WORKING PAPER

Global Value Chains - Participation and Firm Productivity: Evidence from Egypt

Prof. Giorgia Giovannetti[1]   Giulio Vannelli[2]

Abstract

Global Value Chains (GVCs) have become the predominant structure in world trade flows. They allow the specialisation of firms in very specific tasks, thus offering easier access to international markets. Developing countries may benefit from this framework through many channels. We focus on Egypt, a country that has faced remarkable challenges in recent years. The analysis is based on the World Bank Enterprise Surveys. After descriptive statistics that evidence the superior performance of traders with respect to domestic firms, this paper investigates the specific relationship between GVC participation and firm productivity. We are interested in enquiring whether a learning mechanism for Egyptian GVC participants exists, in the aftermath of the revolution. We use the definition by Taglioni and Winkler (2016), that allows participants to be broken down into different groups and, hence, to investigate differential effects for these categories. By using a DiD-PSM procedure, we affirm that entering a GVC produces an increase in a firm's productivity; moreover, the effect is heterogeneous amongst the different groups. In the empirical analysis, we compare the results with those obtained using the Multiple Imputation procedure, in order to partially solve the problem of missing data.

JEL Classification: F61, O10, O12, O55

Keywords: Global Value Chains, Firm Productivity, Egypt

---

[1] Università degli Studi di Firenze & EUI

[2] Università degli Studi di Firenze & Università degli Studi di Trento

---

Introduction

The Arab Republic of Egypt is the third richest African country and, with almost 100 hundred million people, also the third largest by population. The role and the prestige of this country are linked to its geographical position and conformation: the Nile River's regular and abundant floods paved the way for one of the greatest civilisations in history to flourish; being the corner point between the Mediterranean and the Red Sea has made the country a world commercial hub since the opening of the Suez Canal in 1869; finally, during the last century, the country has often served as a buffer state between the West and the Middle East in balancing international tensions, such as during the birth of the State of Israel or, more recently, throughout the ISIS crisis.

Today, Egypt is slowly recovering from turbulent years characterised by severe social unrest and political instability, which caused a significant slowdown in the country's development. Although the economy is gradually finding its feet, many social issues that led to the revolution have not yet been addressed (Arezki et al. 2018; Santos and Ceccacci 2015; IEMed 2015, 2016, 2017, 2018). In such a fragile situation, it is thus even more complex putting into practice sound and far-reaching development policies.

Far from offering a panacea, we empirically investigate possible economic benefits emanating from the engagement of Egyptian firms in international trade. In particular, our focus is on analysing opportunities deriving from the international fragmentation of production and through the underlining structures of Global Value Chains (GVCs).

GVCs emerged in the last decades and changed the landscape of the international organisation of production (Spence and Antràs 2017). A value chain comprises "the full range of activities that firms and workers do to bring a product/good or service from its conception to its end use and beyond [,including] activities such as design, production, marketing, distribution and support to the final consumer" (Global Value Chains Initiative). Value chains became global and, therefore, have largely been studied in international economics literature for two reasons: the reduction of transport costs and the development of new disruptive technologies. R. Baldwin (2012) identifies two specific happenings that caused two major unbundlings of the production process: the industrial revolution in the 19th century, and the ICT revolution in the '80s. These factors sharply increased the possibility of and the profitability from the fragmentation of the production process, into single phases carried out by different firms, which were also located in different countries. This, in turn, changed the perspective of firms now specialising within GVCs.

For value chains to work, intermediate goods have to cross a number of national borders often on numerous occasions the same border and firms, who are the main actors in this process, increasingly rely on foreign market access as a sine qua non condition for carrying out their activities.

Within this framework, developed countries, especially Germany, China and the USA (R. Baldwin and Lopez-Gonzalez 2015) have so far had a central role: they are not only by far the most active participants in GVCs, but they also extract the largest part of value added, positioning themselves in the most pro table segments of the chains. However, GVCs may also offer remarkable opportunities for developing countries, first of all by allowing easier access to international markets. Moreover, by increasing participation and improving their position in GVCs, they may benefit through several channels (Figure 1) (Taglioni and Winkler 2016): first, firms and countries may activate backward and forward linkages with the domestic economy; second, technological spillovers from foreign relationships may arise; third, facing more intense competition may spur minimal scale achievements. Overall, these phenomena may promote a pro-competitive restructuring of the domestic market which, in turn, affects the local labour market, stimulating training and skill upgrading.

Figure 1: GVC transmission channels
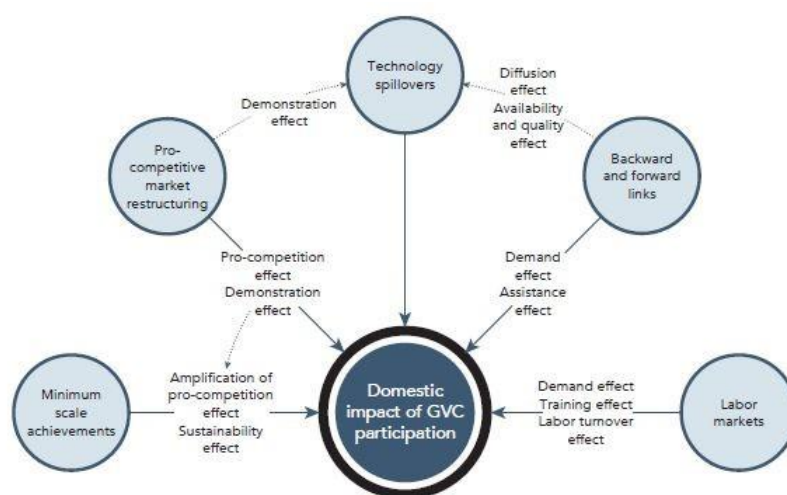
Source: Taglioni and Winkler 2016.

Furthermore, GVCs trigger servicification (Lodefalk 2013; Boddin and Henze 2014). Indeed, firms increasingly buy, produce, sell and export services as integrated or accompanying parts of their primary products. Services are both enablers and phases in the chain: for example, communications, insurance and logistics sustain the chain, whilst R&D, design and after-sales activities are actual stages. Servicification may be incredibly beneficial for many developing countries. Indeed, the enlargement of the service sector may contribute to diversifying their economy, at the same time offering an important contribution to the sectors that already constitute the backbone of the economy.

Acknowledging the large potential of GVCs for economic development, we focus on the effect of GVC participation on firm productivity, a key indicator for countries economic performances. We focus on Egypt. Using a balanced panel dataset, we find that entering GVCs increases firm productivity, especially for domestic firms.

The paper is organised as follows: Section 2 presents related literature; Section 3 provides descriptive statistics on Egyptian firms and internationalisation; Section 4 describes the empirical methodology; Sections 5 and 6 report respectively empirical results and robustness checks. Section 7 concludes.

Literature review

In the 1990s, a growing availability of firm-level data drastically increased the scope of studies on firms' international performance. Emerging evidence of firm heterogeneity has given many scholars the opportunity to expand the Krugman (1979, 1980) model, thus offering new interesting insights into firm performance. Exporters are found to outperform domestic firms (Bernard and Jensen 1999; Aw, Chen, et al. 2001; Aw and Hwang 1995): they are larger, pay higher wages, are more capital intensive and more productive. Firm heterogeneity is then theoretically modelled by Melitz (2003). Adapting the Krugman (1979) model, he introduces heterogeneity by allowing productivity to be firm specific. Opening up to trade causes a sectoral reallocation of revenues and profits, such that the least productive firms are forced to exit the market, whilst the most productive ones survive, export and gain revenues and profits. Therefore, Melitz (2003) concludes that exporters are ex-ante more productive than domestic firms, thus underlining the existence of a self-selection mechanism that leads to internationalisation. If, on one side. the self-selection mechanism is consistent with empirical data, on the other side, a possible alternative explanation suggests that participating in international trade increases firm productivity. Hence, according to this view, internationalising is a learning process for firms.

The investigation on which, if any, of these two mechanisms prevail has filled empirical international economics literature for almost 20 years (Wagner 2007, 2012), along with the discussion of the possible direction of causation.

