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On Modelling the Determinants of TFP in the MENA Region: A Macro-Micro Firm-Level Evidence

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Abstract

Using enterprise surveys for MENA countries, this paper estimates total factor productivity (TFP) and examines its determinants. Our contribution is twofold. First, we provide TFP estimates by country and sector for the MENA region and examine how TFP changes by export status, age, firm size, formal status and ownership. Second, we combine both micro (firm level) and macro (nation level) determinants of TFP. Our findings show that among the micro determinants, government ownership, foreign capital, female managers, owning a foreign certification, and formal registrations of firms are all positively associated with TFP, with competition also exerting a positive impact on firms' productivity. All the macro determinants on the other hand, with the exception of trade openness, display the expected impact on TFP as suggested by the literature. Longer time to enforce contracts, high tax burden and high lending rates tend to have a significantly negative impact on TFP. Higher tariffs, however, has a surprisingly positive impact on TFP which may emphasize the adverse impact trade openness can have on TFP as a result of the economy's increased dependence on imported products and its limited ability to absorb the positive spillovers of trade.

Keywords: TFP, MENA, Macro-Micro Determinants, Firm-Level.

1 Introduction

The Middle East and North African (MENA) region has been lagging behind compared to other regions, in terms of the role of technological progress in its economic growth and development. At the macroeconomic level, most of the output growth in the region has occurred as a result of increases in capital and labor, rather than in total factor productivity (TFP). Furthermore, numerous studies on MENA countries argued that TFP growth is crucial to overall growth. Indeed, they showed that Egypt, Tunisia and Morocco, which have achieved positive TFP growth rates, have also achieved relatively high growth rates since 1960, as they are more diversified than other countries. By contrast, oil-producing countries (chiefly the Gulf Cooperation Countries) often tend to have relatively poor and more volatile growth performance. From a structural perspective, the MENA region is characterized by several impediments that hinder the growth of its TFP. First, with low research and development spending, most of the countries were stuck in low-value added sectors, chiefly oil refineries, processed food, ready-made garments and some chemical products. Second, these low-value added sectors are also capital intensive; this is why growth was jobless in most of these countries. Furthermore, those countries were also characterized by high population growth (a 2.5 percent annual increase over the past 20 years and 7.7 percent of the world's population) and low productivity (4.3 percent of world GDP); stagnating political and institutional reforms (several costly red tape barriers coupled with corruption); costly public sectors (with an average ratio of central government spending to GDP of 42 percent of GDP in the 1970s, higher by 12 percentage points than other developing countries); inequitable educational systems; underdeveloped financial markets (credit to the private sector is half its corresponding level in East Asia) and high trade restrictions (non-tariff measures, tariff peaks and unbound tariffs). This is why it is important to analyze how these structural impediments have hampered the growth of TFP.

The empirical literature on TFP determinants can be classified in three main groups; micro, meso, and macro. At the micro level, empirical studies have outlined four factors that may play a role in influencing a firm's productivity, namely; age of firm, formal status, ownership, and its location (see Brouwer *et al.,* 2005; Palangkaraya *et al.,* 2007; Coad *et al.*, 2013; Abou-Ali and Rizk, 2015). At the meso (regional) level, Gopinath *et al.* (2002) investigated the impact of industrial concentration on the growth rate of TFP at the industry level. Finally, at the macro level, several factors related to the national government and the prevailing institutions (such as; bureaucracy and red tape, corruption, crime, and infrastructure quality) may play an

important role in influencing the productivity levels of individual firms (De Rosa *et al.*, 2015). Yet, variables measuring macro policies (fiscal, trade and monetary policies) have not been considered as determinants of TFP, while they proved to be crucial for TFP growth. Moreover, several papers showed that there is an urgent need to focus on improving governance and quality of institutions, investing in human capital, and establishing market-friendly and peaceful political environments in order to boost TFP.

For the MENA region, there are very few studies estimating TFP using firm-level data. Furthermore, no studies distinguished between macro and micro determinants of TFP in the MENA region. Therefore, using enterprise surveys for MENA countries, this paper estimates total factor productivity (TFP) and examines its determinants. Our contribution is twofold. First, we provide TFP estimates by country and sector for the MENA region and examine how TFP changes by export status, age, firm size, formal status and ownership. Second, we combine both micro (firm level) and macro (nation level) determinants of TFP, by focusing on the channels through which macro-economic policies (fiscal, trade and monetary policies) can affect TFP.

Our findings show that among the micro determinants, government ownership, foreign capital, female managers, owning a foreign certification, and formal registrations of firms are all positively associated with TFP, with competition also exerting a positive impact on firms' productivity. All the macro determinants on the other hand, with the exception of trade openness, display the expected impact on TFP as suggested by the literature. Longer time to enforce contracts, high tax burden and high lending rates tend to have a significantly negative impact on TFP. Higher tariffs, however, has a surprisingly positive impact on TFP which may emphasize the adverse impact trade openness can have on TFP as a result of the economy's increased dependence on imported products and its limited ability to absorb the positive spillovers of trade.

Small firms seem to be more positively affected by foreign ownership and formal status of the firm, which reinforce the important spillovers formal registration and foreign equity can bring to the firm especially at the early stage of its formation. Large firms, however, suffer from difficulty in coping with changing business environment showing an inertia effect in which age has a negative impact on TFP. They also tend to be more affected by the positive impact of owning a foreign certificate, as well as an interesting negative impact of formal registration. The productivity levels of all three types of firms show a negative response to long enforcement time frames and spatial agglomeration. Heavy tax burdens tend to exert negative pressure on

medium and large firms while the adverse effect of high lending rates is significant in the case of small firms only.

The remainder of the paper is organized as follows; Section 2 reviews the literature. Section 3 gives an overview of the macroeconomic environment in MENA countries. Section 4 explains the procedure we adopt to estimate TFP and its determinants. Section 5 provides some stylized facts on TFP in the MENA region. Section 6 is dedicated to empirical findings and Section 7 is the conclusion.

2 Literature Review

The paper classifies the determinants of TFP into three levels; micro, meso, and macro. On the micro level, empirical studies have outlined four factors that may play a role in influencing a firm's productivity, namely; age of firm, formal status, ownership, and its location.

Coad *et al.* (2013) summarized the channels through which a firm's age can affect its performance into three main channels; the learning effect, the selection effect, and the inertia effect. The learning effect - which is particularly applicable for young firms - takes place when firms acquire "more productive production techniques" that increase their productivity levels, once incorporated into their production processes. This effect may also be relevant to older firms, as they capitalize on their business experience, established contacts and wider access to various resources. The second effect, the selection effect, arises as a result of competition and market pressures which gradually eliminate low productivity firms, resulting in a rise in the average productivity level of the surviving -more mature - ones. The third and final effect, the inertia effect, postulates that as firms get older they may face difficulty in coping with the changing business environment, given their accumulated rules and stagnant organizational structures. This, in turn, may result in lower productivity levels.

