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STRENGTHENING THE STABILITY OF EXPORTS THROUGH GVC PARTICIPATION: The who and how matters.

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Carmen Díaz-Mora

Rosario Gandoy

Belén González-Díaz

UNIVERSITY OF CASTILLA-LA MANCHA

Abstract:

Drawing on the literature that has shown the prevalence of short-lived trade relationships, the aim of this paper is to provide further understanding about this issue by exploring the impact of engaging in Global Value Chains (GVCs) on the chance of export survival at product-country level. We also investigate whether the type of GVC participation (backward or forward) matters for export survival. Furthermore, we consider the level of development of countries with which GVC linkages are established. Our findings endorse the hypothesis that deeper participation in GVCs is a key factor in explaining stability in trade relationships, mainly for developing countries where the trade flows are especially fragile. We also find different effects depending on the type of GVC involvement and on whether the value chain partners are advanced or developing.

Key words: Global Value Chains, Export survival, Developing countries, Backward and Forward GVC participation, Discrete-time duration models

JEL codes: F10, F14, F41

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1. INTRODUCTION

Since Besedes and Prusa (2006a) drew attention to the short-lived trade flows for the United States, several recent studies have confirmed, for different economies and time periods, the low survival rates of trade flows. Some of these papers have shown that developing countries experience much lower survival rates which undermine their export growth (Besedes and Prusa, 2011; Brenton et al., 2010; Nicita et al., 2013). This is why export survival is as important as entry into exporting for improving export performance in developing countries.

However, research on understanding the factors that promote the stability of exports is still scarce. Empirical literature identifies the role of several factors in stabilizing trade flows¹. Our paper provides additional insight into this stream of research by incorporating participation in Global Value Chains (GVCs) as an explanatory variable and by examining its influence for two different groups of countries, advanced and developing economies.

GVCs are increasingly being considered to understand international trade patterns, becoming one of the most relevant factors in explaining the recent behaviour of trade (collapse, rebound and subsequent slowdown) (Hoekman, 2015). Our hypothesis is that engagement in GVCs influences the probability of exit from exporting and, therefore, export performance. Specifically, we expect that integration in GVCs will increase the stability of trade flows, with the positive effect being stronger for developing countries.

Besedes and Prusa (2011) provide theoretical support for the link between GVC engagement and export persistence. They develop a model of trade based on the seminal work of Melitz (2003), which includes uncertainty. Uncertainty emerges because exporters may not know in advance the level of demand abroad and it is not clear how far costs associated with exporting can go up. As Alborno et al. (2012) point out, “*firms are initially uncertain about their export profitability*”. When firms are unable to obtain profits after starting to export, their model predicts short-lived trade relationships. Related to this, countries where firms face less (greater) uncertainty are expected to have longer (shorter) export duration. In the same line, Brenton et al. (2009) highlight that imperfect information about the fixed costs of exporting and about the costs of searching for an appropriate trading partner influences the dynamics of firms’ export entry and exit. Because of this lack of perfect information, small-scale entry is more likely and exit is more frequent. Therefore, uncertainty and imperfect information are keys to understanding the short duration of trade flows, although the existence of sunk entry cost suggests the persistence of trade. According to these arguments, elements that reduce uncertainty, providing trust and confidence among partners, will promote better knowledge of foreign markets, leading to higher export survival rates.

Being part of a GVC can play an important role in those directions. First, trust and cooperation between partners matter particularly for trading relationships between geographically dispersed stages of the supply process. Success in production sharing entails an intense collaboration between activities that are located at multiple remote sites. This frequently involves sharing technological knowledge, business strategies, workforce qualification and product specifications to fulfil final user requirements.

¹ Among the most important factors are the following: initial export value (Besedes, 2008), product and market diversification (Volpe and Carvallo, 2009), product differentiation (Besedes and Prusa, 2006b); comparative advantage (Nicita et al., 2013), contract enforcement (Araujo and Ornelas, 2007), previous export experience or membership in a preferential trade arrangement (Carrere and Strauss-Kahn, 2012).

Finding partners who satisfy requirements about quality, delivery time and technical characteristics is crucial for a good performance of GVCs. Once partner suitability has been verified, leader firms in a GVC are reluctant to introduce shifts in the GVC's configuration and to replace current suppliers with new ones. Therefore, trade within GVCs will tend to be more stable than other trade flows.

Second, regarding incomplete information, strong ties among members of GVCs provide regular patterns of information exchange. Firms can use the contacts that their trade partners already have to obtain information about foreign markets (for example, how to establish a network of clients/suppliers abroad, countries' regulations, consumers' preferences, etc.) or to establish new additional contacts (Chaney, 2014). In this way, the risk and costs of exporting would be lower. Therefore, reliability and close collaboration between partners reduce uncertainty and promote the stability of trade relationships within GVCs.

Empirical research focused on export survival in GVCs is very scarce. As far as we know, only Obashi (2010) addressed this question for East Asian networks and Córcoles et al. (2015) for Spain. These articles approached GVC participation by trade in parts and components and show that it exhibits longer-lived relationships and higher survival rates compared to final products trade.

In this paper, we explore the impact of engaging in GVCs on the chance of export survival, using trade data from the CEPII's BACI database for the years 1998-2012. To capture to what extent a country's exports are integrated in GVCs, the OECD Inter-Country Input-Output (ICIO) database is used to estimate value added incorporated in exports. As value chains can be described as a system of value added sources and destinations (Koopman et al., 2010), a country's involvement in GVCs can be achieved by foreign value added included in a country's exports (backward participation) and by domestic value added of the country contained in the exports of other countries (forward participation). Hence, we investigate whether the type of GVC participation (backward or forward) matters for export survival. Furthermore, we consider the level of development of (source and destination) countries with which GVC linkages are established. Here the aim is to determine whether the impact of backward or forward GVC involvement on export stability is different depending on whether the value chain partners are advanced or developing.

