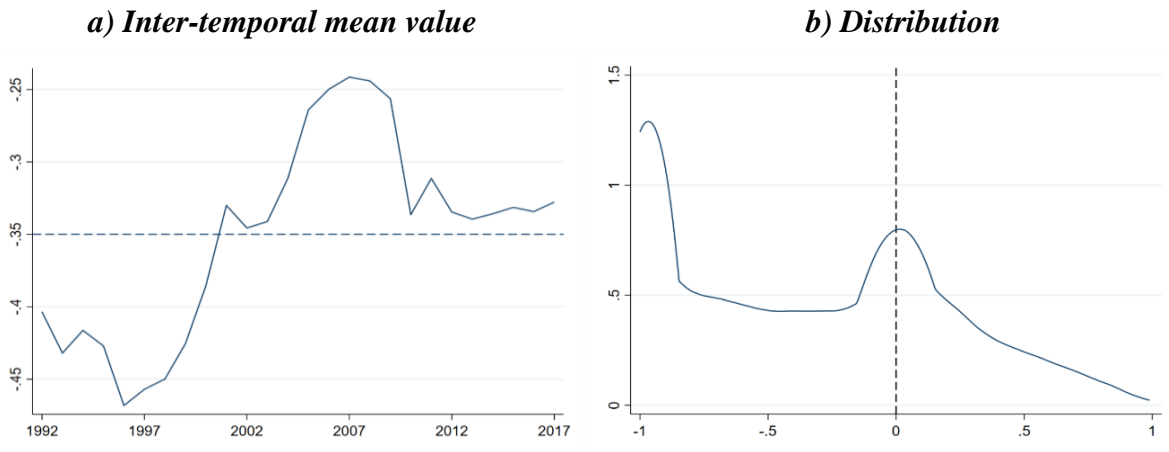
## FIGURES

**Figure 1: Colombian manufacturing value added per capita  
(constant 2014 COP in thousands)**



*Note: This graph shows the per capita value added of the manufacturing sector at the national level for the period 1992-2017.*