Applying to Spanish manufacturing firms, the authors examined the relationship between a firm's age and its productivity level over the 1998-2006 period, while allowing for firms' size. Their regression results (using different methodologies) showed that age has a positive effect on a firm's productivity. Their results also provided evidence of the inertia effect, in which older firms experienced lower expected growth rates of productivity.

Using Dutch manufacturing industry data, Brouwer *et al.* (2005) also examined the relationship between a firm's age and its productivity level,

focusing on more mature firms (10 years and older) with no fewer than 20 employees over the 1994-1999 period. Their regression results, in line with those of Coad *et al.* (2013), revealed that for young firms (less than 10 years old) there is a positive relationship between a firm's age and its productivity; indicating that the productivity levels of firms newly entering the market tend to be below the average level within the industry. These levels increase as the firm ages, in order to catch up with the existing firms in the market and to be able to compete with them. The productivity levels then tend to converge for firms that managed to survive at least 10 years in the market, as the authors could not find any difference in the average productivity levels across different age groups. The paper also reported some evidence for the presence of an inertia effect, in which the productivity levels of older firms (over 40 years) tend to be slightly below the average level.

Applying also to a sample of Spanish manufacturing firms over the period from 1990 to 1998, Huergo and Jaumandreu (2004) investigated the impact of age and process innovations on firms' TFP growth - measured by Solow residual- using a semiparametric model that accounted for the possible nonlinearity between age and productivity growth. Their findings indicated a clear relationship between a firm's age and its productivity growth. The results showed that new entrants into the market experience high rates of productivity growth that gradually decline as a firm becomes older, however, these above average growth rates tend to last for about 8 years, after which the productivity growth of surviving firms tends to converge and stabilize around a common (natural) rate.

Focusing on large firms with more than 100 employees or more than $100 million in assets, Palangkaraya *et al.* (2007) examined the relationship between a firm's age, size, and productivity level, using Australian data over the 1992-2003 period, to investigate whether older firms become more productive as a result of the learning effect or less productive due to the inertia effect. Their results - though not robust against different model specifications - indicated a negative relationship between a firm's age and its productivity levels, providing evidence for an inertia effect where older firms are less productive, on average.

Regarding the firm's formal/informal status, Taymaz (2009) examined the impact of informality on a firm's productivity. Using firm-level data and applying the switching regression methodology, as well as the matching propensity score, he estimated the productivity levels of formal and informal firms in Turkey. His results showed that formal firms are more productive than informal ones. Taymaz suggested that this productivity gap can be attributed to several factors, such as the existence of economies of scale, in which the negative relationship between a firm's size and the extent of

informality deters informal firms from growing further, to avoid being detected. Productivity differences could also arise as a result of the self-selection process, in which the more talented/educated/productive workers, managers, and entrepreneurs choose to work in the formal sector over the informal one. Another important source of the productivity gap is informal firms' restricted access - or lack thereof - to public goods and services (infrastructure, support schemes, legal protection etc) that can enhance their productivity, in addition to their lack of access to formal credit channels (whether public or private) which, in turn, forces these firms to substitute unskilled labor for costly physical capital, resulting in lower productivity levels compared to formal firms.

Using Mexico's Economic Census for the years 1998, 2003 and 2008; Busso *et al.* (2012) examined the relationship between a firm's illegality, informality, and productivity, focusing on the distortions in labor contracts - being a major source behind the existence of illegal and informal firms in Mexico. Using a monopolistic competition model to estimate the productivity losses associated with informality, the paper found evidence for a wide productivity gap between formal and informal firms. Their results indicated that an additional peso of labor and capital allocated to legal and formal firms yields 28 percent more output than in the case of illegal and informal firms, and 50 percent more output than legal but informal firms[1].

Hendy and Zaki (2012), on the other hand, investigated the impact of informality -defined as the lack of industrial or commercial registration - on firm's productivity in the MENA region, focusing particularly on two countries; Egypt and Turkey. Using data from the Micro and Small Enterprises (MSE) survey, the authors compared the TFP of both formal and informal firms and found a significant productivity gap between the two types of firms in Turkey; where informal firms were about 166 percent less productive than formal ones. The results, however, showed no significant difference in TFP between formal and informal firms in Egypt.

The above results were reinforced by Abou-Ali and Rizk (2015) who examined the impact of informality - defined as the lack of business license and accounting books - on MSE's output and (labor) productivity levels in Egypt, using the 2012 Egyptian Labor Market Panel Survey (ELMPS). By applying an Ordinary Least Square OLS model, the authors found that

[1] "Formal and legal" firms are the ones that only hire salaried workers and enroll them with the Mexican Social Security Institute (IMSS). "Informal and illegal" firms also hire salaried workers only but do not enroll any of them with IMSS. Legal and informal firms, on the other hand, hire only non-salaried workers and do not enroll any of them with IMSS since they are not obligated to do so (Busso *et al.* 2012).

informality has a significant negative impact on output level and an insignificant negative impact on productivity level in Egypt.

Moving to the third determinant of a firm's productivity - ownership structure - Waldkirch (2014) reported a positive relationship between the share of foreign ownership and the firm's productivity level. Using data from the World Bank Enterprise Survey of a sample of 118 developing and transition countries, Waldkirch regressed labor productivity levels on the "foreign ownership share of the firm". The results indicated a positive and significant effect of foreign capital on a firm's productivity, which the author attributed to the advanced technology and marketing/management strategies that firms with foreign equity possess.

Focusing on the garment industry in Bangladesh, Kee (2005) examined the traditional wisdom that firms with foreign capital are more productive than purely domestic ones, given the access these foreign owned firms gain to exclusive technology, marketing practices, and product design which, in turn, enables them to produce more at the same input levels. The author first estimated the TFP by regressing output on labor, materials and capital using Ordinary Least Squares (OLS) method. The estimated productivity levels were then regressed on the foreign capital share of the firm, using between firm panel regression, while allowing for industry, firm location, and investment climate/time effects. The results showed that purely domestic firms are, on average, 20 percent less productive than firms with foreign capital.

Greenaway *et al.* (2009) examined the relationship between firm performance and the degree of foreign ownership - measured by the share of foreign equity within each firm - using a sample of 21,582 Chinese firms over the 2000-2005 period. To account for the different types of firms in the Chinese economy (purely foreign owned firms, joint ventures, as well as entirely domestic firms), the authors included three dummy variables, namely; "Minority Foreign", "Majority Foreign", and "All Foreign" to reflect the share of foreign equity in each firm. Using the first-difference Generalized Method of Moments (GMM) methodology while accounting for a firm's size, the results showed that both Minority and Majority Foreign (*i.e.* joint ventures) have a significant positive impact on firms' TFP, whilst being purely foreign has an insignificant positive effect on performance. The authors have also used the actual shares of equity paid by foreigners to further investigate the nature of the relationship and found out that there is a non-linear relationship between foreign ownership and a firm's performance, in which productivity increases with foreign equity up to a certain threshold - 64 percent - after which productivity starts to decline. These results indicate that a certain degree of domestic ownership is required for the optimal

performance of Chinese firms, given the superior knowledge those local partners have of the local market, its legal environment, in addition to their potential connections with the local government.

