WORKING PAPER

Do Exports and Innovation Matter for the Demand of Skilled Labor?

Evidence from MENA Countries

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EMNES Working Paper Nº 9 / April 2018

Abstract

The objective of the paper is to test the impact of exports and innovation on the demand of skilled labor in the MENA region using firm-level data. In this matter, our contribution is threefold. First, we examine the connection between exports and skill bias through several innovation and technology adoption indicators. Second, we differentiate between the effect of innovation on skilled blue-collar (production workers) vs. white collars workers (non-production workers). Third, we test this relationship for nine MENA countries, using firm-level data from the World Bank Enterprise Survey (2013). Our results suggest a positive and significant impact of exports on innovation and technology adoption. Furthermore, demand for skilled production workers by firms in the MENA region is likely to be higher than that for non-production workers. This demand is particularly high when a firm adopts a new logistics method, a new production method, a new product and a new organizational structure. Third, the larger the firm, the higher the demand for skilled production and non-production labor.

J.E.L. classification : F10, F12.

Keywords: Trade Openness, Skill Bias, Job Creation, Egypt.

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1. Introduction

Trade liberalization raises the demand for skilled workers in highly competitive firms (Bernard and Jensen, 1997; Bernard, Jensen, Redding and Schott, 2007). Along the lines of Melitz (2003), firms, in addition to different productivity thresholds, also differ in their skill intensity. Therefore, the tougher the competition, the more likely a firm will be to improve its production process, innovate, and hire more skilled labor in order to export (Thoenig and Verdier, 2003).

The literature on this topic is relatively abundant. At the theoretical level, Feenstra and Hanson (1996, 1997) develop a model examining the simultaneous increase in the skill premium in developed and developing countries, when they liberalize trade in the presence of trade in intermediate inputs and capital movements. Moreover, they develop a theoretical model where trade in inputs has the same impact on labor demand as skill-biased technological change, since both of these will shift demand away from low-skilled activities and raise the relative demand and wages of the better skilled (Feenstra and Hanson, 2001). In the same vein, Verhoogen (2008) showed that exporting requires quality upgrades that are inherently intensive in skilled labor (Brambilla et al, 2012, 2015 and 2016).

Empirically, Goldberg and Pavcnik (2007b) test the methodology by Feenstra and Hanson (1996 and 1997) for Latin American countries within an H-O framework. Harrigan and Reshef (2015) also tested this in the case of Chile in 1995. The results suggest that a fall in trade costs leads to both greater trade volumes and an increase in the relative demand for skill, since the most-skilled firms expand in order to serve the export market. Moreover, Bustos (2011) finds that the reduction in Brazil's tariffs induces the most productive Argentinean firms to upgrade skill, while the least productive ones downgrade. In emerging economies, Meschi, Taymaz, and Vivarelli (2009) find that Turkish firms operating in the sectors that increased their imported inputs from more developed countries witnessed a higher increase in their share of skilled workers. For Brazil, Araújo, Bogliacino, and Vivarelli (2009) demonstrate that manufacturing firms raised their imports of capital goods involving a skill-biased technological change in this sector. Attanasio, Goldberg, and Pavcnik et al. (2007a) prove that, in Colombia, increase in the skill premium has been driven by skilled-biased technological change, thanks to drastic liberalization.

Yet, it is important to note that the demand for skilled labor might differ for blue vs. white-collar workers. Indeed, Brambilla et al. (2016) looked into whether exporting firms hire more engineers relative to blue-collar workers than non-exporting firms. They found more productive firms become exporters and have a higher demand for engineers. This result depends on the structure of exported goods.

Hence, the objective of the paper is to test the impact of exports and innovation on the demand of skilled labor in the MENA region using firm-level data. In this regard, our contribution is threefold. First, we examine the connection between exports and skill bias through several innovation and technology adoption indicators. Second, we differentiate between the effect of innovation on skilled blue-collar (production workers) vs. white collars workers (non-production workers). Third, we test this relation for nine MENA countries using firm-level data from the World Bank Enterprise Survey (2013). The case of MENA countries is interesting; their trade in the manufacturing sector is relatively open (as compared to the agriculture sector). Yet, workers in the region still suffer from a lack of skills required to make their exports internationally competitive level (OECD, 2015).

