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Abstract

We provide new evidence on the participation of firms within Global Value Chains (GVCs) for a large pool of MENA countries included in the World Bank Enterprise Surveys (WBES). Making use of several firm-level GVC participation indices, we find a positive association with firm productivity gains. Based on this result, we further investigate the complexity of GVC relationships and examine how sector/country connectivity affects firm productivity. Using a multi-level model, we augment our analysis by including centrality indicators calculated on the intermediate trade network, constructed from the EORA input-output tables. Positioning within the network structure of trade in intermediate products also plays a role. Our results indicate a positive effect of the connectivity of the sector on the Total Factor Productivity (TFP) of firms. Results remain robust after we control for the endogeneity between firm productivity and participation in GVCs.

Keywords: global value chains, firm heterogeneity, MENA region, trade networks, productivity.

JEL codes: F14, F15, L23, L25, 055.

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1 Introduction

The MENA region has a strategic geographical position in the Mediterranean. With world production being increasingly segmented across countries and the emergence of Global Value Chains (GVCs), as well as concerns about reducing pollution due to goods travelling long distances, these factors could enhance the role of MENA region firms and countries, in terms of intermediate trade. This, in turn, could provide a real opportunity for deeper integration with Europe and economic development.

However, the MENA region has not been able to fully integrate in GVCs, even though the potential exists - not only due to its geographical position, but also its human capital and specialisation. Integrating into GVCs would benefit the region in different ways. First, the export dynamics of MENA countries have been largely unsatisfactory over the past two decades. Integrating GVCs could help boost and improve their exports. Second, as highlighted by Jaud and Freund (2015), MENA countries have export superstars but small and medium enterprises (SMEs), with the lion's share of the total number of enterprises in the MENA region, are still excluded from this mode of internationalisation. Indeed, they remain weak and with low-value added. GVC participation can be a tool to favour their growth and improve the whole productive structure. Third, the MENA region has several characteristics that can attract foreign investors: relatively low labour costs, an abundance of skilled blue-collar workers (highly demanded in most manufacturing industries (see Aboushady and Zaki, 2018), a central location between European and African Markets with several preferential trade agreements (EU association agreements, COMESA and African Continental Free Trade Agreement). Fourth, and notably for the MENA region, participation in GVCs, even if in low value-added tasks, like assembly of imported components, has the potential to boost employment, to reduce unemployment; hence to resolve one of the main structural challenges in this region. Fifth, from a policy perspective, MENA countries are still at the early stages of participation in GVCs (Del Prete et al, 2015), but to trigger international linkages, governments need to pay close attention to education and training policies, in order to ensure the fundamentals for moving up are in place. The above reasons show that it is worth examining the impact of GVCs on firms in the MENA region.

The contribution of this paper is twofold. First, it contributes to the firm-level empirical literature on Global Value Chains' (GVCs) participation, by providing new evidence for a number of MENA countries included in the World Bank Enterprise Surveys (WBES) and makes use of different GVC participation indices (Dovis and Zaki, 2018). We study the different impact of GVCs on small, medium and large firms in the MENA region (mainly North African countries which are more specialised in manufacturing inputs and services). Second, we adopt a multi-level analysis to examine how the sector/country connectivity affects firm productivity. After describing the network of intermediate trade within the MENA countries and between the MENA countries and the rest of the world, and highlighting the large existing heterogeneity between countries which are hubs or authorities, as well as in the size of import and export flows, we show a positive association between productivity gains and GVC participation of firms in the region. We also find a positive effect of the connectivity of the sector on the Total Factor Productivity (TFP) of firms - a largely unexplored result. Our findings remain robust after allowing for endogeneity between firm productivity and GVC participation.

The remainder of the paper is organised as follows. Section 2 reviews the literature on the relationship between GVC and productivity. Section 3 presents the data. Section 4 gives an overview of the international trade network of the MENA region, using sectoral data. Section 5 provides an overview of GVCs using the firm-level data. Section 6 presents the methodology and highlights the rationale behind the multi-level analysis. Section 7 analyses the results and presents some robustness tests, and Section 8 provides the conclusion.

2 Literature Review

In his seminal work, Gereffi (1994) developed the concept of "*global commodity chains*" which relates value-added chains to the global organisation of industries. Since then, several papers have examined the typology, the determinants and the effects of integrating into a GVC. Value chains can be domestic, regional or global. Chang, Bayhaqi & Yuhua (2012) highlight the main differences: value chains become global when their related activities are integrated and connected across geographies, whereas they are regional when their activities are coordinated within a specific region, or countries in a region.

The empirical literature on the nexus between GVCs and firm productivity is relatively abundant and many different areas of the world are studied in detail, with sectoral or even firm data. Baldwin and Yan (2014) find that Canadian firms that integrated into a GVC benefitted from a rise in productivity by 5% during the first year and by 9% four years later. Moreover, as highlighted by Baldwin (2013), in a long-term perspective, integrating into GVCs prevents countries and firms from investing decades into the development of a full-range national supply. In the same vein, Ju and Yu (2015) calculate an upstreamness index for all industries measured as the number of stages that the product will go through before reaching the final demand. They find that upstream firms are more capital intensive.

Del Prete et al. (2016) examine the participation of North African countries into GVCs both from a macro and a micro perspective. The macro analysis exploits the information of Input-Output tables and suggests that North African countries are not fully integrated into GVCs and there are still unexplored opportunities. As for the firm level analysis, based on WBES, the findings show that participation in GVCs had a positive impact on the firms' performance. Kordalska et al. (2017) analyse the relation between participation in GVCs and sectoral productivity growth, using panel data analysis covering 40 countries and 20 industries in the period from 1995 to 2011. The study found that there is a positive relation between TFP growth and involvement of sectors in a GVC. Also, Lu, Sun and Chen (2016) examined the relation between GVC participation and productivity, using a large Chinese firm-level dataset, with 208,078 firm-year observations for the period from 2000 to 2006. The study found that the relation between GVC participation and productivity had an inverted U-shaped. This implies that participation in GVCs increases firm productivity, but there is a diminishing marginal effect of this trend. On the same lines, Manova and Yu (2016) examined how firms choose to participate in global trade and the effect of this decision on firm performance. The study analysed three export modes: ordinary trade, processing trade with imported inputs, and processing trade via pure assembly. It finds that, when financially constrained, firms are more likely to conduct more processing trade and pure assembly, whereas value added and profitability increased with ordinary trade. Yu (2014) analyses how reductions in tariffs on imported inputs and final goods have an impact on the productivity of large Chinese trading firms. The study finds that input and output tariffs' reduction in China induces an increase in a firm's productivity, but this impact decreases with the share of a firm's processing imports.

At the SME level, some studies analysed the effect of participation in GVCs on their internationalisation. Brancati et al. (2015) focused on Italian SMEs. They found that there is a positive association between the probability of internationalisation and a firm's involvement in the supply chain. Using the same dataset, Giovannetti et al. (2015) showed that integrating into a GVC increases the likelihood of becoming an exporter and the quantity of exports. Yet, the number of export destination markets does not seem to be affected by GVCs. OECD (2008) found that the participation in GVCs enhances SMEs internationalisation and growth. ADB and ADBI (2015) examine the effects of integrating Asian SMEs into GVCs and find that participation in GVCs would give SMEs in Asia the opportunity to be exposed to a large customer base and to learn from large firms in global markets. Finally, OECD (2018) suggests that stronger participation of SMEs in global trade provides opportunities to increase productivity and to scale up. GVCs can also create new opportunities for SMEs to integrate in the international market. The study also indicated that there are internal and external factors affecting the ability of SMEs to participate in the global market. Internal factors are innovation, technology adoption, and management and human capital, whereas the external factors include access to finance, access to information and intellectual property.

Some studies focus on the outsourcing and offshoring of GVCs which can be measured by gross trade in intermediate goods (Mitra and Ranjan, 2009; Formai and Vergara Caffarelli, 2015). However, Criscuolo and Timmis (2017) suggest that GVC participation is a broad concept not confined to the trading of intermediate goods. Second, in terms of direction, Banga (2013) also indicated that participation of a certain country in GVCs could either be backward or forward. Backward GVC participation is when firms import foreign inputs to be used in the production of exports, whereas forward GVC participation is when they export domestic inputs for use in the exports of other countries (World Bank, 2017).

A different yet related strand of the literature focuses on the link between being in GVCs and Free Trade Agreements (FTAs). Arudchelvan and Wignaraja (2015) describe the characteristics of SMEs in GVCs and FTAs, based on a survey of Malaysian 234 enterprises. They find that size has a positive and a significant relationship with participation in GVCs. The study also indicated that licensing of foreign technology, investment in R&D, and knowledge of FTA provisions had positive effects on participation in GVCs. Rasiah, Rosli, and Sanjivee (2010) analyse the effect of production networks on productivity, exports and technological upgrading of SMEs in some sectors in Malaysia. The study finds that size and labour productivity are positively and significantly associated with the participation of firms in GVCs. In other words, highly integrated firms in GVCs show higher production.

Finally, integrating GVCs can also help firms overcome financial constraints. Indeed, Manova and Yu (2016) find that financially constrained Chinese firms are more likely to conduct more processing trade and pure assembly, whereas value added and profitability increase, moving from just assembly to processing with imports to arm's length trade. For the MENA region, Del Prete et al. (2018) perform a micro, firm level analysis, based on WBES data for Egypt and Morocco and show that the performance of firms, measured by several indicators, is positively associated with internationalisation and GVC participation.

In summary, most of the studies corroborated the positive and significant relationship between productivity gains and GVCs, especially for SMEs. This paper, using a set of indices of GVCs, re-examines the relationship for a large pool of firms in the MENA region.

3 Data Presentation

We rely on two datasets: the World Bank Enterprise Survey (WBES) and the Eora dataset.

The WBES includes formal (registered) companies with 5 or more employees. Firms with 100% government/state ownership are not eligible to participate in an Enterprise Survey. The survey covers a broad range of business environment topics including access to finance, corruption, infrastructure, crime, competition, and performance measures. The Enterprise Surveys Unit uses two instruments: the Manufacturing Questionnaire and the Services Questionnaire. The standard survey topics include firm characteristics, gender participation, access to finance, annual sales, costs of inputs/labour, workforce composition, bribery, licensing, infrastructure, trade, crime, competition, capacity utilisation, land and permits, taxation, informality, business-government relations, innovation and technology, and performance measures. Enterprise Surveys are available for 9 MENA countries: Djibouti, Egypt, Israel, Jordan, Lebanon, Morocco, Tunisia, West Bank and Gaza, Yemen - for the year 2013. Therefore, our sample contains 5725 manufacturing and services firms located in eight MENA countries, Djibouti being dropped due to the small number of observations. We use the 2013 survey as all the surveys are harmonised for all countries, guaranteeing comparability.