**Figure 2: The inter-temporal mean values and the distribution of the REMS index**

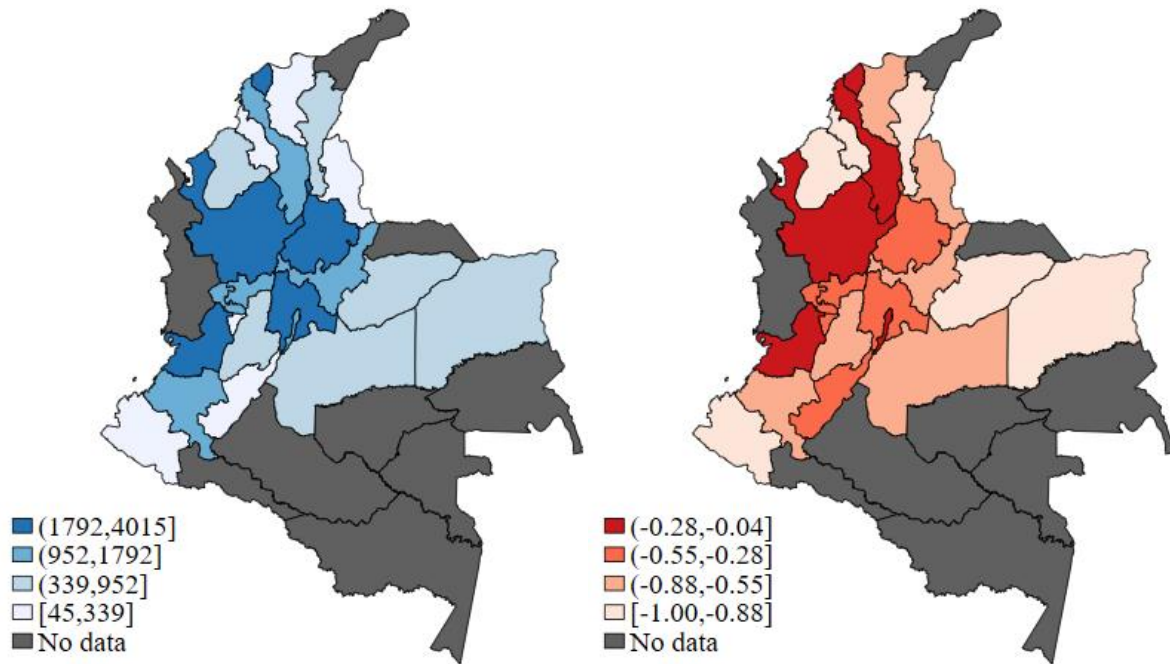


*Note: The plot on the left shows the mean value of the Colombian REMS index for the years 1992 to 2017; whereas the plot on the right-hand side summarizes its distribution during the same period.*

**Figure 3: Regional differences in manufacturing value added and REMS**

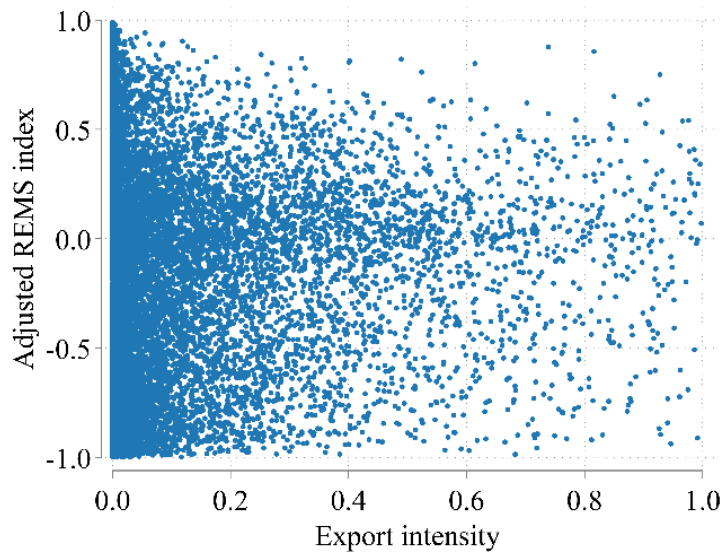
*a) Mean value-added per capita*

*b) Mean REMS index*



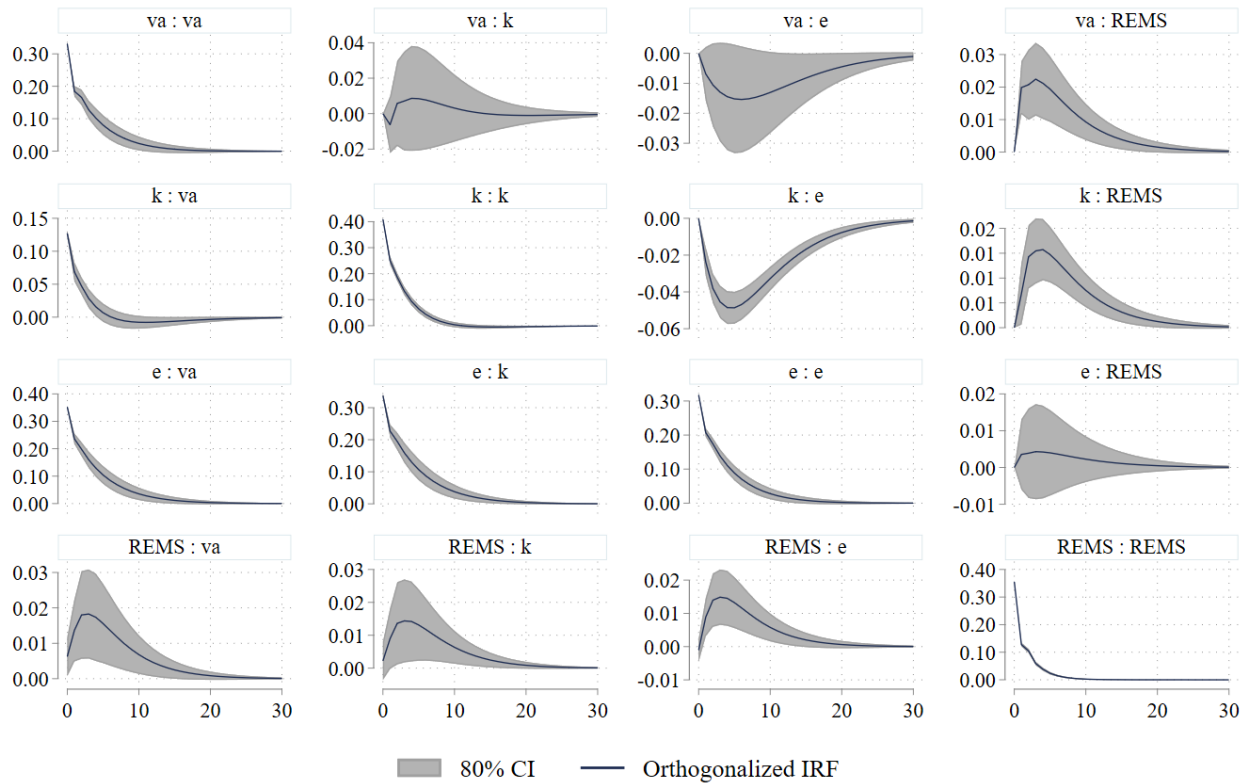
*Note: The left map shows the differences in the regional mean of manufacturing value added per capita in thousand COP among Colombian departments in 2017; the right map shows the regional mean value of the REMS index for the same year and regions.*