Our results suggest a positive and significant impact of exports on the adoption of innovation and technology. Furthermore, demand for skilled production workers by firms in the MENA region is likely to be higher than that for non-production workers. This demand is particularly high when a firm adopts a new logistics method, a new production method, a new product and a new organizational structure. Third, the larger the firm, the higher the demand for skilled production and non-production labor.

The paper is organized as follows: Section 2 presents some stylized facts on trade, innovation and skill bias from the World Bank Enterprise Survey (2013). Section 3 is devoted to the methodology adopted in the paper. Section 4 is a discussion of the econometric results, and Section 5 is the conclusion.

2. Stylized Facts

2.1. Overview

The Enterprise Survey data shows that, relative to other countries, the use of technology by MENA firms is limited. The share of innovating firms is reported in Table 1. This share is at its highest for countries like Djibouti, Yemen, Lebanon and Morocco (29.9% to 28%), and as low as 12% to less than 13% for Israel and Egypt. This might be counterintuitive but two reasons can explain this. First, these figures have been computed from the Survey that is perception-based. Hence, a slight change in the production process for less developed countries is perceived as a significant change by their firms. By contrast, countries that experienced crucial technological advances do not have these perceptions, especially in the short run. Second, the technology of advanced economies grows at a faster pace in developing countries compared to more developed ones, given their low initial level of technology (Alvarez and Marin. 2013). By observing each indicator, three remarks are worth mentioning. First, as mentioned previously, firms in Yemen and Djibouti have the highest share of providing a new product, of adopting a new production method, a new logistics service, a new supplementary activity and a new structure in their hierarchy. Second, Lebanese firms are ranked first in terms of adopting a new marketing method and Tunisian firms spent the most on research and development, followed by those in Djibouti and Moroccan. Third, larger countries like Egypt, or higher income countries like Israel, seem to have a relatively modest performance. Hence, the occurrence of high values for the technology index in countries like Yemen and Djibouti could be explained by market size. In such small economies, the market is still emerging and the share of firms actually adopting new technologies, or of those taking part in international trade, is relatively high compared to larger economies in the region.

Table 1. Innovation Dimensions by Country

	Technology	New Prod.	New Method	New Logis.	New Sup. Act.	New Struc.	New Market	R and D
Morocco	0.26	29.3%	27.1%	20.5%	30.4%	24.2%	32.7%	14.2%
Egypt	-0.33	12.0%	9.4%	6.7%	6.0%	7.3%	14.5%	2.1%
Yemen	0.38	44.0%	39.1%	28.1%	31.0%	27.6%	25.0%	6.4%
Lebanon	0.31	40.5%	27.6%	17.6%	29.4%	29.7%	33.2%	13.3%
Djibouti	0.38	31.9%	28.5%	26.5%	33.5%	39.3%	24.6%	17.4%
Israel	-0.32	17.1%	8.3%	4.6%	6.7%	6.9%	10.1%	9.5%
Tunisia	0.09	27.6%	22.3%	13.1%	20.6%	20.6%	25.0%	18.0%
Jordan	-0.29	17.4%	9.5%	5.0%	11.6%	5.2%	12.4%	6.2%

Source: World Bank Enterprise Surveys.
Note: (i) Reference year for all countries is 2013.
(ii) Technology is an index based on different dimensions using a principal component analysis.
(iii) Variance scaled to handle strata with a single sampling unit.

Table 2 provides an overview of the different innovation dimensions for both exporting and non-exporting firms. For both the composite technology index and the seven dimensions of innovation, the share of innovating firms is always higher amongst exporters. This share is at its highest for launching new products and for the introduction of new marketing methods. 31.5% of exporting firms have introduced a new product; while 25% of all firms have applied new manufacturing methods and 22% have applied new marketing methods. Interestingly, 4% of non-exporters invest in R&D, while this is the case for 18% of exporting firms. The larger share of innovating exporters versus that of non-exporters raises the issue of possible endogeneity between innovation and exports. On one hand, for firms to be able to enter and compete in the market for exports, innovation is necessary. On the other hand, firms entering the export market are more likely to be innovative, compared to firms who do not take part in international trade. The causality of the relation and endogeneity issues will be further discussed in Sections 3 and 4.