To obtain a comprehensive view of trade in intermediate goods, we make use of the Eora global multi-regional input-output tables. The advantage of using input-output data lies in the possibility of using the international inter-sectoral exchanges of intermediate goods, which accurately measure the production linkages between countries and sectors. Relative to similar sources, i.e. WIOD and TiVA, the EORA database includes a larger number of countries, most of which are of direct interest here. In what follows, we present a country-level analysis for the year 2015 (the last available at the moment). The number of sectors is 26 (see Appendix 1) encompassing goods and services.

4 The Intermediate Trade Network of the MENA Region

We investigate the intermediate trade network of the MENA region. We consider two main perspectives: trade within the MENA countries and trade between the MENA region and other countries. Analysing all sectors together, i.e. both goods and services, provides the broad picture. However, Global Value Chains involve many inter-sectoral linkages. Moreover, in the MENA region there are many resource abundant countries for which trade in primary goods is very relevant. For this reason, we also single out the intermediate trade network for the manufacturing sectors. To this end, we consider trade from manufacturing sectors towards all-use sectors.

4.1 Overall trade in goods and services

The value of overall intermediate trade (sum of imports and exports) of MENA countries is very heterogeneous across countries. Saudi Arabia, UAE, Iran and Israel are the top traders, with a value of over $100 billion; whilst the smaller traders account for a fraction of that value, with smaller countries, such as Yemen and Bahrain, trading less than $10 billion.

Among the top traders, only Iran is a net exporter of intermediate goods, i.e. has a positive, normalised intermediate trade balance (see Table 1). Net exporting countries are Kuwait, Qatar and Libya with a normalised intermediate trade balance above 50%. On the contrary, net importing countries are Lebanon, Jordan and Tunisia, all with a negative balance above 18%. Looking at the composition of

intermediate trade, top intra-MENA traders are Jordan, Oman and Lebanon, for which the exchanges with MENA partners account for more than 20% of all intermediates. On the contrary, the most outward oriented countries are Israel, Algeria and Morocco, for which more than 98% of intermediate trade involves non-MENA countries.

Yet, there are differences between intermediate export and import shares with MENA countries. Some countries mostly operate as suppliers within the MENA region (intra-MENA exporters), whilst others are buyers (intra-MENA importers). Lebanon exports almost 60% of its intermediates towards the MENA region; Jordan and Bahrain's intermediate exports are also relatively concentrated towards the region. On the contrary, Algeria, Libya and Israel's intermediate exports are almost completely oriented outside the region. On the import side, Oman, Iraq and Qatar import intermediates from the region relatively more than others. A clearer picture emerges if we also compare intra and extra-MENA trade balances. Interestingly, we see that some countries operate as buyers from the MENA region, but as suppliers to the rest of the world, and vice versa. Those countries seem to operate as regional hubs of inward or outward connections with the rest of the world.

Table 1 – Normalised trade balances and intra and extra-regional trade - Overall trade in goods and services

	Normalised intermediate trade balance (%)			Weight of intra-MENA on intermediate trade (%)		
	intra-MENA	extra-MENA	World	Total trade	Export	Import
Algeria	-45.7	46.1	45.2	1.0	0.4	2.6
Bahrain	75.4	7.0	17.3	15.0	22.5	4.5
Djibouti	-5.9	-17.3	-16.6	6.1	6.9	5.5
Egypt	62.9	-14.9	-9.1	7.4	13.3	2.5
Iran	-2.1	17.7	15.7	9.8	8.3	11.9
Iraq	-90.3	46.6	30.2	12.0	0.9	32.7
Israel	6.0	-7.7	-7.6	0.5	0.6	0.4
Jordan	31.2	-40.2	-21.7	25.9	43.4	14.7
Kuwait	8.1	70.6	69.2	2.2	1.4	6.5
Lebanon	23.4	-76.8	-55.3	21.5	59.2	10.6
Libya	-79.3	55.9	50.8	3.7	0.5	13.6
Malta	58.1	-12.1	-9.7	3.3	5.8	1.3
Morocco	32.7	2.2	2.7	1.8	2.3	1.2
Oman	-22.1	43.1	27.5	23.9	14.6	40.2
Qatar	-17.2	66.6	60.3	7.5	3.9	22.1
Saudi Arabia	-67.8	4.3	0.4	5.4	1.7	9.1
Syria	57.2	7.9	13.8	11.9	16.4	5.9
Tunisia	32.3	-22.0	-18.4	6.5	10.6	3.7
UAE	39.5	-10.6	-3.8	13.4	19.5	7.8
Yemen	7.8	12.6	12.2	7.2	6.9	7.5

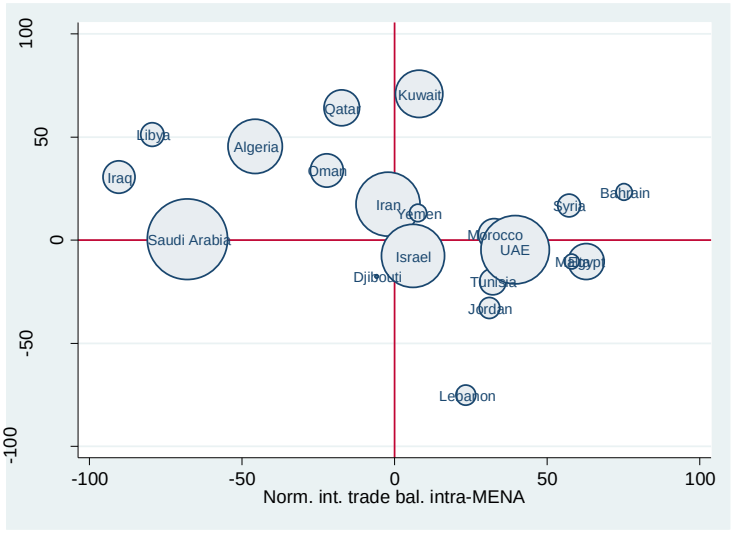
Source: Original elaborations using EORA dataset.

In Figure 1, countries in the top-right quadrant are exporters of intermediate goods both towards the region and outside, generally being "suppliers" in a GVC. No country lies in the bottom-left corner: i.e. there is no country that is a net importer of intermediates, both from inside and outside the region. Countries in the top-left quadrant tend to import from the region whilst exporting to the rest of the world

and, vice versa, countries in the bottom-right quadrant import from the rest of the world whilst exporting to the other MENA countries. The evidence above suggests an underlying network structure in which different countries play different roles, with some of them being important gateways connecting the region to the rest of the world.

It may be informative to take a network approach to investigate trade in intermediates.

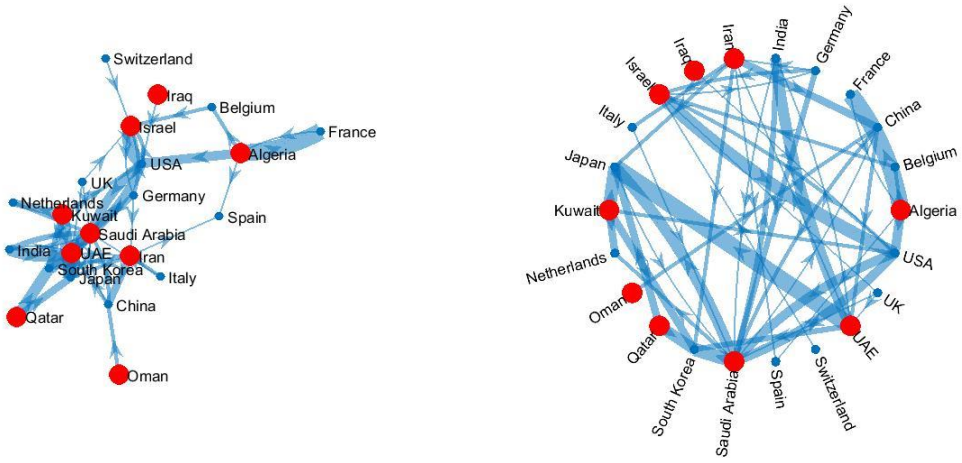
Figure 1 – Intra and extra-MENA trade balances - Overall trade in goods and services.



Source: Original elaborations using EORA dataset.
Note: Circles are proportional to total intermediate trade.

Figure 2 shows the overall intermediate trade network of MENA countries. Each country is a node (MENA countries highlighted), the spokes are proportional to trade, the arrows indicate the direction of the trade flow and more connected countries tend to occupy central positions. The largest traders, i.e. Saudi Arabia, UAE, Iran, are very central. USA and Germany are also very central and have a role in connecting some MENA countries. For instance, Algeria is clearly an extra-MENA supplier of intermediates and is connected to other MENA countries only through third-party countries, namely USA, Belgium and Spain, thus being an indirect supplier of intermediate goods.

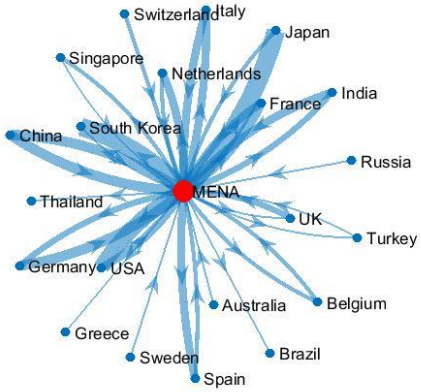
Figure 2 - Trade in intermediates network of MENA countries - Overall trade in goods and services (flows above 0.5%).



Source: Original elaborations using EORA dataset.

Outward linkages of the region are more clearly observed if we consider the MENA aggregate, as in Figure 3. The main trading partners are China, USA, Germany, France, South Korea, Japan and Italy. The region is a supplier of intermediates to many countries, especially to South Korea, Japan and USA. Intermediate trade is mostly balanced with China, France and Italy, whilst the region imports from Germany, UK and Switzerland.

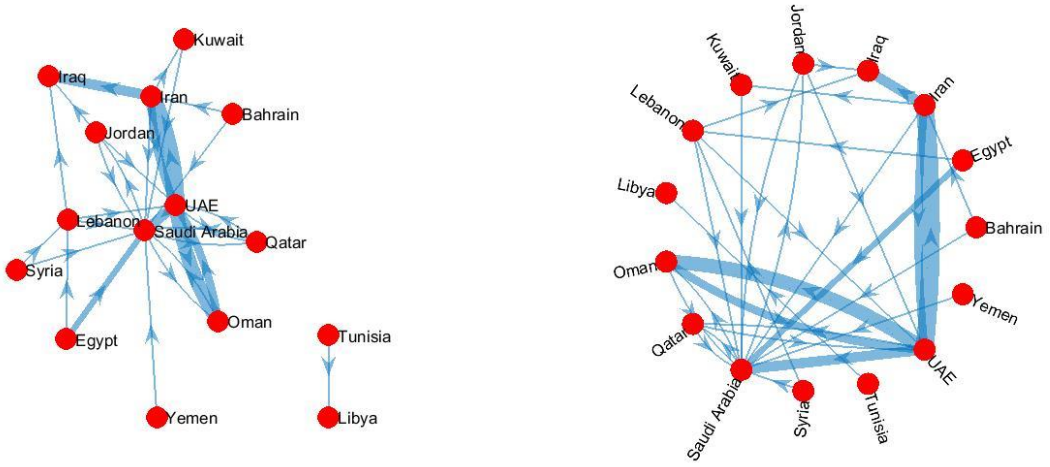
Figure 3 - Trade linkages of aggregate MENA region - Overall trade in goods and services (flows above 0.5%).