**Figure 4: The correlation between the REMS index and export intensity**



*Note: This scatter plot shows that the REMS index values are not correlated with export intensity (i.e., export sales to total sales ratios)*

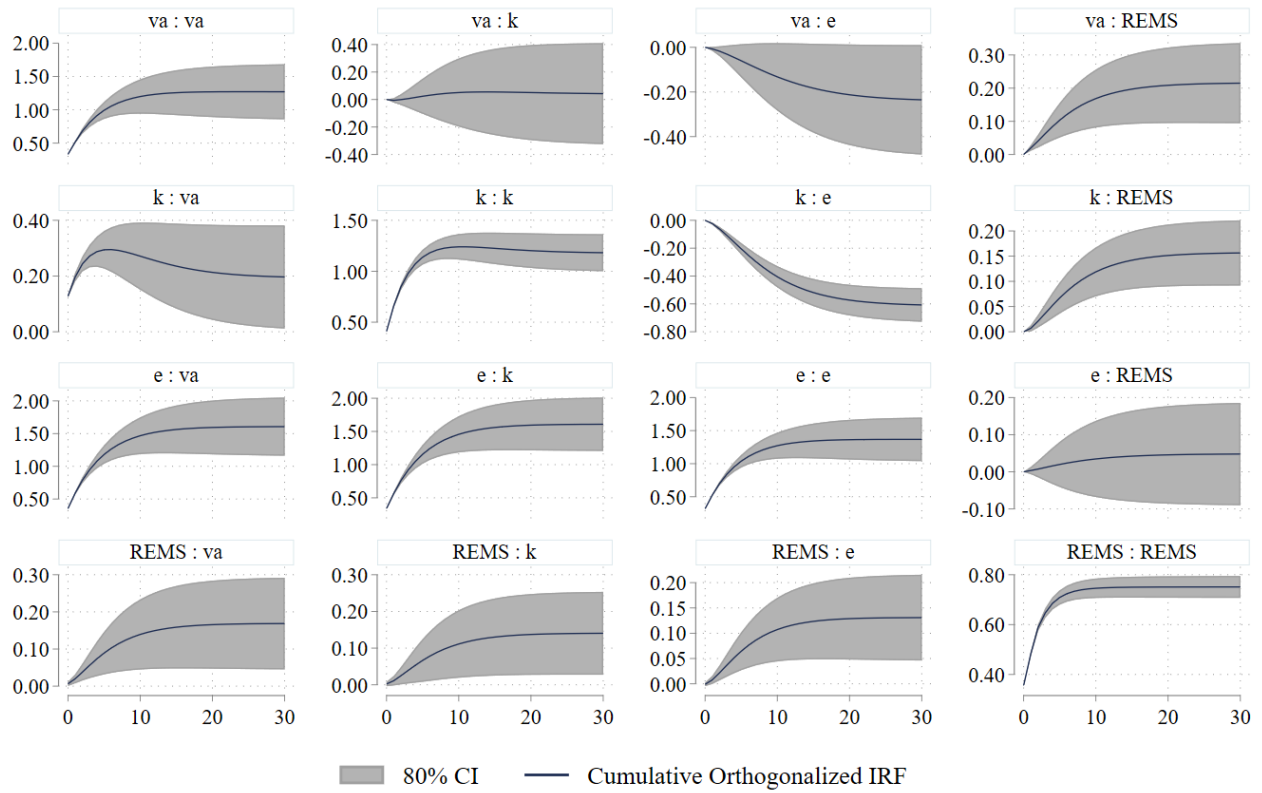
**Figure 5: Orthogonalized impulse-responses function**