Last, but not least, is the firms' location, the fourth and final determinant of TFP on the micro level. Focusing on the Chinese textile industry over the 2000-2005 period, Lin et *al.* (2011) found out - using EG spatial concentration index - that textile firms are highly agglomerated towards the south-eastern coastal counties, to facilitate their exporting activities and to benefit from large markets. To examine the impact of this geographical concentration on the productivity levels of individual firms, the authors used productivity regression analysis which revealed a non-linear relationship between spatial agglomeration and firms' TFP. Their findings showed that agglomeration has an initial positive effect on productivity levels, as firms benefit from positive externalities; such as, knowledge spillovers and lower transaction costs of labor and intermediate inputs. However, as concentration levels increase, this may result in higher costs of trade (due to tithed competition, rise in cost of land, and cost of congestion) which negatively affect the productivity levels of firms operating in these concentrated areas.

Martin *et al.* (1991) also examined the location effect by classifying the establishments in the household furniture and the meat product industries into three categories based on their location; whether in the metropolitan, small urban, or rural counties, and then estimating a three factor translog production function, to assess the impact of location on an establishment's productivity in each industry. Their results revealed statistically significant location effects for both sectors. For the household furniture sector, on the one hand, manufacturers located in small urban areas were about 9 percent more productive than those located in rural counties, who also produced about 7 percent less output than establishments in metropolitan areas. For meat products, on the other hand, metropolitan manufacturers were found to be 5 percent more productive than their counterparts in rural or small urban areas. However, after adjusting for establishment size, these location effects remained significant only for the largest manufacturers in the furniture sector and the smallest establishments in the meat product industry.

At the meso level, industry concentration (or industry size) may have a potential impact on firm-level productivity. Given the sharp rise in the meatpacking industry in the U.S. from 1958 to 1982, Ward (1987) analyzed the relationship between industry concentration and firms' TFP. Using Ordinary Least Squares (OLS), the author regressed TFP on the industry concentration ratio and included a dummy variable to reflect periods of

increasing or decreasing concentration. The estimation results showed no significant impact of concentration in the meatpacking industry on TFP over the 24-year period. Focusing also on the food industry in the U.S. over the 1964-1992 period, Gopinath *et al.* (2002) investigated the impact of industrial concentration on the growth rate of TFP at the industry level. The regression of TFP growth on the industry concentration ratio and its square value, revealed an inverted U-shape relationship between industry concentration and its productivity growth. Their findings showed that higher concentration ratios lead to higher rates of TFP growth up to a certain threshold - 62.3 percent concentration ratio - after which the relationship between the two variables turns negative.

Finally, at the macro level, several factors related to the national government and the prevailing institutions (such as; bureaucracy and red tape, corruption, crime, and infrastructure quality) may play an important role in influencing the productivity levels of individual firms.

De Rosa *et al.* (2015) examined the effect of corruption on TFP, using frim-level data obtained from the 2009 World Bank/EBRD Business Environment and Enterprise Performance Survey for enterprises in Central and Eastern Europe and Central Asia. Two measures of corruption were used; "bribe tax" that reflects any informal payments made to public officials to ease a firm's daily operations and "time tax" reflecting the amount of time firms spend dealing with bureaucratic requirements and red tape. Using an augmented production function that controls firm performance, industry, and country-specific characteristics (age of firm age, size, export and innovation status, foreign ownership, competition intensity, quality of courts, and political instability) and applying an instrumental variable approach to account for the potential endogeneity, the results showed that bribes have a significantly negative effect on firm's TFP, such that a firm that does not pay bribes is, on average, 5 percent more productive than the corrupt one. The effect of prolonged bureaucratic procedures, however, turned out to be insignificant. By considering the set of country characteristics that may influence the corrupt behavior of individual firms (two measures were used; the Transparency International Corruption Perception Index and the index of the effectiveness of the legal framework in resolving disputes), the authors showed that the adverse effect of corruption on firm-level productivity is – surprisingly - stronger for countries with high corruption environments and weaker legal systems.

Evaluating the same relationship in developing countries, Williams and Martinez-Perez (2016) found opposing results to those of De Rosa *et al.* (2015). Using the World Bank Enterprise Survey for 132 developing

economies and applying a random slope and random constant models, the authors estimated the effect of bribery - measured by firm perception regarding their need to pay bribes in order to get things done - on a firm's performance[2]. The results showed that enterprises who believe they should make informal payments to government officials to get things done, achieve substantially higher annual labor productivity growth rates - 48 percent higher - compared to firms who do not perceive bribery as a necessity. The authors explained this corruption enhancing effect as a compensation for the institutional imperfections prevailing in developing countries.

Fernandes (2008) examined the impact of bureaucracy and red tape, poor infrastructure quality, and crime on TFP. Using firm-level data for 575 Bangladeshi firms covering five main industries - food, pharmaceuticals, leather, readymade garments, and textiles - over the 2004-2005 period, she estimated a Cobb-Douglas production function for each industry. The results showed that heavy bureaucracy (measured by the time spent dealing with bureaucratic requirements and the number of days needed to clear customs) and poor infrastructure quality (measured by the yearly power supply outage) have a negative impact on firm-level productivity. Crime (measured by the protection payments made by firms) was also found to have a dampening effect on productivity. With regard to the impact of bribery, results showed that - in line with Williams and Martinez-Perez (2016) - firms paying more bribes to get things done are, on average, more productive.

Khan (2006) and Loko and Diouf (2009) examined the impact of macroeconomic policies (fiscal, monetary and trade policies) on TFP levels of individual firms. Focusing on the Pakistani economy, Khan (2006) specified a simple regression model in which TFP is regressed on four macro determinants that are hypothesized as important factors for boosting TFP. These four determinants are; macroeconomic stability measured by the inflation rate, openness of the economy measured by foreign direct investment FDI inflows and the ratio of sum of exports and imports to GDP, human resource development measured by the value of education expenditure and, finally, the size of private credit used as a proxy for the developments in the financial sector. Some control variables (government consumption, budget deficit, population, and labor and investment indicators) were also included in the model. The regression results showed that small changes in inflation rate have a positive, however small, impact on TFP, indicating that low and stable inflation rates (i.e. macroeconomic

[2] While allowing for other determinates that affect firm's performance; namely firm's age, size, starting-up unregistered, ownership structure and legal status, economic sector, access to finance, level of technological innovation, human capital factors, and the wider business environment (Williams and Martinez-Perez 2016).

stability) provide a favorable environment for TFP growth. The financial sector development indicator also showed a positive relation with TFP, implying that easy access to private credit can accelerate the rate of capital accumulation and technological innovation which, in turn, enhances TFP of individual firms. Education expenditure and the degree of trade openness, however, showed negative association with TFP. According to the author, this result may reflect, on the one hand, the "lack of skill-oriented education" in Pakistan which is perceived as a necessary aspect to enhance labor productivity. The negative impact of trade openness on TFP, on the other hand, may reflect the increased dependence of the Pakistani economy on imported manufactured goods and the deficiencies in its ability to absorb the positive spillovers of trade.