Source: Original elaborations using EORA dataset.

Figure 4 shows the intra-MENA intermediate trade network. The graph confirms the centrality of UAE, Saudi Arabia and Iran. Out of the 20 countries considered, 15 are represented in the graph (which excludes flows below 0.5% of total trade) showing that most of the countries are well integrated within the region, although with few important links, whilst a few do not exploit the geographical closeness and, as a result, are relatively isolated - notably Israel and Algeria which are among the larger traders in the region. Saudi Arabia and Jordan have the highest number of linkages (number of import and export trade partners, i.e. indegree + out degree), being connected with all the other MENA countries and are the two most central countries of the network, together with Iran, Oman, Qatar and Tunisia, if we only consider existing linkages, i.e. the unweighted structure of the network. Some of these countries, however, whilst being well integrated within the region, do not have large trade flows, which reduce their importance in the production chain. For instance, Jordan is very well connected and central, but its flows are relatively small.

Figure 4 - Intra-MENA network of intermediates - Overall trade in goods and services (flows above 0.5%).



Source: Original elaborations using EORA dataset.

A more detailed description of the role of each country within the region is obtained by looking at the (weighted) centrality indexes, reported in Table 2 (for unweighted measures, see Appendix 1). The PageRank measures the number of times a given country is encountered when moving within the network: Saudi Arabia, UAE and Iran are the most central countries. There is a probability of randomly encountering one of these three countries of about 27% (unweighted) to 43% (weighted). Hubs and authorities are recursive connected measures. Hubs represent countries who export to many important destinations, whilst authorities represent countries that import from many important sources. These measures are more sophisticated than outdegree and indegree, but the intuition is similar. UAE is by far the most important hub in the region and the one with the largest (weighted) outdegree. Authorities are less concentrated; Iran, Oman and Saudi Arabia being the main ones. UAE is not a particularly important authority, despite having a high in degree. Finally, Saudi Arabia and UAE are the most central countries

in terms of betweenness, a measure that indicates the frequency with which the shortest path between two countries passes through a given country.

Table 2 - Centrality indicators of the intra-regional intermediate trade - Overall trade in goods and services (indexes weighted by trade flow; flows above 0.1%).

	PageRank	Hubs	Authorities	Outdegree	Indegree	Betweenness
Algeria	0.023	0.000	0.008	0.5	1.4	12
Bahrain	0.009	0.046	0.000	2.9	0.1	0
Egypt	0.021	0.055	0.001	6.2	1.2	40
Iran	0.125	0.032	0.383	15.5	16.3	81
Iraq	0.084	0.006	0.011	0.4	9.4	13
Israel	0.012	0.000	0.001	0.6	0.7	0
Jordan	0.072	0.024	0.011	5.5	2.8	64
Kuwait	0.023	0.022	0.002	1.9	1.7	0
Lebanon	0.029	0.012	0.007	4.0	2.4	2
Libya	0.036	0.000	0.001	0.1	1.3	17
Malta	0.008	0.000	0.000	0.2	0.0	0
Morocco	0.016	0.011	0.000	0.9	0.3	0
Oman	0.090	0.025	0.292	8.2	12.9	70
Qatar	0.064	0.018	0.049	2.8	4.4	0
Saudi Arabia	0.158	0.039	0.216	4.5	23.6	135
Syria	0.015	0.028	0.001	3.7	1.0	0
Tunisia	0.053	0.010	0.001	2.2	1.0	51
UAE	0.148	0.659	0.016	35.1	15.0	127
Yemen	0.014	0.012	0.001	0.8	0.6	0

Source: Constructed by the authors using EORA dataset.

4.2 Trade in manufacturing

Let us now focus on the manufacturing trade, i.e. intermediate exports from manufacturing sectors towards all sectors of importing countries. The definition used here considers international exports of manufacturing industries towards all sectors of importing countries; this is standard and corresponds to the way in which customs data is recorded. This definition keeps track of actual international flows of manufacturing intermediate products.

Manufacturing represents about 46% of all trade in intermediates of the MENA countries (Table 3). The manufacturing share for imports (63%) is almost twice that for exports (33%), indicating that the region is a net importer of processed intermediates. Normalised trade balances confirm this result. The trade balance for goods and sectors is positive, whilst the balance for manufacturing alone is negative. This means that the region is a net exporter of non-manufacturing intermediates (i.e. primary goods and services) and a net importer of intermediate products.

Table 3 – Manufacturing and overall trade of the MENA region.

	Manufacturing	All sectors	Share (%)
Intermediate trade (bln $)	417	910	45.8
Intermediate export (bln $)	168	513	32.7
Intermediate import (bln $)	249	396	62.9
Normalised trade balance (%)	-19.6	12.8	

Source: Original elaborations using EORA dataset.

Whilst the region is a net importer of intermediate manufacturing goods, some countries have a positive trade balance, either intra-MENA or extra-MENA or both (Table 4). Egypt, for instance imports from outside the region, but exports to other MENA countries. On the contrary, Morocco has a positive trade balance with respect to both areas, but the intra-MENA surplus is much larger. Kuwait, Bahrain and Morocco are the only countries with a positive trade balance outside the region, all other countries import intermediates. On the contrary, many countries are net regional exporters.

Table 4 – Normalised trade balances and regional trade - Manufacturing.

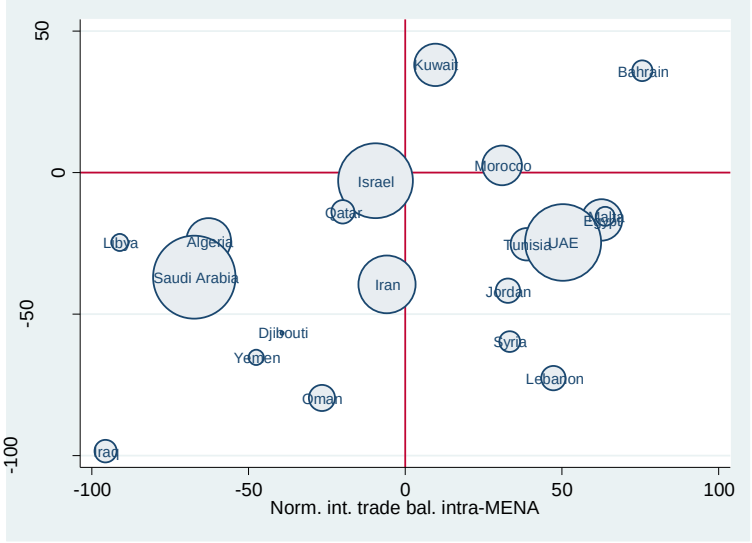
	Normalised intermediate trade balance (%)			Weight of intra-MENA on intermediate trade (%)		
	intra-MENA	extra-MENA	World	Total trade	Export	Import
Algeria	-62.6	-23.8	-22.9	2.2	1.1	2.9
Bahrain	75.8	27.5	20.0	13.5	18.6	4.5
Djibouti	-39.2	-54.8	-55.6	5.4	7.2	4.8
Egypt	62.8	-14.2	-21.1	8.1	15.4	2.6
Iran	-5.8	-33.0	-38.8	17.6	24.8	14.0
Iraq	-95.6	-96.8	-97.5	38.2	52.5	38.0
Israel	-9.5	-2.8	-2.8	0.5	0.5	0.6
Jordan	32.8	-26.4	-48.9	27.6	49.8	14.7
Kuwait	9.6	36.2	37.4	4.5	3.7	6.4
Lebanon	47.4	-47.5	-76.5	23.4	65.8	8.4
Libya	-91.1	-24.4	-17.9	8.8	1.0	13.6
Malta	63.9	-14.6	-17.3	3.3	6.4	1.1
Morocco	31.0	2.5	2.0	1.6	2.1	1.1
Oman	-26.6	-48.4	-73.4	53.4	76.0	45.6
Qatar	-19.8	-11.3	-8.9	22.6	20.5	24.4
Saudi Arabia	-67.3	-35.8	-33.0	8.4	4.3	10.3
Syria	33.4	-46.8	-62.3	16.2	40.6	7.3
Tunisia	38.8	-23.2	-27.3	6.3	11.3	3.1
UAE	50.5	-18.9	-32.0	15.9	29.5	6.6
Yemen	-47.5	-62.3	-63.7	8.4	11.7	7.6

Source: Original elaborations using EORA dataset.

Figure 5 depicts the intra and extra-MENA normalised trade balances. Whilst for goods and sectors the correlation between regional intermediate trade balances is negative, there is a positive correlation for manufacturing. Exporting countries tend to export both inside and outside the region, and the same holds true for imports. A few countries, however, import from outside the region and export to other MENA countries, whilst no country does the opposite. The change in correlation, as compared to overall intermediate trade, is mainly due to the exclusion of primary resources. The extra-MENA trade balances change significantly, whilst the intra-MENA balances are much more stable. Focusing on

manufacturing improves the extra-region trade balance for intra-MENA exporters (upward shift) and worsens it for intra-MENA importers (downward shift). Intra-MENA exporters of goods and services (positive intra-regional trade balance) tend to have relatively developed manufacturing sectors and import some non-manufacturing intermediates from the rest of the world. If we do not account for non-manufacturing products, mostly imports, then the extra-regional trade balance must improve. Similarly, resource abundant countries, whilst their industry needs to import manufacturing, also tend to sell large amounts outside the region, which gives rise to a positive extra-regional trade balance. Excluding non-manufacturing intermediates, mostly exports, reduces the extra-regional trade balance, which turns negative.

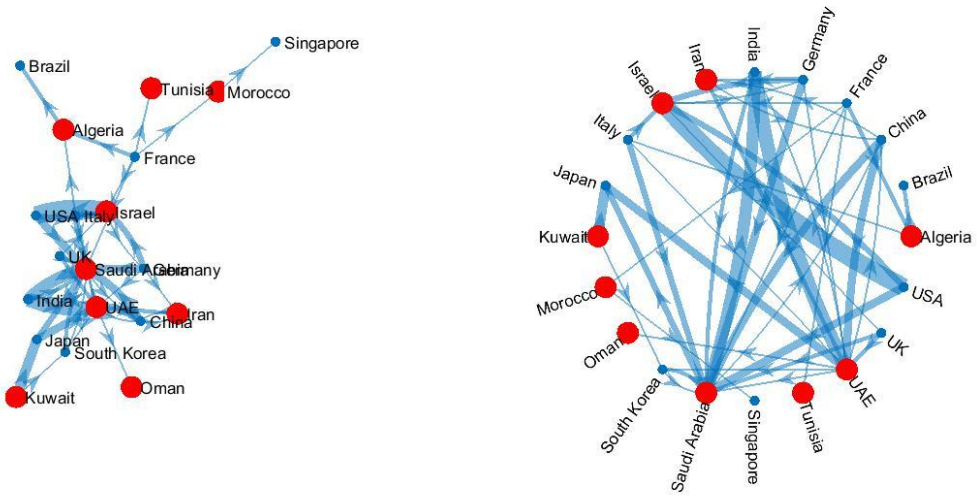
Figure 5 – Intra and extra-MENA trade balances - Manufacturing.