*Note: This plot summarizes the orthogonalized impulse response function of the PVAR model. The variables are ordered from the most endogenous to the most exogenous, both in rows and columns. Variables in the rows represent the ones being shocked and the ones in the columns show the response function. The shaded area shows the 80% confidence interval (see Table 1 notes for variables descriptions)*



**Figure 6: Cumulative impulse responses**



*Note: This plot shows the cumulative impulse response function of the PVAR model (see Figure 4 notes for more details).*

## TABLES

**Table 1: Descriptive Statistics**

	<i>Obs.</i>	<i>Mean obs. per year</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Min</i>	<i>Max</i>
<b><i>REMS<sub>dst</sub></i></b>	16,923	651	-0.35	0.53	-1.00	0.99
<b><i>k<sub>dst</sub></i></b>	16,911	650	9.04	2.06	-0.92	15.98
<b><i>e<sub>dst</sub></i></b>	16,923	651	2.64	1.37	-3.66	7.38
<b><i>va<sub>dst</sub></i></b>	16,923	651	8.88	1.87	0.26	15.28

*Note: This table shows the descriptive statistics of the variables used in the PVAR regressions; REMS is the REMS index, k is the log of capital stock per capita, e is the log of employment per 100,000 habitants, and va is the log of value added per capita. The data consists of 129 manufacturing sectors (s) in 23 Colombian regions (d) during the period 1992-2017 (t).*

**Table 2: Mean values of observations with REMS index values of <0 vs. >0**

	<i>REMS index &lt;0</i>		<i>REMS index &gt;0</i>	
	<i>Mean value</i>	<i>No. of Observations</i>	<i>Mean value</i>	<i>No. of Observations</i>
<b><i>va<sub>dst</sub></i></b>	8.88	11,467	9.05	4,772
<b><i>e<sub>dst</sub></i></b>	2.65	11,467	2.76	4,772
<b><i>k<sub>dst</sub></i></b>	9.07	11,462	9.19	4,768
<b><i>X<sub>dst</sub></i></b>	6.33	8,370	6.73	4,772

*Note: This table shows the mean values for the period 1992-2017 for the observations that export to relatively small markets (REMS index <0) vs. those that export to relatively large markets (REMS index >0). The mean differences of the variables are statistically significant at the 1%-level between the two groups of observations.*

**Table 3: Results of the unit root tests**

	<i>Dickey-Fuller</i>	<i>Phillips-Perron</i>	<i>No. of Panels</i>	<i>Avg. period no.</i>
<b><i>REMS</i><sub>dst</sub></b>	-13.00***	-49.20***	994	17.03
<b><i>k</i><sub>dst</sub></b>	-13.67***	-35.51***	994	17.01
<b><i>e</i><sub>dst</sub></b>	-4.02***	-11.71***	994	17.03
<b><i>va</i><sub>dst</sub></b>	-4.71***	-20.21***	994	17.03

Note: This table shows the results of the unit root tests; \*\*\* indicates significance at the 1%-level (see Table 1 notes for variables descriptions).