Table 2. Innovation Dimensions for Exporting and Non-Exporting Firms

	Non-exp	Exp.	Ratio
Technology	-0.23	0.07	-0.32
New Prod.	15.3%	31.5%	2.07
New Method	11.6%	24.8%	2.13
New Logis.	9.4%	11.3%	1.21
New Sup. Act.	10.7%	19.8%	1.85
New Struc.	10.7%	17.2%	1.61
New Market	17.2%	22.0%	1.28
R and D	4.2%	18.1%	4.34

Source: World Bank Enterprise Surveys.
Note: (i) Reference year for all countries is 2013.
(ii) Technology is an index based on different dimensions, using a principal component analysis.
(iii) Variance scaled to handle strata with a single sampling unit.

Table 3 focuses on the ratio of innovation for exporting firms and non-exporting firms by country. In general, this ratio is greater than the one for all the indices, confirming a positive association between exporting and technology adoption in all countries. In all these indices, Jordan is ranked first followed by Israel, especially in terms of offering a new product, adopting a new production method and spending on R&D. Exporters are also better endowed with technology in Egypt and Tunisia. This shows the importance of adopting new technology, as these countries have the highest share of exporters compared to other economies.

Table 3. Innovation Dimensions for Exporting compared to Non-Exporting Firms by Country

	Technology	New Prod.	New Method	New Logis.	New Sup. Act.	New Struc.	New Market	R and D
Morocco	1.6	1.40	1.30	1.14	1.10	1.04	1.00	1.47
Egypt	0.6	1.76	2.07	0.52	1.89	1.42	1.11	3.53
Yemen	2.2	0.59	2.02	0.73	2.79	1.04	1.17	1.57
Lebanon	2.1	1.17	1.44	0.97	1.44	1.01	1.72	1.12
Djibouti	1.9	1.12	0.90	1.45	1.52	1.27	1.82	1.02
Israel	0.3	3.42	2.75	0.97	0.82	1.31	0.95	9.19
Tunisia	-3.9	1.79	2.07	1.82	1.57	1.65	1.02	3.92
Jordan	0.0	2.78	8.40	3.22	3.06	5.65	2.42	10.39
Total	-	1.37	1.73	1.14	1.70	1.25	1.32	2.29

Source: World Bank Enterprise Surveys.
Note: (i) Reference year for all countries is 2013.
(ii) Technology is an index based on different dimensions using a principal component analysis.
(iii) Variance scaled to handle strata with a single sampling unit.

The demand for skilled labor also appears to be higher for exporting firms than for non-exporting firms (columns (e) and (f)). This is in line with previous results on innovative behavior for exporters, since new products, new methods or even new marketing methods require more skilled labor. Another interesting fact is that the demand for skilled production labor (i.e. blue collars) is often higher than that for skilled non-production labor (white collars), as shown in column (g). This observation holds true for 6 out of the 8 countries in the study (see Table 4). Indeed, given the nature of specialization for most of these countries is in manufacturing products where firms are more intensive in labor than in technology, the demand for skilled blue collars is higher than non-production ones. By contrast, in Israel (whose exports are intensive in high-technology) and Lebanon (which is chiefly in exporting services), exporters tend to produce higher quality goods, which are intensive in engineers and other non-production workers relative to blue-collar workers. This is in line with the findings of Brambilla et al. (2016) for the Chilean case.

Table 4. Export status and Demand for Skilled Labour (percentage of firms)

	Exporters		Non-exporters		Ratio		
	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.	Skill prod/Lab. Non-prod
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Morocco	24.8	37.0	11.8	17.2	2.1	2.2	1.5
Egypt	33.8	64.5	6.4	15.3	5.3	4.2	1.9
Yemen	24.0	26.9	5.0	5.7	4.8	4.7	1.1
Lebanon	15.5	11.6	14.4	5.8	1.1	2.0	0.7
Djibouti	0.9	9.1	3.3	6.5	0.3	1.4	10.2
Israel	50.1	44.5	10.4	10.9	4.8	4.1	0.9
Tunisia	18.6	64.6	7.6	15.0	2.4	4.3	3.5
Jordan	13.2	36.6	5.7	10.1	2.3	3.6	2.8
Total	22.6	36.9	8.1	10.8	2.8	3.4	1.6

Source: World Bank Enterprise Surveys.
Note: (i) Reference year for all countries is 2013.
(ii) Variance scaled to handle strata with a single sampling unit.