A further question to be explored is whether there are differences across countries regarding the effect of GVCs on export survival. We hypothesize that those differences exist and that GVCs play a more important role for developing than advanced countries. Three arguments support this idea. The first one refers to the potential of GVCs to provide opportunities to encourage competitiveness for countries, mainly for developing countries (UNCTAD, 2013; WTO, 2014; OECD, 2015). GVC involvement facilitates integration of developing countries into the global economy since they do not need to be competitive in the total production process (from start to finish) but only in some stage of the value chain. Furthermore, GVC engagement represents a major source of socio-upgrading opportunities for developing countries because it is a way to learn by doing that enables an accumulation of productive capabilities, helping them to improve their export performance and competitive position in international markets (Hausman, 2014). The second one is related to empirical evidence on the effects of credit constraints on export performance. Brenton et al. (2012) point out that the lack of financial development is particularly important in determining the ability of developing countries' exports to survive. Firms usually begin exporting a small amount because buyers are not sure about the success of the supplier-buyer relationship. When the supplier's performance is

satisfactory, large-buyers rise steeply their orders and then supplier needs to invest rapidly to face buyers' demand. At this point, trade relationship may break down if suppliers cannot access credit, as often happens in developing countries where there is a lack of financial development². It can be expected that there will be fewer trade credit constraints in firms involved in GVCs. This is because they can receive financial support from other value chain partners, in particular when, as usually occurs, multinational companies lead GVCs. At this respect, Manova (2015) shows that multinational companies are less constrained than domestic firms are because they use internal capital markets to arbitrage cross-country differences in external financial markets. Moreover, subsidiary firms can access external finance directly or through their parent company. Finally, the third argument assumes that, in the context of GVCs, establishing trade relationships with firms in developing countries is more costly and risky. So that once it is established successfully, it will be less likely to break it than a trade relationship with an advanced country where leaving and locating new partners may be a significantly cheaper and easier activity.

Using discrete-time survival survival models with product-country random effects to control for unobservable heterogeneity, we find that participation in GVCs is a key factor in explaining stability in trade relationships. These results endorse the hypothesis that joining GVCs helps to prevent interruptions of export flows. In addition, the impact is higher for developing countries where trade flows are especially fragile. We also find different effects depending on the type of GVC involvement and the level of development of the value chain partners.

The rest of the paper is organized as follows. After the Introduction, Section 2 presents the data used and provides some descriptive statistics on export duration and probability of export survival depending on the level of GVC involvement at the country-sector level. Section 3 presents the model and discusses the estimation results. Section 4 concludes.

2. DATA AND DESCRIPTIVE ANALYSIS

2.1. DATA

In this paper, we analyse the survival of exports through the estimation of a discrete-time duration model. As survival analysis needs to be performed using highly disaggregated data, we use bilateral trade flows collected at a very detailed commodity level (6-digit Harmonized System, around 5,000 products) from the CEPII's BACI database. This database is a variant of the original UN COMTRADE database that solves the problem of too many missing flows in the original one. BACI uses a mirror statistics strategy to reconcile the declarations of exporting and importing countries, providing harmonized values for each bilateral trade flow reported twice (Gaulier and Zignago, 2010).

To quantify to what extent a country-sector is engaged in GVCs, we use indicators of trade in value added. Trade in value added is a statistical approach that has been specifically developed to better track global production networks and supply chains. It addresses the double counting implicit in current gross flows of trade and identifies value added that is generated by each industry and country in the

² Brenton et al. (2012) consider exports at the firm-level for countries in Africa, Asia, Eastern Europe, Latin America and the Middle East. Jaud et al. (2009) also highlight the role of financial constraints on export survival in their study on export duration at the product level for 121 developing countries.

production of any good or service. Therefore, the country's contribution to a cross-border production chain can be delimited.

Trade in value added indicators for measuring GVC engagement rely on Koopman et al. (2010). The authors developed an accounting framework to discover the value-added structure of a country's exports, by measuring the share of each country in vertical specialization processes and its relative position in GVCs. They build a "GVC participation index" which takes into account that a country can be involved in GVCs in two ways: (1) by using foreign value added embodied in exports (Backward GVC participation) and (2) providing domestic value added that other countries incorporate into their exports (Forward GVC participation).

Koopman et al. (2010) define their index of GVC participation as the ratio of all value added involved in chains (forward and backward) over gross exports. This measure facilitates the comparison across countries and industries. Instead of this measure, we use backward and forward indicators expressed in value terms so that the results are not altered by the behaviour of gross exports. Nevertheless, we will employ backward and forward GVC involvement as a share of gross exports as a robustness check of estimation results. We construct these GVC indicators through the input-output analysis using data from OECD-ICIO. A brief description of the methodology employed is presented in the Methodological Annex.

Although data is available for 61 countries, our sample is limited to 55 countries because of the lack of data for some necessary variables in the econometric analysis. To test the hypothesis that engagement in GVCs has a positive effect on export survival, which is more pronounced for developing countries, it is appropriate to distinguish countries according to their level of development. To do that, we use traditional World Bank's income classification between developed countries (defined as high-income economies) and developing countries (define as upper-middle income, lower-middle income or low-income economies)³. Despite knowing these terms are not perfect synonyms, advanced, developed and high-income countries are used interchangeably in this paper. And the same is done for the terms developing and low-middle income countries. Countries included in our sample are listed in Table A1 of the Statistical Annex.⁴

There are two additional caveats related to the use of the ICIO database. The first is related to its low level of industrial disaggregation. It provides data for 34 economic activities covering the entire economy. These activities are classified according to the International Standard Industrial Classification (ISIC Rev.3) at 2-digit codes. Since BACI only reports trade data for goods categories,

³ Since the 2016 edition of the Word Development Indicators, the World Bank no longer uses the distinction between developed and developing countries, arguing that those terms are becoming less relevant because income classification does not necessarily reflect the development status of a country. As robustness check, we use the country classification of the International Monetary Fund's World Economic Outlook for distinguishing between Advanced and Emerging and Developing Economies and the World Economic Forum's Global Competitiveness Index for distinguishing between Innovation-driven economies (most developed countries) and all other countries.

⁴ It should be noted that the ICIO database includes a greater number of high-income economies. Moreover, among developing countries, most of them are upper-middle income, a few of them (around 25 per cent) are lower-middle income economies and only one is a low-income economy. Hence, our sample of developing countries is biased towards middle-income countries. An alternative database is the EORA Multi-Region Input-Output table (MRIO), which has the advantage of including a higher number of countries and a wider coverage for developing and the least developed countries. Nevertheless, Kowalski et al. (2015) compare both databases – OECD Trade in Value Added and EORA- and conclude that this advantage must be weighted by the poor quality of data for those non-developed countries. The EORA database provides good information about GVC participation at country level but this is not the case at the sectoral level.

our analysis on the effect of GVC involvement on export survival covers 18 goods sectors⁵. Since export survival is calculated at the country-product level whereas GVC engagement is at the country-sector level, it is assumed that all products within a sector shared the same GVC engagement⁶. To deal with these two different classifications and sectorial disaggregation of trade data for duration analysis and trade in value added, Eurostat correspondence tables are used⁷. The second caveat is related to the time coverage of the 2015 version of the OECD- ICIO database, which just includes the years 1995, 2000, 2005 and 2008 to 2011, whereas trade data are available for the whole period 1998-2012. We extrapolate missing data using a linear trend.