**Table 4: Panel-VAR results**

	<b><i>REMS</i><sub>dst</sub></b>	<b><i>e</i><sub>dst</sub></b>	<b><i>k</i><sub>dst</sub></b>	<b><i>va</i><sub>dst</sub></b>
<b><i>REMS</i><sub>dst-1</sub></b>	0.36 (0.00)	0.03 (0.02)	0.02 (0.25)	0.03 (0.11)
<b><i>e</i><sub>dst-1</sub></b>	-0.05 (0.03)	0.73 (0.00)	0.08 (0.10)	0.13 (0.00)
<b><i>k</i><sub>dst-1</sub></b>	-0.00 (0.86)	-0.05 (0.00)	0.62 (0.00)	-0.01 (0.84)
<b><i>va</i><sub>dst-1</sub></b>	0.06 (0.01)	-0.02 (0.33)	-0.02 (0.62)	0.56 (0.00)
<b><i>REMS</i><sub>dst-2</sub></b>	0.17 (0.00)	0.01 (0.18)	0.01 (0.46)	0.01 (0.44)
<b><i>e</i><sub>dst-2</sub></b>	-0.02 (0.15)	0.15 (0.00)	0.01 (0.76)	-0.05 (0.10)
<b><i>k</i><sub>dst-2</sub></b>	0.01 (0.09)	-0.01 (0.25)	0.07 (0.00)	-0.03 (0.21)
<b><i>va</i><sub>dst-2</sub></b>	0.01 (0.61)	-0.01 (0.62)	0.04 (0.14)	0.19 (0.00)

Note: This table shows the panel-VAR results. Values inside the matrices show the estimated coefficients, while the values in parenthesis refer to the respective p-value for the Z statistic. The total number of observations is 13,534, with 861 panels and an average number of years per panel of 15.7 (see Table 1 notes for variables descriptions)

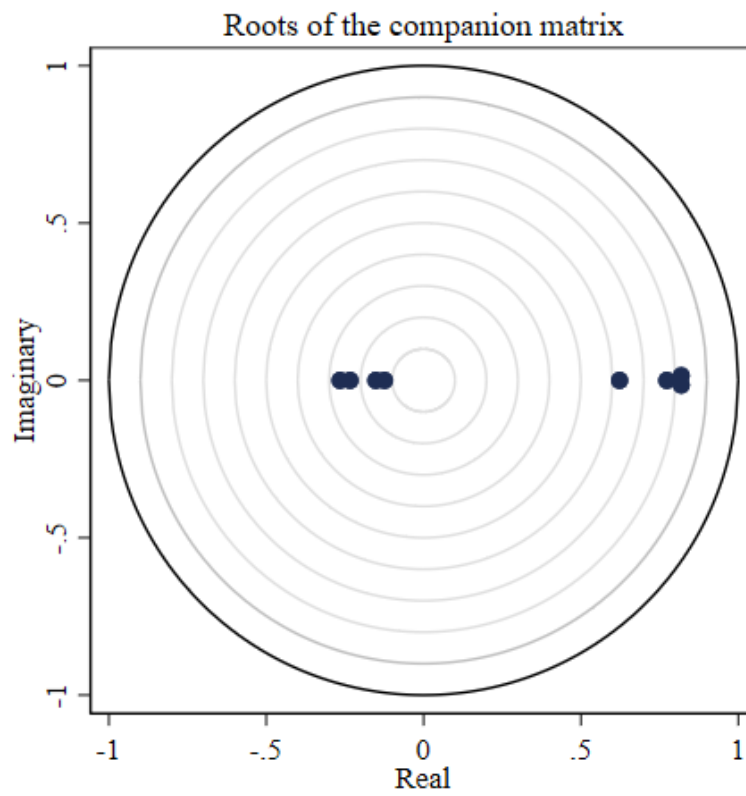
**Table 5: Results of the Granger causality tests**