The first studies on the issue were mainly confined to exporting as internationalisation mode. On one hand, Clerides et al. (1998) for Colombia, Mexico and Morocco, and Bernard and Jensen (1999) for the USA found no evidence of the existence of learning by exporting, suggesting that productivity differentials are determined by ex-ante differences; Delgado et al. (2002) confirm this hypothesis for Spain, evidencing that a learning mechanism exists, albeit weak, only for "younger" exporters. On the other hand, several studies highlight the existence of a learning by exporting effect: amongst these, J. Baldwin and Gu (2003) document it for Canadian manufacturing firms; Van Biesebroeck (2005) reports an increasing gap over time between exporters and domestic firms on a panel of firms from nine Sub-Saharan countries, identifying scale achievement as the main contributor to the increase in productivity; De Loecker (2007) finds similar effects in his study on Slovenia; Lileeva and Trefler (2010), analysing the effect of US tariff cuts on Canadian firms, find an overall but heterogeneous learning by exporting impact.

The literature has also investigated the existence of learning mechanisms de- riving from other modes of internationalisation.

As far as importing is concerned, Amiti and Konings (2007) document for In- donesia that a reduction of import tariffs induces productivity gains deriving from an easier access to foreign intermediate inputs through which learning, variety and quality effects spread; similar results are found for India by Topalova and Khandelwal (2011); productivity is also found to increase with internationalisation for Chilean firms: Kasahara and Rodrigue (2008) report a learning by importing effect, while Kasahara and Lapham (2013) single out the complementarities between imports and exports as the main driver for this growth.

In addition, the effect on productivity of the interaction of different in- ternationalisation modes has also been investigated (Altomonte and Békés 2009; Vogel and Wagner 2010).

Criscuolo and Timmis (2017) assess the relationship between productivity and GVC participation. GVCs, as said, are complex structures in which firms may perform different roles and functions according to their position and involvement. A first consequence of this complexity is the difficulty in finding a definition of a GVC participant that could encompass this heterogeneity. A unique definition does not exist, with different attempts focused only on specific aspects. As a consequence, the literature investigating the relationship between productivity and GVC participation is today experiencing its primal development. Nevertheless, the first studies seem to confirm gains in productivity from participation. Giovannetti et al. (2015) investigate the positive impact of GVC participation on the performances of Italian small enterprises. J. Baldwin and Yan (2016), considering two-way traders as GVC participants, find a learning effect for Canadian entrants in GVCs; Del Prete et al. (2017), by defining traders with an internationally recognised quality certification as participants, also single out a learning by participating effect for Morocco and Egypt in the timespan from 2004-2007.

This paper aims to contribute to this recent literature on the relationship be- tween GVC participation and productivity. It has a threefold objective: first, enlarging this narrow and specific strand of the literature; second, addressing the issue by testing a new definition of GVC participation proposed by Taglioni and Winkler (2016) which offers an original perspective that, to our knowledge, has never been empirically assessed previously; third, updating the analysis on Egypt by Del Prete et al. (2017) in the aftermath of the Arab Spring revolution, thus providing interesting insights for policy implementation. Furthermore, we propose a statistical solution to avoid some of the problems arising from missing data.

Data and stylised facts

This section reports descriptive statistics regarding Egyptian traders. Data comes from the Enterprise Surveys (ES) project, a World Bank programme providing standardised firm-level data. 135,000 non-agricultural enterprises in 139 countries have so far been interviewed and 41 new surveys have been implemented. Each dataset is nationally representative and is based on a questionnaire characterised by a base structure containing information on firm characteristics, firm outcomes (such as sales, supplies, employment and capital), and business environment (both factual and perceived). Area- and country-specific questions complete the base framework. As far as Egypt is concerned, 5 waves of enterprise surveys are available (2004, 2007, 2008, 2013, 2016). This paper is based on the last two waves that, thanks to developments in questionnaire implementation, are more harmonised with each other, making them more reliable than the previous ones. This choice allows us to study the post-Arab Spring economic environment, which is supposed to have been profoundly shaken by the social conflicts that hit the country between 2011 and 2013. The 2013 wave comprises 2897 enterprises, with 1827 in the 2016 wave[3].

The first set of statistics reports the firms' status, i.e. if firms operate domestically or also internationally. In the timespan considered, Egyptian firms have increased their participation in foreign markets[4] (Table 1). The percentage of traders increased 10pp in the timespan, from 26% to 36%. In particular, the percentages of both exporters and importers rose, respectively by 2 and 13pp . As a consequence, the percentage of two-way traders also increased from 8.7 to 13.8%[5].

---

[3] For details about dataset structure see Appendix.

[4] Modes of internationalisation taken into account are as follows: traders refer to firms that either import, or export, or both; importers are firms that use directly bought foreign inputs (variables 9 and 10, Dataset Structure Table, Appendix); exporters are firms that directly sell their output abroad (variable 8, Dataset Structure Table, Appendix); two-way traders are firms that both import and export. As a consequence, these classes are not mutually exclusive, e.g. traders also comprise two-way traders, importers also comprise some exporters and vice-versa.

[5] The large increase in the rate of importers is affected by a large degree of missing data in the 2013 variables used to define the importer status. However, some controls suggest that missing data is not linked to a correlation with specific firm characteristics. Hence, given the aggregate results for traders, an increase in the percentage of importers is expected to have been detected even with the completed data

**Table 1: Exporters, Importers, and Two-way traders
in 2013 and in 2016**

| | | Exporters | | | | | |
| | | 2013 | | | 2016 | | |
		No	Yes	Total	No	Yes	Total
Importers	No (%)	1487 (74.05%)	152 (7.57%)	1639 (81.62%)	1160 (64.05%)	83 (4.58%)	1243 (68.64%)
	Yes (%)	194 (9.66%)	175 (8.72%)	369 (18.38%)	318 (17.56%)	250 (13.80%)	568 (31.36%)
	Total (%)	1681 (83.72%)	327 (16.28%)	2008 (100%)	1478 (81.61%)	333 (18.39%)	1811 (100%)

Notes: Importers are firms that use directly bought foreign inputs (variables 9 and 10, Dataset Structure Table, Appendix); exporters are firms that directly sell their output abroad (variable 8, Dataset Structure Table, Appendix). Both exporters and importers are considered as direct.

In addition to the increase in participation, Egyptian firms have also improved their "quality" in foreign markets. Indeed, the share of international enterprises with recognised quality certifications has drastically increased in the timespan from 2013-2016 (Table 2). In particular, the share of internationally-recognised certified firms has increased by 8pp, if traders are taken into account. The change is found to be relatively smaller (2pp) for importers, and substantially larger for exporters (19pp). The large increase in the share of certified exporters is an important result for the country: indeed, the adoption of certifications and the meeting of product and process standards have become, especially for firms in developing countries, a sine qua non condition for implementing sound international relationships (Nadvi 2008). Hence, given that firms in developing countries often operate in the international production process as assemblers or recipients of de-localised tasks (Grossman and Rossi-Hansberg 2008), to have an international quality certification is fundamental to increasing or just triggering GVC integration.

Table 2: Traders and International Quality Certifications

	Traders		Importers		Exporters		Two-way traders	
	2013	2016	2013	2016	2013	2016	2013	2016
Non- Certified	49.74%	41.69%	44.44%	42.65%	42.08%	23.28%	20.83%	19.20%
Certified	50.26%	58.31%	55.56%	57.35%	57.92%	76.72%	79.17%	80.80%
Total Obs.	577	650	360	565	385	335	168	250

Notes: Traders refers to firms that either import, or export, or both; importers are firms that use directly bought foreign inputs (variables 9 and 10, Dataset Structure Table, Appendix); exporters are firms that directly sell their output abroad (variable 8, Dataset Structure Table, Appendix); two-way traders are firms that both import and export. Both exporters and importers are considered as direct. Internationalisation modes are not mutually exclusive.