Table 5 provides a more detailed analysis of the demand for skilled production and non-production labor by firm status (exporters vs. non-exporters) and across different aspects of innovation. On average, over 8% of exporting firms adopting new technology demand skilled labor, compared to 3.5% in the case of non-exporters. For exporting firms, the demand for skilled white collars is highest when the firm is applying significantly enhanced or new supporting activities (10.7% out of all exporters) followed by a new structure (9.6% out of all exporters). Meanwhile, the demand for skilled blue collars is more frequent in the case of a new technology, a new supplementary activity and, surprisingly, a new organizational structure.

Table 5. Exports, Labor Demand and Innovation

	Exporters			Non-exporters		
	Lab. Non-prod	Skill Prod.	Average	Lab. Non-prod	Skill Prod.	Average
Technology	11.5%	10.0%	10.8%	7.3%	2.1%	4.7%
New Prod.	9.5%	3.9%	6.7%	4.1%	0.0%	2.0%
New Method	3.6%	6.1%	4.8%	1.5%	0.6%	1.1%
New Logis.	5.0%	4.4%	4.7%	5.7%	3.0%	4.4%
New Sup. Act.	12.9%	8.5%	10.7%	5.8%	1.7%	3.7%
New Struc.	8.9%	10.3%	9.6%	6.4%	2.3%	4.4%
New Market	7.9%	8.9%	8.4%	4.3%	0.0%	2.2%
R and D	8.7%	6.3%	7.5%	9.2%	3.0%	6.1%

Source: World Bank Enterprise Surveys.
Note: (i) Reference year for all countries is 2013.
(ii) Technology is an index based on different dimensions using a principal component analysis.
(iii) Variance scaled to handle strata with a single sampling unit.

It is also interesting to observe technology adoption based on firm size across our sample. We introduce some additional indicators from the Enterprise Survey (Table 6). We observe that the share of firms using technology licensed from foreign companies generally increases by firm size, reaching as high as 64.4% in Yemen, followed by 32.1% in Morocco. The ratio is relatively modest for the remainder of the countries: in the case of countries with larger and relatively diversified industries, such as Egypt, Morocco and Tunisia, this share ranges from 12.5% to 20%. Another interesting observation is that a slightly higher share of medium size firms in Morocco and Lebanon tend to use licensed foreign technology than large firms. This could be explained by the low number of medium firms in both countries in absolute terms, or by the increased competitiveness of medium size firms.

A higher share of large firms also has their own website and use email to communicate with their clients, as compared to medium and small firms. Firm size also seems to affect the capacity of the firm to use technology. For example, the share of large firms having introduced new products is higher than that of small and medium size firms. The same generally holds true for the share of firms who introduced a process of innovation as well as firms who spend on R&D. However, this conclusion does not apply to the introduction of a new product in the main market. A larger share of medium enterprises introduces a new product to the export market at the same time as introducing it locally. This allows one to draw an important conclusion on the potential competitiveness of medium size firms and their ability to provide products that not only compete domestically, but also internationally.

Table 6. Innovation and Firm Size (exporters and non-exporters)

		Firms using technology licensed from foreign companies	Firms having their own Web site	Firms using e-mail to interact with clients/suppliers	Percent of firms that introduced a new product/service	Firms whose new product/service is also new to the main market	Firms that introduced a process innovation	Firms that spend on R&D
Djibouti	Small	5.5	35	62.1	23.8	65.2	34.1	15.4
	Medium	13.1	45.4	85.5	42.2	61.9	66.9	23.3
	Large		74.9	100	72.8	81.1	65	19.9
Egypt	Small	2.9	26	35.1	10.5	48.2	13.6	1.2
	Medium	5.1	45.5	54.6	13.4	69.4	15.5	2.1
	Large	12.5	75.5	84.1	19.6	67.8	26.6	10.4
Jordan	Small	5.7	35.9	52.1	13.6	44.4	14.4	3.3
	Medium	6.7	62.1	77	22.7	56.3	24.7	7.9
	Large	32.1	76.1	94.9	39.2	78.8	37.6	35.4
Lebanon	Small	1.4	53.8	78.3	31.5	61.3	39.9	8.1
	Medium	8.4	78.5	87.1	55.6	88.8	43.7	20
	Large	7.5	92.3	98.4	56.7	85.8	50.7	33.6
Morocco	Small	13	66.8	96.8	24.7	48.5	32.2	9.4
	Medium	21.9	71.4	98	32.8	62	50.1	17.7
	Large	20.2	74	94.4	39.3	37.2	58.1	24.8
Tunisia	Small	3.5	59.4	90.8	28	45.3	32.2	14.1
	Medium	10.7	73	97.4	27.1	70	39	22
	Large	13	80.7	95.9	27.1	62.5	39.6	25.2
Yemen, Rep.	Small	0.1	13.2	13.4	41.6	49.2	41.6	3
	Medium	8.4	53.6	57.6	47.7	88.3	60.7	8.9
	Large	64.4	95.5	100	82.7	74.5	86.2	68.1