	$REMS_{dst}$	$e_{dst}$	$k_{dst}$	$va_{dst}$
$REMS_{dst}$	-	6.7 (2)**	1.7 (2)	2.7 (2)
		0.03	0.41	0.25
$e_{dst}$	8.1 (2)**	-	4.1 (2)	8.9 (2)***
	0.02		0.13	0.01
$k_{dst}$	3.1 (2)	27.5 (2)***	-	3.1 (2)
	0.21	0.00		0.21
$va_{dst}$	10.1 (2)***	1.0 (2)	2.7 (2)	-
	0.01	0.59	0.26	
<b>All</b>	20.1 (6)***	38.8 (6)***	12.0 (6)*	22.0 (6)***
	0.00	0.00	0.06	0.00

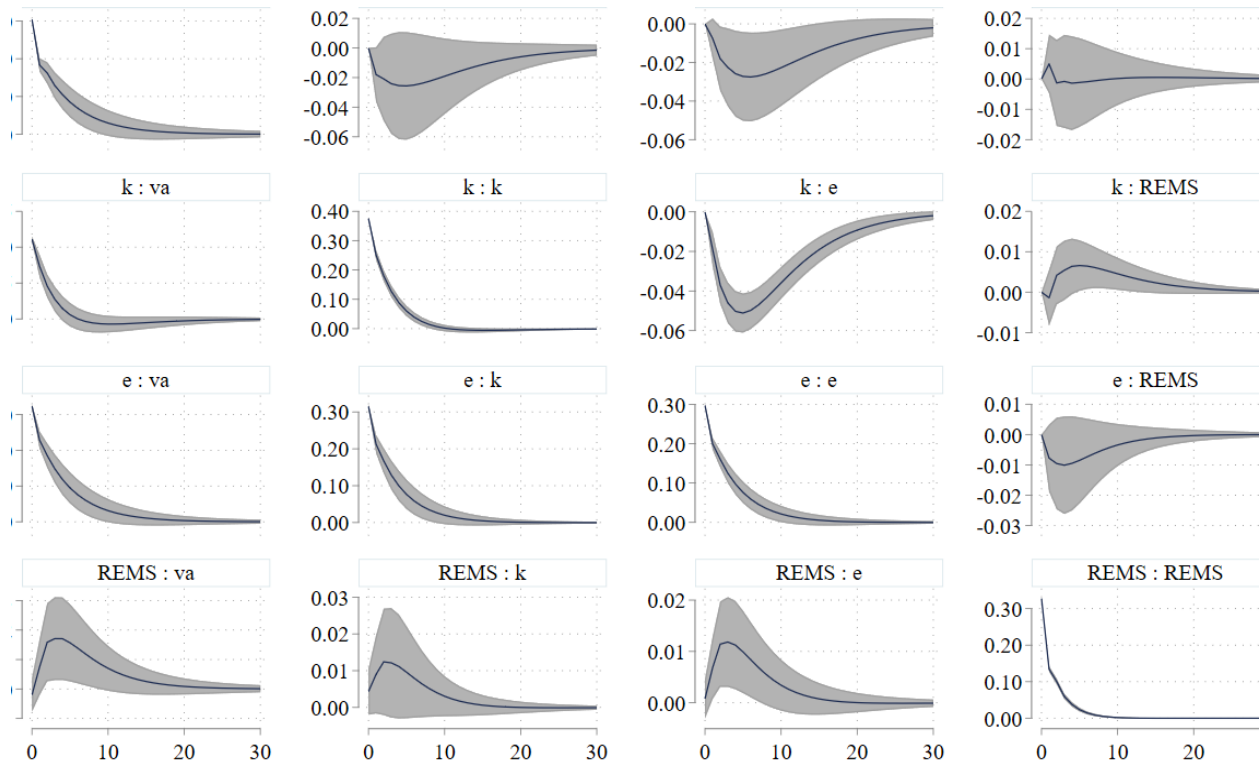
*Note: This table summarizes the results of the Granger causality tests. The variables in the first row are the endogenous variables and the variables in the first column are the tested ones. The significance of the test statistic at the 1%, 5% and 10% level is indicated by \*\*\*, \*\* and \*, respectively (see Table 1 notes for variables descriptions).*