These considerations are reinforced by the figures regarding two-way traders. Indeed, the firms that both import and export and are, therefore, highly integrated in international markets, even in 2013 exhibit a very large share of certifications (79%). This share slightly increases (1.5 pp) in 2016.

Let us now investigate some characteristics of international firms. Are firmsthat are involved in international trade different from domestic ones (Bernard and Jensen 1999)? To address this question, we investigate, in line with the existing literature, the existence of premia for traders (Table 3)

Table 3: Traders' premia

		Traders		Importers		Exporters		Two-way traders	
		No	Yes	No	Yes	No	Yes	No	Yes
Small Firms (5-19) (%)		45.90	21.42	43.98	18.79	44.93	18.54	43.66	10.59
Medium Firms (20-99) (%)		36.34	29.06	36.26	27.81	34.54	26.25	34.60	21.41
Large Firms (100+) (%)		17.76	49.52	19.75	53.40	20.82	55.21	21.74	68.00
	Total	100	100	100	100	100	100	100	100
Mean of employment (#)		61.68	361.58	81.09	384.13	81.06	485.06	93.36	625.72
Mean of VA (ln)		13.70	16.35	13.92	16.38	13.98	16.79	14.15	17.09
Mean of Labour Productivity (ln)		11.25	12.14	11.30	12.22	11.41	12.11	11.43	12.26

Notes: Traders refers to firms that either import, or export, or both; importers are firms that use directly bought foreign inputs (variables 9 and 10, Dataset Structure Table, Appendix); exporters are firms that directly sell their output abroad (variable 8, Dataset Structure Table, Appendix); two-way traders are firms that both import and export. Both exporters and importers are considered as direct. Internationalisation modes are not mutually exclusive. Labour Productivity is calculated as Total Sales over Total Employment

As expected, traders are larger. The share of large firms is indeed higher (50%) than for domestic firms (18%) (Column 1-2), and the opposite is true for small and medium enterprises. Almost no differences can be found when switching between importers and exporters (Columns 3-6). Instead, a difference exists when dealing with two-way traders (columns 7-8): the share of large firms is much higher (68%) for this type of internationalisation, with only 10% represented by small firms.

By analysing the differences in size, taking into account total employment, we obtain similar results. Traders outperform domestic enterprises with, on average, 300 more workers. Again, two-way traders have a larger premium in terms of size, with an average of 626 workers, almost 6 times the non-two-way (93). Finally, in this case, importers and exporters exhibit differences: exporters employ, on average, 100 more workers than importers.

The last two rows of Table 3 show two other types of traders' premia. Traders obtain larger VA from their activities and have higher labour productivity than domestic firms. For these two measures, no particular variation appears between the different modes of internationalisation.

The tables directly above underline the existence of premia for traders. In particular, we detected a status-size-productivity nexus. Figures 2 and 3 provide further support for this evidence. Figure 2 shows the dominance of traders' distribution with respect to domestic firms. Indeed, of all the three modes of internationalisation considered here, only importers, only exporters and two-way traders have an average productivity that is higher than domestic firms. Moreover, importers are found, on average, to be more productive than exporters, whilst two-way traders outperform both of them, with a skewed distribution characterised by a larger density about the 13-15 productivity level.
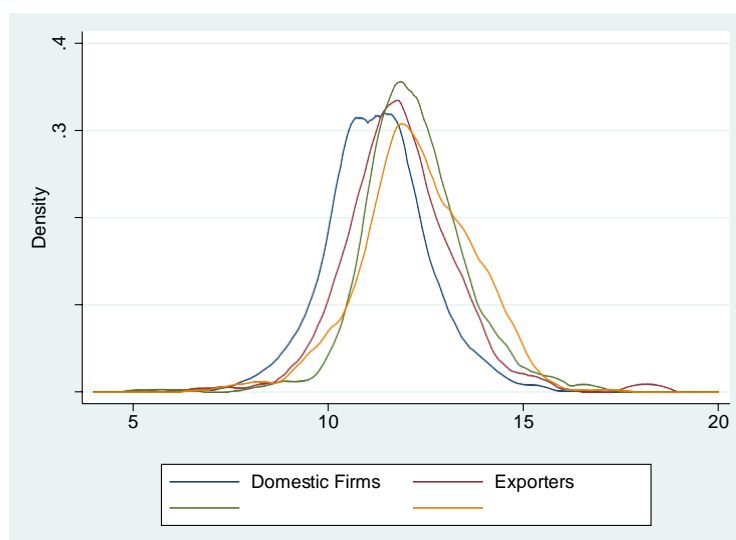
Figure 2: Labour productivity distribution by firm status

Figure 3, on the other hand, shows the relationship between productivity and size, closing the circle of the nexus mentioned above. Large firms, that are more likely to integrate into international markets, are found, on average, to be more productive than small and medium firms. The productivity distributions of the latter do not appear that different.

Figure 3: Labour productivity distribution by firm size
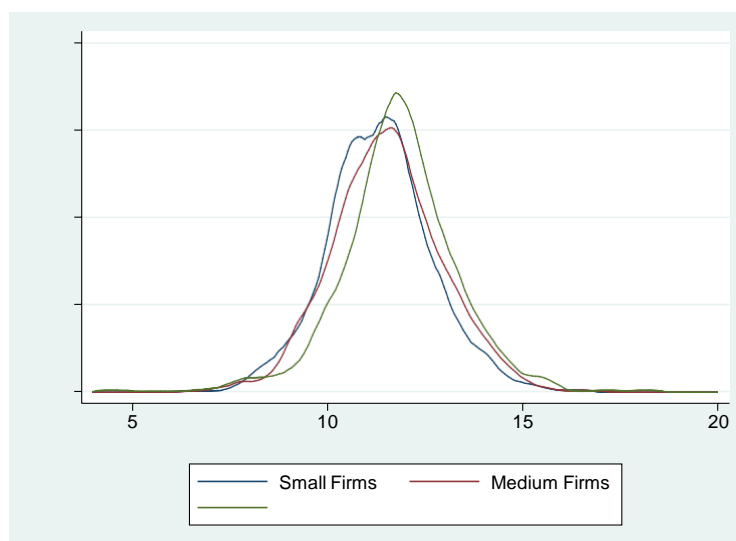
Methodology

After having shown the existence of better performances for Egyptian traders with a wide array of descriptive statistics, we now describe our empirical approach. We discuss here the main choices regarding data and methodologies.

We use a balanced panel dataset, obtained by the last two waves (2013 and 2016) of the Egyptian Enterprise Surveys. The estimation sample comprises all the 659

firms that have been interviewed in both waves, for a total of 1318 observations. Firms are considered GVC participants according to the definition given by Taglioni and Winkler (2016, p. 112). Such a definition considers 4 types of firms as GVC participants: multinationals, domestic suppliers of a country's multinationals, domestic suppliers that export, and domestic producers that import[6]. The relevance of this definition relies on the fact that it recognises the existence of different types of firms and, thus, of their different roles, in GVCs. Hence, it defines GVC participants as a heterogeneous group of firms, thus conveying the complexity of the chain structure and of its internal relationships. Given this peculiarity, this definition allows, on the one hand, the inclusion into GVCs a heterogeneous set of actors for which other definitions may have overlooked and, on the other hand, the exclusion of firms that are not actually involved in GVCs but are instead (well-recognised) traders who, with certain other criteria, may have been included. Two examples of this selection mechanism are briefly given: defining GVC participants as two-way traders may constitute a too strict a criterion, since, for example, domestic suppliers that only export but who source domestically, will be excluded, whilst having a role in the world production process and possibly being integrated into GVCs; conversely, defining GVC participants as certified traders may constitute too large a criterion, since some one-way certified traders, as simple certified exporters or importers, that possibly may not be integrated into GVCs, can be included. In this work, according to data availability, the following groups have been identified: multinationals, as foreign owned (>10%) firms which source domestically; domestic suppliers, as domestic firms which export at least 10% of their production; and domestic

---

[6] Data constraints prevent the precise identification of the 4 groups: domestic sup- pliers of a country's multinationals cannot be identified; moreover, it is not possible to un-ambiguously distinguish between producers and suppliers. A detailed description about the way different status is assigned, is given in the Appendix.

producers, as domestic importers of at least 25% of their inputs[7] . Therefore, any firm belonging to one of these group is considered to be a GVC participant.