2.2. DESCRIPTIVE ANALYSIS

To examine the duration of exports, we use annual bilateral trade data for each product to calculate a spell, that is, the number of years of consecutive exporting. The more times the trade flow is interrupted and then later restored, the greater the number of spells and the lower their average duration. According to previous works, the probability of failure in trade relationships will be high in the short-term (the first two or three years) but it will decrease in the medium and long term as partners consolidate their commercial ties.

When the spell length is calculated, the beginning and ending years of the corresponding trade spell need to be observed. Data will be left-censored when the export relationship started before the first year of the period of observation and so the starting year is unknown. On the other hand, right-censoring occurs when the export relationship finished after the last year of the period of observation and it cannot be observed. We use survival analysis techniques to deal with right-censoring. To avoid left-censoring, spells beginning before the observation window are omitted. Hence, the spell length varies between one to fourteen years (when it stays alive the whole period). This length is determined by the probability of maintaining trade relationships (the survival function) and it is estimated by using non-parametric techniques based on the Kaplan-Meier model (1958). The survival function is the probability that the trade relationship lasts a certain number of years. It is calculated as a complementary function of the exit rate or, in continuous terms, a function of risk or “hazard” which is defined as the probability that the trade relationship fails at times t conditional upon having survived until that time:

$$\hat{O}(t) = Pr(T=t|T \geq t) = \frac{Pr(T=t)}{Pr(T \geq t)} = \frac{h_i}{n_i} \quad (1)$$

⁵ We consider intersectoral linkages between all industries (34) in the construction of GVC indicators. Table A2 in the Statistical Annex lists the sectors included in the sample.

⁶ This assumption does not seem to be very different from the production assumption used for constructing input-output tables. This assumes that all products generated in an industry group have the same technical coefficients and hence use the same production technique.

⁷ Correspondences tables are available at:

http://ec.europa.eu/eurostat/ramon/rerelations/index.cfm?TargetUrl=LST_REL&StrLanguageCode=EN&IntCurrentPage=10

where n_i denotes the number of trade relationships that remain active in t and h_i denotes the number of trade relationships that terminate exactly in t . The survival function is expressed as follows:

$$S(t) = \prod_{t(i) \leq t} 1 - \frac{h_i}{n_i} \quad (2)$$

According to expression (2), longer-lasting export relationships are characterized by low and decreasing exit rates ($\emptyset$) which imply high survival rates with a tendency to reduce their negative slope over time. These exit and survival rates vary by source country, destination country and product.

The statistical analysis of the survival functions reveals the lower probability of survival of export flows for developing countries according to Besedes and Prusa (2011), Brenton et al. (2010) and Nicita et al. (2013). In Figure 1, the Kaplan-Meier estimates are shown separately for advanced and developing countries. The negative and decreasing slope of survival functions shows that the probability of interruption is greater in the first few years, but the risk of failure gradually declines as relationships last longer. The results show that advanced countries experience higher survival rates than developing ones, although these rates fall over time for both groups of countries.

Figure 1: Kaplan-Meier survival estimates for advanced and developing countries

Source: Own elaboration from BACI database.

Our hypothesis is that more engagement in GVCs will increase the stability of trade flows and, therefore, the average length of exports with the positive effect being stronger for developing countries. Figure 2 shows the clouds of points that result from plotting the time average GVC engagement over 1995-2011 and the average duration of exports flows for each country-sector. The broad trend reveals a positive linear correlation; that is, the higher the GVC involvement, the longer the mean length of

the export flows⁸. When distinguishing between advanced and developing countries, it is possible to identify that this relationship is a bit stronger for the latter, as we expected.

Figure 2: GVC involvement and mean length of export spells at country-sector level

Source: Own elaboration from BACI and ICIO databases.

Therefore, descriptive analysis is in line with the hypothesis suggested in this work. The positive influence of GVC involvement on export survival will be tested in the empirical model presented in Section 3.

3. EMPIRICAL MODEL AND RESULTS

We analyse the impact of GVC involvement on export survival through the estimation of a discrete-time duration model. In order to test and quantify the effect of determining factors on the probability of persistence in a specific event from a dynamic point of view, duration models are often used in the literature (Van der Berg, 2001). These models are based on the concept of conditional probability that, in our work, would be the probability of ceasing to export at moment t , conditioned upon having exported at least t periods (Kiefer, 1988). This conditional probability of failure, i.e., hazard rate, is the dependent variable, which is defined as in expression (1). This hazard rate is calculated for each bilateral trade flow between countries i and j for each HS 6-digit product k .

Our explanatory variable of interest, GVC involvement, is calculated for country i at sector k . Sector dummies are also included to take into account industry-specific characteristics. Following related literature, other variables that influence the survival of trade flows are included in the empirical model. These variables are: economic size of exporter and importer, geographical distance between them,

⁸ We have also plotted the average participation in GVCs versus the median length of exports and the results remain the same.

belonging to the same trade agreement, initial value of trade and previous export experience. The length of the (current) export spell is also incorporated among the regressors to assess the existence of duration dependence which refers to how the hazard rate changes with time. Empirical studies of trade typically find negative duration dependence, that is, the hazard rate decreases with the duration of the export spell.

$$\begin{aligned} \phi(t)_{ijk} = f & (GVC\ involvement_{ist} + Developing\ country\ dummy_i + GDP_{it} + GDP_{jt} + \\ & Distance_{ij} + Initial\ trade\ value_{ijk} + RTA\ membership\ dummy_{ijt} + Duration\ spell_{ijk} + \\ & Duration\ previous\ spell_{ijk}) \end{aligned} \quad (3)$$

Although previous analysis of trade duration has been dominated by the application of the Cox proportional hazard model (Besedes and Prusa, 2006b; Nitsch, 2009; Besedes and Blyde, 2010; Obashi, 2010)⁹, Hess and Persson (2012) point out that it can be inappropriate for studies of trade duration. These authors argue that, given that observed durations of trade are measured in yearly intervals and the Cox model is suitable for continuous time data, biased estimates can be obtained when discrete data is used. Moreover, they point out that the duration of trade flows with large datasets (high number of products and countries) is very difficult to properly control for the existence of unobservable heterogeneity (frailty) which would lead to biased estimators and spurious negative duration dependence. Consequently, discrete-time duration models with frailty, which can deal with these problems, are more appropriate. Specifically, we perform the estimates using a logit model with product-country random effects to control for unobserved heterogeneity.