Source: Original elaborations using EORA dataset.
Note: Circles are proportional to total intermediate trade.

The manufacturing intermediate trade network that emerges does not change greatly, relative to the intermediate overall trade in goods and services, as regards to the main country-nodes of the network, namely Saudi Arabia, UAE, Iran and Israel (see Figure 6). However, three things stand out: first, the direction of trade flows is, in many cases, inverted; second, the role of France is now much more evident; third, some countries, such as Morocco and Tunisia, gain importance and are now included in the network (which only shows the main flows for clarity). Take, for instance, Algeria. Overall, it is a net exporter to France, USA, Belgium and Spain but, if one looks only at manufacturing, one sees that it imports from France and Saudi Arabia in order to export to Brazil. The link between Algeria and France relates to non-manufacturing intermediates and is France's only important link in overall intermediate trade with the region. But, in manufacturing, France is much more central and has many export links that include Algeria, Israel, Tunisia and Morocco, the latter further exporting to Singapore.

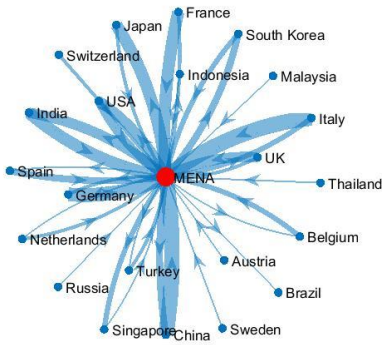
Figure 6 - Trade in intermediates network of MENA countries - Manufacturing (flows above 0.5%).



Source: Original elaborations using EORA dataset.

The above network represents individual countries and their main bilateral flows. A different picture is obtained by taking the aggregate MENA region and its manufacturing links with other countries (Figure 7). For instance, it can be noted that, relative to overall intermediate trade, Italy becomes part of the network as an exporter of manufacturing; Thailand switches from importer to exporter, and several other countries strengthen their role as exporters, including China, India, South Korea, Germany and others.

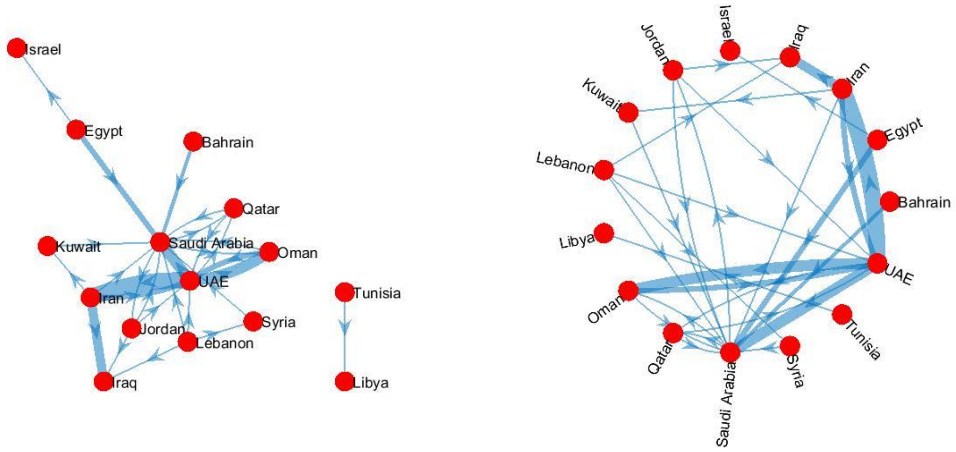
Figure 7 - Trade linkages of aggregate MENA region – Manufacturing (flows above 0.5%).



Source: Original elaborations using EORA dataset.

The intra-MENA network of intermediate trade, on the other hand, does not change greatly when we focus purely on manufacturing products. The main traders are the same and, with minor changes, the structure and direction of flows remain similar (see Figure 8). The only notable change is Israel, which is generally not very integrated within the region regarding overall trade, but cannot be excluded from the manufacturing trade network. The similarity of the intra-region overall trade and manufacturing networks confirms the evidence obtained from trade balances.

Figure 8 - Intra-MENA network of intermediates - Manufacturing (flows above 0.5%).



Source: Original elaborations using EORA dataset.

Table 5 shows the intra-regional centrality measures for the manufacturing network. Saudi Arabia, Iran and UAE are the most central countries, according to the PageRank index. On the export side, UAE is the most important country within the region (Hub), whilst on the import side we have Iran, Oman and Saudi Arabia (Authorities). This is also confirmed by the outdegree and indegree. In terms of betweenness, the most central countries are Saudi Arabia and UAE.

The analysis of the position in networks of intermediates can drive our choice (amongst the countries for which we have data available) of countries to check as to whether entering a GVC can help improve the performance of small firms. An increase in productivity, due to joining a value chain, is likely to have a positive impact on the country's competitiveness and could trigger a virtuous micro-macro-micro circle. Thus, in the following sections, we will focus mainly on non-oil countries that have an emerging or a well-established manufacturing sector. Hence, the focus will be on North African countries (Egypt, Morocco and Tunisia) plus other countries in the Middle East region (Jordan, Israel, Lebanon, Palestine and Yemen).

Table 5 - Centrality indicators of intra-regional intermediate trade - Manufacturing (indexes weighted by trade flow; flows above 0.1%).

	PageRank	Hubs	Authorities	Outdegree	Indegree	Betweenness
Algeria	0.023	0.000	0.010	0.323	1.668	0
Bahrain	0.011	0.038	0.000	2.575	0.151	0
Egypt	0.022	0.065	0.001	6.300	1.256	54
Iran	0.159	0.022	0.386	14.683	16.500	45
Iraq	0.106	0.005	0.008	0.212	10.465	3
Israel	0.013	0.000	0.002	0.501	0.834	0
Jordan	0.047	0.031	0.012	5.637	2.898	76
Kuwait	0.029	0.030	0.002	2.298	1.978	0
Lebanon	0.028	0.015	0.006	5.075	1.731	0
Libya	0.023	0.000	0.000	0.000	1.133	0
Malta	0.009	0.000	0.000	0.340	0.000	0
Morocco	0.011	0.009	0.000	0.809	0.193	0
Oman	0.093	0.026	0.262	7.275	12.624	69
Qatar	0.062	0.020	0.040	2.385	4.013	0
Saudi Arabia	0.172	0.038	0.258	5.100	26.034	167
Syria	0.016	0.019	0.001	2.366	1.146	0
Tunisia	0.026	0.008	0.001	2.333	0.821	43
UAE	0.137	0.673	0.011	38.102	12.425	110
Yemen	0.015	0.003	0.001	0.228	0.673	0

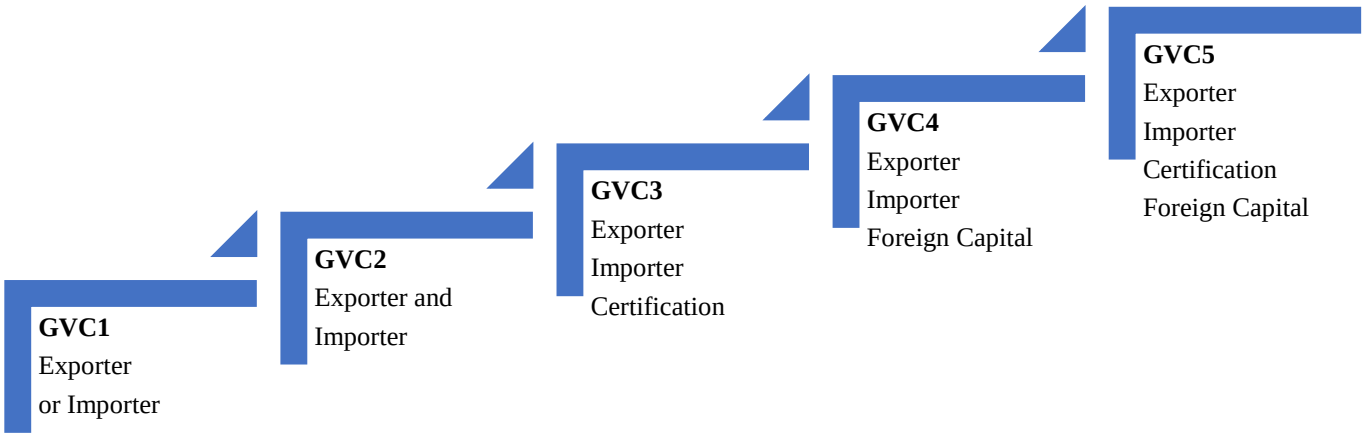
Source: Original elaborations using EORA dataset.

4. Overview of GVC and Productivity in MENA

4.1. A Firm-level Analysis of GVCs

In order to see whether MENA firms have exploited the opportunities of GVCs and whether this has enhanced their productivity, we use different definitions of GVCs. First, the least strict definition includes firms that export or import intermediate inputs. Second, a stricter definition combines the two criteria together: a firm that exports and imports intermediate goods. Third, two stricter definitions are related to firms that are simultaneously exporters and importers and have either an international certification, or a share of its capital owned by a foreign firm. The strictest definition combines the four criteria altogether (see Figure 9). Our preferred definition is the strictest one, since it guarantees that a firm has several characteristics increasing its participation in a GVC, namely exporting, importing, with a foreign certification and has foreign owner.

Figure 9: GVC Definitions



Source: Authors' own elaborations, based on Dovis and Zaki (2018).

Tables 6 and 7 show the distribution of firms by country and by sector using the five different definitions. We note that the number of firms in a GVC, as expected, falls the more restrictive the criteria (dropping from 68.1% in GVC1 to only 3% in GVC5). At the country level, whilst Egypt has the highest share of firms that export and/or import (GVC1 and GVC2 respectively), Tunisian and Moroccan firms are ranked first in GVC5. Indeed, Morocco experienced significant improvements in integrating GVCs and upgrading its exports, particularly in the automobile sector. Moroccan firms also understood the importance of certifications for entering GVCs (see Del Prete et al, 2017). Second, at the sectoral level, the stricter the definition, the more complex the sectors. For instance, in GVC1 and GVC2, leather, rubber, printing, and paper and chemicals have a large share of firms being part of a GVC. By contrast,

electrical equipment, machinery and equipment are amongst the sectors that have a large share of firms being part of GVC5. These sectors have a higher value-added and are more technology intensive.

Table 8 shows that the stricter the definition, the more likely small firms will not be part of a GVC. To reach this result, we interact our variable of interest (GVC) with firm size, For instance, in GVC2, the share of small, medium and large firms integrating into a GVC is 8.3%, 20.1% and 46% of the respective total number of firms. These shares decline drastically in GVC5, being the most restrictive definition, to reach 0.4%, 1.6% and 9% respectively. This conclusion is crucial to our understanding of the link between SMEs and GVCs since, whilst firms can benefit enormously from entering a GVC, they are still excluded because of several impediments that hinder their sustainability and growth (going from financial, to technological, infrastructural and procedural barriers).