Source: World Bank Enterprise Surveys.
Note: (i) Reference year for all countries is 2013.

3. Methodology

We perform our analysis in two stages. First, we estimate the impact of the change in exporting status on different measures of technology adoption, by estimating the following regression:

$$Tech_{ijk} = \alpha_o + \alpha_1 \, Prob(X_{ijk}) + f_j + f_k + \varepsilon_{ijk} \qquad (1)$$

Where $Prob(X_{ijk})$ measures the probability of becoming an exporter of firm i in country j in sector k, $Tech_{ijk}$ is measured by new or significantly improved products/services during the last 3 years, new/improved products/services which were also new to the establishment's main market, new/significantly improved methods of manufacturing products /offering service, new / significantly improved logistics delivery or distribution methods for inputs, new or significantly improved supporting activities for the firm's processes, new or improved organizational structure or management activities, and new or improved marketing methods. We allow for country dummies f_i and sector dummies f_k and ε_{ijk} is the discrepancy term. As the probability of becoming an exporter is endogenous, we adopt an instrumental variable approach by instrumenting this variable using the age of the firm, the highest education level of the owner, the share of imported inputs and the size of the firm when it started operating. These variables are likely to increase the probability of becoming an exporter and, hence, are used as instruments[1].

Second, we document systematic differences in skill intensity of both production and non-production labour for different measures of technology adoption (taken from the first stage) as follows:

$$Ln(Skill_{ijk}) = \beta_o + \beta_1 \, Tech_{ijk} + f_j + f_k + \varepsilon_{ijk} \qquad (3)$$

With $Skill_{ijk}$ is the share of skilled workers (workers are divided based on the share of production vs. non-production workers by firm), f_j and f_k are country and industry dummies respectively.

We use manufacturing establishment surveys, carried out by the World Bank (World Bank Enterprise Survey) in most developing countries in 2013, including several from the MENA region. We examine these for nine countries; Egypt, Jordan, Lebanon, Tunisia, Yemen, Djibouti, West Bank and Gaza, Morocco and Israel. The choice of these countries is chiefly driven by data availability. The surveys are answered by business owners and top managers. Typically, 1200-1800 interviews are conducted in larger economies, 360 interviews are conducted in medium-sized economies and, for smaller economies, 150 interviews take place. The surveys cover a broad range of business environment topics, including

[1] We performed Durbin and Wu-Hausman Tests of endogeneity. Indeed, the probability of becoming an exporter is endogenous. When we apply them using the instruments mentioned above, we tested whether the latter are weak or not and we rejected the null hypothesis according to which instruments are weak. Finally, the tests of Sargan and Basmann in over-identifying restrictions showed that our instruments are valid.

access to finance, corruption, infrastructure, crime, competition, and performance measures. The standard survey topics include firm characteristics, gender participation, access to finance, annual sales, costs of inputs/labor, workforce composition, bribery, licensing, infrastructure, trade, crime, competition, capacity utilization, land and permits, taxation, informality, business-government relations, innovation and technology, and performance measures. The manufacturing sector is the primary business sector of interest. This corresponds to firms classified with ISIC codes 15-37, 45, 50-52, 55, 60-64, and 72 (ISIC Rev.3.1).