Logit model estimates can be displayed as two different formats. The first format is in an exponential form (odds ratios), where the effect is presented on a multiplicative scale. It expresses the ratio by which the odds (the expected number of successes-the event occurs- per failure-the event does not occur-) changes for a unit change in an explanatory variable. An odds ratio close to unity means no association between the dependant and the explanatory variable (holding other regressors fixed); and values below (above) the unit indicate a negative (positive) impact of the explanatory variable on the hazard rate. The impact will be much larger the further the coefficient is from the unit value. The second format is as marginal effects (probabilities), where an additive scale is used. Marginal effects provide a good approximation of the amount of change in the dependent variable that will be produced by a one-unit change in an explanatory variable. In this sense, probability is considered a more natural metric, but the problem is that the predicted probabilities change as the values of a covariate change in non-linear models. This is precisely the main advantage of working in odds ratios: they remain the same for different values of the covariates (Long and Freese, 2006).

The results of the econometric estimates are presented, in an exponential form, in Table 1. In column (1), total GVC involvement (as sum backward and forward GVC participation) is included. The coefficient is statistically significant and below unity, revealing that the hazard rates are substantially lower for deeper GVC involvement. This result confirms that countries' engagement in GVCs fosters stability of their export flows.

⁹ This Cox proportional hazards model has been preferred because no assumptions about the shape of the baseline hazard function over time are required (semi-parametric model).

Table 1. Estimation Results: Logit model.
Dependent variable: Hazard rate of export flows (exit of export flow=1)

VARIABLES	Column (1)	Column (2)	Column (3)	Column (4)	Column (5)	Column (6)	Column (7)	Column (8)
GVC involvement (total)	0.939*** (0.0004)	0.944*** (0.0005)						
GVC involvement (total) # developing country		0.990*** (0.0006)						
Backward GVC involvement			0.940*** (0.0007)	0.943*** (0.0009)				
Forward GVC involvement			1.004*** (0.0009)	1.005*** (0.0011)				
Backward GVC involvement # developing country				0.998*** (0.0012)				
Forward GVC involvement # developing country				0.993*** (0.0013)				
Backward from advanced source countries					0.956*** (0.0008)	0.980*** (0.0010)		
Backward from developing source countries					0.986*** (0.0009)	0.965*** (0.0010)		
Backward from advanced source countries # developing country						0.909*** (0.0018)		
Backward from developing source countries # developing country						1.094*** (0.0021)		
Forward to advanced destination countries							0.923*** (0.0007)	0.952*** (0.0008)
Forward to developing destination countries							1.028*** (0.0007)	1.003*** (0.0008)
Forward to advanced destination countries # developing country								0.902*** (0.0014)
Forward to developing destination countries # developing country								1.089*** (0.0016)
Developing country dummy	0.926*** (0.0012)	0.997 (0.0050)	0.934*** (0.0012)	0.981*** (0.0045)	0.933*** (0.0012)	1.130*** (0.0059)	0.918*** (0.0012)	1.120*** (0.0047)
GDP exporter	0.965*** (0.0005)	0.964*** (0.0005)	0.957*** (0.0005)	0.956*** (0.0005)	0.960*** (0.0005)	0.962*** (0.0005)	0.958*** (0.0005)	0.958*** (0.0005)
GDP importer	0.990*** (0.0003)	0.990*** (0.0003)	0.990*** (0.0003)	0.990*** (0.0003)	0.990*** (0.0003)	0.990*** (0.0003)	0.989*** (0.0003)	0.989*** (0.0003)
Geographical distance	1.025*** (0.0005)	1.026*** (0.0005)	1.025*** (0.0005)	1.026*** (0.0005)	1.026*** (0.0005)	1.028*** (0.0005)	1.022*** (0.0005)	1.026*** (0.0005)
Initial value of export flow	0.850*** (0.0003)	0.850*** (0.0003)	0.850*** (0.0003)	0.850*** (0.0003)	0.850*** (0.0003)	0.850*** (0.0003)	0.849*** (0.0003)	0.849*** (0.0003)
RTA membership dummy	0.823*** (0.0010)	0.822*** (0.0010)	0.825*** (0.0010)	0.825*** (0.0010)	0.824*** (0.0010)	0.818*** (0.0010)	0.834*** (0.0011)	0.821*** (0.0011)
Duration spell (Logged spell length of exports)	0.371*** (0.0005)	0.371*** (0.0005)	0.370*** (0.0005)	0.370*** (0.0005)	0.370*** (0.0005)	0.370*** (0.0005)	0.372*** (0.0005)	0.372*** (0.0005)
Duration of previous spell	0.881*** (0.0003)	0.881*** (0.0003)	0.881*** (0.0003)	0.881*** (0.0003)	0.882*** (0.0003)	0.881*** (0.0003)	0.879*** (0.0003)	0.879*** (0.0003)
Observations	34,697,686	34,697,686	34,696,848	34,696,848	34,696,848	34,696,848	34,697,686	34,697,686
Number of _spell	9,249,148	9,249,148	9,248,965	9,248,965	9,248,965	9,248,965	9,249,148	9,249,148
Log likelihood	-13962802	-13962687	-13961401	-13962064	-13962110	-13960926	-13963551	-13961434
Rho	0.036	0.037	0.037	0.037	0.035	0.035	0.043	0.041
P-value	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Notes: Coefficients are expressed in hazard ratios. Standard errors in brackets. *p < 0.05; **p < 0.01; ***p < 0.001. All variables, except dummies, are expressed in logs. All models include country-product random effects and a set of sector dummies defined at the 2-digit SITC level.

All the remaining variables show the expected influence. As usual, the likelihood of export exit decreases as the spell increases in length (negative duration dependence). Moreover, the higher the initial value of the trade flow, the lower the hazard of failure. Previous export experience, which is captured by the duration of the previous spell positively, affects the stability of export flows¹⁰. Furthermore, economic size of the trading partners, geographic proximity and membership to the same RTA also facilitate export survival.