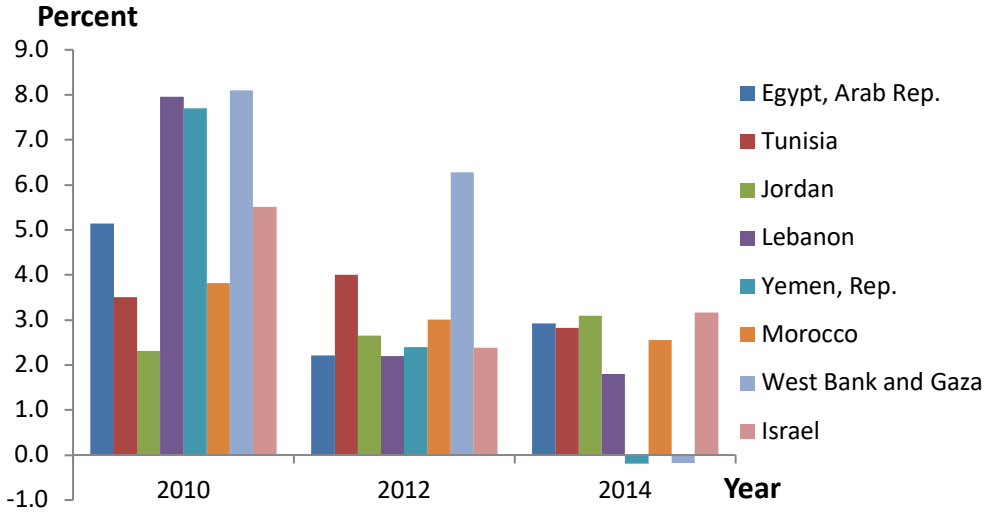
Using a sample of 62 countries over the period from 1970 to 2005, Loko and Diouf (2009) examined the impact of several macroeconomic determinants on the rate of TFP growth. The factors incorporated in the regression equation included; the level of per-capita income, the average inflation rate as an indicator of macroeconomic stability, the ratios of exports and imports to GDP and FDI to GDP as proxies for the degree of trade openness, the ratio of public expenditure to GDP to reflect government size, in addition to some institutional indicators measuring the rule of law, government effectiveness, and regulatory burdens. The estimation results - using the Generalized Methods of Moments (GMM) technique - indicated that while high inflation and large government size hinder productivity growth, strong efficient institutions and a high degree of trade openness would result in higher rates of TFP growth. The authors also concluded that the impact of trade openness on TFP is conditional on the absorption capacity of individual economies. This conclusion was established from the positive sign of the coefficient of the interaction term between FDI ratio and education level, suggesting that as the level of education increases, the economy can benefit more from the positive spillovers associated with openness.

3 Macroeconomic Overview

First, it would be beneficial to provide a brief overview of the macroeconomic performance of the countries under investigation (with regard to their growth rates, trade, fiscal, and monetary policies, and quality of institutions) over the 2013-2014 period, during which the 2013 World Bank Enterprise Surveys were conducted. This overview will enable us to take into account the macroeconomic environment prevailing in each country when analyzing TFP estimates.

Figure 1 shows that most of the countries under study have witnessed rapid economic growth, prior to the outbreak of the revolutionary wave that toppled the regimes in Tunisia, Egypt, and Yemen. The rise in oil prices in 2003 and the increased interest of global investors in the MENA region, along with the adoption of some reform plans, have allowed these countries - particularly Egypt, Lebanon, Yemen, WBG, and Israel - to grow at an average annual rate of 6.9 percent in 2010 (World Bank 2014).

Figure 1: Annual Real GDP Growth rates, Percent

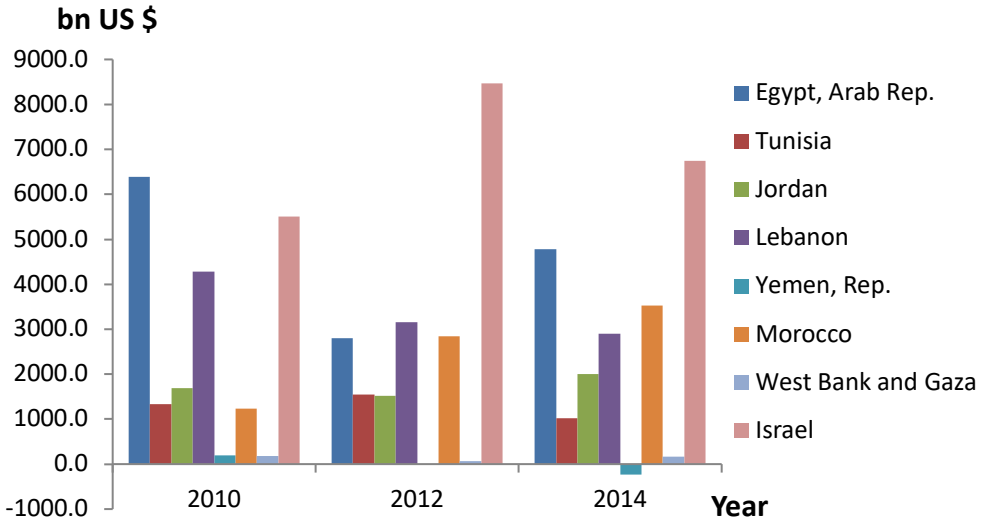


Source: *Constructed by authors based on World development indicators.*

This remarkable growth was reversed in the aftermath of the Arab spring. Starting in 2011, sharp economic slowdown was experienced by the three countries that witnessed revolution, as well as by the other five countries as a result of regional tensions and negative spillovers, resulting in a collective average annual growth rate of 2.5 percent over the 2011-2014 periods.

This economic slowdown is also evident from Figure 2 which shows the decline in FDI inflows in the three affected countries - Egypt, Tunisia, and Yemen - as well as in Lebanon as a result of the negative spillovers from the ongoing conflict in Syria.

Figure 2: FDI Net Inflows



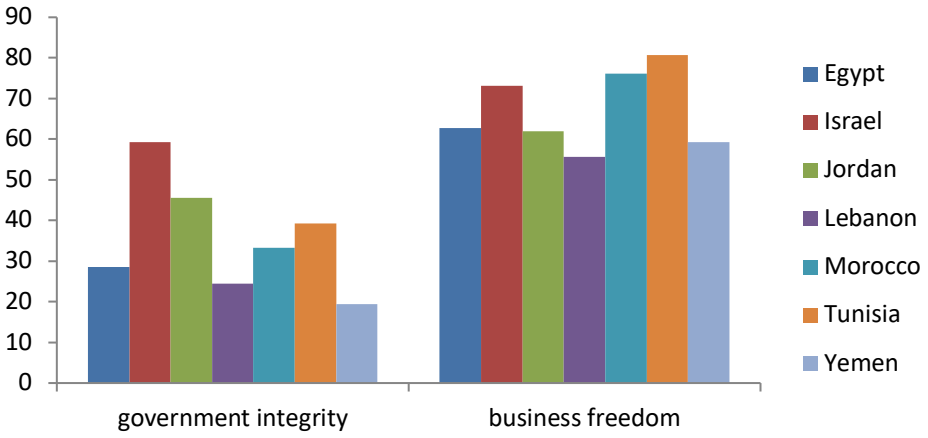
Source: *Constructed by authors based on World development indicators.*

For the analysis of quality of institutions and macroeconomic policies, we rely on the 2014 Index of Economic Freedom to highlight the positive aspects, as well as the deficiencies in each country[3].

