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Trade policy and input liberalization: The effect on Egyptian firms' productivity

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This paper explores the link between trade liberalization and firms'performance in Egypt combining macro and micro data. Using theEconomic Census of Egypt 2013, we examine the association betweentariffs and non-tariffs measures (NTM) imposed on intermediate inputsand total factor productivity (TFP). In a first step TFP is estimated as theresidual of a Cobb-Douglas/Translog production function and in thesecond, TFP is regressed on weighted tariffs and NTM imposed onintermediate inputs. Egyptian input-output tables are used to constructthe weights. Our main findings show a positive and significant association between imported inputs and value-added and a significantly negative relationship between tariffs and TFP.

KEYWORDS
firm-level, input, productivity, trade

JEL CLASSIFICATION
F10; F12; F15

1 | INTRODUCTION

Trade policy has been widely used during different historical episodes and by different countries as a basis for a comprehensive development strategy, and its contribution to a country's development has long been investigated. Findings on this matter, however, have been as diverse as the postulated theories supporting them (Hirschman, 1971; Luong, 2011; Page, 1994; Winters, 2004). Revisionists argue that government interventions are required for the generation of proper incentives in industries that would have otherwise not developed under the rule of comparative advantage (Asian Development Bank, 1997). On the contrary, supporters of free trade claim that distortionary policies are counterproductive as integration to world markets improves access to foreign technology, expands input

availability, and unleashes competitive forces that raise efficiency (Goldberg et al., 2010; Grossman & Helpman, 1991; Melitz, 2003; Taylor, 1998). While in the 1990s and early 2000s studies tended to favor trade openness over trade protection, the heterogeneity of its impact across and within countries was widely acknowledged (Rodrıguez & Rodrik, 2000; Schor, 2004). Meanwhile, in the 2010s, Autor et al. (2013) showed that trade can have negative effects on jobs, and the aftermath of the recent crises also indicates that firms have suffered from disruptions in the supply chain, especially those that intensified offshoring strategies in the 1990s.

The extent to which tariff barriers impact firm growth is predicated on how it affects the inflow of imports. This transmission channel is then differentiated on whether the imported product is an intermediate good or a final good, as each is expected to deliver different incentives to the firm. Namely, imported final goods represent inflowing competition from abroad, while imported intermediate goods may be valuable factors of production.[1] As a result, the ambiguous link between trade openness and growth is assessed by targeting the effects of tariff barriers that are mediated by the extent of the market, as proposed by Alesina et al. (2005).[2]

It is also important to note that firm competitiveness is a function of the cost and quality of the inputs to which firms have access. Although Freund and Jaud (2015) highlight the relatively weak performance of MENA exporters due to the fact that firms do not have access to a wide variety of competitively priced inputs, most studies focus on developing countries like Chile, Argentina, Colombia, Hungary, and India (Altomonte & Békés, 2009; Amiti & Konings, 2007; Bas, 2012; Smeets & Warzynski, 2013). The MENA region has been relatively neglected in this literature. This is why this research explores the link between change in trade policy variables (measured by both tariff and non-tariff measures [NTM]) and firms' performance in Egypt.

Egypt is an interesting case because although it has taken a gradual approach to trade liberalization, the once highly restrictive trade regime has been reversed with the initiation of reforms from 1986 to the beginning of WTO agreements in 1994/1995 and the signing of several multi and bilateral trade agreements in the mid-1990s. Pledged to be in full compliance with WTO commitments, Egypt has had a policy of removing non-tariff barriers and replacing them with tariffs (Refaat, 2003). During the 1990s, Egypt passed legislation protecting its industries, such as increasing the local component requirements for car assembly. Following WTO accession in 1995, Egypt's commitments have been more or less to bind tariff rates[3] at levels that in many cases have exceeded existing levels (WTO, 2005). To further open the Egyptian economy, a reform was introduced in 2004 to reduce the average unweighted tariff rate and rationalize the tariff structure. The number of products subject to non-tariff barriers was also substantially reduced. It is evident that both nominal and effective protection has declined for almost all manufacturing sectors, with most trade liberalization efforts concentrated in the area of intermediate and capital goods. It is, therefore, interesting to measure the impact of such significant changes in trade liberalization variables on the productivity of Egyptian firms.

Against this background, and since the observation of microeconomic dynamics enriches the impact assessment of macroeconomic policies, this study relies on standardized survey data representative of the entire population of firms. Using the Economic Census of Egypt 2013, this paper contributes to the literature in three ways. First, we combine both tariffs and NTM to examine their association with value-added and productivity. Second, the main methodological contribution is the use of input–output (IO) tables to weight both tariffs and NTM, given that each industry relies on different imported inputs. It is important to note that previous papers did not consider explicitly NTM and disregarded the contribution to each intermediate product in the value added of the final products. Third, we apply this for Egypt, a MENA country understudied in the existent literature. Our main findings show a positive and significant association between imported inputs and value-added and a significant negative relationship between tariffs and total factor productivity (TFP).

The remainder of this paper is organized as follows. Section 2 reviews the literature. Section 3 provides some stylized facts on trade policy and TFP in Egypt. Section 4 explains the procedure we adopt. Section 5 is dedicated to the empirical findings, and Section 6 concludes.

2 | LITERATURE REVIEW

Theoretically, the relationship between free trade and firms' productivity is studied and depicted by a number of researchers. In his seminal paper, Melitz (2003) shows that competition is a main factor in determining the gains from trade. The model's findings suggest a positive relationship between trade liberalization and growth for high-productivity firms, as low-productivity firms exit the market as a result of the higher competition generated by trade liberalization. In the same vein, Goldberg et al. (2010) provide theoretical groundwork for microeconomic mechanisms through which imported inputs impact firm growth. They stress static and dynamic gains arising from the availability of new input varieties, whereby the effect of input tariffs on the total availability of input varieties operates through two different channels. The first is the price of previously imported inputs, where diminishing prices enable the production of previously unprofitable products. The second is the inflow of new input varieties, where imported varieties expand the set of intermediate inputs. Similarly, Halpern et al. (2015) propose a model using the quality ladder and the product-variety models, to explain gains from using imported inputs. These models support policies lowering tariff barriers, as they increase productivity by reducing the price of imports and raising the number of input varieties (Goldberg et al., 2010; Halpern et al., 2015). In a recent contribution, Defever et al. (2020) develop a theoretical model to examine the role of wholesalers in increasing productivity. Indeed, intermediaries provide indirect access to foreign-produced inputs that help firms become more productive.

On the empirical side, the empirical studies conducted on the relationship between trade and productivity have mainly focused on periods of deep economic change and transformation that involved trade liberalization policies. The analyses at the firm level have extensively covered economies in America and Asia. In particular, for the former region there are studies for Chile 1979–1986 (Pavcnik, 2002), the US 1977–2001 (Bernard et al., 2006), Brazil 1988–1990 (Schor, 2004; Ferreira & Rossi, 2003), Colombia 1977–1991 (Fernandes, 2007), and Argentina (Bas, 2012). Among the Asian countries investigated are India 1987–2001 (Balakrishnan et al., 2000; Nataraj, 2011; Topalova & Khandelwal, 2011), Indonesia 1991–2001 (Amiti & Konings, 2007), and China (Defever et al., 2020).