4. Empirical Findings

4.1. Exports and Technology Adoption

Table 8 exhibits the results for the instrumental variables. We use the estimated likelihood of becoming an exporter from the first stage and test for its impact on the firm's use of different aspects of technology. Three variables are likely to affect the likelihood of becoming an exporter, which are the share of imported intermediate inputs, the age of the firm and its size when it started operations. This demonstrates that the larger the firm, the greater probability that it will start exporting. Obviously, all these factors affect the productivity of the firm and, hence increase its probability of serving the external market.

Table 8. Results of the First Stage

	Prob (Exp)
Imp. input	0.00170***
	(0.000413)
Ln(age)	0.000260**
	(0.000105)
Ln(size st.)	0.0549***
	(0.0184)
High educ.	0.0222
	(0.0350)
Constant	-0.0154
	(0.0495)
Observations	3,291

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

The results, shown in Table 9, suggest positive and significant effects of innovation in becoming an exporter across six dimensions, as well as at the level of the aggregate technology index. We also allow for country and sector-specific dummies. Our results are in line with the literature, since new entrants are usually more likely to adopt new technologies, in order to be able to enter and compete in the export market, which is usually not the case for incumbent firms. Among the different dimensions of technology, R&D, adopting a new marketing strategy and introducing new supporting activities are those with the highest coefficient. We also introduce formality as an explanatory variable and find, as in line with the literature, that registered firms are more likely to innovate. This could be explained by their easier access to credit, allowing them to upgrade their activities, while unregistered firms do not have access to such facilities.

Table 9. Results of the Second Stage

	Technology	New Prod.	New Method	New Logis.	New Sup. Act.	New Struc.	New Market	R and D
Prob (Exp)	1.766***	0.467**	0.424**	0.277	0.630***	0.521***	0.681***	0.774***
	(0.497)	(0.197)	(0.210)	(0.200)	(0.181)	(0.192)	(0.216)	(0.173)
Form. Regis.	0.0216**	0.00784**	0.0104***	0.00346	0.00563	0.00805**	0.0102**	-0.00187
	(0.00870)	(0.00319)	(0.00312)	(0.00253)	(0.00344)	(0.00372)	(0.00412)	(0.00314)
Constant	-1.220***	-0.0326	-0.134	-0.121	-0.218**	-0.204**	-0.280**	-0.315***
	(0.284)	(0.116)	(0.116)	(0.106)	(0.107)	(0.101)	(0.124)	(0.107)
Country dum.	YES	YES	YES	YES	YES	YES	YES	YES
Sector dum.	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3,633	3,633	3,633	3,633	3,633	3,633	3,633	3,633
R-squared	0.015	0.064	0.060	0.009	0.010	0.003	0.022	0.003

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Variance scaled to handle strata with a single sampling unit.

4.2. Technology and Demand for Skilled Labor

In the second stage, we explore the impact of different measures of technology adoption on differences in skill intensity for production and non-production labou0r (Table 10). In general, there seem to be differences in demand for production and non-production skilled labor by the dimension of technology. Indeed, the coefficient in skilled blue-collar workers is higher than those in the white-collar workers, confirming higher demand for the former than the latter. Those that seem to matter most in demand of skilled labor are the adoption of new logistics and new methods of manufacturing, followed by offering a new product and a new organizational structure. This is in line with Attanasio, Goldberg, and Pavcnik et al. (2004) who prove that, in Colombia, the increase in the skill premium has been driven by skilled-biased technological change, thanks to drastic liberalization.

Yet, these regressions do not take into account the differential effect on firm size. In the following section, we introduce firm size to observe differences in skill bias, based on the type of firm.

Table 10. Demand for Skilled Labor

	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.		Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.
Tech. Index	0.387***	0.394***			New Struc.	1.308***	1.330***		
	(0.0580)	(0.0677)				(0.197)	(0.230)		
New Prod.			1.457***	1.480***	New Logis.			2.465***	2.511***
			(0.219)	(0.256)				(0.370)	(0.432)
Constant	2.048***	1.998***	1.736***	1.681***	Constant	1.837***	1.784***	1.543***	1.483***
	(0.128)	(0.183)	(0.133)	(0.191)		(0.130)	(0.187)	(0.144)	(0.204)
Country dum.	YES	YES	YES	YES	Country dum.	YES	YES	YES	YES
Sector dum.	YES	YES	YES	YES	Sector dum.	YES	YES	YES	YES
Observations	3,422	3,053	3,422	3,053	Observations	3,422	3,053	3,422	3,053
R-squared	0.179	0.147	0.179	0.147	R-squared	0.180	0.149	0.180	0.148