Strong efficient institutions are essential for enhancing the business environment and boosting productivity and growth of individual firms (Loko and Diouf 2009). Two indicators are used to reflect the quality of institutions in each country. The first is the government integrity index, which reflects the absence of corruption practices (such as bribery and graft). Figure 3 shows that, except for Israel, all the countries under study suffer from high levels of corruption, which is particularly pervasive in Egypt, Lebanon, and Yemen. This, in turn, raises the costs faced by enterprises and results in allocating valuable resources to unproductive activities.

[3] Data is unavailable for WBG. Throughout the analysis of Index of Economic Freedom, the higher the index the better.

Figure 3: Institutional Quality Indexes

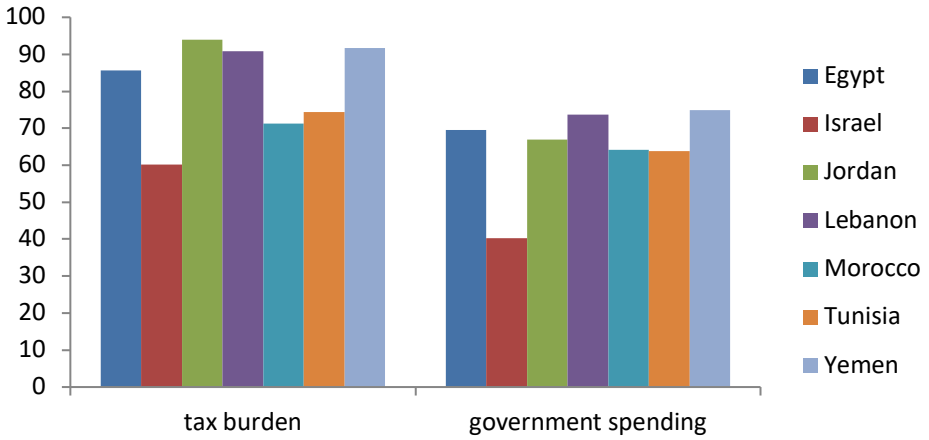


Source: *Constructed by authors based 2014 Index of Economic Freedom.*

The second indicator is the business freedom index which reflects the extent to which the prevailing regulatory and infrastructure environments promote the efficient operation of enterprises. Figure 3 shows that Lebanon sits at the bottom of the list with a poor regulatory environment that raises the cost of starting new business or completing licensing requirements. Israel, Morocco, and Tunisia are the best three performers with regard to this index.

Fiscal policy (or government size) is also analyzed using two indicators, the tax burden and the ratio of government spending to GDP. Israel has the highest tax burden and government spending ratio across all countries, as shown in Figure 4. This can either result in a positive or a negative impact on productivity. While government spending can generate positive spillovers, stemming from infrastructure developments and the provision of public goods, resulting in a positive impact on firm-level productivity, excessive government spending can also hinder productivity, due to the tax burden associated with it and the potential distortions that can be associated with government interventions (Loko and Diouf 2009).

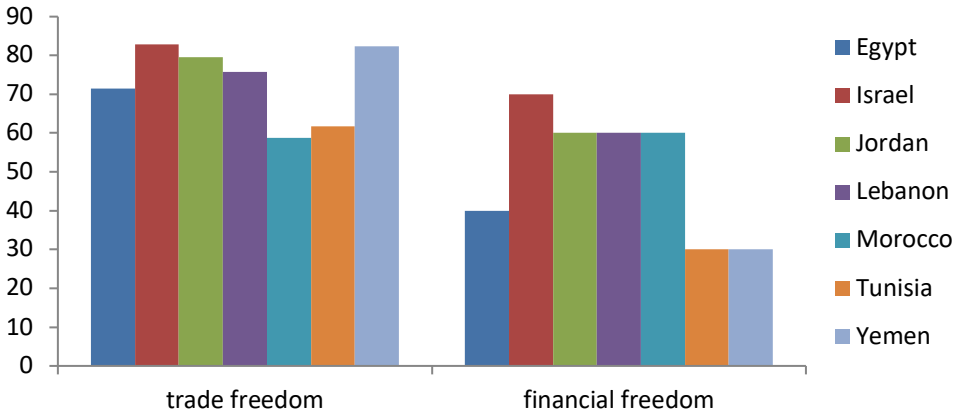
Figure 4: Government size Indexes



Source: *Constructed by authors based 2014 Index of Economic Freedom.*

With regard to the openness of the economy (trade policy), Figure 5 displays the scores of the seven countries with respect to the trade freedom index, which measures the extent of tariffs and non-tariffs affecting the country's exports and imports. Most countries score well with respect to their openness to trade - with Egypt, Israel, Jordan, Lebanon, and Yemen being the top performers. As was highlighted in Khan (2006), trade openness can have a favorable impact on productivity, as firms benefit from the positive externalities associated with an open trade policy, in terms of technology transfers, increased competition, and access to larger markets.

Figure 5: Trade Freedom and Financial Freedom Indexes



Source: *Constructed by authors based 2014 Index of Economic Freedom.*

And finally, the financial freedom index is used to reflect the monetary policy status, with regard to the efficiency of the banking sector and the extent of government influence on the allocation of credit within the economy. Again, Israel comes out on top of all the other countries with a wide range of financial services designed to support the developments in the private sector.

Easy access to credit can accelerate the rate of capital accumulation and technological innovation which, in turn, enhances TFP of individual firms (Khan 2006). Firms in Egypt, Tunisia, and Yemen, however, suffer from limited access to private credit with a considerable crowding out effect of government borrowing from the banking sector on private credit - particularly in Egypt.

4 Methodology

To examine the structure of TFP, we undertake our empirical analysis in several steps. We estimate the logarithmic form of production function and retrieve the logarithm of TFP as the residual, then examine the determinants of TFP. This estimation is done at both country and sector levels. Sectoral regressions allow for change in capital and labor intensity across different sectors.

The production function which takes a general Cobb-Douglas form is as follows:

$$Y_{ijsr} = A_{ijsr} L_{ijsr}^{\alpha} K_{ijsr}^{\beta} I_{ijsr}^{\sigma} \quad (1)$$

where Y is total output, K is capital, L is labor, I is total intermediate inputs, A is technology efficiency parameter, i denotes individual plant operating in sector j located in region r in country s.