More specifically, Pavcnik (2002) finds that trade liberalization in Chile increased productivity in import-competing industries, and that the low-productivity firms exited the market due to import-competition. In her paper, the production function is estimated semi-parametrically to correct for the presence of selection and simultaneity biases. For the United States, Bernard et al. (2006) merge firm-level manufacturing data with industry-level measures on tariffs and transportation costs. They find that between 1977 and 2001, a reduction in trade costs generated more gains within and across industries and plants, where plants with low productivity were more likely to exit the market. For the Brazilian case, Ferreira and Rossi (2003) combine IO data with tariffs to examine the effect of trade barriers on firms' productivity. They find that trade liberalization over the 1988–1990 period increased the productivity growth rate by 6%. Also for Brazil, Schor (2004) uses data gathered from manufacturing firms between 1986 and 1998 to investigate trade liberalization and productivity gains. He finds that an increase in the level of both the quality of foreign inputs being imported and the foreign technologies being implemented creates a more competitive final product for the firms in question. This, in turn, allows them to sell their exported goods at a higher price. However, this finding is not homogenous across all sectors and firms. Those that were exposed to liberalization while having

a low level of production were either able to drastically increase their production efficiency or were forced out of the market by foreign imports (Schor, 2004). On the contrary, Fernandes (2007), using a rich panel of Colombian firms between 1977 and 1991, tests whether increased exposure to foreign competition generates gains in plant productivity. She shows that not only the tariff reductions but also the higher imports of intermediate goods, higher skill intensity, and heavy machinery investment had a positive impact in Colombia. Yet, it is important to note that liberalizing input can also affect export performance. Indeed, Bas (2012) finds that the probability of entering the export market is higher for firms producing in industries that have experienced greater input tariff reductions in Argentina.

Moving to the Asian region, for India, Balakrishnan et al. (2000), using a panel of 2,300 firms between 1988–1989 and 1997–1998, find that there is no evidence for any growth in productivity due to the trade liberalization of 1991. However, Topalova and Khandelwal (2011) and Nataraj (2011) obtain a large and positive effect of input tariff reduction on productivity for India; although the impact and the role of output tariffs vary from one study to another. In the same line, Amiti and Konings (2007) use plant census data from Indonesia for the period 1991–2001 to estimate productivity gains from output and input tariffs. They find that a 10-percentage point decrease in input tariffs leads to a productivity gain of 12% for firms that import their inputs. Also for China, Defever et al. (2020), using firm level data, find that firms experience productivity gains from reducing input tariffs if trade intermediation of foreign inputs within their sector is high.

Some recent studies also investigate countries in Europe. For example, Halpern et al. (2015) use Hungarian data to analyze the effect of imported inputs on productivity. They find that importing all input varieties would increase a firm's revenue productivity by 22%. They also show that 25% of Hungarian productivity growth during the 1993–2002 period can be attributed to imported inputs. For the African continent, there are, to the best of our knowledge, no studies investigating the effects of trade liberalization on TFP considering the different incidence of protection on final and intermediated goods. A related study considers instead the effect of NTMs on imports (Baghdadi et al., 2019). The authors find an overall positive effect of NTMs on Tunisian firms' imports, which could be explained by the fact that firms that can face the cost of NTMs are more likely to capture more market share in Tunisia and increase their imports.

Against this background, although the literature shows a relative consensus on the positive effect of input liberalization on firms' performance, most of it has focused on countries in Latin America and Asia and addressed mainly tariff liberalization. We add to this the introduction of NTMs, since they can exert a different effect on trade and productivity and the focus on Egypt, an important economy in the MENA region that has been scarcely investigated in this regard.

3 | DATA AND STYLIZED FACTS

To examine the effect of input liberalization on Egyptian firms, we rely on several sources. First, we use Egypt's Economic Census of 2013 that includes around 62,108 firms in 27 regions (see descriptive statistics in Appendix 1). This census covers a host of firms' characteristics (size, sales, labor, capital, etc.) that we use to estimate TFP. As per trade policy variables, tariffs come from the World Trade Organization data set (we used 2012 data set as the liberalization effect is always lagged). They are measured by the applied most-favored nation (MFN) tariff. The Ad-Valorem Equivalent (AVE) of NTMs comes from the World Bank data set that relies on the TRAINS database. These NTMs include the AVEs of both technical and non-technical measures. Yet, it is important to note that, due to data constraints,[4] we could not distinguish between tariffs (and NTMs) imposed on final products and those imposed on intermediate inputs. This is why we calculated these weighted trade barriers

using an IO table. The latter comes from the Ministry of Planning, Egypt (see Appendix 2 for variables description).

3.1 | Demand for inputs by industry

Table 1 shows the IO table of Egypt in 2000/2001[5] with 17 sectors (289 cells). Almost 20% of the cells are zero (bold letters) showing that some industries have no backward nor forward linkages with other industries.

A more detailed look at forward linkages shows that, among the manufacturing sector, four main sectors provide other sectors with their outputs. These are chemicals, basic metals, spinning and weaving, and engineering and machinery, along with some products from the crops and vegetables production sector and from services. Indeed, these sectors are characterized by heavy forward linkages with other sectors. As per backward linkages, food, productive and social services, construction, chemicals, clothing, and animal production rely heavily on other sectors. By contrast, the tobacco sector is not linked to any other sector.

At the sectoral level, 50% of the oil and extraction sector goes to chemicals and 18% to the construction sector. The rest of its output is distributed to other sectors more or less equally. As for chemicals, its output is chiefly distributed to crop and vegetables production (12%), food industries (6.5%), clothing (6.8%), chemicals (17.6%), non-metallic (10.4%), and basic metals (6.6%). Engineering and machinery's output is distributed to all sectors with an average of 3%, with the lion shares going to engineering and machinery itself (17%), transport (15%), and social services (30%).

Some of these products are imported from developed countries. Indeed, technological change, declining transport costs, and the process of globalization have led to the splitting up of interdependent production chains and the distribution to different locations of the various elements in the production of a good. Therefore, trade experienced a significant increase in the use of imported intermediate inputs in exported products. This same analysis applies to the Egyptian case. Indeed, in Egypt, it is worthy to note that around 75% of imports are either raw materials, intermediate inputs, investment goods, or fuel (see Figure 1).

Trade policy measured by both tariffs and NTM imposed by the Egyptian government is likely to have a significant effect on imports from the rest of the world, and thus firms' production and productivity. The following section provides an overview of both tariffs and NTM in Egypt.

3.2 | Trade policy overview

In terms of tariffs and NTM, Egypt has significantly liberalized its manufacturing sector since early 1990s. Figure 2 shows the simple average MFN applied tariffs in 2012. Some sectors such as petroleum products, cotton, chemicals, and dairy products have low tariffs. Yet, among the goods that are heavily used as intermediate inputs or as investment goods, transport equipment has a tariff of 13% followed by electrical machinery with 8% and non-electrical machinery with 5%.