In this column (1), the baseline hazard is common to advanced and developing countries and a dummy variable has been introduced to capture the different behaviour in terms of export survival of the two types of countries, once the aforementioned factors are addressed. Here a surprising result arises, developing economies do not show a higher probability of interrupting export relationships, as our previous descriptive analysis had suggested. Other estimates have been conducted (which results not reported but available on request) to explain it. This unexpected finding is not robust to excluding the initial value of exports as a covariate; i.e., when the initial export scale is not taken into consideration, developing countries exhibit lower survival rates. According to empirical literature on trade survival (Besedes and Prusa, 2006b; Cadot et al., 2013), smaller initial transactions have a lower life expectancy. A possible explanation is that, in a context of uncertainty about the success of the supplier-buyer relationship, a high initial export value would provide an indication of trust in the feasibility of this relationship (Rauch and Watson, 2003; Besedes, 2008), possibly contributing to lower chances of failure. Additionally, large quantities of exports at the country-product level at the beginning of the spell might indicate a larger number of firms selling the same product to the same destination from the same country simultaneously. That is, as Helpman et al. (2008) showed, higher trade volumes may be due to a larger proportion of exporters as well. Consequently, we can expect that higher initial export values drastically reduce the possibility of interruption of export flows.

In order to evaluate whether the effect of GVC involvement on the hazard rate is the same for the two groups of countries, an interaction term between the group variable (low-middle income country dummy) and GVC participation is introduced in column (2) of Table 1. Differences in coefficients across countries will be significant when this interaction is significant (Allison, 1999). As for the remaining variables, interaction effects can be displayed as odds ratios or as marginal effects. In the first case, the interaction coefficient is a ratio of odds ratios, so that how much the effect of an explanatory variable differs between groups is expressed in multiplicative terms (Buis, 2010). A value close to 1 reflects that the two odds ratios (for developing and advanced countries) are similar and no differences in the GVC involvement effect across groups are found. By introducing this interaction term, the odds ratio for the GVC participation variable now refers to advanced countries. Its value below unity (0.944) means that for the specific group of advanced countries, the risk of ceasing to export decreases with GVC involvement. The different impact for developing economies is showed by the coefficient of the interaction term; for them, the effect is 0.990 times the effect for advanced countries and this differential effect is statistically significant. Hence, we find a significant difference in the impact of GVC engagement on export survival between the two groups of countries, the effect

¹⁰ As this variable is coded as zero for spells where no information about the duration of the preceding spell is available, these spells, which are the first of several spells observed during the period, are eliminated from the sample. We have checked the robustness of the results by including all (observed) spells.

being higher for low-middle income countries¹¹. That is, developing economies benefit from GVC participation in terms of trade stability more intensively than advanced countries¹².

Figure 3 represents the estimated effects (odds ratios taken from the regression results of Table 1) of the different GVC variables on export failure for developing and advanced countries. This gives a better illustration of how the hazard rate varies with GVC variables and does it differently for each country group. In the first two columns of the Figure 3, we observe that, for both groups of countries, the predicted probability of export failure decreases as total GVC involvement increases but the effect is slightly more pronounced for developing countries.

Figure 3: Estimated effects (odds ratios) of GVC involvement on export failure for advanced and developing countries

Note: the estimated effects come from the logit model reported in Table 1.

However, a debate exists on whether the influence of unobserved heterogeneity in logistic model makes the comparisons of odds ratios across groups problematic (Buis, 2016). Some authors (Allison, 1999; Long, 2009; Mood, 2010; Williams, 2012) point out that, when estimating interaction effects in non-linear models with unobserved heterogeneity, differences in the degree of residual variation across groups imply that the scale of the dependant variable in one group is different from the scale of the dependant variable in the other group. Hence, apparent differences that do not correspond to real group differences can be found. For these authors, this argument makes odds ratios incomparable across groups. Others authors such as Buis (2016) states that unobserved heterogeneity does not have to be a problem in comparing odds ratios in order to explore differences in effects across groups. His argument

¹¹ The odds ratio for developing countries would be 0.934, which is the result of multiplying 0.944 by 0.990.

¹² The interpretation of the coefficient for the country group variable is more complicated with interaction effects. The coefficient denotes the effect of being a developing country on export exit when GVC participation takes the value 0. However, this value is highly unlikely for a continuous variable like this, making the coefficient meaningless.

is that in logistic regression the dependant variable is not a latent variable (which does not have a known scale, so that it changes when something changes the residual variation). It is the degree of plausibility measured by the log-odds, which scale is known (the logarithm of the expected number of successes per failure) and it is the same across groups (as well as for different values of the covariates). This is the main advantage of working in odds ratio metric¹³.

Anyway, to address the concerns about the comparisons of odds ratios across groups in the presence of unobserved heterogeneity, following Long (2009) we also computed predicted probabilities (which are unaffected by residual variation) for each country group separately. Then, to ensure the existence of these group differences, we employ a test of the equality of these predicted probabilities across groups. A drawback here is that the value of the difference in predicted probabilities between the two groups and its statistical significance depends on the values of the covariate in the interaction term. In addition, the estimated probabilities depend on all variables in the model. Therefore, testing the equality of predicted probabilities would require multiple tests, leading to very complex conclusions on how the effect of a variable differ across groups (Williams, 2012). Following Williams (2016), average marginal effects as well as marginal effects at different values of the explanatory variable are computed for each country group¹⁴. Differences in predicted probabilities between them depending on GVC involvement are reported in Table A4. All of them are statistically significant.

In the following two specifications, we examine the effects of backward and forward GVC participation separately. We find that the risk of ceasing to export decreases as the value of backward linkages increases, whereas greater forward linkages have practically no effect on the stability of trade flows (column 3). Moreover, when interaction terms between each type of GVC linkages and country group variable are included (column 4), we observe that backward linkages raise the likelihood of survival for both groups, the increasing being slightly more pronounced for developing countries. Differences in the nil effect of forward linkages between the two groups of countries hardly exist.

We go a step further and investigate the impact of GVC linkages on export stability, differentiating by origin of foreign value added in the backward participation and by destination of domestic value added in the forward participation. Specifically, we distinguish whether the source/destination countries of the value added are developing or advanced in order to know whether the type of country, which the ties are established with, matters for export stability. The outcomes of the estimates are reported in columns 5-8 of Table 1.