As far as productivity is concerned, we computed different measures: Labour productivity, and Total Factor Productivity (TFP) based on Levinsohn and Petrin (2003) (L&P) and on Olley and Pakes (1992) (O&P) procedures[8].

As regards identification assumption, a causality issue is to be addressed. As a consequence, the empirical strategy is based on the combination of two widely used impact evaluation techniques: Difference-in-Difference (DiD) and Propensity Score Matching (PSM) (Caliendo and Kopeinig 2008). This procedure makes allowance for both unobservable (DiD) and observable (PSM) factors that could have affected firms' decisions and performances (De Loecker 2007; J. Baldwin and Yan 2016; Del Prete et al. 2017).

We define treatment and control groups: treated firms are firms that entered GVCs - hence they were outside in 2013 and inside in 2016; controlled firms are the ones always outside (Table 4).

The comparability between the Treatment and the Control groups is ensured by the establishment of a common support through PSM. This procedure is fundamental to ensure that productivity differentials, emerging from DiD analysis, can be attributed only to the Treatment.

Table 4: Change in GVC status

	# of firms	%
Exiters	58	8.80
Always outside (Control Group)	392	59.48
Enters (Treatment Group)	130	19.73
Always inside	79	11.99
Total	659	100.00

Explicitly, the PSM firm probability in 2013 of getting the treatment is calculated by using a Probit Model, where the treatment variable is regressed against

---

[7] Different thresholds for domestic suppliers' exports and domestic producers' imports have been tested: the ones selected are average values. A detailed description about the way different status is assigned, is given in the Appendix.

[8] For details about the computation of productivity measures, see Appendix.

firm productivity, either Labour or L&P or O&P productivity, firm age in 2013, and a categorical variable defining firms as small, medium or large. The choice of these variables is in line with the international economics literature (Del Prete et al. 2017; De Loecker 2007). The balancing between Treatment and Control for each observable is assessed along 8 different blocks; propensity scores have then been used in the DiD analysis as probability weights. Several matching procedures have been implemented and, hence, different common supports and probability weights have been obtained, according to the specific productivity estimates used[9].

Once the matching is performed, the effect of the treatment is measured on the subset of firms inside common support, using a standard DiD procedure.

Empirical Results

Section 3 evidences how traders outperform domestic firms in many characteristics, including productivity. Table 5 provides such evidence on the estimation sample, showing how GVC participants outperform non-GVC firms in all the measures of productivity.

Table 5: GVC Participation and Productivity

	Labour Prod.	TFP (L&P)	TFP (O&P)
Non GVCs	11.36	8.25	9.17
# of obs.	786	521	528
GVCs	12.06	8.72	9.65
# of obs.	289	193	199

Notes: GVC participants are defined according to Taglioni and Winkler (2016).

To go beyond a simple association and to detect a causal effect, we estimate the following equations. The baseline is Equation 1:

$$PROD_{it} = \beta_0 + \beta_1 t + \beta_2 TREATMENT + \beta_3 POST + \gamma_s + \varepsilon_i \qquad (1)$$

where *PROD_{it}* may be either labour productivity or TFP, *t* is a dummy equal to 0 in 2013 and 1 in 2016, *TREATMENT* is a dummy equal to 1 if the firm entered

---

[9] For more details about the PSM procedure, see Appendix.

GVCs during the 2013-2016 timespan, *POST* is the interaction dummy between t and TREATMENT, and γ_s are industry controls[10].

To allow for certain other factors that could induce a productivity increase, we also estimate Equation 2:

$$PROD_{it} = \beta_0 + \beta_1 t + \beta_2 TREATMENT + \beta_3 POST + \beta_4 preR\&D + \beta_5 preTr + \beta_6 C + \gamma_s + \varepsilon_i$$

(2)

where *preR&D* is a dummy equal to 1 if the firm had R&D expenditure in 2012, *preTr* is a dummy equal to 1 if the firm implemented a training programme for its workers in 2012, and *C* is a dummy equal to 1 if the firm has an internationally recognised quality certification.

Table 6 reports the results of the estimate. The third row shows the coefficient of interest, β_3. Entering GVCs produces a net increase in labour productivity (Columns 1-2). The coefficient is significant at 5%, and no relevant changes occur when adding controls (Column 2). Considering TFPs as dependent variable does not change the results. The magnitude of the coefficient (floating around 0.50) is almost unaffected with the two different techniques (Columns 3-6). However, these coefficients are found to be significant only at the 10% significance level, with the exception being the one for O&P TFP (Column 6), just above the 10% threshold.

---

[10] Robust standard errors and weights reflecting firm probability to be treated, derived from the PSM, have been used.

Table 6: Learning by participating in GVC effect

VARIABLES	(1) Labour Prod.	(2) Labour Prod.	(3) TFP (L&P)	(4) TFP (L&P)	(5) TFP (O&P)	(6) TFP (O&P)
t	0.13	0.14	-0.21	-0.20	-0.11	-0.12
	(0.12)	(0.12)	(0.19)	(0.19)	(0.18)	(0.18)
TREATMENT	0.04	0.05	-0.03	-0.04	-0.06	-0.0710
	(0.17)	(0.18)	(0.17)	(0.18)	(0.18)	(0.18)
POST	0.57***	0.52**	0.52*	0.51*	0.49*	0.47
	(0.22)	(0.23)	(0.28)	(0.29)	(0.28)	(0.29)
Constant	11.43***	11.40***	8.41***	8.35***	9.29***	9.21***
	(0.21)	(0.22)	(0.21)	(0.22)	(0.23)	(0.24)
Industry dummies.	✓	✓	✓	✓	✓	✓
Controls		ᵛ		ᵛ		ᵛ
Obs.	753	738	482	473	493	484
R-squared	0.10	0.10	0.09	0.09	0.06	0.07

Notes: Robust standard errors in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Productivity is in logarithm. TREATMENT refers to entering GVCs during the 2013-2016 timespan. GVC participants are defined according to Taglioni and Winkler (2016). POST identifies the interaction between time and the treatment, thus identifying the DiD parameter. Weights reflecting firm probability to be treated, derived from the PSM, have been used.

These results corroborate the large empirical evidence regarding learning by internationalising and, also, the specific outcomes for MENA countries found by Del Prete et al. (2017) and Ayadi et al. (2020). In particular, an increase in productivity due to GVC participation is found to exist in Egypt the day after the Arab Spring revolution and this effect has manifested in just three years (maximum). The estimated coefficient is also in line with Del Prete et al. (2017), even if its significance is lower.

The heterogeneity that characterised our set of GVC participants prevents us from detecting some specific causes of the productivity that is valid for all three categories. In any case, as domestic suppliers and domestic producers are the largest groups amongst treated firms, access to foreign high-technology inputs and the increase in competition in foreign markets appear to provide the strongest arguments (Taglioni and Winkler 2016). This issue is further addressed in more depth in the following paragraph.

Enalrgements and Robustness Checks

Multiple Imputed Data

The estimates, reported in Table 6, show a positive effect on productivity measures from participating in GVCs. However, the significance is weaker when TFP is the dependent variable with respect to labour productivity. This is probably due to the lower number of observations for TFP: indeed, its estimation is largely affected by missing data in several variables that are used to construct the index. To allow for the possibility that this may have altered the results, we perform a multiple imputation (MI) analysis (Rubin 2004).

This procedure allows us to fill missing data with imputations. In particular, it provides a set of imputed values for each missing data in the variables of interest, so that the variability of original data is conserved. Although we implement MI to reduce the missingness of TFP estimations, we do not actually impute TFPs, but rather, the variables used to construct TFP: Total sales, Total employment, Assets, Total electricity costs, Total fuel costs, Total raw material costs, Total labour costs and Total investments. The imputation has been performed using predictive mean matching chained equations, taking into account the longitudinal structure of the dataset. 10 imputations per variables have been produced. Once the imputation has been implemented, single estimations are performed on the 10 datasets and then combined into a single MI result, according to the so-called Rubin rules[11].