As per NTM, it is important to note that NTM remain costly, numerous, and less transparent. They represent a protective mechanism for domestic production adding, thus, an additional (non-directly measurable) cost. Péridy and Ghoneim (2013) calculate the average tariff equivalents (AVEs) of NTMs in selected MENA countries including Egypt, and estimate them at 39%, compared to 34% in Tunisia, 37% in Morocco, and 47% in Lebanon. Figure 3 shows that in Egypt, conformity assessment represents the most important impediment since 42.4% of Egyptian importers argued that

TABLE 1 Input–output table 2000/2001

	AGR-VG	AGR-ANM	OIL&EXTR	FOOD-IND	TOBC	SPIN&WEAV	CLOTH	CHEM-IND	NMET-IND	BAS-MET	MET-IND	ENG&MACH-IND	OTR-IND	CONST&ELECTR	TRANSP&COM	OTR PROD-SER	SOC-SER	Total
AGR-VG	932	6,788	0	17,411	0	2,392	0	172	3	0	0	16	353	0	91	656	779	29,593
AGR-ANM	388	103	0	4,487	0	30	0	0	0	0	0	0	0	0	134	286	295	5,723
OIL&EXTR	0	0	853	695	0	53	19	7,737	415	197	2	0	4	2,816	935	1,137	914	15,777
FOOD-IND	0	2,481	154	1,275	18	46	68	231	0	0	0	0	60	0	1,042	3,504	1691	10,570
TOBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPIN&WEAV	133	19	0	441	0	4,236	4,034	29	3	0	26	14	120	41	12	142	2,886	12,136
CLOTH	0	0	161	92	0	0	543	54	58	44	22	14	53	0	61	308	1539	2,949
CHEM-IND	2,876	176	718	1555	64	971	1642	4,247	2,508	1581	265	623	1,088	1,086	1769	333	2,577	24,079
NMET-IND	19	0	79	63	0	18	0	324	63	28	166	144	61	7,410	2	129	54	8,560
BAS- MET	11	14	454	189	36	96	100	420	31	3,257	718	672	596	6,722	644	98	264	14,322
MET-IND	23	8	254	125	144	153	97	214	24	37	45	615	363	202	154	61	804	3,323
ENG&MACH-IND	16	182	488	140	187	171	458	513	492	206	81	1877	393	219	1,680	660	3,305	11,068
OTR-IND	16	25	319	366	366	155	236	312	241	158	67	480	723	1539	119	2,358	757	8,237
CONST&ELECTR	131	132	143	424	55	776	327	449	214	182	65	131	276	116	447	1,560	1,500	6,928
TRANSP&COM	37	38	48	48	41	69	59	88	78	14	95	101	124	8	396	3,236	256	4,736
OTR PROD-SER	771	1,108	1,489	699	318	3,025	1777	4,787	2,104	1882	127	1,343	1593	1,530	1,401	7,658	1,236	32,848
SOC-SER	28	55	555	402	25	1,095	3,034	328	116	435	25	272	578	86	523	1,347	2,711	11,615
Total	5,381	11,129	5,715	28,412	1,254	13,286	12,394	19,905	6,350	8,021	1704	6,302	6,385	21,775	9,410	23,473	21,568	202,464

Source: Constructed by the author using the Social Accounting Matrix of 2000/2001.

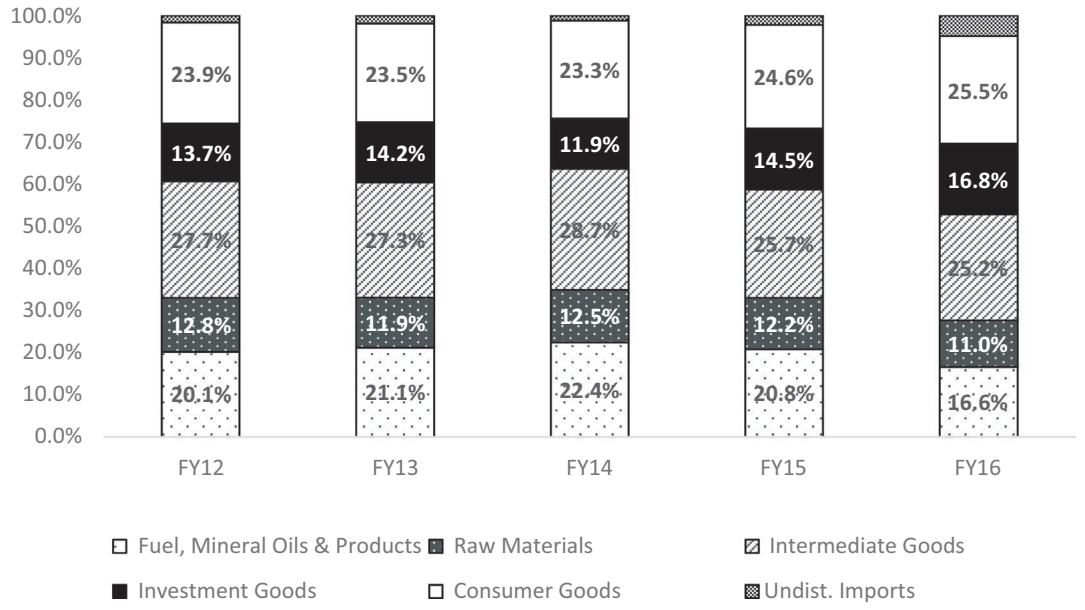

FIGURE 1 Egyptian import structure from 2012 to 2016. *Source*: The Central Bank of Egypt

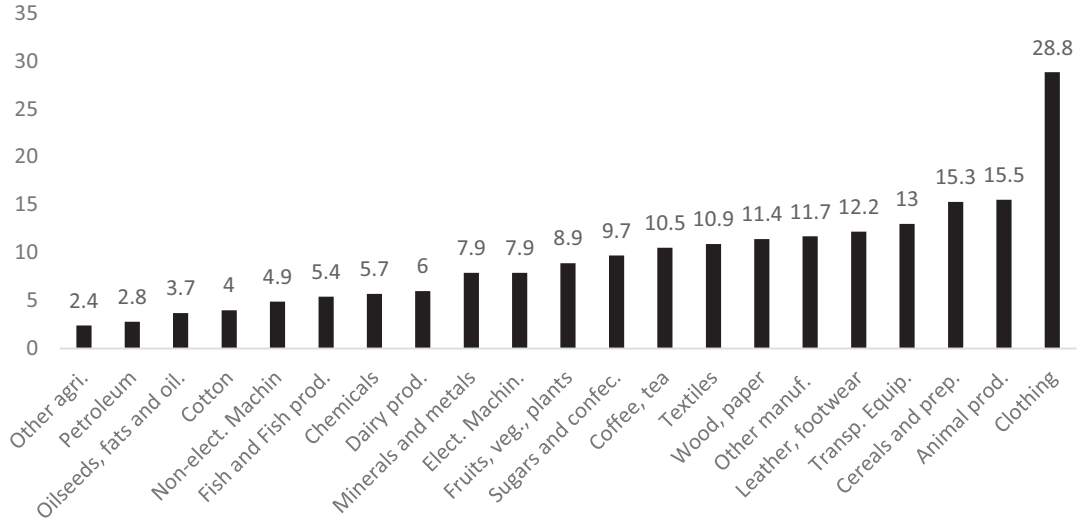

FIGURE 2 Most-favored nation applied tariffs in 2012 (average). *Source*: World Trade Organization

conformity assessment measures are the most important obstacles facing their imports, followed by charges, taxes, and para-tariff measures and technical regulations.