	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.		Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.
New Method	1.595***	1.612***			R and D	0.887***	0.913***		
	(0.241)	(0.282)				(0.132)	(0.154)		
New Market			1.001***	1.018***	New Sup. Act.			1.087***	1.110***
			(0.151)	(0.176)				(0.163)	(0.190)
Constant	1.706***	1.653***	1.894***	1.842***	Constant	2.010***	1.959***	1.802***	1.746***
	(0.135)	(0.193)	(0.128)	(0.185)		(0.128)	(0.183)	(0.131)	(0.188)
Country dum.	YES	YES	YES	YES	Country dum.	YES	YES	YES	YES
Sector dum.	YES	YES	YES	YES	Sector dum.	YES	YES	YES	YES
Observations	3,422	3,053	3,422	3,053	Observations	3,422	3,053	3,422	3,053
R-squared	0.179	0.146	0.179	0.147	R-squared	0.179	0.147	0.179	0.147

Standard errors in parentheses

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

Variance scaled to handle strata with a single sampling unit.

4.3. Does Firm Size Matter?

We take the analysis to a deeper level by allowing for firm size, while testing the impact of technology adoption on the demand for skilled production and non-production workers (Tables 11 and 12). Our results are interesting for several reasons. First of all, the coefficients are all positive and significant for the aggregate, as well as the separate technology measures. Second, firm size does matter for the demand of skilled labor. The coefficient values are always higher for large firms across all innovation indicators. Third, the coefficient for skilled production labor is higher than that for non-production labor across all aspects of technology in general. Furthermore, we interact the different dimensions of innovation with firm size.

To our surprise, most of the coefficients are insignificant, except for medium size firms, where there is a significant negative impact of technology on the demand for skilled labor. This is true for the introduction of new supporting activities and R&D. These results could be justified by the "missing middle" hypothesis, since the number of medium size firms is generally low in the Middle East, compared to large or small enterprises. By contrast, the interaction coefficient for the adoption of a new product is statistically significant for large firms. This confirms the fact that the latter are more likely to offer a new product and develop multiple products.

Table 11. Demand for Skilled Labor by Firm Size 1

	Technology Index		New Logistic		New Structure		New sup. act.	
	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.
Small	0.424*	0.732***	0.105	0.835***	0.270	0.821***	0.228	0.833***
	(0.243)	(0.170)	(0.346)	(0.114)	(0.263)	(0.126)	(0.294)	(0.122)
Medium	1.375***	1.697***	1.151***	1.857***	1.264***	1.818***	1.227***	1.830***
	(0.249)	(0.177)	(0.355)	(0.133)	(0.271)	(0.140)	(0.303)	(0.135)
Large	2.531***	2.973***	2.182***	2.784***	2.275***	2.882***	2.273***	2.894***
	(0.291)	(0.324)	(0.428)	(0.452)	(0.337)	(0.394)	(0.363)	(0.392)
Technology	-0.260	0.236						
	(0.345)	(0.181)						
Tech*Small	0.374	-0.200						
	(0.352)	(0.188)						
Tech*Medium	0.277	-0.258						
	(0.353)	(0.199)						
Tech*Large	0.545	0.219						
	(0.376)	(0.302)						
Logistic			-1.530	0.700				
			(1.610)	(1.183)				
Logis*Small			2.453	-0.351				
			(1.645)	(1.205)				
Logis*Medium			1.649	-0.827				
			(1.657)	(1.268)				
Logis*Large			2.827	1.890				
			(1.821)	(1.833)				
Structure					-0.156	0.844		
					(1.313)	(0.613)		
Struc*Small					0.471	-0.690		
					(1.323)	(0.634)		
Struc*Medium					0.230	-0.925		
					(1.325)	(0.674)		
Struc*Large					1.169	0.625		
					(1.407)	(0.982)		
Sup. Act.							-0.853	0.843*
							(1.006)	(0.500)
Sup. Act.*Small							1.203	-0.703
							(1.025)	(0.521)
Sup. Act.*Medium							0.895	-0.917*
							(1.028)	(0.550)
Sup. Act.*Large							1.596	0.390
							(1.088)	(0.826)
Constant	0.846***	0.380*	1.020***	0.205	0.937***	0.270	0.974***	0.251
	(0.259)	(0.221)	(0.360)	(0.185)	(0.276)	(0.188)	(0.310)	(0.185)
Country dum.	YES	YES	YES	YES	YES	YES	YES	YES
Sector dum.	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3,422	3,053	3,422	3,053	3,422	3,053	3,422	3,053
R-squared	0.570	0.521	0.568	0.522	0.570	0.522	0.572	0.521

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Variance scaled to handle strata with a single sampling unit.