Table 7 reports the estimation of Equations 1 and 2 on the imputed measures of TFPs. The coefficient of interest, β_3, is positive, but slightly lower than before (Table 6, Columns 3-6). However, participation in GVCs still increases productivity. Moreover, the significance is higher: all the effects are significant at the 10% level, with the ones for L&P TFP as dependent variable (Column 1-2) almost reaching the 5% level. It is important to note that the combination of the m estimates follows the so-called Rubin rules (ibid.), an averaging formula that also takes into account the variability that exists between the different imputations. Such a procedure may result in an enlargement of the variability of the single MI result. Thus, the significance of our coefficients could be considered as a sort of lower bound, since it comprises a variability inflation due to the difference between the imputations. Hence, it is possible that, had the data been complete, the estimates would have had a significance level, more similar to those for Labour Productivity (Table 6, Columns 1-2).

---

[11] For a more detailed description of MI procedure, see Appendix.

Table 7: Learning by participating in GVCs effect on MI data

VARIABLES	(1) TFP (L&P)	(2) TFP (L&P)	(3) TFP (O&P)	(4) TFP (O&P)
t	-0.25	-0.24	-0.01	-0.00
	(0.24)	(0.25)	(0.18)	(0.19)
TREATMENT	0.06	0.06	0.02	0.03
	(0.18)	(0.18)	(0.19)	(0.19)
POST	0.47**	0.47**	0.44*	0.44*
	(0.23)	(0.23)	(0.24)	(0.25)
Constant	8.59***	8.60***	9.63***	9.62***
	(0.31)	(0.30)	(0.31)	(0.30)
Sectors	√	√	√	√
Controls		√		√
Obs.	1014	990	1010	986

Notes: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Productivity is in logarithm. TREATMENT refers to entering GVCs during the 2013-2016 timespan. GVC participants are defined according to Taglioni and Winkler (2016). POST identifies the interaction between time and the treatment, thus identifying the DiD parameter. Weights reflecting firm probability to be treated, derived from the PSM, have been used.

Bernard and Jensen (1999) Procedure

As a robustness check of results, we implement an alternative identification strategy, developed by Bernard and Jensen (ibid.), and widely used in the literature (Wagner 2007), to detect the relationship between productivity and GVC participation.

This procedure works on first differences and regresses changes in productivity against dummies that identify the behaviour of firms with respect to participation in GVCs (Equation 3):

$$PROD_{it} - PROD_{it-1} = \beta_0 + \beta_1 ENTER + \beta_2 ALWAYS + \beta_3 EXIT + \gamma_s + \varepsilon_i$$

(3)

where $PROD_{it}$ may be either labour productivity or TFP; $ENTER$, $ALWAYS$ and $EXIT$ are dummy variables equal to 1, if the firm respectively entered has been inside in both times, or exited GVCs, and 0 otherwise; γ_s are industry controls[12].

This strategy allows us to compare the performances of GVC entrants with the group of always inside and exiting firms as well. The benchmark are firms that are always outside GVCs. Results are reported in Table 8.

As far as labour productivity is concerned (Column 1), GVC entrants exhibit a positive and highly significant increase in productivity. For always inside firms and for firms that exited GVCs, the effect is positive but it is not significant.

Analysing TFPs (with MI data), the coefficients for entrants is again found to be positive (Columns 2 and 3), even if its magnitude decreases with respect to Column 1. For L&P productivity, the coefficient is significant at the 10% level, whilst for O&P it is just above the threshold, only reaching the 11% level. Also, for these productivity measures, no effect is found for always inside firms and for firms which exited.

In a nutshell, and with caution due to the short period considered in our sample, GVC participation seems to mostly benefit firm productivity at entry: the coefficient for enters are indeed much larger and significant with respect to the other groups. In particular, since the reference category is composed by always outside GVC firms, it is possible to state that the productivity dynamics of always inside firms are not different from those of always outside.

The existence of a beneficial effect of GVC participation only at entry could suggest that the gains from internationalisation mainly derive from opportunities coming from outside the country, rather than from their interactions with national policies: in other words, it looks like, once access to foreign markets is achieved, participating firms are not able to further increase their performances in terms of productivity, as if they lack proper national policies to provide further incentives and opportunities. The latter has to be considered a suggestion that explains the perverse effect that hits always-inside firms.

---

[12] Robust standard errors have been used.

Table 8: B&J Procedure

VARIABLES	(1) Δ Labour Prod.	(2) Δ TFP (L&P)	(3) Δ TFP (O&P)
ENTER	0.620***	0.431*	0.401
	(0.215)	(0.248)	(0.251)
ALWAYS	0.337	0.0524	0.101
	(0.301)	(0.345)	(0.363)
EXIT	0.163	0.0129	0.0405
	(0.256)	(0.354)	(0.347)
Constant	0.572*	0.237	0.431
	(0.317)	(0.488)	(0.436)
Sectors Obs.	∨	∨	∨
	441	598	604

Notes: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Dependent variable is the difference in ln(PROD) between 2016 and 2013. START, ALWAYS, EXIT are dummies defining firm behaviour in terms of GVC participation in timespan 2013-2016.

Entering into GVC participants' heterogeneity

In this paper, we investigate the existence of learning effects by identifying GVC participants following Taglioni and Winkler (2016). As said, this definition is characterised by heterogeneity, in terms of firm types that are considered as GVC participants. For this reason, possible differential effects for these groups of firms are now investigated.

First, it can be very useful to provide productivity estimations of the different types of participants. It is worth recalling the composition of GVC participants, whose identification is based both on their ownership and on their international performance: multinationals are foreign owned (>10%) firms which source domestically; domestic suppliers are domestic firms (>90%) which export at least 10% of their production; and domestic producers are domestic (>90%) importers of at least 25% of their inputs.

GVC participants, as already shown, exhibit large productivity premia with respect to non-participants. Domestic producers, in particular, outperform the other two groups in terms of labour productivity, whilst multinationals are characterised by the largest values of TFPs (Table 9).

From the definition of our classes of participants, two additional categories may be analysed. This offerrs the opportunity to enlarge the

classification by Taglioni and Winkler (ibid.), thus providing possible suggestions for future developments of this approach.

The first of these is composed of what may be called 'Superstars'. Being domestic suppliers and domestic producers are not mutually exclusive groups; their intersection may be seen as an additional category composed of domestic firms characterised by a strong integration in international markets, both as buyers and sellers. Surprisingly, Superstars' productivity, although markedly higher than non-GVC firms, is not characterised by supplementary premia, with respect to single groups of domestic suppliers and producers: only O&P TFP is found to be higher, whilst the other two productivity measures lie in the middle.

The second additional category considers Superstars and Multinationals together, so as to reflect firms that exhibit the most complex internationalisation mode. This group is characterised by firms experiencing deep integration in international markets, the Superstars, but also international financing and expertise through FDI (multinationals). By construction, productivity estimates lie in the middle between the values of the two groups, thus outperforming non-GVC firms' performance.

Table 9: GVC participants decomposition and productivity

	Labour Prod.	TFP (L&P)	TFP (O&P)
Non GVCs	11.36	8.25	9.17
# of obs.	786	521	528
GVCs:			
Multinationals	11.95	8.80	9.80
# of obs.	64	43	44
Domestic Suppliers	11.94	8.74	9.63
# of obs.	130	98	102
Domestic Producers	12.27	8.65	9.62
# of obs.	142	87	91
Superstars	12.18	8.69	9.66
# of obs.	47	35	38
Superstars & Multinationals	12.05	8.75	9.74
# of obs.	111	78	82

Notes: Productivity is in logarithm. GVC participants are identified according to the Taglioni and Winkler (2016) definition. Multinationals are foreign owned firms which source domestically; Domestic Suppliers are domestic firms which export at least 10% of their production; Domestic Producers are domestic importers of at least 25% of their inputs. Superstars are firms which are identified both as Domestic Producers and Domestic Suppliers. Superstars&Multinationals is a group containing the two categories mentioned above.