Table 2 shows that at the sectoral level importers face the most impeding measures in input-related sectors. Indeed, according to the NTM Business Survey done by the International Trade Center, 51% of importers in engineering products are facing burdensome NTMs, followed by 41% in the chemicals sector and 39% in the textiles sector. This becomes even more important as 31% of the reported procedural obstacles are in the engineering products followed by 22% in chemicals, which are chiefly used as inputs in other industries as it was mentioned before.

Figure 3. Non-Tariff Measures in Egypt

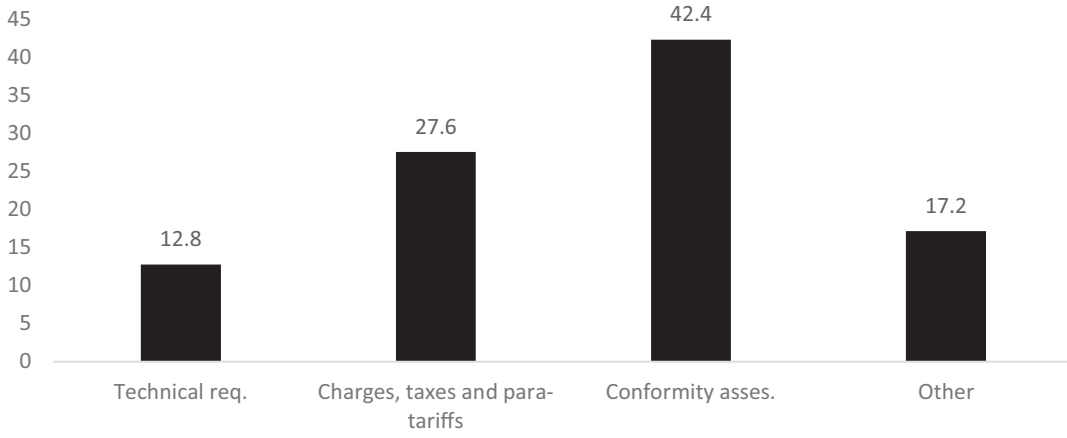

FIGURE 3 Non-tariff measures in Egypt. *Source*: NTM Business Survey, International Trade Center

TABLE 2 Non-tariff measures. Importance by sector in 2010

Main import sectors	Import value million US$	Share in total non-oil imports (%)	Share of importers facing burdensome NTMS (%)	Share of reported procedural obstacles (%)
Processed food	3,272,860	7	63	8
Fresh food	7,386,007	17	55	12
Engineering prod.	12,941,593	29	51	31
Clothing	607,609	1	43	2
Chemicals	6,905,816	16	41	22
Textiles	2,035,411	5	39	2
Metals	7,042,373	16	35	7
Furniture and wood prod.	2,439,730	5	21	6
Leather prod.	175,829	0	0	0
Other manuf.	1,661,681	4	59	11
Oil and minerals	8,533,981	19	0	0
Total non-oil imports	44,468,909	100	45	100

Source: NTM Business Survey, International Trade Center.

To calculate the weighted tariffs and NTMs, we multiply the tariff (or NTM) of industry s used by industry k (Tar_{ks}) by the technical coefficient, being the share of industry s in industry k coming from IO tables (IO_{sk}), that is:

$$\text{Weighted } Tar_k = \sum_s Tar_s IO_{sk}. \tag{1}$$

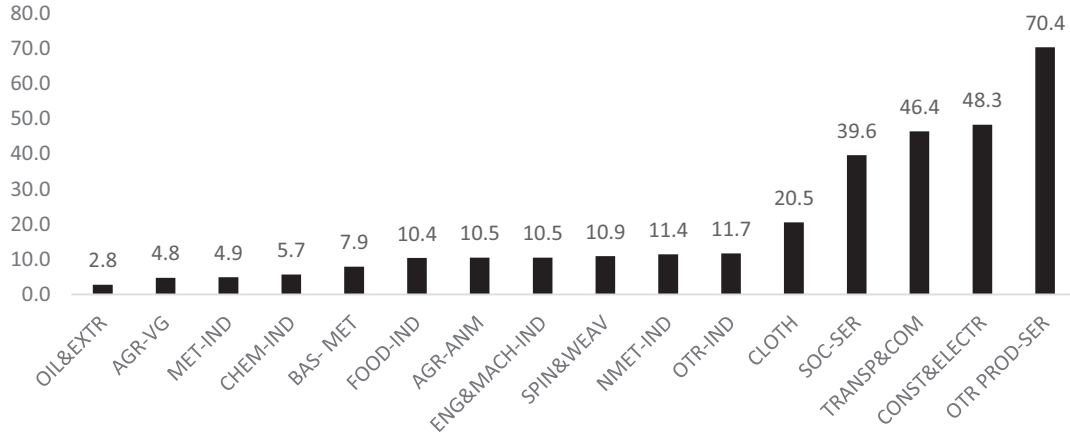

FIGURE 4 Weighted tariffs by input utilization. *Source*: Constructed by the authors using the Social Accounting Matrix of 2000/2001

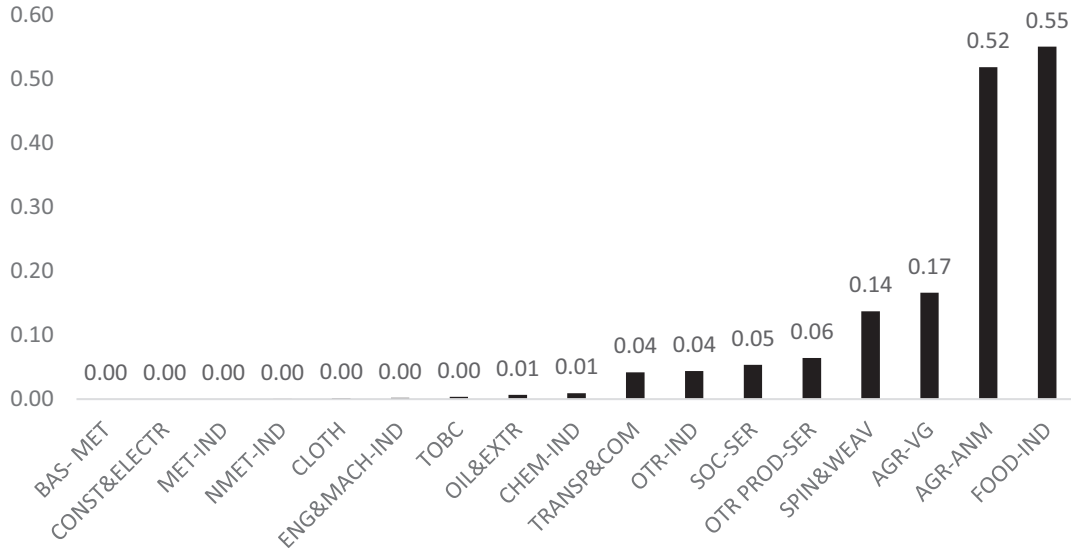

FIGURE 5 Weighted non-tariff measures by input utilization. *Source*: Constructed by the authors using the Social Accounting Matrix of 2000/2001