By log-linearizing equation (1), we obtain an estimable equation as follows:

$$logY_{ijsr} = logA_{ijsr} + \alpha\, log\, L_{ijsr} + \beta\, log\, K_{ijsr} + \sigma\, log\, I_{ijsr} + \pi_r + \mu_s \quad (2)$$

where π_r regional dummies and μ_s country dummies.

We estimate the TFP as follows:

$$TFP_{ijsr} = logA_{ijsr} = logY_{ijsr} - logYest_{ijsr} \quad (3)$$

with $logYest_{ijsr}$ the estimated production.

Second, we examine the micro and macro determinants of this estimated TFP, as follows:

$$TFP_{ijsr} = \beta_0 + \beta_1 X_{ijsr} + \beta_2 Z_s + \beta_3 V_{sr} + \varepsilon_{it} \quad (4)$$

With X a vector of individual characteristics including the share of government ownership in the firm, foreign ownership, the age of the firm, whether it is formally registered or not when it started to operate, the gender of its owner/manager, the share of imported inputs, whether it owns a certification from a foreign firm or not and its legal status. Among the regional variables, we calculated the number of firms by region (to measure urbanization or Jacob's externalities) and the number of firms by sector and region (to measure competition). From a macro perspective, we introduced four variables measuring different macroeconomic policies: tariffs for trade policy, tax profit rates for fiscal policy and lending rate to measure monetary policy. We also included time to enforce contracts as a proxy for institutions. We allow for regional dummies and all errors were clustered by country, given that our dependent variables are at the firm level and some of our interdependent ones are at the country level. Moreover, all the regressions were run by taking into account the fact that the data are complex survey. Hence, weights and stratum identifiers were included. It is worth to mention also that all local currencies have been converted to USD to guarantee the comparability of different countries.

5 TFP Estimations

5.1 Results

Table 1 shows the results of the production function estimation by country. For all the countries, the coefficient of labor is always greater than the one of capital, as it includes both skilled and unskilled workers that are significantly important in production. Yet, while the coefficient of intermediate inputs is higher than the one of capital, it also exceeds the labor coefficient in some cases and, in other cases, it is lower than the labor coefficient. Lebanon, Morocco and Jordon have the highest labor coefficients, whereas Egypt and Tunisia have the highest capital ones. Inputs matter most for Egypt, Israel, and West Bank and Gaza which imports a lot of intermediate inputs used in the production process and in exporting.

In general, as can be seen in Table 1, the explanatory power of the model is very high, once we allow for both country and region dummies

pointing to the fact that growth in most of these countries is chiefly explained by growth in labor, capital, intermediate inputs and not by TFP growth, as the residual is likely to be trivial.

Table 1. TFP Regressions by Country

	All Ln(Sales)	Egypt Ln(Sales)	Israel Ln(Sales)	Jordan Ln(Sales)	Lebanon Ln(Sales)	Morocco Ln(Sales)	Tunisia Ln(Sales)	WBG Ln(Sales)	Yemen Ln(Sales)
Log(Capital)	0.039*	0.072***	0.175	0.032	0.025	-0.030	0.069**	0.068	0.144
	(0.022)	(0.019)	(0.126)	(0.023)	(0.023)	(0.035)	(0.032)	(0.078)	(0.086)
Log(Labor)	0.397***	0.348***	0.287*	0.563***	0.653***	0.611***	0.210	0.124	0.096
	(0.069)	(0.065)	(0.148)	(0.079)	(0.104)	(0.147)	(0.128)	(0.118)	(0.326)
Log(Input)	0.483***	0.539***	0.540***	0.422***	0.115***	0.290***	0.459***	0.656***	0.280
	(0.040)	(0.048)	(0.108)	(0.075)	(0.042)	(0.071)	(0.087)	(0.107)	(0.184)
Constant	2.279***	1.938***	1.255	1.294***	4.478***	3.429***	4.907***	3.283***	5.873*
	(0.518)	(0.493)	(1.857)	(0.446)	(1.302)	(1.043)	(1.422)	(1.153)	(3.341)
Sector dum.	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country dum.	YES	NO	NO	NO	NO	NO	NO	NO	NO
Obs.	2,476	1,432	117	226	125	118	270	122	66
R2	0.808	0.817	0.736	0.923	0.731	0.807	0.741	0.861	0.438

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

Sectoral regressions have also been run to examine the factor intensity of each sector. While most of the industries are labor intensive, the capital coefficient is mainly significant for publishing and printing, chemicals, non-metallic and fabricated metallic products. Similar to Table 1, other intermediate inputs matter more than capital for most of the industries. Moreover, growth in most of the sectors is chiefly explained by growth in labor, capital, and intermediate inputs, not by technology improvements, as the explanatory power of these variables is on average 99% leading to a small residual.

Table 2. TFP Regressions by sector (1)

	15 and 16 Leather and Wood	17 Paper	18 Printing	19 Coke and Refined pet.	20 Chemical	21 Pharma.
	Ln(Sales)	Ln(Sales)	Ln(Sales)	Ln(Sales)	Ln(Sales)	Ln(Sales)
Log(Capital)	0.027	0.042	0.098***	0.023	0.210**	0.035
	(0.043)	(0.059)	(0.027)	(0.112)	(0.094)	(0.036)
Log(Labor)	0.540***	0.094	0.434***	0.741***	0.249	0.632***
	(0.104)	(0.286)	(0.116)	(0.270)	(0.180)	(0.063)
Log(Input)	0.416***	0.755***	0.360***	0.422	0.566***	0.256***
	(0.063)	(0.140)	(0.049)	(0.287)	(0.114)	(0.038)
Constant	1.895**	2.385	2.608**	-0.959	0.911	2.746***
	(0.755)	(1.480)	(1.195)	(1.512)	(0.893)	(0.313)
Country dum.	YES	YES	YES	YES	YES	YES
Obs.	516	202	309	93	84	76
R2	0.827	0.778	0.782	0.848	0.921	0.922

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

Table 3. TFP Regressions by sector (2)

	22 Rubber	23 and 24 Non-metallic and basic metal	25 Fab. Metals	26 Computer and electronics	27 Electrical	28 Machinery	29 Vehicls
	Ln(Sales)	Ln(Sales)	Ln(Sales)	Ln(Sales)	Ln(Sales)	Ln(Sales)	Ln(Sales)
Log(Capital)	-0.002	0.154**	0.046**	0.070	0.112	0.172	-0.081
	(0.016)	(0.066)	(0.022)	(0.057)	(0.088)	(0.113)	(0.066)
Log(Labor)	0.530***	0.206	0.227**	0.312***	0.430**	0.301**	0.619***
	(0.122)	(0.165)	(0.086)	(0.095)	(0.188)	(0.121)	(0.196)
Log(Input)	0.403***	0.531***	0.605***	0.634***	0.565***	0.488***	0.484***
	(0.077)	(0.125)	(0.065)	(0.075)	(0.142)	(0.046)	(0.142)
Constant	2.122**	2.869**	2.655***	1.308**	-0.022	1.737***	1.531***
	(0.958)	(1.261)	(0.745)	(0.588)	(0.662)	(0.399)	(0.506)
Country dum.	YES	YES	YES	YES	YES	YES	YES
Obs.	81	186	141	243	76	135	78
R2	0.800	0.668	0.880	0.876	0.893	0.925	0.839

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

5.2 Stylized Facts

In this section, we utilize Solow's residual methodology - outlined in equation (3) in the previous section - to estimate firm-level TFP for each of the eight MENA countries considered in this study: Egypt, Tunisia, Jordan, Yemen, Morocco, Lebanon, West Bank and Gaza WBG, and Israel. In addition to these aggregate TFP estimates, we will investigate how these estimates change with respect to the firm-specific characteristics, in terms of their export status, formality status, ownership structure, age, and size.