Firstly, we focus on backward GVC involvement depending on the income level of the source countries. The effect on export survival is positive regardless of the source (high or low-middle income countries) of foreign value added embodied in exports (column 5). To test for differences in these effects between the two groups of countries, interaction terms between these backward linkages by origin and country group are added in column (6). Both interactions are statically significant,

¹³ Buis (2016) explains that this degree of plausibility can differ from group to group because it depends on the information available, which is represented by the set of explanatory variables. In groups where we are more certain about the event of interest happens, stronger effects are expected because there is more room for a variable to have an effect. Hence, differences in effects across groups are accurately given by the comparisons of the odds ratios. Li and Barry (2012) consider that both metrics (odds ratios and predicted probabilities) are valid techniques for exploring the presence of an interaction and its direction in a logistic regression model.

¹⁴ It is important to note that an additional shortcoming of estimating predicted probabilities is that product-country random effects are assumed to be zero.

supporting the existence of differences, so the effects change depending on the country group. On the one hand, when source countries in backward GVC involvement are advanced, this type of GVC involvement decreases the risk of ceasing to export for both types of countries, with a more pronounced effect for developing countries. That is, benefits from backward GVC participation when foreign value added embodied in exports comes from advanced countries are higher for developing countries (Figure 3). On the other hand, when source countries in backward GVC linkages are low-middle income countries, the hazard rate diminishes with this type of GVC involvement, but only for advanced countries. In this case, advanced countries benefit from backward GVC participation when foreign value added comes from developing countries, while the effect on export failure is positive, hampering survival chances, for developing countries (Figure 3).

Secondly, we focus on the effects of forward GVC participation on trade stability depending on whether destination countries are advanced or developing. Our results reveal that they are in the opposite direction: the effect is positive when destination countries of domestic value added are advanced and negative when they are developing countries (column 7). In order to find out whether there are differences in these effects between the two groups of countries, we incorporate interaction terms in the model (column 8). On the one hand, the positive effect on export survival for forward linkages with advanced destination countries is common for both groups of countries but much stronger for low-middle income economies (Figure 3). That is, in the case of developing countries, their survival chances are enhanced by increasing forward linkages with advanced destination countries. On the other hand, related to forward linkages with developing destination countries, their negative impact on export stability takes place mainly for developing countries. That is, export survival diminishes when developing countries establish forward linkages with other developing countries, while their influence is almost nil in advanced countries (Figure 3).

We perform alternative estimates as robustness checks. First, as mentioned above, classifying countries into advanced and developing countries requires that somewhat arbitrary classification categories be established. Hence, we re-estimate the model using the country classification of the International Monetary Fund's World Economic Outlook for distinguishing between Advanced and Emerging and Developing Economies and the World Economic Forum's Global Competitiveness Index for distinguishing between Innovation-driven economies and all other countries. The estimation results using the last classification, which is the most different from that of World Bank¹⁵, are reported in Table A5 of the Statistical Annex. Some small differences regarding forward GVC involvement's effects appear. Now, the negative effect of forward linkages with developing destination countries on export survival occurs only for developing countries, whereas is positive for advanced countries. The high degree of forward participation in GVCs of natural resource abundant countries such as Brunei, Chile, Russia and Saudi Arabia (World Trade Organization, 2014) could help to explain the differences across estimates. When those countries are excluded from the group of advanced countries and they are considered as developing countries, the influence of forward linkages with developing destination countries on export survival becomes positive for advanced countries (and remains negative for

¹⁵ According to the World Bank's classification, Brunei, Chile, Croatia, Latvia, Lithuania, Poland, Russia and Saudi Arabia are high-income countries, whereas they are not considered into the most developed group (innovation-driven economies) by the World Economic Forum's Global Competitiveness Index.

developing countries). These results (unreported for reasons of space, but available upon request) hold when the country classification of the International Monetary Fund's World Economic Outlook is used.

To further check the robustness of the estimation results, we interpolate using data from surrounding years where values of GVC indicators are missing or unavailable. Moreover, we use GVC indicators as a share of gross exports. In both cases, the results yield very similar conclusions to those obtained in Table 1. Furthermore, the robustness checks commonly used in survival analysis are performed. Analogous findings emerge from estimates using the number of previous spells as a proxy for previous experience (instead of the duration of the previous spells), or considering two spells with a one-year interruption as a single longer spell. All these estimation results are omitted here for reasons of space, but are available upon request.

4. FINAL CONSIDERATIONS

This paper has investigated the influence of being engaged in GVCs on export survival, paying special attention to the differences between advanced and developing countries. The results from the empirical analysis confirm the two hypotheses presented. Firstly, the positive impact of GVC involvement on the stability of export flows; and secondly, its greatest impact on developing countries. These findings support the need for policies to promote participation in GVCs in order to strengthen the stability of exports and consequently boost exports and economic growth.

Moreover, our analysis shows that the likelihood of export failure depends on the type of GVC participation the countries are involved. Higher backward GVC participation (foreign value added embodied in domestic exports) facilitates longer export flows. This result is consistent with the productivity-enhancing effect of importing intermediate inputs. The effect tends to be amplified for firms engaged in GVCs (Agostino et al, 2015). Our study suggests that this improvement in productivity translates into a more solid, more stable competitive position in the international markets. The benefits of backward GVC involvement are greater for developing countries, at least for middle-income economies that are predominant in our sample. This fact seems to show a higher use of technology transfer associated with imported intermediate inputs in those economies distant from the technological frontier (the so called "a learning by importing effect").

Furthermore, when we go a step further and analyse whether the level of development of the source countries of these intermediate inputs matters or not for export survival, we find that it does. Export survival increases when foreign value added comes from source countries with a different degree of development. On the one hand, developing countries achieve longer-lived export flows when that foreign value added comes from advanced economies providing them with additional competitive capabilities (technological capacity, skilled labour, etc.). On the other hand, export duration increases in advanced economies when they incorporate foreign value added from developing countries, which usually enjoy cost advantages. In short, backward GVC involvement promotes more stable trade flows when complementary comparative advantages are combined.