Figures 4 and 5 show the tariffs and NTMs weighted by the technical coefficients coming from the IO table. Two remarks are worth mentioning. First, the tariff-equivalent of services is extremely high in Egypt (39.6% for social services, 46.4% for transport, and 70.4% for other productive services). Second, for the manufacturing sector, while chemicals are moderately protected (with a weighted tariff of 5.7%), engineering and machinery and spinning and weaving are characterized by a relatively higher tariff (10.5% and 10.9%, respectively). Therefore, the higher the tariffs imposed on inputs, the higher the cost of production and the lower the efficiency of Egyptian firms. The pattern for NTMs is significantly different. Indeed, the sectors characterized by most of the NTMs are those where Egypt has a comparative advantage, such as processed food, textiles, and agricultural products.

It is important to note that Egypt's trade policy favors exporters who rely on intermediate inputs. Indeed, this can be highlighted by three main schemes. First, Egypt has one Special Economic Zone

(Suez Governorate in the Sokhna area and adjacent to the Sokhna Port) that benefits from simplified customs procedures, tariff-free imports of inputs and equipment, and lower taxes. Second, the Presidential Decree No. 184/2013 (Article 6) allows for the reduction of customs duties on intermediate goods if the final product has a certain percentage of local inputs.[6] For instance, the exemptions granted to the assembly industries under this Decree during 2013–2014 reached EGP202.9 million, whereas during 2014–2015 they were EGP112.1 million (WTO, 2018). Finally, Egypt's trade policy is also characterized by a duty drawback scheme (under Articles 102–106 of the Customs Law and Prime Minister Decree No. 1635/2002). This scheme allows a full refund of customs duties paid on imports of inputs and components used in the manufacture of finished products as long as the final products are exported or shipped to a free zone within 2 years after the date of duties payment.

4 | METHODOLOGY

In this context, and in contrast to previous studies, this research exploits the inter-sectoral in tariff barriers and NTM to estimate the impact stemming from import tariffs on labor productivity and TFP.

The identification strategy combines empirical methods used in Frankel and Romer (1999) and Amiti and Konings (2007) with theoretical developments in Anderson and van Wincoop (2003), Melitz (2003), and Goldberg et al. (2010). In this context, the effect of trade liberalization on firm growth is estimated in a two-step procedure.

First, to determine the effect of trade liberalization on productivity and firms' growth, we consider a plant with a Cobb–Douglas production function as follows:

$$VA_{ikg} = A_{ikg} L_{ikg}^{\alpha} K_{ikg}^{\beta}, \tag{2}$$

where *Value Added,* VA_{ikg}, is the total output, Y_{ikg}, minus used inputs, I_{ikg}, K is the capital, L is the labor, A is the technology efficiency parameter, i denotes the individual plant, and k denotes the industry (four-digit level) and g governorate (region). By log-linearizing Equation 2 and adding a number of dummy variables for exporters (ExpDum), importers of inputs (InputDum), and several sets of fixed effects (for sectors at two-digits, regions),[7] we obtain an estimable equation as follows:

$$\ln\left(Y_{ikg} - I_{ikg}\right) = \ln A_{ikg} + \alpha_0 \ln L_{ikg} + \beta_0 \ln K_{ikg} + \lambda_1 ExpDum + \lambda_2 InputDum + \xi_k + \pi_g + \varepsilon_{ikg}. \tag{3}$$

Alternatively, we also estimated a translog production function using value added as dependent variable (production minus inputs used in production) and as explanatory variables we used labor, capital, and the squared term of both inputs and their interaction.[8] The translog production function is as follows:

$$VA_{ikg} = A_{ikg} L_{ikg}^{\alpha} K_{ikg}^{\beta} \left(L_{ikg}^2\right)_3^{\lambda} \left(K_{ikg}^2\right)_4^{\lambda} \left(L_{ikg} K_{ikg}\right)_5^{\lambda}. \tag{4}$$

Therefore, the log–log specification of the translog model is given by:

$$\ln VA_{ikg} = \ln A_{ikg} + \alpha_1 \ln L_{ikg} + \beta_1 \ln K_{ikg} + \lambda_3 \left(\ln L_{ikg}\right)^2 + \lambda_4 \left(\ln K_{ikg}\right)^2 + \lambda_5 \ln L_{ikg} * \ln K_{ikg} + \xi_k + \pi_g + \varepsilon_{ikg}. \tag{5}$$

Therefore, we obtain TFP as follows:

$$TFP'_{ikg} = \ln VA_{ikg} - \ln \widehat{VA}_{ikg}, \tag{6}$$

where $\ln \widehat{VA}_{ikg}$ is the estimated value added from Equation 5.

We extended the value-added model by including a dummy variable for an exporting firm and another dummy for those who have imported inputs from the rest of the world. It is important to note that only 369 firms are exporters, which represent less than 1% of the firms (chiefly food, textile, apparel, and chemicals). Meanwhile 7,176 firms are importing inputs, which represent 11.5% of all firms. Most of the firms are concentrated in the following sectors: repair and computers, manufacture of food, furniture, wearing apparel, fabricated metal products, textile, rubber and plastic, and repair and installation of machinery.

In the second stage, we examine the impact of trade liberalization on plant-level productivity. Using the plant-level measures of TFP from Equation 6, we estimate the following equation:

$$TFP'_{ikg} = \gamma_0 + \gamma_1 Inputtariff_k + \gamma_2 NTM_k + \delta_g + \varepsilon_{ikg}, \tag{7}$$

where *Inputtariff* for each industry k (four-digit level activities) is measured as a weighted average of all tariffs, with the weights based on the cost shares of each input used in the industry and *NTM* is an index of NTM. Industry (two-digit level activities, see Appendix 3) and regional dummies (Appendix 4) are also included. Alternatively, we also use the trade shares as measures of trade openness and exclude the trade policy variables from the model. The specification in this case is given by:

$$TFP'_{ikg} = \gamma_0 + \gamma_1 shareIM_k + \gamma_2 shareX_k + \delta_g + \varepsilon_{ikg}. \tag{8}$$

It is worthy to note that since we have a single cross-section, that is, data are only available for 2013, it is not possible to apply the procedures suggested by Olley-Pakes (1996) or Levinsohn-Petrin (2003), which require panel data.