Table 12. Demand for Skilled Labour by Firm Size (2)

	RD		New Market		New Method		New Product	
	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.	Lab. Non-prod	Skill Prod.
Small	0.321	0.759***	0.248	0.848***	0.0774	0.827***	0.0294	0.914***
	(0.267)	(0.134)	(0.274)	(0.123)	(0.426)	(0.135)	(0.414)	(0.145)
Medium	1.301***	1.739***	1.243***	1.845***	1.120**	1.829***	1.067**	1.908***
	(0.274)	(0.145)	(0.282)	(0.137)	(0.436)	(0.155)	(0.424)	(0.165)
Large	2.343***	2.888***	2.253***	2.842***	2.081***	2.692***	1.970***	2.773***
	(0.326)	(0.367)	(0.356)	(0.410)	(0.505)	(0.502)	(0.493)	(0.529)
RD	-0.492	0.822**						
	(0.910)	(0.400)						
RD*Small	0.687	-0.731*						
	(0.923)	(0.419)						
RD*Medium	0.537	-0.853*						
	(0.922)	(0.446)						
RD*Large	1.259	0.184						
	(0.967)	(0.666)						
Market			-0.251	0.700				
			(1.008)	(0.430)				
Mar*Small			0.487	-0.625				
			(1.020)	(0.448)				
Mar*Medium			0.330	-0.750				
			(1.020)	(0.481)				
Mar*Large			0.970	0.477				
			(1.085)	(0.714)				
Method					-1.002	0.187		
					(1.524)	(0.749)		
Method*Small					1.523	-0.0872		
					(1.548)	(0.762)		
Method*Medium					1.076	-0.237		
					(1.560)	(0.803)		
Method*Large					2.048	1.653		
					(1.640)	(1.243)		
Product							-1.366	0.688
							(1.370)	(0.610)
Product*Small							1.792	-0.614
							(1.395)	(0.624)
Product*Medium							1.443	-0.698
							(1.406)	(0.665)
Product*Large							2.456*	0.943
							(1.473)	(1.117)
Constant	0.928***	0.360*	0.973***	0.255	1.089**	0.257	1.150***	0.177
	(0.281)	(0.194)	(0.286)	(0.183)	(0.438)	(0.191)	(0.427)	(0.195)
Country dum.	YES	YES	YES	YES	YES	YES	YES	YES
Sector dum.	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3,422	3,053	3,422	3,053	3,422	3,053	3,422	3,053
R-squared	0.570	0.521	0.568	0.522	0.570	0.522	0.572	0.521

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Variance scaled to handle strata with a single sampling unit.

5. Conclusion

The objective of this paper is to explore the connection between exports, innovation and the demand for skilled labor. Our results suggest a positive and significant impact of exports on the adoption of innovation and technology. Furthermore, demand for skilled production workers by firms in the MENA region is likely to be higher than that for non-production workers. This demand is particularly high when a firm adopts a new logistics method, a new production method, a new product and a new organizational structure. Third, the larger the firm, the higher the demand for skilled production and non-production labor.

The results highlight one of the main concerns in the MENA manufacturing sector: the lack of skilled workers. In this context, the OECD (2015) argues that the two key constraints on employment in Arab countries are lack of job creation and employability (which is defined as the skills mismatch due to failures in the education system). This is why more open trade policies may act as a driver for job creation in Arab countries, especially for skilled workers, in order to face fierce competition in international markets. However, more open trade policies without any serious steps towards enhancing the quality of education and vocational training to respond to the needs of the labour market are less likely to yield significant outcomes. This is particularly important, as most of the products exported by the MENA region are more intensive in skilled blue-collar workers than white-collar workers.

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EMNES funding: European Commission and EMNES partners.

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Financially supported by the European Commission