When we focus on forward GVC participation, for both developed and developing economies, it decreases the probability of export failure only when destination countries are advanced countries. This effect is clearly stronger for developing countries. A possible explanation is that supply firms are committed to maintain high levels of competitiveness that enhance export survival, probably due to

the quality and efficiency requirements demanded by advanced countries. Since it is more difficult to find partners who fulfil these requirements for developing countries, the effect would be larger for developing countries. Again, the argument of the complementary capabilities achieved through GVC involvement would help explain these results. However, when developing countries establish forward linkages with other developing countries, the likelihood of export exit increases.

These findings indicate that the GVC configuration, which is determined by the partner countries involved, is important for the stability of trade relationships. It is important to highlight that, for both types of GVC participation, we find that developing countries exhibit a higher risk of export disruption when the source or destination countries of the value added are other developing countries. This result is worrisome because it brings to light the fragility of GVC trade flows among developing countries, at least, again, when they are middle-income economies. It calls into question the confidence of some international trade organizations in the recent growth of South-South trade and its potential benefits for economic development.

To sum up, our results confirm that GVCs are an important avenue for countries to strengthen the stability of their export flows and to consolidate their integration in the global economy, mainly for developing countries. Benefits are higher when GVC linkages are established among countries with different levels of development, by providing them with additional competitive advantages.

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Statistical Annex:

Table A.1. Countries included in the sample.

High-income economies	Australia (AUS), Austria (AUT), Belgium-Luxembourg (BEL), Canada (CAN), Switzerland (CHE), Chile (CHL), Czech Republic (CZE), Germany (DEU), Denmark (DNK), Spain (ESP), Estonia (EST), Finland (FIN), France (FRA), United Kingdom (GBR), Greece (GRC), Hong Kong SAR (HKG), Ireland (IRL), Iceland (ISL), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Lithuania (LTU), Latvia (LVA), Netherlands (NLD), Norway (NOR), New Zealand (NZL), Poland (POL), Portugal (PRT), Singapore (SGP), Slovakia(SVK), Slovenia(SVN), Sweden(SWE), USA (USA).
Low- and medium-income economies	Argentina (ARG), Bulgaria (BGR), Brazil (BRA), Brunei Darussalam (BRN), China (CHN), Hungary (HUN), India (IND), Indonesia (IDN), Cambodia (KHM), Mexico (MEX), Malta (MLT), Malaysia (MYS), Philippines (PHL), Romania (ROM), Thailand (THA), Turkey (TUR), Viet Nam (VNM), Russian Federation (RUS), South Africa (ZAF), Saudi Arabia (SAU).

Table A.2. Sectors included in the sample.

ISIC Rev. 3	Economic activities
01T05	Agriculture, hunting, forestry and fishing
10T14	Mining and quarrying
15T16	Food, beverages and tobacco
17T19	Textiles, leather and footwear
20	Wood and product of woods
21T22	Pulp, paper, printing and publishing
23	Coke
24	Chemical
25	Rubber and plastic
26	Other non-metallic mineral
27	Basic metals
28	Fabricated metal products
29	Machinery and equipment
30T33X	Computer, electronic and optical equipment
31	Electrical machinery and apparatus
34	Motor vehicles, trailers
35	Other transport equipment
36T37	Other manufacturing

Table A.3. Dependent and explanatory variables: definition and sources.

Variable	Definition	Source
Hazard rate of export flows (Dependent variable)	Categorical variable equals one when the export spell (country/partner/product) ends in t year and zero-value when the spell continues in $t+1$ year.	BACI-CEPII dataset
GVC involvement (total)	Sum of Backward and Forward GVC involvement	ICIO Database (OCDE)
Backward GVC involvement	Foreign value added embodied in a country's exports (in US dollar, millions).	ICIO Database (OCDE)
Forward GVC involvement	Domestic value added of the country contained in the exports of other countries (in US dollar, millions).	ICIO Database (OCDE)
Backward from HI source countries	Foreign value added included in a country's exports when the source countries are high-income (in US dollar, millions).	ICIO Database (OCDE)
Backward from LMI source countries	Foreign value added included in a country's exports when the source countries are low- and medium-income (in US dollar, millions).	ICIO Database (OCDE)
Forward to HI destination countries	Domestic value added contained in the exports of other countries, when the destination countries are high-income (in US dollar, millions).	ICIO Database (OCDE)
Forward to LMI destination countries	Domestic value added contained in the exports of other countries, when the destination countries are low- and medium-income (in US dollar, millions).	ICIO Database (OCDE)
LMI countries dummy	Dummy variable, which is unity if the exporter country is a low- and medium-income countries and zero otherwise (a high-income country).	The Global Competitiveness Report. World Economic Forum
GDP exporter, GDP importer	Gross Domestic Product of the exporting country and the importing country expressed in nominal US dollars	World Development Indicators. The World Bank.
Geographical Distance	The Great Circle distance between capital cities of the trading partners.	CEPII: http://www.cepii.fr
Initial value of export flow	Value of export in the first year of the spell, expressed in nominal USA dollars.	BACI-CEPII dataset
AIR membership	Dummy variable = 1 if the exporter country belongs to the regional trade agreement (EU, NAFTA, ASEAN, MERCOSUR) and zero otherwise.	RTA Database (WTO)
Duration spell	Spell length of current Spell (in logs).	BACI-CEPII dataset
Duration previous spell	Number of years that the previous spell lasted.	BACI-CEPII dataset

Table A4. Differences in predicted probabilities between High-income and Low and Medium-income Economics depending on GVC involvement

Marginal effects, dy/dx	Column (2)	Column (4)		Column (6)		Column (8)	
	GVC involvement (total)	Backward GVC involvement	Forward GVC involvement	Backward from HI source countries	Backward from LMI source countries	Forward to HI destination countries	Forward to LMI destination countries
Average Marginal Effects	-0.009*** (0.0001)	-0.009*** (0.0002)		-0.011*** (0.0001)		-0.013*** (0.0002)	
At mean	-0.010*** (0.0001)	-0.009*** (0.0002)	-0.009*** (0.0002)	-0.014*** (0.0002)	-0.007*** (0.0002)	-0.016*** (0.0002)	-0.009*** (0.0002)
At minimum value	0.067*** (0.0001)	-0.012*** (0.0039)	0.002 (0.0019)	0.269*** (0.0061)	-0.179*** (0.0032)	0.291*** (0.0047)	-0.119*** (0.0018)
At maximum value	-0.014*** (0.0002)	0.008*** (0.0008)	-0.015*** (0.0011)	-0.066*** (0.0011)	0.079*** (0.0021)	-0.068*** (0.0008)	0.087*** (0.0018)

Notes: Interaction effects from logit model of Table 1. Standard errors in brackets. *p < .05; **p < .01; ***p < .001. Marginal effects dy/dx computed from logit estimates in Table 1.