In what follows, we enquire about a possible positive association between GVCs and productivity. Figure 10 shows that productivity (whether measured by total factor productivity or by labour productivity) is positively correlated to GVC (no matter what definition is used). The next section will examine this nexus empirically.

Table 6: GVC by Country

	GVC1		GVC2		GVC3		GVC4		GVC5		
By country	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
Egypt	40.5%	59.5%	87.5%	12.5%	92.2%	7.8%	96.7%	3.3%	97.6%	2.4%	100%
Israel	23.9%	76.1%	74.6%	25.4%	77.6%	22.4%	95.5%	4.5%	96.5%	3.5%	100%
Jordan	23.6%	76.4%	58.5%	41.5%	85.4%	14.6%	89.6%	10.4%	95.8%	4.2%	100%
Lebanon	18.4%	81.6%	60.7%	39.3%	83.3%	16.7%	97.5%	2.5%	97.9%	2.1%	100%
Morocco	17.1%	82.9%	72.2%	27.8%	88.2%	11.8%	91.4%	8.6%	94.1%	5.9%	100%
Tunisia	9.7%	90.3%	54.8%	45.2%	83.0%	17.0%	84.2%	15.8%	93.9%	6.1%	100%
West B.	18.4%	81.6%	72.2%	27.8%	91.8%	8.2%	99.4%	0.6%	99.4%	0.6%	100%
Yemen	51.3%	48.7%	90.6%	9.4%	95.7%	4.3%	99.1%	0.9%	99.1%	0.9%	100%
Total	31.9%	68.1%	77.9%	22.1%	89.2%	10.8%	94.8%	5.2%	97.0%	3.0%	100%

Table 7: GVC and Sector

	GVC1		GVC2		GVC3		GVC4		GVC5		
By sector	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
Food and Bev.	37.8%	62.2%	82.9%	17.1%	89.8%	10.2%	96.1%	3.9%	96.6%	3.4%	100.0%
Textiles	27.6%	72.4%	78.1%	21.9%	89.2%	10.8%	96.4%	3.6%	98.9%	1.1%	100.0%
Apparel	24.2%	75.8%	58.4%	41.6%	87.2%	12.8%	85.6%	14.4%	94.7%	5.3%	100.0%
Leather	18.9%	81.1%	81.1%	18.9%	94.4%	5.6%	95.8%	4.2%	98.6%	1.4%	100.0%
Pub. Printing	24.4%	75.6%	85.2%	14.8%	94.8%	5.2%	97.8%	2.2%	98.5%	1.5%	100.0%
Chemicals	21.7%	78.3%	71.5%	28.5%	82.9%	17.1%	92.9%	7.1%	95.4%	4.6%	100.0%
Rubber	22.8%	77.2%	77.2%	22.8%	89.6%	10.4%	97.4%	2.6%	98.4%	1.6%	100.0%
Non-met.	62.1%	37.9%	87.1%	12.9%	94.7%	5.3%	98.9%	1.1%	99.7%	0.3%	100.0%
Base Met.	33.1%	66.9%	87.1%	12.9%	90.3%	9.7%	97.6%	2.4%	97.6%	2.4%	100.0%
Fab. Metals	34.2%	65.8%	82.1%	17.9%	90.0%	10.0%	96.3%	3.7%	97.9%	2.1%	100.0%
Machinery	23.8%	76.2%	71.4%	28.6%	82.9%	17.1%	94.3%	5.7%	95.2%	4.8%	100.0%
Electrical	11.8%	88.2%	74.2%	25.8%	74.2%	25.8%	93.5%	6.5%	93.5%	6.5%	100.0%
Furniture	31.9%	68.1%	87.0%	13.0%	94.4%	5.6%	98.1%	1.9%	98.6%	1.4%	100.0%
Other	28.9%	71.1%	75.2%	24.8%	87.0%	13.0%	92.9%	7.1%	95.3%	4.7%	100.0%
Total	31.9%	68.1%	77.9%	22.1%	89.2%	10.8%	94.8%	5.2%	97.0%	3.0%	100.0%

Source: Authors' own elaborations using the WBES.

Table 8: GVC by Firm Size

	GVC1		GVC2		GVC3		GVC4		GVC5		
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
Small (<20)	45.7%	54.3%	91.7%	8.3%	98.7%	1.3%	98.7%	1.3%	99.6%	0.4%	100.0%
Medium (20-99)	30.4%	69.6%	79.9%	20.1%	92.6%	7.4%	96.8%	3.2%	98.4%	1.6%	100.0%
Large (>100)	13.2%	86.8%	54.0%	46.0%	69.7%	30.3%	85.8%	14.2%	91.0%	9.0%	100.0%
	31.9%	68.1%	77.9%	22.1%	89.2%	10.8%	94.8%	5.2%	97.0%	3.0%	100.0%

Source: Authors' own elaborations using the WBES.

Figure 10: GVC and TFP Level

Source: Authors' own elaborations using the WBES.

In order to link the network analysis with our GVC indicators, we report the main descriptive figures in Table 9. Along the rows, we report TFP, the GVC and the centrality indicators. In the columns, we compare firms (i) with TFP above (high) and below (low) average, (ii) with centrality (PageRank[1]) above (high) and below (low) average, and (iii) by GVC participation (we refer to the more restrictive definition, namely GVC5). Highly productive firms are clearly both more likely to be in a GVC and more central in the trade networks (i.e. more precisely, they belong to countries that occupy a more central position in the sectoral networks). These findings are very consistent, since they apply to all five GVC indicators, as well as to all six centrality indicators. Whilst comparing high and low productivity firms yields very clear results, the same does not apply when we compare either central firms with peripheral firms, or GVC firms with the rest. Central firms are slightly more productive but are not more involved in GVCs. Similarly, GVC firms that are consistently with the baseline econometric results, display higher productivity, but GVC participation is not necessarily associated with higher centrality.

These results corroborate the idea that centrality, at least at the available level of disaggregation, matters for firms' TFP and captures an aspect of GVC participation that cannot be gauged with simple firm level indicators, such as GVC1 to GVC5. Based on this finding, including centrality into our regressions enables us to allow for an additional (multilateral) dimension of GVCs which is neglected in our baseline estimates.

[1] Using other centrality indicators produces similar results.

Table 9: Averages of relative productivity, centrality and GVC participation

	TFP			Centrality*			GVC5		
	High*	Low*	Delta	High*	Low*	Delta	Yes	No	Delta
Firm's productivity (%, relative to mean)									
TFP	142.3	51.0	91.3	102.1	98.5	3.6	136.9	99.0	37.9
Global Value Chain indicators (% of firms)									
GVC1	73.3	55.4	17.9	68.7	67.7	1.0	100	67.2	32.8
GVC2	26.0	12.4	13.5	21.7	22.3	-0.6	100	19.7	80.3
GVC3	13.1	5.2	7.9	11.1	10.6	0.5	100	8.1	91.9
GVC4	6.6	1.7	4.9	4.2	6.0	-1.8	100	2.3	97.7
GVC5	3.9	0.8	3.1	3.0	3.0	0.0	100	0	100.0
Network centrality indicators (%, relative to mean)									
Pagerank	102.2	94.4	7.8	152.8	61.4	91.4	99.2	100.0	-0.9
Hubs	102.5	93.8	8.7	127.0	80.3	46.7	101.4	100.0	1.5
Authorities	102.6	93.5	9.1	130.8	77.5	53.3	98.9	100.0	-1.2
Outdegree	103.6	91.0	12.6	161.6	54.9	106.7	104.6	99.9	4.8
Indegree	104.6	88.5	16.2	186.7	36.6	150.1	118.4	99.4	19.0
Betweenness	108.4	79.2	29.2	217.4	14.1	203.3	85.5	100.4	-15.0

* High = above average, low = below average; centrality refers to PageRank.

5. Methodology

5.1. Econometric Specification

To examine the relationship between productivity and GVC, we use the World Bank Enterprise Surveys and rely on the following specification:

$$Y_{ijsr} = \beta_0 + \beta_1 X_{ijsr} + \beta_2 GVC_{ijsr} + \gamma j + \varepsilon_{ijsr}$$

where Y is productivity of firm *i* in country *j* operating in sector *s* and country *r*. We estimate the TFP using a Cobb-Douglas function, where the dependent variable is sales and the independent ones are wages, inputs and capital payments. *X* includes a vector of control variables, amongst which are firm age, share of female workers, location etc. Age is calculated as the difference between 2013 and the date of the firm establishment. The share of females is defined as the share of women within the number of workers. Location is a dummy variable that takes the value of 1, if the firm is located in the capital and zero otherwise. Our variable of interest is GVC, measured by the five definitions discussed above, γ country dummies and ε the error term.

From an empirical perspective, we have to account for two issues. On the one hand, all local currencies have been converted to USD to guarantee the comparability of different countries. On the other hand, the possible existence of a reverse relationship between GVC and productivity must be taken into consideration, to avoid biased estimates of the effect of GVCs on productivity.

5.2. Multi-level Analysis

In order to include trade network centrality into the analysis, we merge our firm-level dataset with the centrality indicators, computed at the country-sector level. The merging applies to the manufacturing

sector and is based on the sector correspondence table, reported in the Appendix. Due to data constraints, i.e. EORA sectors are more aggregate, we lose some detail on the sector of firms. After the merging, our sample includes 3,581 firms.

The final sample includes variables defined at two different levels: firm-level variables and the newly added centrality indicators that capture country centrality in sectoral trade networks. In this situation, performing a regression analysis, ignoring the hierarchical structure of data, e.g. simply adding the centrality indicators in OLS estimations, produces biased estimates (Burstein et al., 1978; Aitkin and Longford, 1986). To avoid bias, we employ a (linear) multi-level model or mixed effects model (Snijders, 2011; Rabe-Hesketh and Skrondal, 2010; Searle et al., 1992). Our specification includes two different levels: we allow firm productivity to depend on firm characteristics (first level), as well as on country-level characteristics, namely country centrality in the trade network (second level). A similar approach has been used, for instance, by Giovannetti et al. (2013) to investigate how firm-level characteristics and context factors (defined at the province level) affect the propensity of Italian firms to export.

The main difference between a multi-level and a standard linear model lies in the less restrictive treatment of the error terms. Standard regression models rely on the assumption that observations (firms) are uncorrelated between themselves, whilst the productivity levels of firms operating in the same country are likely to be correlated and, we maintain, especially so if the country (and its firms) occupy more central positions in the trade network, which possibly reflects stronger firm-to-firm linkages and scope for spillover effects. Although, for instance, OLS with clustered errors allows us to consider that correlation is not constant across units, they assume homogeneous correlation within each cluster, thus neglecting the hierarchical structure of the data and producing biased estimates. In multi-level models, instead, the error part of the model may include a random intercept and/or a random slope and is structured so to allow for correlation between subjects (firms) within the same cluster (country). We estimate the multi-level models through maximum likelihood.