To further investigate differences amongst the groups in terms of productivity dynamics, we assess the existence of learning mechanisms appertaining to the different categories.

To address this issue, we implement the same identification analysis of the baseline estimation. We run estimates using Equation 1 where the *TREATMENT* corresponds to becoming each of the specific GVC participants[13].

Amongst the different types of treatment investigated, only becoming domestic suppliers or domestic producers appear to significantly increase productivity (Table 10, Columns 2 and 3). Becoming a domestic supplier has an especially large effect. Surprisingly, the other treatments analysed - becoming a multinational, a superstar, or one of the two - do not increase productivity.

Table 10: Differential learning mechanisms for GVC participants

VARIABLES	(1)	(2)	(3) Labour.	(4)	(5)
t	0.30***	0.22*	0.26**	0.31**	0.29***
	(0.10)	(0.12)	(0.11)	(0.11)	(0.11)
TREATMENT$_{NewMultinationals}$	0.12				
	(0.41)				
POST$_{NewMultinationals}$	0.13				
	(0.54)				
TREATMENT$_{NewDomProd}$		0.06			

---

[13] As above, robust standard errors and weights reflecting f i rm probability to be treated, derived from the PSM, have been used.

		(0.19)			
POST$_{NewDomProd}$		0.49**			
		(0.22)			
TREATMENT$_{NewDomSup}$			-0.18		
			(0.24)		
POST$_{NewDomSup}$			0.55*		
			(0.32)		
TREATMENT$_{NewSuperstar}$				-0.21	
				(0.33)	
POST$_{NewSuperstar}$				0.19	
				(0.36)	
TREATMENT$_{NewMulti\&Superstar}$					-0.00
					(0.29)
POST$_{NewMulti\&Superstar}$					0.17
					(0.38)
Constant	11.44***	11.45**	11.47***	11.47**	11.45***
	(0.21)	(0.20)	(0.20)	(0.21)	(0.20)
Observations	753	753	753	753	753
R-squared	0.086	0.094	0.088	0.085	0.085

Notes: Robust standard errors in parentheses. * $p<0.10$, **$p<0.05$, *** $p<0.01$. NewMultinationals, NewDomSup, NewDomProd, NewSuperstar, NewMulti&Superstar are the treatments taken into account in each column. They refer respectively to becoming a multinational, a domestic supplier that exports, a domestic producer that imports,   a superstar, a multinational or a superstar. POST for each treatment identifies the DiD parameter. The common support used is the same as Table 6. Weights reflecting firm probability to be treated, derived from the PSM, have been used.

These results confirm the hypotheses from the baseline estimation: the learning effect passes mainly through the increase in domestic producer and supplier productivity. The higher coefficient for domestic suppliers seems to suggest that meeting the standards and, in general, facing stronger foreign competition, are the main engines for this growth. Access to foreign technology and know-how may be considered the main causes for domestic producer increase in productivity.

As far as the lack of learning mechanism for the other groups, we believe it may be linked to a reduced number of observations in these categories.

Anyway, DiD coefficient, the β_3, is found to be much lower than the one estimated for domestic suppliers and domestic producers. This constitutes an interesting starting point for future analyses, focused on shedding light on this puzzling result.

Conclusions

Egypt's development has come to a dramatic halt in recent years. Serious social issues, that led to the revolution, have still not been addressed and economic growth has stalled, with the government mainly concerned in restoring stability and control over the country. Despite this unfavourable framework, development opportunities may still arise, especially from beyond national borders.

This paper assesses the impact of internationalisation on firm performance. After highlighting the characteristics of firms that are engaged in international trade, it addresses the impact of GVC participation on a specific index that conveys the country's performance and competitiveness, that is firm productivity. Using a DiD-PSM procedure as an identification strategy, we show that productivity differentials between GVC participants and domestic firms are also a consequence of participation. This work enlarges the evidence supporting the hypothesis of the existence of learning mechanisms for internationalising firms. Results are also robust to changes in the identification strategy.

Moreover, this paper, thanks to the use of a novel definition of GVC participants by Taglioni and Winkler (2016), characterised by the inclusion of different types of firms as participants, allows to detect differential impacts on these categories.

In summary, entering GVCs is found to be extremely beneficial for the productivity of firms. This effect is supposed to be driven, on one hand, by access to foreign technology and know-how, and, on the other hand, by meeting process and product standards and by the fierce competition that characterises international markets. Opening up to international trade is not a panacea, nevertheless it constitutes an important opportunity to foster development, especially for developing countries.

References

1. Altomonte, Carlo and Gábor Békés (2009). Trade complexity and productivity. Tech. rep. IEHAS Discussion Papers.

2. Amiti, Mary and Jozef Konings (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia. In: American Economic Review 97.5, pp. 1611 1638.

3. Arezki, Rabah, Lili Mottaghi, Andrea Barone, Rachel Yuting Fan, Youssouf Kiendrebeogo, and Daniel Lederman (2018). Middle East and North Africa Economic Monitor, Spring 2018: Economic Transformation.

4. Aw, Bee Yan, Xiaomin Chen, and Mark J Roberts (2001). Firm-level evidence on productivity differentials and turnover in Taiwanese manufacturing. In: Journal of Development Economics 66.1, pp. 51 86.

5. Aw, Bee Yan and Amy Rueymeng Hwang (1995). Productivity and the export market: A firm-level analysis. In: Journal of Development Economics 47.2, pp. 313 332.

6. Ayadi, Rym, Giorgia Giovannetti, Enrico Marvasi, and Chahir Zaki (2020). Global Value Chains and the Productivity of Firms in MENA countries: Does Connectivity Matter? Tech. rep. Universita' degli Studi di Firenze, Dipartimento di Scienze per l'Economia e l'Impresa.

7. Baldwin, John and Wulong Gu (2003). Export-market participation and productivity performance in Canadian manufacturing. In: Canadian Journal of Economics/Revue Canadienne d'Economique 36.3, pp. 634 657.

8. Baldwin, John and Beiling Yan (2016). Global value chain participation and the productivity of Canadian manufacturing firms. Institute for Research on Public Policy.

9. Baldwin, Richard (2012). Global supply chains: Why they emerged, why they matter, and where they are going. Tech. rep. CEPR Discussion Papers.

10. Baldwin, Richard and Javier Lopez-Gonzalez (2015). Supply-chain trade: A portrait of global patterns and several testable hypotheses. In: The World Economy 38.11, pp. 1682 1721.

11. Bernard, Andrew B and J Bradford Jensen (1999). Exceptional exporter performance: cause, effect, or both? In: Journal of International Economics 47.1, pp. 1 25.

12. Boddin, Dominik and Philipp Henze (2014). International Trade and the Servitization of Manufacturing: Evidence from German Micro Data. In: ETSG, Münich, Germany.

13. Caliendo, Marco and Sabine Kopeinig (2008). Some practical guidance for the implementation of propensity score matching. In: Journal of Eco- nomic Surveys 22.1, pp. 31 72.

14. Clerides, Sofronis K, Saul Lach, and James R Tybout (1998). Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico, and Morocco. In: The Quarterly Journal of Economics 113.3, pp. 903-947.

15. Criscuolo, Chiara and Jonathan Timmis (2017). The Relationship Between Global Value Chains and Productivity. In: International Productivity Monitor 32, pp. 61 83.

16. De Loecker, Jan (2007). Do exports generate higher productivity? Evidence from Slovenia. In: Journal of International Economics 73.1, pp. 69 98.

17. Del Prete, Davide, Giorgia Giovannetti, and Enrico Marvasi (2017). Global value chains participation and productivity gains for North African firms. In: Review of World Economics 153.4, pp. 675 701.

18. Delgado, Miguel A, Jose C Farinas, and Sonia Ruano (2002). Firm productivity and export markets: a non-parametric approach. In: Journal of International Economics 57.2, pp. 397 422.