Table A5. Robustness check. Results from logit model using the country classification from the WEF's GCI. Dependent variable: Hazard rate of export flows (exit of export flow=1)

VARIABLES	Column (1)	Column (2)	Column (3)	Column (4)	Column (5)	Column (6)	Column (7)	Column (8)
GVC involvement (total)	0.938*** (0.0004)	0.9435*** (0.0005)						
GVC involvement (total) # developing country		0.990*** (0.0006)						
Backward GVC involvement			0.939*** (0.0007)	0.952*** (0.0009)				
Forward GVC involvement			1.005*** (0.0009)	0.995*** (0.0011)				
Backward GVC involvement # developing country				0.973*** (0.0012)				
Forward GVC involvement # developing country				1.021*** (0.0013)				
Backward from advanced source countries					0.979*** (0.0008)	0.996*** (0.0011)		
Backward from developing source countries					0.951*** (0.0008)	0.949*** (0.0010)		
Backward from advanced source countries # developing country						0.885*** (0.0015)		
Backward from developing source countries # developing country						1.119*** (0.0018)		
Forward to advanced destination countries							0.926*** (0.0007)	0.960*** (0.0008)
Forward to developing destination countries							1.024*** (0.0007)	0.996*** (0.0008)
Forward to advanced destination countries # developing country								0.899*** (0.0013)
Forward to developing destination countries # developing country								1.091*** (0.0014)
Developing country dummy	0.929*** (0.0011)	1.001 (0.0049)	0.936*** (0.0011)	1.001 (0.0045)	0.926*** (0.0011)	1.227*** (0.0063)	0.930*** (0.0011)	1.161*** (0.0048)
GDP exporter	0.965*** (0.0005)	0.964*** (0.0005)	0.957*** (0.0005)	0.957*** (0.0005)	0.973*** (0.0005)	0.963*** (0.0005)	0.958*** (0.0005)	0.956*** (0.0005)
GDP importer	0.990*** (0.0003)	0.990*** (0.0003)	0.990*** (0.0003)	0.991*** (0.0003)	0.990*** (0.0003)	0.989*** (0.0003)	0.989*** (0.0003)	0.990*** (0.0003)
Geographical distance	1.025*** (0.0005)	1.026*** (0.0005)	1.025*** (0.0005)	1.026*** (0.0005)	1.029*** (0.0005)	1.029*** (0.0005)	1.022*** (0.0005)	1.025*** (0.0005)
Initial value of export flow	0.850*** (0.0003)	0.850*** (0.0003)	0.850*** (0.0003)	0.851*** (0.0003)	0.851*** (0.0003)	0.851*** (0.0003)	0.849*** (0.0003)	0.849*** (0.0003)
AIR membership dummy (AIR Membership=1)	0.826*** (0.0010)	0.825*** (0.0010)	0.828*** (0.0010)	0.826*** (0.0010)	0.822*** (0.0010)	0.823*** (0.0010)	0.837*** (0.0011)	0.828*** (0.0011)
Duration spell (Logged spell length of exports)	0.370*** (0.0005)	0.370*** (0.0005)	0.370*** (0.0005)	0.368*** (0.0005)	0.369*** (0.0005)	0.372*** (0.0005)	0.371*** (0.0005)	0.369*** (0.0005)
Duration of previous spell	0.881*** (0.0003)	0.881*** (0.0003)	0.881*** (0.0003)	0.881*** (0.0003)	0.883*** (0.0003)	0.883*** (0.0003)	0.880*** (0.0003)	0.879*** (0.0003)
Observations	34,697,686	34,697,686	34,696,848	34,696,848	34,696,848	34,696,848	34,697,686	34,697,686
Number of _spell	9,249,148	9,249,148	9,248,965	9,248,965	9,248,965	9,248,965	9,249,148	9,249,148
Log likelihood	-14009781	-14009776	-14003662	-14002213	-14001979	-14001653	-14001979	-14001653
Rho	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
P-value	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Notes: Coefficients are expressed in hazard ratios. Standard errors in brackets. *p < 0.05; **p < 0.01; ***p < 0.001. All variables, except dummies, are expressed in logs. All models include country-product random effects and a set of sector dummies defined at the 2-digit SITC level.

Methodological Annex:

Our estimation of backward and forward GVC participation is derived from OECD inter-country input output tables (ICIO). These tables are based on national input-output tables that are harmonized and linked together using Bilateral Trade Database in goods by industry and end-use category and estimates of bilateral trade flows in services.

At country-sector level, value added embodied directly and indirectly within gross exports flows (*VAE*) can be calculated using the following equation:

$$VAE = \hat{V} [I - A]^{-1} \hat{X}$$

Where:

$\hat{V}$: is a diagonalised $nk \times nk$ matrix (n is the number of countries ($n = [1, 2, \dots, c, p, \dots, 61]$) and k is the number of industries ($k = [1, 2, \dots, i, j, \dots, 34]$). Each element, v_i^c , captures the share of industry i 's direct value added in total output in country c .

$[I - A]^{-1}$: is the Leontief inverse matrix. Each entry in this matrix (b_{ij}^{cp}) represents the amount of direct and indirect output requirements from industry i and country c that country p needs for support a unit of final demand of j .

$\hat{X}$: is a diagonalised $nk \times nk$ matrix of export flows by country and industry.

VAE: is a $nk \times nk$ matrix, providing a decomposition of gross export by country/industry sources of value-added.

Each row of the matrix *VAE* shows how domestic value added embodied in exports from a country/sector is distributed across all countries and sectors (all columns). By summing the elements of each row (except when country column is the same that row country), we obtain domestic value added from a country-industry incorporated in third countries' exports, that is, *Forward participation*. Note that the domestic value added is content in exports of all industries of exporting countries. We will decompose this indicator to take into account whether the domestic value added is embedded in the exports of advanced or developing countries.

Each column of the matrix *VAE* presents a disaggregation by countries and industries of value added of exports. We construct the measure of *Backward participation* by summing all data in each column excluding domestic value added. In the same way than in Forward, we distinguish the source of foreign value added from advanced and developing countries to develop the econometric analysis.