6. Empirical Findings

6.1. Basic Specification

Table 10 presents our main empirical findings. First, amongst our control variables, age is negatively associated to firms' TFP. In general, younger firms are more likely to innovate and, hence, have a higher TFP. As per the location variable, it shows a negative association between TFP and a firm's location in the capital. This is in line with the literature on the link between productivity and agglomeration, where congestions can exert a negative impact on TFP if infrastructure is not sufficiently developed (Badr et al., 2019 and Glaeser and Mare, 2001). The share of female workers increases TFP, as suggested by the literature on trade and gender, where large exporting firms employ a higher share of women than smaller firms (especially in yarn, fabrics and textiles, clothing and leather, and leather products) (ITC, 2015). Furthermore, it is important to note that women's participation as owners and employees in exporting firms is higher than firms that do not export and foreign-owned firms tend to employ more women than local firms (Asian Development Bank, 2019). Finally, Table 10 shows how the level of employment plays a significant role in boosting TFP. Indeed, larger firms (endowed with more workers and, in most cases, more capital) have a higher TFP. This result is confirmed by Table 11, where we introduced a dummy variable that takes the value of 1, if the firm is small and zero otherwise. The latter is negative and statistically significant, showing how smaller firms face several impediments in the

MENA regions. First, they are specialised in traditional products with a low value-added. Second, their lifetime is very short. Indeed, since they do not have a high value-added, their activity is not sustainable and, hence, they disappear rapidly from the market. Third, and as a consequence of this, they do not have any potential to expand, leading to the so-called "Missing Middle".

As per our main variables of interest, Tables 10 and 11 show that all GVC definitions exert a positive and significant effect on productivity. Moreover, the stricter the definition, the higher the value of the coefficient. This shows to what extent international certification and foreign capital increase the effect of GVC on productivity. Indeed, they are conducive to higher productivity through improved management practices and business organisation. Recall that GVC5 is the most restrictive definition, that takes into consideration all the criteria of integrating a GVC (the firm is exporting, importing, has foreign capital and international certification). From a policy standpoint, this finding is interesting, since TFP, as a measure of technological advancement, is likely to improve when the firm is part of a GVC.

Table 10: GVC and Productivity (1)

	TFP	TFP	TFP	TFP	TFP
Ln(Age)	-0.110***	-0.110***	-0.112***	-0.107***	-0.109***
	(0.0333)	(0.0333)	(0.0333)	(0.0335)	(0.0334)
Female share	0.124***	0.124***	0.126***	0.125***	0.126***
	(0.0180)	(0.0181)	(0.0180)	(0.0180)	(0.0180)
Location	-0.195***	-0.186***	-0.188***	-0.187***	-0.188***
	(0.0661)	(0.0660)	(0.0660)	(0.0660)	(0.0660)
Ln(Emp)	0.157***	0.156***	0.153***	0.163***	0.164***
	(0.0225)	(0.0230)	(0.0232)	(0.0220)	(0.0219)
GVC1	0.118**				
	(0.0592)				
GVC2		0.133*			
		(0.0741)			
GVC3			0.198**		
			(0.100)		
GVC4				0.229*	
				(0.135)	
GVC5					0.329*
					(0.192)
Constant	1.415***	1.472***	1.487***	1.446***	1.450***
	(0.112)	(0.112)	(0.113)	(0.111)	(0.111)
Country dum.	YES	YES	YES	YES	YES
Observations	2,092	2,092	2,092	2,092	2,092
R-squared	0.096	0.095	0.096	0.095	0.095

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Table 11: GVC and Productivity (2)

	TFP	TFP	TFP	TFP	TFP
Ln(Age)	-0.0906***	-0.0909***	-0.0993***	-0.0857***	-0.0908***
	(0.0324)	(0.0324)	(0.0324)	(0.0325)	(0.0325)
Females	0.391***	0.380***	0.385***	0.393***	0.395***
	(0.0572)	(0.0573)	(0.0572)	(0.0572)	(0.0573)
Location	-0.219***	-0.202***	-0.207***	-0.207***	-0.209***
	(0.0635)	(0.0634)	(0.0634)	(0.0635)	(0.0635)
Small	-0.322***	-0.315***	-0.321***	-0.350***	-0.356***
	(0.0572)	(0.0572)	(0.0568)	(0.0562)	(0.0562)
GVC1	0.210***				
	(0.0568)				
GVC2		0.291***			
		(0.0682)			
GVC3			0.394***		
			(0.0895)		
GVC4				0.397***	
				(0.122)	
GVC5					0.455***
					(0.170)
Constant	2.014***	2.099***	2.127***	2.116***	2.135***
	(0.107)	(0.101)	(0.100)	(0.101)	(0.100)
Country dum.	YES	YES	YES	YES	YES
Observations	2,205	2,205	2,205	2,205	2,205
R-squared	0.092	0.094	0.095	0.091	0.090

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

6.2.Results of Multi-level Analysis

Let us now investigate the role of trade network centrality. By considering the multilateral links of each country and its position relative to others, centrality indicators take into account a dimension of GVC that is neglected by simple firm-level indicators and, thus, might represent another potential channel through which firm productivity can be enhanced.

Recall that the centrality indicators are defined at the country-sector level, hence, all firms of the same country operating in the same sector share the same value of the centrality indicators. In other words, centrality is measured at a more aggregate level, relative to our firm-level dataset and, by construction, variability in centrality cannot capture variability in firm-level outcomes within countries and sectors. However, a high country-level centrality is necessarily the outcome of firms of that country holding more important positions in the trade network. And more central firms may display a higher average productivity and be in a better position to benefit from GVC participation. In this section, we investigate whether being more central is associated with higher productivity (TFP) and higher GVC participation, as measured from our firm-level indicators.

As explained in the methodology section, we take into account the fact that firm-level variables and centrality are measured at different levels by means of multi-level models.[2] The main results are in Table 12, in which we focus on GVC5 only.[3] The first model represents our reference, as it reproduces the same type of estimation presented earlier in the paper, with similar results, augmented with two levels: firms and countries. In columns (2) to (7), we add the different centrality indicators. Results are mostly consistent across specifications with minor differences. GVC participation is positive and significant in all cases (except betweenness), confirming the previous results. Moreover, occupying more central positions in the trade network is also associated with a productivity premium in most cases (centrality is insignificant for hubs and indegree).

Replacing the firms' size dummy with employment produces consistent results. The centrality indicators remain significant, although with somewhat lower p-values; whilst controlling for employment reduces the significance of a GVC indicator: GVC5 remains significant only in the PageRank specification. However, GVC5 is the most restrictive measure of GVC; similar regressions with GVC1 to GVC4 (not reported) still produce positive and significant coefficients, confirming that GVC participation and centrality tend to be associated with higher productivity. Table 13 confirms the same findings but with the *small* dummy variable.

Table 12: Multi-level regressions with network centrality indicators (1)

	Base TFP	pagerank TFP	hubs TFP	authorities TFP	indegree TFP	outdegree TFP	betweenness TFP
Age (ln)	-0.119***	-0.139***	-0.137***	-0.177***	-0.181***	-0.140***	-0.167***
	(0.0325)	(0.0344)	(0.0346)	(0.0391)	(0.0391)	(0.0346)	(0.0498)
Females	0.345***	0.360***	0.382***	0.489***	0.456***	0.359***	0.395***
	(0.0563)	(0.0590)	(0.0594)	(0.0700)	(0.0678)	(0.0601)	(0.0858)
Location	-0.195***	-0.222***	-0.194***	-0.212***	-0.225***	-0.200***	-0.337***
	(0.0631)	(0.0685)	(0.0690)	(0.0774)	(0.0773)	(0.0689)	(0.0967)
Empl. (ln)	0.177***	0.181***	0.180***	0.208***	0.208***	0.178***	0.265***
	(0.0201)	(0.0212)	(0.0213)	(0.0245)	(0.0246)	(0.0213)	(0.0307)
GVC5	0.272	0.300*	0.253	0.157	0.173	0.269	-0.0446
	(0.171)	(0.176)	(0.178)	(0.216)	(0.216)	(0.178)	(0.272)
Centrality		0.303***	0.00533	0.0115*	-0.0236	0.0985**	0.158**
		(0.0671)	(0.00718)	(0.00607)	(0.0470)	(0.0410)	(0.0750)
Constant	1.664***	2.722***	1.703***	1.716***	1.717***	1.597***	1.160***
	(0.137)	(0.265)	(0.142)	(0.149)	(0.154)	(0.148)	(0.264)
Observations	2,197	1,977	1,962	1,511	1,511	1,962	921
N. of countries	8	7	7	6	6	7	5

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[2] The appropriateness of multi-level models, adding the country level to the analysis and of the inclusion of centrality indicators, is confirmed by likelihood ratio tests. Results available upon request.
[3] Results for the other GVC indicators are consistent and available upon request.

Table 13: Multilevel regressions with network centrality indicators.

	Base TFP	pagerank TFP	hubs TFP	authorities TFP	indegree TFP	outdegree TFP	betweenness TFP
Age (ln)	-0.0928***	-0.116***	-0.115***	-0.150***	-0.155***	-0.119***	-0.133***
	(0.0323)	(0.0343)	(0.0346)	(0.0392)	(0.0391)	(0.0346)	(0.0505)
Females	0.384***	0.395***	0.416***	0.534***	0.503***	0.388***	0.451***
	(0.0564)	(0.0594)	(0.0596)	(0.0707)	(0.0681)	(0.0605)	(0.0872)
Location	-0.202***	-0.223***	-0.198***	-0.240***	-0.251***	-0.204***	-0.393***
	(0.0634)	(0.0689)	(0.0694)	(0.0777)	(0.0777)	(0.0692)	(0.0975)
Small	-0.359***	-0.388***	-0.385***	-0.442***	-0.446***	-0.387***	-0.560***
	(0.0560)	(0.0605)	(0.0609)	(0.0698)	(0.0698)	(0.0608)	(0.0916)
GVC5	0.462***	0.494***	0.444**	0.393*	0.407*	0.457***	0.257
	(0.169)	(0.175)	(0.177)	(0.214)	(0.214)	(0.176)	(0.272)
Centrality		0.291***	0.00533	0.0103*	-0.0216	0.112***	0.181**
		(0.0681)	(0.00726)	(0.00615)	(0.0481)	(0.0415)	(0.0797)
Constant	2.328***	3.391***	2.407***	2.523***	2.532***	2.283***	2.155***
	(0.137)	(0.270)	(0.141)	(0.148)	(0.153)	(0.149)	(0.267)
Observations	2,205	1,983	1,968	1,516	1,516	1,968	924
N. of countries	8	7	7	6	6	7	5

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.3.Robustness Checks

In order to check the robustness of our results and to control for the endogeneity between productivity and GVC, we run a battery of sensitivity analysis. Yet, unfortunately, we do not have the panel data for all the countries and different years. Hence, we confine the last part of the analysis to Egypt, for which coherent surveys for different years exist (2013 and 2016). We run a fixed effect regression and a propensity score matching (Table 15). Whilst the former focusses only on changes over time within unit, the latter compares a treated group (firms belonging to a GVC) to a control group (firms who do not, but have similar characteristics). Hence, our treatment here will be the likelihood of integrating into a GVC. More specifically, we first run a logit where the dependent variable takes the value of 1, if the firm participates in a GVC and zero otherwise. We can hence obtain the propensity score measuring the predicted probability (p). We then match each participant to one or more nonparticipants on propensity score, using the "Nearest neighbour matching" (using age, the female share, the firm's location and the sector where it operates). Table 14 shows that GVC (using the five definitions) exerts a positive and statistically significant effect on TFP and labour productivity. Moreover, for the TFP results, the more restrictive the definition, the stronger the effect on TFP, confirming our previous results on the importance of international certification and foreign capital.