19. Giovannetti, Giorgia, Enrico Marvasi, and Marco San lippo (2015). Supply chains and the internationalization of small firms. In: Small Business Economics 44.4, pp. 845 865.

20. Grossman, Gene M and Esteban Rossi-Hansberg (2008). Trading tasks: A simple theory of offshoring. In: American Economic Review 98.5, pp. 1978-97.

21. IEMed (2015). IEMed Mediterranean Yearbook 2015.
    - (2016). IEMed Mediterranean Yearbook 2016.
    - (2017). IEMed Mediterranean Yearbook 2017.
    - (2018). IEMed Mediterranean Yearbook 2018.

22. Kasahara, Hiroyuki and Beverly Lapham (2013). Productivity and the decision to import and export: Theory and evidence. In: Journal of International Economics 89.2, pp. 297 316.

23. Kasahara, Hiroyuki and Joel Rodrigue (2008). Does the use of imported intermediates increase productivity? Plant-level evidence. In: Journal of Development Economics 87.1, pp. 106 118.

24. Krugman, Paul (1979). Increasing returns, monopolistic competition, and international trade. In: Journal of International Economics 9.4, pp. 469 479.
    - (1980). Scale economies, product differentiation, and the pattern of trade. In: The American Economic Review 70.5, pp. 950 959.

25. Levinsohn, James and Amil Petrin (2003). Estimating production functions using inputs to control for unobservables. In: The Review of Economic Studies 70.2, pp. 317 341.

26. Lileeva, Alla and Daniel Tre er (2010). Improved access to foreign markets raises plant-level productivity. . . for some plants. In: The Quarterly Journal of Economics 125.3, pp. 1051 1099.

27. Lodefalk, Magnus (2013). Servicification of manufacturing evidence from Sweden. In: International Journal of Economics and Business Research 6.1, pp. 87 113.

28. Melitz, Marc J (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. In: Econometrica 71.6, pp. 1695 1725.

29. Nadvi, Khalid (2008). Global standards, global governance and the organization of global value chains. In: Journal of Economic Geography 8.3, pp. 323 343.

30. Olley, G Steven and Ariel Pakes (1992). The dynamics of productivity in the telecommunications equipment industry. Tech. rep. National Bureau of Economic Research.

31. Rovigatti, Gabriele and Vincenzo Mollisi (2018). Theory and practice of total-factor productivity estimation: The control function approach using Stata. In: STATA JOURNAL 18.3, pp. 618 662.

32. Rubin, Donald B (2004). Multiple imputation for nonresponse in surveys. Vol. 81. John Wiley & Sons.

33. Santos, Nuno and Iride Ceccacci (2015). Key trends in the agrifood sector. FAO.

34. Spence, Michael and Pol Antràs (2017). GLOBAL VALUE CHAIN DEVELOPMENT REPORT 2017 - Measuring and analyzing the impact of GVCs on economic development. The World Bank.

35. Taglioni, Daria and Deborah Winkler (2016). Making global value chains work for development. The World Bank.

36. Topalova, Petia and Amit Khandelwal (2011). Trade liberalization and firm productivity: The case of India. In: Review of Economics and Statistics 93.3, pp. 995 1009.

37. Van Biesebroeck, Johannes (2005). Exporting raises productivity in sub-Saharan African manufacturing firms. In: Journal of International Economics 67.2, pp. 373 391.
    (2008). The sensitivity of productivity estimates: Revisiting three important debates. In: Journal of Business & Economic Statistics 26.3, pp. 311 328.

38. Vogel, Alexander and Joachim Wagner (2010). Higher productivity in importing German manufacturing firms: self-selection, learning from importing, or both? In: Review of World Economics 145.4, pp. 641 665.

39. Wagner, Joachim (2007). Exports and productivity: A survey of the evidence from firm-level data. In: World Economy 30.1, pp. 60 82.
    (2012). International trade and firm performance: a survey of empirical studies since 2006. In: Review of World Economics 148.2, pp. 235 267.

Appendix

A1. Assignment of GVC participant status

According to Taglioni and Winkler (2016) GVC participants can be divided into four specific groups: multinationals, domestic suppliers of a country's multinationals, domestic suppliers that export, and domestic producers that import. Being unable to detect the domestic suppliers of a country's multinationals, only the other three groups are here taken into account here and defined, as follows:

- Multinationals: firms with a share of foreign ownership ≥ 10% and with a share of domestic sourcing > 0;

- Domestic Suppliers: firms with a share of private domestic ownership > 90%

  and with a percentage of sales that are exported (directly + indirectly) ≥ 10%

- Domestic Producers: firms with a share of private domestic ownership > 90%

  and with a percentage of material inputs of foreign origin (directly imported)

  > 25%

The thresholds of imports and exports for domestic suppliers and producers have been introduced to address the lack of a specific variable in the questionnaire defining firms' main products as final or intermediate. Such thresholds have been chosen as average values amongst the many attempts performed.

A2. Productivity Measurement

Productivity essentially measures the ability of a firm to transform inputs into outputs. Despite the concept appearing so simple, its estimation is affected by several issues (Van Biesebroeck 2008) and, as a consequence, many different approaches and techniques for its measurement have been proposed. In this paper, three calculations of productivity have been implemented: Labour Productivity and two estimates of Total Factor Productivity (TFP).

Labour productivity only takes into account labour as a production factor. In particular, it measures the units of output produced per worker.

Hence, it has been calculated as the simple ratio between firm "Total sales" and "Total employment" and expressed in logarithmic terms.

Differently from labour productivity, TFP takes into account all production factors used by firms. In its simplest version it can be measured as the residual, u_{it}, from the regression of production against capital, k_{it}, and labour, l_{it}:

$$y_{it} = \beta_0 + \beta_1 l_{it} + \beta_2 k_{it} + u_{it} \quad (4)$$

As a matter of fact, this procedure considers productivity completely exogenous to both labour and capital. However, this is very unlikely to occur. To address this issue, several techniques have been proposed. According to them, u_{it} may be decomposed as:

$$u_{it} = \varepsilon_{it} + \omega_{it} \quad (5)$$

where ε_{it} is an un-anticipated error term, whilst ω_{it} an anticipated productivity shock, upon which firms base their choices regarding labour and capital. As a consequence of Equation 5, productivity can be measured as a residual, and the only issue is to find a proxy for the anticipated productivity shock, ω_{it}.

The first technique used to estimate TFP is based on Levinsohn and Petrin (2003), a two-stage procedure that uses raw materials as a proxy for ω_{it}.

In particular, the variables used for the estimation are: "Total sales" for production, "Total employment" for labour, "Assets" for capital, and "Total electricity costs" as proxy. All variables are expressed in logarithmic terms, and their values have been inflated for monetary variables to 2015 values, through WB GDP deflator. The other measure of TFP, developed by Olley and Pakes (1992), differs from the Levinsohn and Petrin (2003) technique only for the proxy used. Indeed, O&P link firm choices about production factors with the amount of expenditure for investments. Hence, "Total investments" has been chosen as a proxy for ω_{it}. All other variables stay the same and are still expressed as inflated log-values.

Both the TFP estimations have been conducted using the Stata programme Prodest developed by Rovigatti and Mollisi (2018).

To conclude, Table 11 reports correlation matrix of the productivity measures developed. Despite the differences of the approaches, the correlations are found to be very high. This is also true for Labour Productivity and TFPs, (Column 1).

Table 11: Correlation matrix of productivity estimates

	Labour Productivity	L&P (TFP)	O&P (TFP)
Labour Productivity	1.0000		
L&P (TFP)	0.9201	1.0000	
O&P (TFP)	0.9404	0.9805	1.0000

A3. PSM

The use of PSM is fundamental in our identification strategy. It ensures the comparability between Treatment and Control groups by allowing for differences in some observable factors that could lead to productivity differentials that depart from the exposure to the treatment.