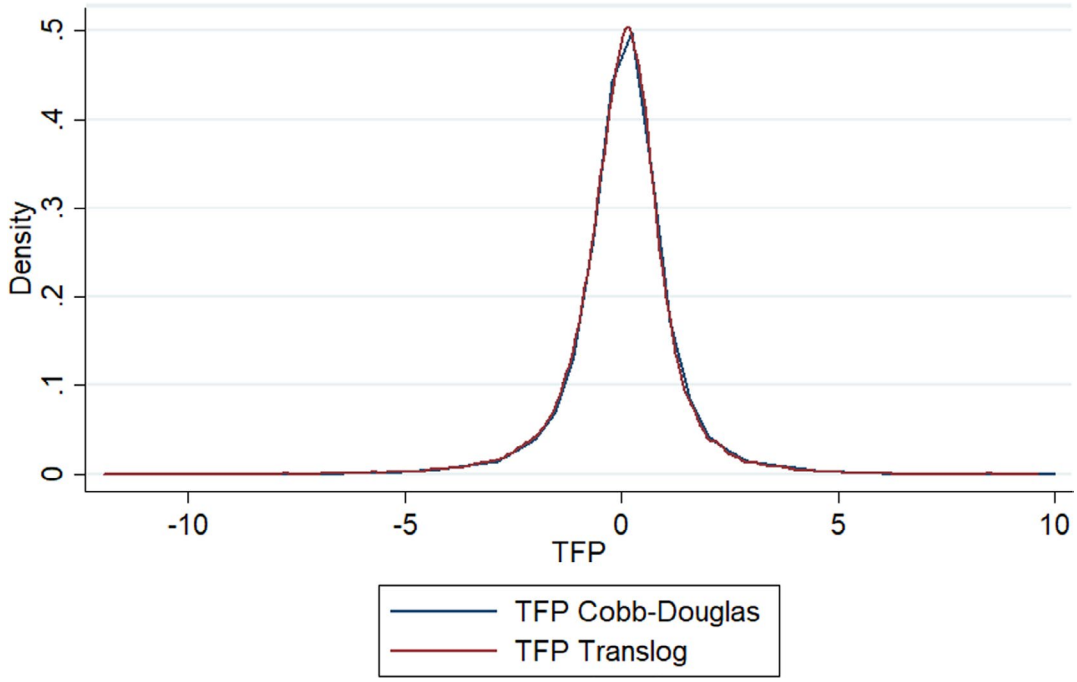

FIGURE 6 Estimated total factor productivity. *Source*: Constructed by the authors

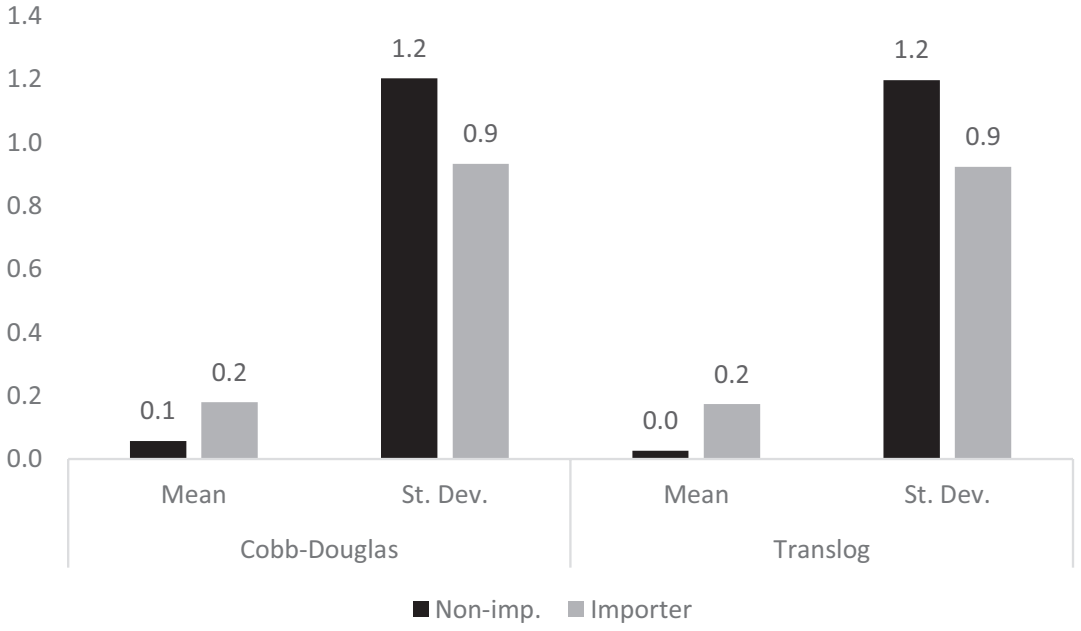

FIGURE 7 Total factor productivity and importing firms. *Source*: Constructed by the authors using the Economic Census

Figure 6 shows the Kernel density distribution of the estimated TFP (both Cobb–Douglas and translog). It is clear that both measures yield similar estimates and slightly skewed to the right. Figure 7 provides a preliminary assessment of the association between TFP and firms that import intermediate inputs. Indeed, firms that rely on intermediate inputs are, on average, more productive and less heterogeneous (since they have a lower standard deviation).

5 | EMPIRICAL FINDINGS

The main results are presented in Tables 3–5. Table 3 presents the estimates obtained from Equation 2 without exporter and importer dummies. Labor and capital are positive and statistically significant for the Cobb–Douglas function (columns 1 and 2) with the labor coefficient higher than the capital one. Using the translog function (columns 3 and 4), while labor is significant, neither capital nor squared terms are significant. By contrast, the interaction labor and capital are positive and statistically significant.

Table 4 presents the estimation of Equation 2. The first column includes in addition to the production factors, capital and labor, a dummy for firms that sell part of their production abroad. The estimated coefficient indicates that exporters perform better than non-exporters in terms of value added. Exporter value added is on average 40% higher ((exp(0.341)−1)*100) than non-exporters value added. In the second column, a dummy for firms importing intermediate goods is added, indicating that those firms value added is around 15% higher. Column 3 includes both dummies simultaneously, and only the estimated coefficient of the exporter dummy is slightly lower than in column 1. Finally, when introducing also an interaction term that takes the value of 1 when a firm exports and imports, the corresponding coefficient is not statistically significant.

TABLE 3 Production function estimates—Basic specification

	Cobb–Douglas		Translog	
	(1)	(2)	(3)	(4)
Ln(Labor)	1.044***	0.958***	0.537***	0.593***
	[0.0213]	[0.0278]	[0.111]	[0.0987]
Ln(Capital)	0.140***	0.128***	0.0645	0.0486
	[0.0120]	[0.0112]	[0.0735]	[0.0784]
Ln(Labor) × Ln(Capital)			0.0561***	0.0340***
			[0.0137]	[0.0120]
Ln(Labor)^2			−0.0420***	−0.00187
			[0.0156]	[0.0138]
Ln(Capital)^2			0.00167	0.00267
			[0.00433]	[0.00442]
Constant	8.128***	8.561***	8.686***	8.964***
	[0.0952]	[0.693]	[0.318]	[0.718]
Region dum.	No	Yes	No	Yes
Industry dum.	No	Yes	No	Yes
Observations	60,661	60,661	60,661	60,661
R^2	0.411	0.512	0.414	0.515

Note: Robust standard errors in brackets. Industry dummies at the four-digit level.