## APPENDIX

**Figure A1: Roots of the companion matrix**

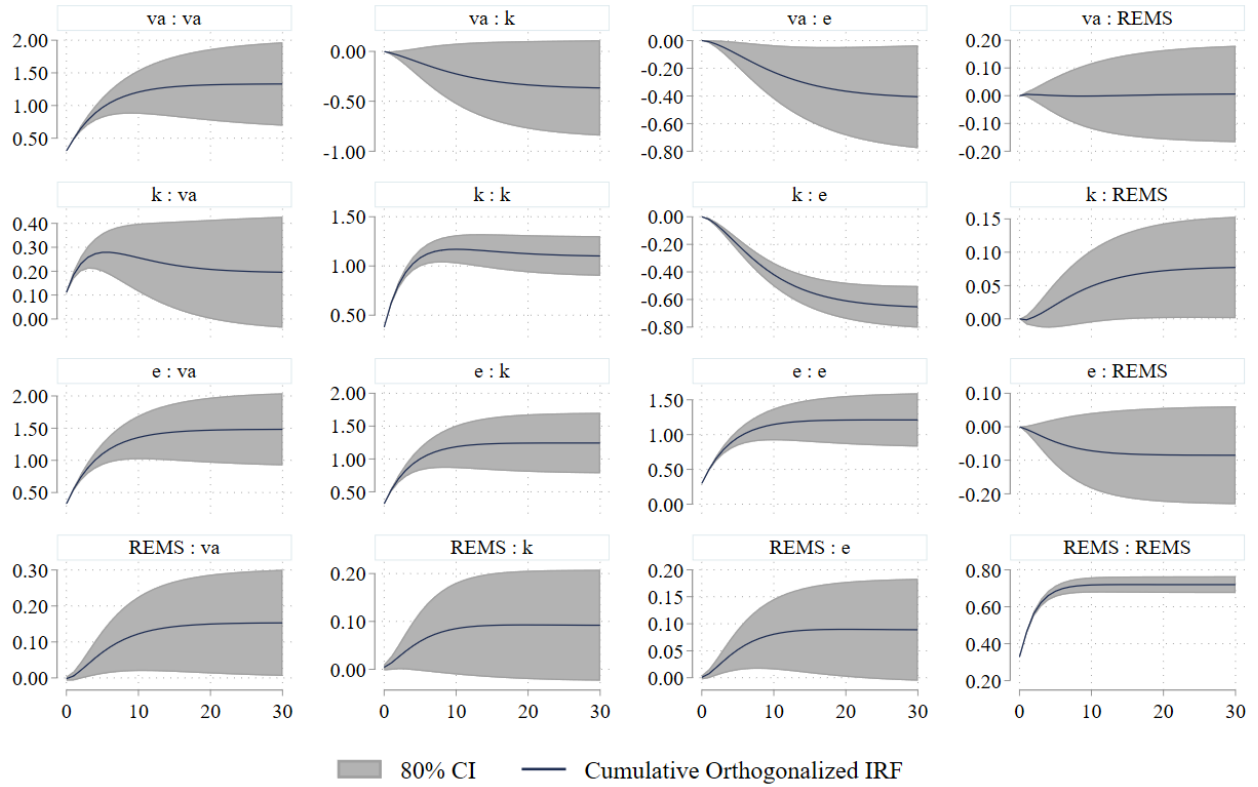


**Figure A2: Orthogonalized impulse-responses function, excluding non-exporters**



*Note: This plot summarizes the orthogonalized impulse response function of the PVAR model. when non-exporting sectors are excluded from the sample.*

**Figure A3: Cumulative impulse responses, excluding non-exporters**



*Note: This plot shows the cumulative impulse response function of the PVAR model when non-exporting sectors are excluded from the sample (see Figure 4 notes for more details).*