In other words, PSM excludes from the DiD analysis all firms that do not have a proper comparison, i.e. that lie outside the common support, with respect to some specific variables. This procedure is then fundamental to ensure that productivity differentials, emerging from DiD analysis, can only be attributed to the Treatment. Explicitly, PSM firm probability in 2013 of getting the treatment is calculated according to the following Probit Model:

$$TREATMENT_i = \beta_0 + \beta_1 PROD_i + \beta_2 AGE_i + \beta_3 SIZE_i + \varepsilon_i \qquad (6)$$

where *PROD* is either Labour or L&P or O&P productivity, *AGE* is firm age in 2013, and *SIZE* a categorical variable defining firms as small, medium or large. The choice of these variables relies on a deep analysis of international economics literature (Del Prete et al. 2017; De Loecker 2007), and on several attempts on the dataset to achieve the highest level of balancing.

The propensity scores from the Probit model have been divided in 8 different blocks, where the balancing between Treatment and Control average values for each observable is assessed. Propensity scores have then been then used in the DiD analysis as probability weights.

Given the fact that more than one productivity estimate has been performed, different matching and, hence, different common supports and probability weights for the DiD analysis, have been implemented. Moreover, to calculate the common support for the DiD analysis on imputed data for TFPs, an average of the m imputations per firm has been calculated and then used as $PROD_i$ in the Probit Model.

A4. Multiple Imputation Procedure

Multiple imputation (MI) is a statistical procedure that allows the filling of missing data with imputations (Rubin 2004). In particular, this technique provides a set of m imputed values for each missing data of the variables of interest, so that the variability of original data is conserved. Then, estimations are computed in each m imputed dataset and then combined according to the so-called Rubin rules.

MI has been used in this study to reduce the missingness of TFP estimations. However, TFPs have not actually been imputed, rather the variables used to construct such indicators have been. To better allow for a correlation between variables identifying firm performances, 8 variables have been imputed: Total sales, Total employment, Assets, Total electricity costs, Total fuel costs, Total raw material costs, Total labour costs, Total investments.

Before imputing missing data, the dataset has been reshaped from long to wide: this essentially dropped the time variable and duplicated all the other variables, with one identifying value in 2013 and one in 2016 per each firm. This step takes into account the correlations between the observations of the same

firm and, thus, the longitudinal structure of the dataset.

The imputation step has been performed using predictive mean matching chained equations. Each of the 16 imputed variables[14] has been regressed on the other 15 in a chained system of equations. The missing values are replaced with imputations that correspond to the nearest real observation to the fitted value obtained by the regression. Chaining the equations takes into account the correlation between the variables, so that imputed values simultaneously solve the system. 10 imputations per variables have been produced.

After the imputation step, the dataset has again been reshaped to its original structure.

At this point, TFPs have been estimated. Following the same procedure described in the "Productivity Measurement" section, one L&P and one O&P TFP per each imputed dataset have been calculated.

---

[14] Each of the variables mentioned above is indeed split in 2013 and 2016 variables.

Dataset Structure

	Variable	Description
	Variable	**Description**
1	idstd	Observation's identification code
2	panelid	ID that is the same across the waves for panel firms
3	year	Year of survey
4	panel	Panel: Firm interviewed in these years
5	Trader	Importer and/or exporter
6	Exporter	Direct exporter in that year
7	Importer	Direct importer in that year
8	Exported sales	% of sales directly exported
9	Use of imported inputs	% of inputs of foreign origin
10	Foreign inputs directly imported	Are foreign inputs used directly imported?
11	Two-way trader	Is the firm a two-way trader?
12	Certification	Does Establishment Have an Internationally-Recognised Quality Certification?
13	Multinational	Multinational which sources domestically (TW definition)
14	Domestic supplier	Domestic supplier that exports (exp. threshold 10%) (TW definition)
15	Domestic producer	Domestic producer that imports (imp threshold 25%) (TW definition)
16	Superstar	Domestic supplier and domestic producer
17	TWgvc	GVC participant (TW definition)
18	TWgvc change	Change in TWgvc status
19	Treatment	Does the firm enter GVCs during the 2013-2016 timespan?
20	New Multinationals	Does the firm became a multinational during the 2013-2016 timespan?
21	New domestic supplier	Does the firm became a domestic supplier during the 2013-2016 timespan?
22	New domestic producer	Does the firm became a domestic producer during the 2013-2016 timespan?

23	New Superstar	Does the firm became both a dom. sup. and a dom. prod. during the 2013-2016 timespan?
24	Female owner	Amongst the Owners of The Firm, Are There Any Females?
25	Female top manager	Is the Top Manager Female?
26	Female production workers	Num. Full-Time Employees at End of Last Fiscal Yr: Female Production Workers
27	Female non-production workers	Num. Full-Time Employees at End of Last Fiscal Yr: Female Non-Production Workers
28	Female workers	Num. Full-Time Employees at End of Last Fiscal Yr: Female
29	Total production workers	Num. Full-Time Employees at End of Last Fiscal Yr: Production Workers
30	Total non-production workers	Num. Full-Time Employees at End of Last Fiscal Yr: Non-Production Workers
31	Average years of education	Average Years of Education for Typical Production Worker
32	Young production workers	Number of production workers under 30 years old
33	Young non-production workers	Number of non-production workers under 30 years old
34	Total skilled workers	Num. Full-time Employees at End of Last Fiscal Yr: Skilled Production Workers
35	Firm type	Manufacturing or Services
36	Total sales	In Last Fiscal Year, What Were This Establishment's Total Annual Sales?
37	Total employment	Num. Permanent, Full-Time Employees at End of Last Fiscal Year
38	Total electricity costs	Total Annual Costs of Electricity in Last Fiscal Year
39	Total fuel costs	Total Annual Cost of fuel in last fiscal year
40	Total raw material costs	Cost of Raw Materials and Intermediate Goods Used in Prod. In Last Fiscal Year
41	Total labour costs	Total Labour Cost (Incl. Wages, Salaries, Bonuses, etc) In Last Fiscal Year
42	Capital	Cost for Establishment to Re-Purchase All of its Machinery
43	Assets	Value of total assets
44	VA	Value Added (total sales-total raw material costs)
45	Total investments	Total Annual Expenditure for Purchases off Equipment in Last Fiscal Year
46	R&D	During last Fiscal yr, Establishment Spent On R&D (Excl Market Research)?
47	training_prog	During last Fiscal yr, Establishment did a formal training programme for employees?

48	Labour Productivity	Total sales/total employment (ln)
49	L&P TFP	TFP with L&P procedure
50	O&P TFP	TFP with O&P procedure

About EMNES

The Euro-Mediterranean Network for Economic Studies (EMNES) is a network of research institutions and think tanks working on socio-economics policy in the Euro-Mediterranean. EMNES is coordinated by the Euro-Mediterranean Economists Association (EMEA).

The research conducted by EMNES Researchers, Associates and Fellows aims to design sound and innovative socio-economic models that are inclusive, sustainable and employment creative, to devise new models for regional integration and to provide policy recommendations towards this goal.

EMNES research agenda is organized around the following mutually reinforcing and interconnected themes led by EMNES researchers, associates and fellows:

- Governance, institutions and institutional reforms;
- Macroeconomic policies and employment creation;
- Private sector, micro, small and medium –sized enterprises development, entrepreneurship and social business;
- Digital economy;
- Healthcare policy;
- Human capital development, education, innovation, skill mismatch and migration;
- Labor markets, employment and employability;
- Finance, financial inclusion and the real economy;
- Sustainable development;
- Regional integration;
- Euro-Mediterranean economic partnership;
- Scenarios analysis and foresight.

EMNES performs **research activities**, disseminated through series of internal and external publications (studies, working papers, policy papers, policy-graphics and books) and the organization of **annual conferences**, and **policy workshop meetings and online webinars** to bring together leading researchers, policy makers and representatives of the civil society to discuss and debate optimal policies for the future of the region.

EMNES research and outputs are underpinned on the **four fundamental principles: Independence, Scientific Excellence, Policy Relevance and Deep Knowledge of Euro-Mediterranean Affairs**.

Disclaimer: The contents of EMNES' documents are the sole responsibility of the authors and can under no circumstances be regarded as reflecting the position of their institutions.