***p <.01; **p <.05; *p <.1.

The results from the second step estimation using the Cobb–Douglas and translog production functions (Equation 6) are shown in Tables 5 and 6, respectively. In general, the effect of tariffs and NTM does not change with the TFP specification. Indeed, for the translog estimation, the coefficient of the tariff variable, which has been weighted using IO coefficients, indicates that a decrease in tariffs by 1% is associated with an increase in TFP of around 3%; this effect can mostly be attributed to tariffs on imported inputs, since this is the relevant protection for firms that heavily rely on imported products (whether machines, equipment, or raw materials). Concerning the effect of NTM, the coefficient of the IO-NTM variable is negative and significant in column 2, indicating that a decrease in NTMs is also associated with a decrease in TFP. However, when tariffs and NTM are introduced in the model simultaneously, the results in column 3 indicate that whereas the effect of tariffs stays negative and statistically significant at the 1% level, the coefficient of NTM turns out to be positive and significant, probably due to the negative correlation between both trade policy measures. Indeed, the correlation between the two is high and negative (−0.64); therefore, we should rely on the estimates obtained in columns (1) and (2). However, as it was argued in the literature, combining the two variables can lead to a different interpretation. When the effect of NTBs is considered without controlling for tariff protection, the negative effect may be capturing an indirect tariff effect: lower tariffs lead to an increase in NTMs and this translates into lower TFP; however, when controlling for the effect of tariffs, the former indirect effect is not present any longer. For a given level of tariff protection, higher NTMs could be signaling higher quality of the imported products. Consequently, firms that are unable to face higher costs of these imported inputs might be forced to exit the market. This could explain the positive correlation between NTMs and TFP in columns (3) and (4) of Table 4. In the last column, we

TABLE 4 Extended production function (Cobb–Douglas)

	(1)	(2)	(3)	(4)
	Ln(VA)	**Ln(VA)**	**Ln(VA)**	**Ln(VA)**
Exporter dummy	0.341**		0.289**	0.337**
	[0.134]		[0.133]	[0.136]
Imported input dummy		0.141***	0.140***	0.140***
		[0.0277]	[0.0278]	[0.0278]
Exp. dum. × input dum.				0.132
				[0.172]
Ln(Labor)	0.919***	0.917***	0.916***	0.916***
	[0.0298]	[0.0296]	[0.0298]	[0.0298]
Ln(Capital)	0.122***	0.121***	0.121***	0.121***
	[0.0112]	[0.0112]	[0.0112]	[0.0112]
Constant	8.898***	8.919***	8.921***	8.921***
	[0.649]	[0.650]	[0.651]	[0.651]
Region dum.	YES	YES	YES	YES
Industry dum.	YES	YES	YES	YES
Observations	60,661	60,661	60,661	60,661
R^2	0.515	0.516	0.516	0.516

Note: Robust standard errors in brackets. Industry dummies at the four-digit level.

***p <.01; **p <.05; *p <.1.

TABLE 5 Model with total factor productivity (TFP) estimated from Cobb–Douglas production function

	(1)	(2)	(3)	(4)
	Ln(TFP)	**Ln(TFP)**	**Ln(TFP)**	**Ln(TFP)**
IO tariff	−0.0248***		−0.0563***	−0.0563***
	[0.00609]		[0.0125]	[0.0125]
IO NTM		−0.182***	0.231***	0.231***
		[0.0447]	[0.0472]	[0.0472]
Foreign owned	1.007***	1.007***	1.007***	1.007***
	[0.192]	[0.192]	[0.192]	[0.192]
Stock market	0.712*	0.712*	0.712*	0.712*
	[0.356]	[0.356]	[0.356]	[0.356]
Constant	1.167***	1.376***	0.900***	0.900***
	[0.141]	[0.191]	[0.0894]	[0.0894]
Region dum.	YES	YES	YES	YES
Sector dum.	YES	YES	YES	YES
Observations	31,267	31,267	31,267	31,267
R^2	0.161	0.161	0.161	0.161

Note: Robust standard errors in brackets. Sector dummies at the two-digit level.

***p <.01; **p <.05; *p <.1.

TABLE 6 Model with total factor productivity (TFP) estimated from translog production function

	(1)	(2)	(3)	(4)
	Ln(TFP)	**Ln(TFP)**	**Ln(TFP)**	**Ln(TFP)**
IO tariff	−0.0376***		−0.0742***	−0.0742***
	[0.00648]		[0.0133]	[0.0133]
IO NTM		−0.276***	0.268***	0.268***
		[0.0475]	[0.0502]	[0.0502]
Foreign owned	0.997***	0.997***	0.997***	0.997***
	[0.217]	[0.217]	[0.217]	[0.217]
Stock market	0.323	0.323	0.323	0.323
	[0.373]	[0.373]	[0.373]	[0.373]
Constant	1.386***	1.663***	1.131***	1.170***
	[0.519]	[0.634]	[0.392]	[0.401]
Region dum.	YES	YES	YES	YES
Sector dum.	YES	YES	YES	YES
Observations	31,267	31,267	31,267	31,267
R^2	0.158	0.158	0.158	0.159

Note: Robust standard errors in brackets. Sector dummies at the two-digit level.

***p <.01; **p <.05; *p <.1.

TABLE 7 Effect of exports and import shares on total factor productivity (TFP)

	(1)	(2)
	Ln(TFP Cobb–Douglas)	**Ln(TFP translog)**
Exp. share	0.0175	0.0672
	[0.149]	[0.169]
Share of imp. input	0.160**	0.163**
	[0.0814]	[0.0854]
Foreign owned	−0.174	−0.377*
	[0.203]	[0.217]
Stock market	−0.091	0.0384
	[0.159]	[0.161]
Constant	0.787***	0.428**
	[0.254]	[0.202]
Region dum.	YES	YES
Sector dum.	YES	YES
Observations	9,240	9,240
R^2	0.194	0.174

Note: Robust standard errors in brackets. Sector dummies at the two-digit level.

***p <.01; **p <.05; *p <.1.

add additional controls, in particular a dummy for firms with foreign participation and another dummy for firms that are in the stock market, and the results stay similar.

Finally, in Table 7 we present the results obtained from estimating Equation 7, in which the share of exports over total sales and the share of imported inputs over total inputs are used as explanatory variables. The results show that only the second shows a positive and statistically significant coefficient, indicating that the firms that use a higher share of imported inputs are more productive. However, it cannot be concluded that firms exporting a higher share have higher TFP.