5.2.1 Aggregate

Looking at each country separately, Table 4 displays the simple mean of TFP across all industries, along with the dispersion of aggregate TFP for each country.

Table 4. TFP by Country

	Mean	St. Dev.
EGY	1.77	0.07
ISR	1.29	0.58
JOR	2.00	0.14
LBN	1.80	0.19
MAR	2.45	0.16
PSE	2.15	0.18
TUN	1.96	0.14
YEM	1.64	0.32
Average	1.88	0.22

Source: *Constructed by the authors.*
Variance scaled to handle strata with a single sampling unit.

The results show that, among the eight countries considered, Morocco has the highest average productivity level across all industries. This result reflects the country's commitment to implement reforms aiming at supporting and reinforcing the private sector. These reforms are evident in the notable progress Morocco is witnessing with regard to liberalizing the financial sector and improving the regulatory and infrastructure environments -with high ratio of government spending to GDP- in order to promote the efficient operation of enterprises.

Jordon comes just right after Morocco scoring the second highest TFP level. This result comes as no surprise, given that the country has scored relatively well in most of the aforementioned indicators, especially in the trade and fiscal-related indexes, which emphasizes the positive impact of trade openness and sound fiscal policies on TFP, as indicated by Loko and Diouf (2009).

The results also show that Israel has the lowest TFP, compared to the other seven countries. This is a surprising result, given that the country has achieved the highest scores -among all the countries included in the study- in the trade, financial, and government integrity (lack of corruption) indexes, in addition to its efficient regulatory system that supports start-ups and entrepreneurial activity. This result may, however, reflect the poor fiscal policies implemented in Israel, as the country has the highest ratio of government expenditure to GDP and the highest tax burden among the selected countries. This negative relation between large government spending (or government size in general) and firm-level productivity was highlighted by Loko and Diouf (2009); in which they suggested that the negative impact of excessive government expenditure, in terms of the high tax burden and the potential market distortions, may outweigh the positive spillovers stemming from the provision of public goods and infrastructure developments, resulting in an overall negative effect on TFP.

Egypt and Lebanon also score low in terms of their TFP levels. For Egypt, this low productivity level may be understood in light of the country's high corruption levels that pervade all government levels, in addition to the difficulties enterprises face to secure credit from the banking sector, as a result of the crowding out effect of government borrowing in order to finance its domestic debt. These institutional and financial deficiencies led to a negative impact on firm productivity levels. As for Lebanon, while the country scores high in most of the indicators (those related to trade openness, fiscal policies, and access to finance), it suffers from poor institutions, which is evident in the low scores achieved with regard to the country's government integrity and business freedom indexes, resulting in downward pressures on the TFP levels of individual firms.

On the industry level, Table 5 provides TFP estimates for all the sectors included in the analysis. The data shows that the entry for Fabricated Metals has the highest average productivity level, while the least productive industry is Electrical sector.

Table 5. TFP by Sector

	Mean	St. Dev.
Paper	2.43	0.08
Printing	2.70	0.13
Coke and Refined pet.	-1.00	0.15
Chemical	0.97	0.09
Pharma.	2.76	0.07
Rubber	2.19	0.18
Fab. Metals	2.84	0.12
Computer and electronics	1.31	0.09
Electrical	0.10	0.13

Machinery	1.81	0.10
Vehicles	1.64	0.14
Leather and Wood	1.93	0.10
Non-metallic and basic metal	2.75	0.18
Average	1.72	0.12

Source: Constructed by the authors.
Variance scaled to handle strata with a single sampling unit.

Following an overall look at the average TFP across countries and across industries, Tables 6 to 15 provide a closer look at TFP, with regard to some of its determinants at both the country and the sectoral levels.

5.2.2 Formality

Table 6 displays the average TFP estimates for registered and non-registered firms when they were established. The results show that, except for Jordon and Yemen, registered (formal) firms are more productive than the non-registered (informal) ones. This positive relationship between formality and firm-level productivity is in line with Taymaz (2009) who attributed this productivity gap to the difficulties informal firms face in terms of limited access to public goods and services, the lack of access to formal credit channels, and the pressures extorted on them to stay small in order to avoid detection, which denies them benefiting from economies of scale.

Table 6. TFP by country and formality status

	Not regis.	Regist.	Ratio
EGY	1.66	1.79	1.08
ISR	0.34	1.36	3.99
JOR	2.98	1.96	0.66
LBN	1.28	1.98	1.55
MAR	1.99	2.51	1.26
PSE	2.06	2.16	1.05
TUN	1.90	1.96	1.03
YEM	1.70	1.61	0.95
Average	1.74	1.91	1.10

Source: Constructed by the authors.
Note: the last column shows the ratio between the average TFP of registered and non-registered firms.
Variance scaled to handle strata with a single sampling unit.

The productivity gap is highest in Israel, where formal firms are almost 4 times more productive than informal ones, while the gap is the narrowest in Egypt, since a significant fraction of economic activity is conducted in the informal sector as a result of institutional deficiencies and bureaucracy, and Tunisia. The results for Egypt are in line with those of Hendy and Zaki (2012) and Abou-Ali and Rizk (2015) who found insignificant difference in TFP levels between formal and informal firms in Egypt.

At the sectoral level, most of the industries included in the study display a higher average TFP for registered firms, compared to non-registered ones.

Table 7. TFP by sector and formality status

	Not regis.	Regist.	Ratio
Paper	2.29	2.45	1.07
Printing	2.85	2.69	0.94
Coke and Refined pet.	-1.19	-0.96	0.81
Chemical	1.05	0.95	0.91
Pharma.	2.77	2.75	0.99
Rubber	2.49	2.14	0.86
Fab. Metals	2.72	2.87	1.05
Computer and electronics	1.05	1.33	1.26
Electrical	0.00	0.12	-70.55
Machinery	1.76	1.82	1.03
Vehicles	1.54	1.70	1.10
Leather and Wood	2.01	1.92	0.96
Non-metallic and basic metal	1.75	2.89	1.65
Average	1.62	1.74	1.07

Source: Constructed by the authors.
Note: the last column shows the ratio between the average TFP of registered and non-registered firms.
Variance scaled to handle strata with a single sampling unit.