Table 14: Robustness Checks

	Fixed Effects					Propensity Score Matching				
	TFP	TFP	TFP	TFP	TFP	TFP	TFP	TFP	TFP	TFP
GVC1	0.476***					0.451***				
	-0.133					-0.0765				
GVC2		0.698***					0.674***			
		-0.156					-0.128			
GVC3			0.780***					0.519***		
			-0.18					-0.131		
GVC4				1.340***					0.816***	
				-0.416					-0.178	
GVC5					1.597***					0.914***
					-0.586					-0.277
Observations	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068	1,068

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

7. Conclusion and Policy Recommendations

This paper examines the trade opportunities of MENA countries, their position in the network of world trade in manufacturing and the nexus between firm productivity and Global Value Chains (GVCs). It contributes to the literature in several respects: it provides a network analysis of the links and centrality of the different MENA countries highlighting an important heterogeneity. Using several GVC indices, the paper analyses GVC participation within a subset of countries - the North African countries - and, therefore, the ways in which GVC participation can change the relation between firms (also small and medium-sized) and productivity. Our main findings show that there is a positive and significant association between TFP gains and GVCs in the North African region. This effect is more important for small firms. It remains relatively robust after we control for endogeneity and whether we measure productivity gains by TFP or labour productivity. Furthermore, if a firm is located in a sector/country that is well connected, its TFP is likely to be higher. Hence, connectivity at the sector/country level matters.

From a policy standpoint, several conclusions can be withdrawn from our empirical analysis, for both GVCs and connectivity.

GVCs should be perceived as a tool that can help MENA countries overcome some of their structural problems. On the one hand, GVCs can improve the structure of exports and not just increase the level of exports. In fact, since MENA countries have been confined into exporting traditional goods for a long period, integrating a GVC will increase their productivity and allow them to export new and relatively non-traditional goods. On the other hand, such GVCs can lead to an upgrade in the skills of workers required for more sophisticated products Thus, enhancing the quality and the quantity of vocational training is likely to amplify the positive effects generated by GVCs, which reduces the skills mismatch problem that characterises countries in the MENA region.

On another front, since connectivity at the macroeconomic and sectoral levels matters for firm productivity, it is important to improve trade in intermediaries at the national level. This can take place by several measures. First, connectivity in MENA countries is still hampered by several barriers related to the efficiency of customs, where lengthy procedures negatively affect the clearance of intermediate goods. Hence, trade facilitation is a key issue in improving the connectivity of MENA countries. Second, deficient infrastructure (in terms of ports and roads) reduces the likelihood of developing trade networks that are sensitive to time and speed of delivery. Investing in a well-developed infrastructure will affect trade networks and, hence, help firms improve their productivity. Finally, it is worth that there is a large potential to develop deeper networks between the two shores of the Mediterranean due to geographical proximity and complementarity in terms of know-how and wages, demography and also resource endowment.

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Appendix 1: Sector classification

Table A1 - Sector classification in Eora26.

1	Agriculture
2	Fishing
3	Mining and Quarrying
4	Food & Beverages
5	Textiles and Wearing Apparel
6	Wood and Paper
7	Petroleum, Chemical and Non-Metallic Mineral Products
8	Metal Products
9	Electrical and Machinery
10	Transport Equipment
11	Other Manufacturing
12	Recycling
13	Electricity, Gas and Water
14	Construction
15	Maintenance and Repair
16	Wholesale Trade
17	Retail Trade
18	Hotels and Restaurants
19	Transport
20	Post and Telecommunications
21	Financial Intermediation and Business Activities
22	Public Administration
23	Education, Health and Other Services
24	Private Households
25	Others
26	Re-export & Re-import

Table A.2.: Correspondence between EORA sectors and ISIC Rev. 3.

EORA sector code	EORA sector description	ISIC Rev. 3
4	Food & Beverages	15
4	Food & Beverages	16
5	Textiles and Wearing Apparel	17
5	Textiles and Wearing Apparel	18
5	Textiles and Wearing Apparel	19
6	Wood and Paper	20
6	Wood and Paper	21
6	Wood and Paper	22
7	Petroleum, Chemical and Non-Metallic Mineral Products	23
7	Petroleum, Chemical and Non-Metallic Mineral Products	24
7	Petroleum, Chemical and Non-Metallic Mineral Products	25
7	Petroleum, Chemical and Non-Metallic Mineral Products	26
8	Metal Products	27
8	Metal Products	28
9	Electrical and Machinery	29
9	Electrical and Machinery	30
9	Electrical and Machinery	31
9	Electrical and Machinery	32
9	Electrical and Machinery	33
10	Transport Equipment	34
10	Transport Equipment	35
11	Other Manufacturing	36
11	Other Manufacturing	37

Appendix 2: Descriptive analysis

Figure A1 - World trade of intermediates for the MENA countries.

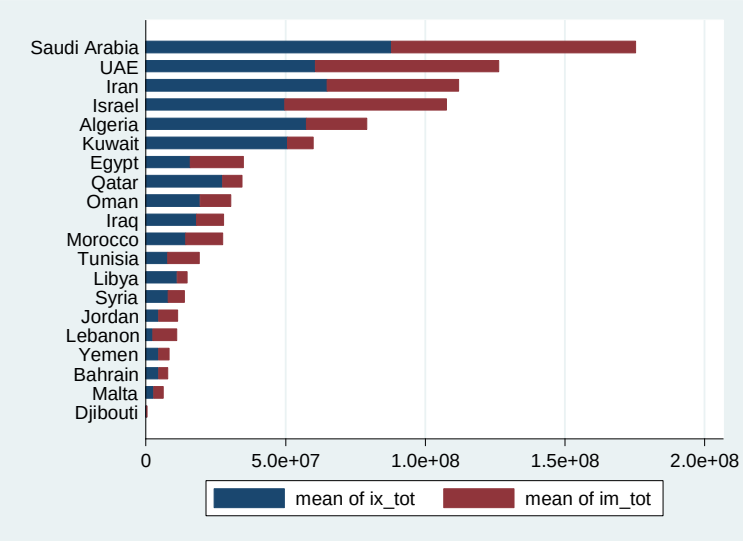

Figure A2 - Intra-MENA trade of intermediates.

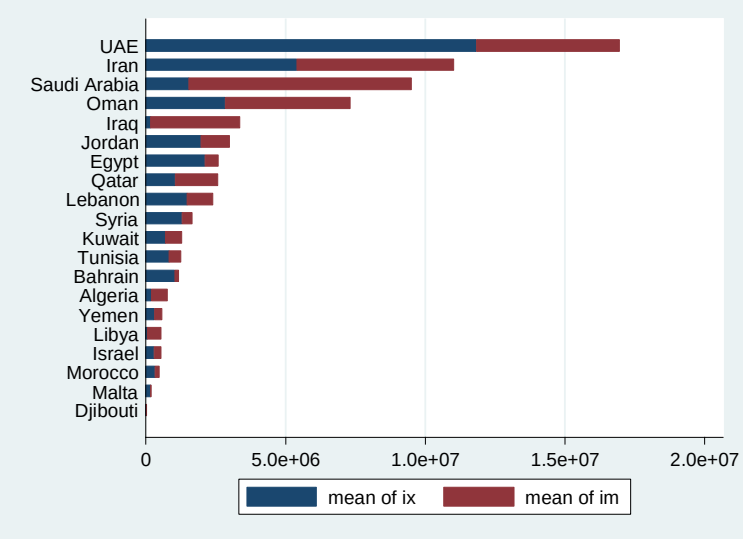

Figure A3 - Share of intermediate exports to MENA.

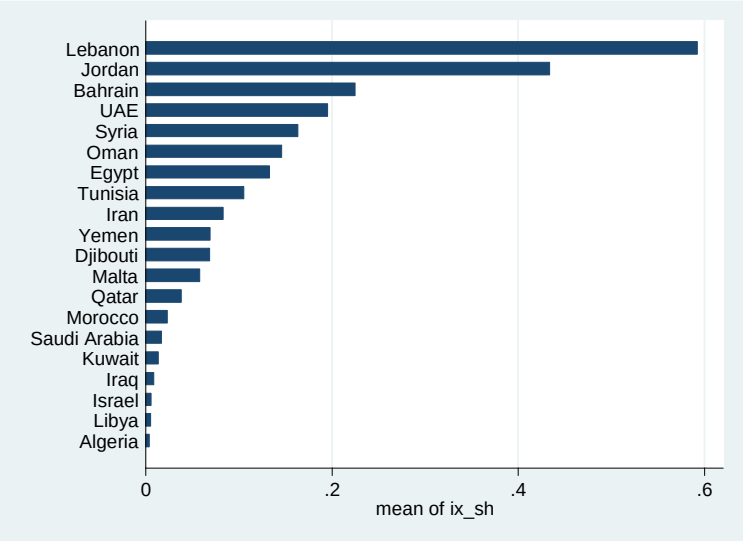

Figure A4 - Share of intermediate imports from MENA.

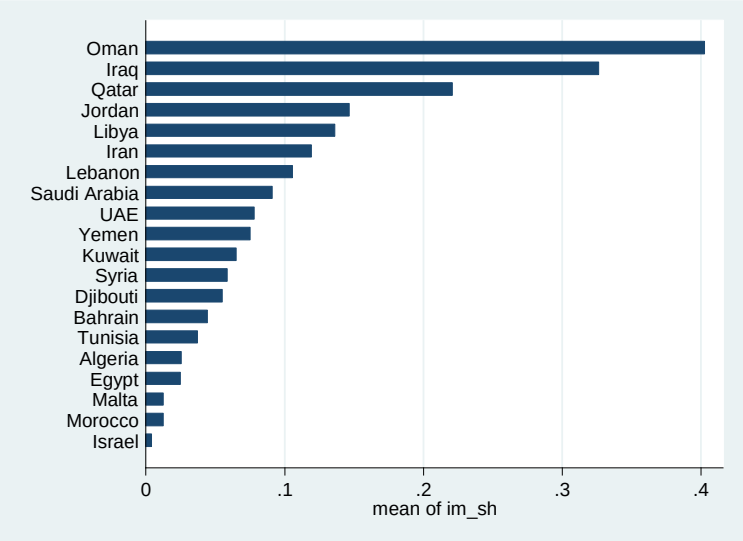

Figure A5 - Share of intermediate trade with MENA.