6 | CONCLUSION AND POLICY RELEVANCE

Using the Economic Census of Egypt 2013, this paper contributes to the literature in three ways. First, we combine both tariffs and NTM to examine their association with value added and productivity. Second, we use IO tables in weighting both tariffs and NTM given that each industry relies on different imported inputs. Third, we apply this for a MENA country (Egypt) since the latter has been understudied in this literature. Our main findings show a positive and significant association between imported inputs and value-added and a significantly negative relationship between tariffs and TFP. When taken individually, tariffs and non-tariffs have a negative association with TFP. Yet, when they introduced together, only tariffs remain negative and significant.

From a policy standpoint, this paper sheds some light on the role of trade liberalization (both in terms of tariff reduction and NTM removal) in improving firms' productivity. This will allow Egyptian firms benefit at three levels. First, they will have access to inputs that are not available on the domestic market. Second, they will be able to benefit from cheaper imported intermediate inputs since the latter will be subject to lower tariffs and lower NTM. Third, such imported inputs might be associated with technology transfer, which can also improve firms' productivity. It is worthy to note that NTM and administrative barriers to trade are still costly in Egypt. Indeed, according to the World Bank Enterprise Survey, customs and trade regulations are identified as a major constraint by 20% of the surveyed firms, which shows a notable deterioration compared to the 9% of 2013. Again, this is mainly due to a lengthier time to clear exports and imports. For these reasons, further reforms to be undertaken are highly recommended to address NTM.

In a nutshell, trade liberalization has become an important part of many countries' development strategies. Opening local markets to foreign competition and foreign direct investment can lead to a more efficient allocation of resources that will result in productivity improvements in domestic industries and higher overall output.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in the Economic Research Forum (Cairo, Egypt). Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the authors with the permission of Economic Research Forum (Cairo, Egypt).

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ENDNOTES

[1] It is worth mentioning that there could also be firms producing intermediate inputs in the home country in competition with imported intermediate imports, but this is not always the case in developing countries, where capital inputs are in many instances not available. We thank an anonymous referee for pointing this out.

[2] Alesina et al. (2005) claim that there are many reasons why trade openness (however measured) may display a positive coefficient on growth. For instance, trade policy toward reduced protection may induce improved functioning of institutions, increased foreign direct investment, scale effects, technology spill-over, etc.

[3] The bound tariff is the maximum MFN tariff level for a given commodity line. When countries join the WTO or when WTO members negotiate tariff levels with each other during trade rounds, they make agreements about bound tariff rates, rather than actually applied rates.

[4] Data on effective tariffs are not available in the IO tables.

[5] Although this matrix might be a little bit outdated, we opted to use it as it is the most disaggregated one in the manufacturing sector. We found other matrices with much more services sector and just one manufacturing sector. This is why we rely on this one assuming that sector intensity did not change significantly over this period.

[6] Under this concession, the customs duty rate assessed based on the final product may be reduced by rates ranging from 10% if the local content of the final product is less than 30%, up to a maximum of 90% if the local content exceeds 60%.

[7] Two additional dummy variables are added indicating whether the firm holds a commercial registration and regular accounting statements.

[8] In this case, we excluded the exporter and importer dummies, as in the second step we will estimate TFP as a function of trade policy variables as proxies for openness.

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APPENDIX 1

Variables and its definitions

Variable	Definition
TFP translog	The estimated total factor productivity using a translog production function
TFP CD	The estimated total factor productivity using a Cobb–Douglas production fun
Ln(VA)	Value-added by firm
Ln(Wages)	Total wage bill by firm
Ln(Capital)	Total capital remuneration by firm
Input imp.	Intermediate goods consumed (b) materials and tasks

Source: Constructed by the authors.

APPENDIX 2

Descriptive statistics

Variable	Obs.	Mean	Std. dev.	Min.	Max.
TFP translog	60,661	0.03	1.20	−11.94	9.60
TFP CD	60,661	0.06	1.20	−11.67	9.92
Ln(VA)	61,114	11.01	1.93	1.39	25.09
Ln(Wages)	62,108	1.34	1.28	0.00	11.06
Ln(Capital)	61,625	10.26	2.33	0.69	24.47
Input imp.	62,108	218.13	20,730.48	0.00	3,308,987

Source: Constructed by the authors.

APPENDIX 3

List of two-digit level activities

Two-digit level activities	Freq.	Percentage
Accommodation	597	1.91
Activities of membership organizations	185	0.59
Advertising and market research	233	0.75
Air transport	10	0.03
Civil engineering	86	0.28
Construction of buildings	178	0.57
Education	1,444	4.62
Employment activities	129	0.41
Fishing and aquaculture	9	0.03
Food and beverage service activities	5,971	19.1
Forestry and logging	61	0.2
Gambling and betting activities	1	0
Human health activities	4,661	14.91
Information service activities	21	0.07
Legal and accounting activities	1,890	6.04
Manufacture of basic metals	169	0.54
Manufacture of beverages	13	0.04
Manufacture of electrical equipment	223	0.71
Manufacture of food products	3,347	10.7
Manufacture of furniture	1,870	5.98
Manufacture of paper and paper products	228	0.73
Manufacture of textiles	600	1.92
Manufacture of tobacco products	17	0.05
Manufacture of wearing apparel	1,519	4.86
Mining of metal ores	3	0.01
Mining support service activities	7	0.02
Other manufacturing	162	0.52
Other mining and quarrying	373	1.19
Other personal service activities	4,047	12.94
Postal and courier activities	39	0.12
Programming and broadcasting activities	20	0.06
Publishing activities	46	0.15
Real estate activities	449	1.44
Rental and leasing activities	1,737	5.56
Residential care activities	28	0.09
Scientific research and development	4	0.01
Security and investigation activities	38	0.12
Sewerage	1	0
Specialized construction activities	50	0.16
Telecommunications	641	2.05
Veterinary activities	34	0.11
Water collection, treatment, and supply	16	0.05
Water transport	110	0.35
Total	31,267	100

APPENDIX 4

List of regions

Governorate	Freq.	Percentage
Cairo	5,099	16.31
Alexandria	2,699	8.63
Port Said	596	1.91
Suez	527	1.69
Damietta	695	2.22
Al-Dakahleya	1,868	5.97
Al-Sharkeya	1,554	4.97
Al-Kalyoubeya	1,621	5.18
Kafr Al-Sheikh	735	2.35
Al-Gharbeya	1,635	5.23
Al-Monoufeya	1,030	3.29
Al-Beheira	1,430	4.57
Al-Ismaeliya	634	2.03
Al-Giza	2,523	8.07
Beni Suwif	667	2.13
Al-Fayum	714	2.28
Al-Meniya	1,335	4.27
Asiyut	997	3.19
Sohag	1,055	3.37
Qena	653	2.09
Aswan	642	2.05
Luxor	699	2.24
Red Sea	316	1.01
Al-Wadi Al-Gadid	311	0.99
Matruh	379	1.21
Northern Sinai	409	1.31
Southern Sinai	444	1.42
Total	31,267	100