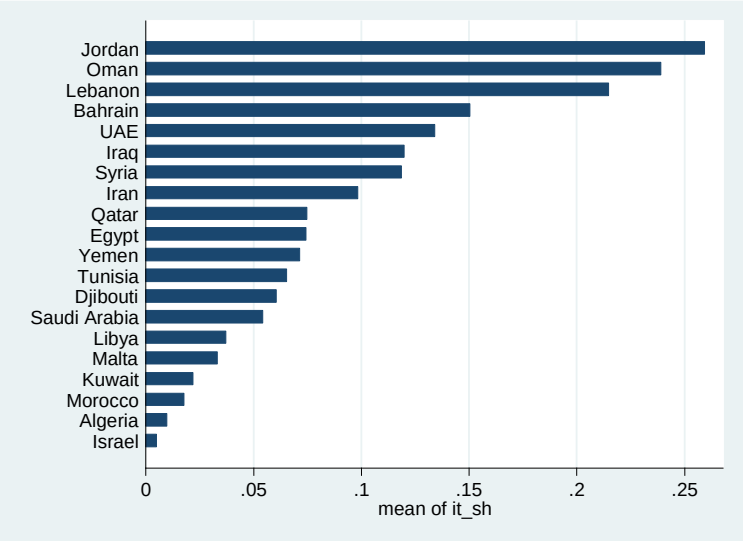

Figure A6 - Share of intermediate trade with MENA with export and import highlighted.

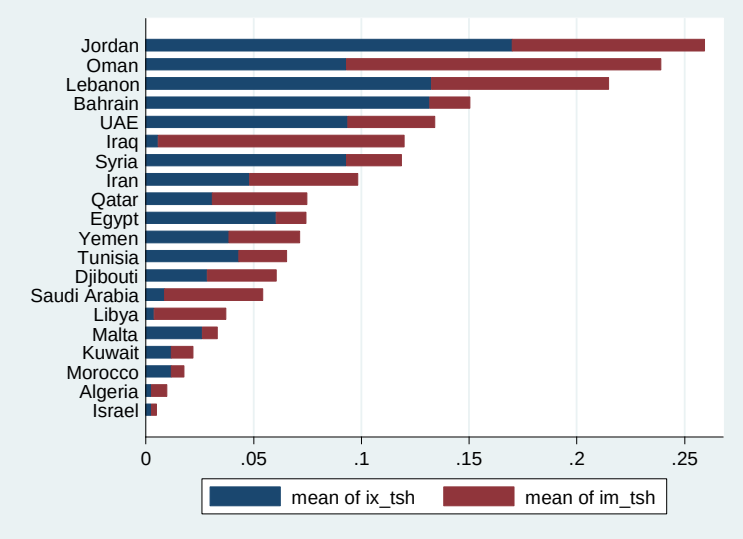

Figure A7 - Trade in intermediates network of MENA countries. Overall trade in goods and services (flows above 0.1%).

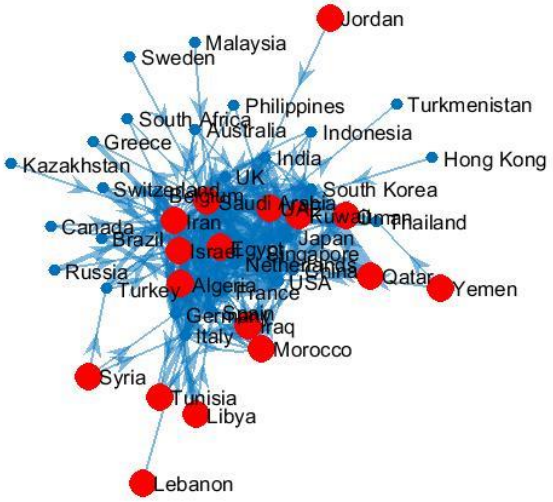

Figure A8 - Trade linkages of aggregate MENA region. Overall trade in goods and services (flows above 0.1%).

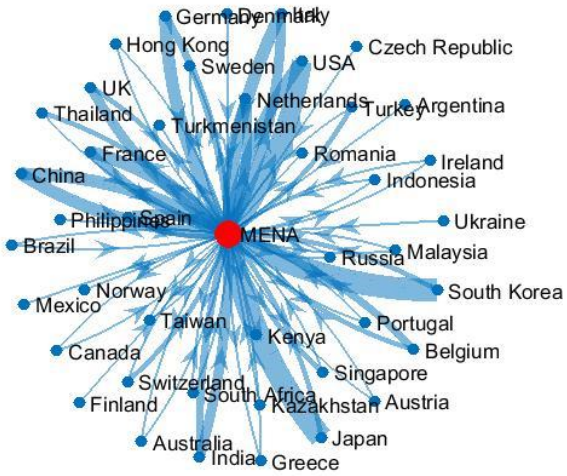

Figure A9- Intra-MENA network of intermediates. Overall trade in goods and services (flows above 0.1%).

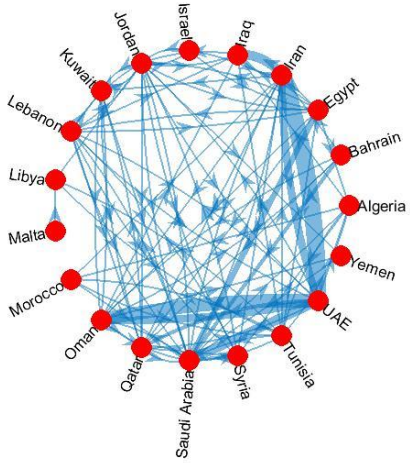

Table A.3. - Centrality indicators of the intra-regional intermediate trade. Overall trade in goods and services (unweighted indexes; flows above 0.1%).

	PageRank	Hubs	Authorities	Outdegree	Indegree	Betweenness
Algeria	0,051	0,017	0,057	3	5	11,074
Bahrain	0,015	0,057	0,011	4	1	0,450
Egypt	0,037	0,089	0,048	8	4	16,060
Iran	0,081	0,092	0,050	8	6	44,870
Iraq	0,062	0,019	0,067	2	6	12,158
Israel	0,019	0,019	0,030	2	2	0,000
Jordan	0,092	0,103	0,079	11	8	56,826
Kuwait	0,059	0,061	0,062	4	5	4,548
Lebanon	0,047	0,093	0,065	8	5	7,359
Libya	0,033	0,005	0,025	1	3	17,753
Malta	0,008	0,004	0,000	1	0	0,000
Morocco	0,034	0,033	0,011	3	2	3,300
Oman	0,059	0,073	0,071	7	6	28,131
Qatar	0,083	0,039	0,124	3	10	3,167
Saudi Arabia	0,131	0,072	0,135	7	13	67,762
Syria	0,029	0,069	0,045	5	3	2,172
Tunisia	0,080	0,051	0,033	6	5	47,457
UAE	0,059	0,087	0,062	7	5	11,913
Yemen	0,022	0,020	0,027	1	2	0,000

Table A.4. - Trade values and manufacturing shares.

	Int. manuf. export (bln $)	Int. export (bln $)	Share (%)	Int. manuf. import (bln $)	Int. import (bln $)	Share (%)

Algeria	9,2	57,5	16,0	14,9	21,7	68,8
Bahrain	3,4	4,6	74,7	2,0	3,3	60,3
Djibouti	0,0	0,2	20,4	0,1	0,2	50,0
Egypt	9,1	15,9	57,2	12,1	19,1	63,7
Iran	13,4	64,9	20,7	26,6	47,3	56,4
Iraq	0,1	18,2	0,5	6,1	9,8	62,5
Israel	33,0	49,7	66,3	34,9	57,9	60,2
Jordan	2,7	4,5	59,5	4,6	7,1	65,8
Kuwait	14,9	50,7	29,5	7,0	9,2	75,9
Lebanon	1,8	2,5	72,9	5,1	8,7	59,0
Libya	1,4	11,2	12,4	2,3	3,6	62,4
Malta	1,8	2,8	65,1	2,5	3,4	71,8
Morocco	9,6	14,2	67,5	9,1	13,5	67,8
Oman	2,2	19,5	11,2	6,3	11,1	56,6
Qatar	3,0	27,6	10,8	3,7	6,8	54,7
Saudi Arabia	26,5	88,0	30,1	56,1	87,3	64,3
Syria	1,4	7,9	17,1	3,7	6,0	62,2
Tunisia	5,0	7,9	63,0	8,0	11,5	69,5
UAE	28,6	60,7	47,1	41,9	65,6	63,8
Yemen	0,5	4,6	11,4	2,3	3,6	63,0
Total	167,6	513,1	32,7	249,4	396,5	62,9

Table A.5. - Centrality indicators of the intra-regional intermediate trade. Manufacturing (unweighted indexes; flows above 0.1%).

	PageRank	Hubs	Authorities	Outdegree	Indegree	Betweenness
Algeria	0,052	0,016	0,055	2	5	5,421
Bahrain	0,016	0,048	0,013	3	1	0,000
Egypt	0,048	0,088	0,061	8	5	29,012
Iran	0,103	0,089	0,039	7	5	34,081
Iraq	0,068	0,006	0,073	1	6	3,686
Israel	0,020	0,021	0,031	2	2	0,000
Jordan	0,072	0,111	0,075	10	7	34,870
Kuwait	0,064	0,059	0,068	4	5	5,616
Lebanon	0,051	0,108	0,063	9	5	13,244
Libya	0,019	0,000	0,011	0	2	0,000
Malta	0,009	0,013	0,000	2	0	0,000
Morocco	0,016	0,032	0,009	3	1	0,000
Oman	0,056	0,081	0,054	7	5	26,521
Qatar	0,087	0,043	0,115	3	9	3,033
Saudi Arabia	0,136	0,068	0,137	7	13	76,096
Syria	0,032	0,051	0,048	4	3	2,208
Tunisia	0,057	0,060	0,032	7	4	46,880
UAE	0,067	0,084	0,070	7	6	28,333
Yemen	0,027	0,021	0,047	1	3	0,000

Appendix 3: Firms' statistics

Table A.6: Number of Firms

	Egypt	Israel	Jordan	Lebanon	Morocco	Tunisia	West Bank	Yemen
Leather and Wood	13000	1580	660	571	2225	1124	374	628
Paper	5675	46	27	74	1020	615	189	20
Printing	6092	189	319	96	1592	973	13	186
Coke and Refined pet.	2435	507	8	78	5	302	32	12
Chemical	3938	499	110	41	192	33	326	4
Pharma.	1011	148	117	47	33	95	95	12
Rubber	1737	234	519	216	947	198	58	66
Non-met and basic met.	3848	716	418	42	686	279	249	182
Fab. Metals	1699	194	120	87	865	451	521	8
Comp. and electronics	4827	52	295	53	764	205	375	324
Electrical	3286	71	165	52	461	349	30	5
Machinery	1767	496	322	38	1120	797	240	501
Vehicles	1646	281	321	93	1109	358	102	0
Other	13311	1472	397	261	1806	1122	187	189
Total	64272	6485	3797	1749	12825	6899	2788	2137

Source: Authors' own elaborations using the WBES.