5.2.3 Sector ownership

Looking at the ownership structure of individual firms; Table 8 shows that, for Egypt, Jordon, Morocco, and Tunisia, enterprises with the government owning some of the shares have higher average TFP levels, compared to purely private firms. This result can be explained in terms of the benefits positive spillovers that government ownership can generate; namely permanent employment contracts and more stable job opportunities which can have a positive impact on firms' productivity especially in developing countries. The difference in productivity levels between purely private firms and those partially owned by the government is highest in Jordan.

Table 8. TFP by country and sector ownership

	Private	Gov	Ratio	Domestic	Foreign	Ratio
EGY	1.76	2.57	0.69	1.74	2.05	1.18
ISR	1.29			1.34	0.01	0.007
JOR	1.99	2.34	0.85	1.94	2.61	1.34
LBN	1.80			1.77	3.79	2.14
MAR	2.39	3.56	0.67	2.42	2.62	1.08
PSE	2.13	2.68	0.80	2.12	2.49	1.18
TUN	1.95	3.36	0.58	1.89	2.41	1.28
YEM	1.64			1.64		0.00
Average	1.87	2.90	1.55	1.86	2.28	1.23

Source: Constructed by the authors.

Note: the last column shows the ratio between the average TFP of private and public firms.

Variance scaled to handle strata with a single sampling unit.

The table also shows that firms with the foreign capital are more productive than purely domestic ones; except for Israel. This result reinforces Kee (2005) and asserts the positive spillovers –in terms of access to exclusive technology and marketing practices- that foreign ownership can bring to the firm.

The same conclusion for both government ownership and foreign ownership can be reached at the sectoral level, with the entries of most sectors showing that purely private or domestic firms are less productive than the ones co-owned by the government or by a foreign entity.

Table 9. TFP by sector and sector ownership

	Private	Gov	Ratio	Domesti c	Foreign	Ratio
Paper	2.42	2.75	0.88	2.43	2.29	0.94
Printing	2.70	2.77	0.97	2.61	3.11	1.19
Coke and Refined pet.	-1.00			-1.05	-0.48	0.46
Chemical	0.97			0.95	2.08	2.19
Pharma.	2.76			2.75	2.84	1.03
Rubber	2.17	2.64	0.82	2.18	2.33	1.07
Fab. Metals	2.84	2.73	1.04	2.86	2.73	0.96
Computer and electronics	1.31	1.55	0.85	1.32	1.11	0.85
Electrical	0.10			0.10	0.03	0.32
Machinery	1.81	2.16	0.84	1.76	2.17	1.23
Vehicles	1.64	1.42	1.15	1.59	2.64	1.66
Leather and Wood	1.90	3.57	0.53	1.91	2.11	1.10
Non-metallic and basic metal	2.75	2.77	0.99	2.88	1.86	0.65
Average	1.72	2.48	1.44	1.71	1.91	1.11

Source: Constructed by the authors.

Note: the last column shows the ratio between the average TFP of private and public firms.

Variance scaled to handle strata with a single sampling unit.

5.2.4 Export status

The data in Table 10 shows the differences in TFP between exporter and non-exporter firms for each country. Except for Lebanon, exporter firms seem to be more productive than non-exporters.

Table 10. TFP by country and export status

	Non-exporter	Exporter	Ratio
EGY	1.73	2.16	1.25
ISR	1.22	1.71	1.41
JOR	1.90	2.23	1.17
LBN	1.87	1.57	0.84
MAR	2.19	2.84	1.30
PSE	2.10	2.22	1.06
TUN	1.86	2.09	1.12
YEM	1.63	1.89	1.16
Average	1.81	2.09	1.15

Source: Constructed by the authors.

Note: the last column shows the ratio between the average TFP of exporters to non-exporters.

Variance scaled to handle strata with a single sampling unit.

At the industrial level, no clear relationship can be detected between TFP and the exporting status of individual firms. In some industries (Paper, Printing, Chemicals, Pharmaceutical, Electrical, Machinery, Vehicles, Leather and Wood) exporters are, on average, twice as productive as non-exporter enterprises. Those are the sectors where countries mainly have a high comparative advantage. While in the remaining industries, non-exporters are the more productive firms.

Table 11. TFP by sector and export status

	Non-exporter	Exporter	Ratio
Paper	2.37	2.60	1.10
Printing	2.61	2.99	1.15
Coke and Refined pet.	-1.00	-0.97	0.96
Chemical	0.88	1.77	2.00
Pharma.	2.74	2.97	1.08
Rubber	2.22	2.00	0.90
Fab. Metals	2.86	2.76	0.96
Computer and electronics	1.32	1.27	0.97
Electrical	0.02	0.85	52.84
Machinery	1.78	1.91	1.07
Vehicles	1.55	2.07	1.33
Leather and Wood	1.85	2.31	1.24
Non-metallic and basic metal	2.80	2.49	0.89
Average	1.69	1.92	1.14

Source: Constructed by the authors.

Note: the last column shows the ratio between the average TFP of exporters and non-exporters.
Variance scaled to handle strata with a single sampling unit.

5.2.5 Age and Firm Survival

With regard to the age of the firm and its relationship with productivity, Tables 12 and 13 displays the results at both the country and industry levels. At a country level, Egypt and Yemen might be experiencing an inertia effect where younger firms are, on average, more productive than older ones. In this case older firms might be facing difficulty in coping with the changing business environment, in light of their stagnant rules and organizational structures; as was suggested by Coad *et al.* (2013). This negative relationship between age and productivity is also found in Palangkaraya (2007).

The rest of the countries, however, show signs of a positive relationship between age and productivity, in which older firms are, on average, more productive. Coad *et al.* (2013) indicated that this finding might happen as a result of the learning effect, according to which older firms are capable of utilizing their business experience and established contacts to achieve higher productivity levels.

Table 12. TFP by country and age

	New	Old	Ratio
EGY	1.85	1.63	0.88
ISR	0.77	1.68	2.18
JOR	1.83	2.22	1.21
LBN	1.53	1.96	1.28
MAR	2.32	2.53	1.09
PSE	2.09	2.20	1.05
TUN	1.91	1.99	1.04
YEM	1.87	1.59	0.85
Average	1.77	1.97	1.11

Source: Constructed by the authors.
Note: the last column shows the ratio between the average TFP of old and new firms.
Variance scaled to handle strata with a single sampling unit.

The same conclusion can be reached by looking at TFP estimates at the sectoral levels, portrayed in Table 13l which displays no clear relationship between age and productivity across the different industries.

Table 13. TFP by sector and age

	New	Old	Ratio
Paper	2.56	2.30	0.90
Printing	2.60	2.86	1.10
Coke and Refined pet.	-0.89	-1.06	1.19
Chemical	1.10	0.90	0.82
Pharma.	2.81	2.60	0.93
Rubber	2.32	2.08	0.90
Fab. Metals	2.74	2.93	1.07
Computer and electronics	1.31	1.30	0.99
Electrical	-0.07	0.91	-12.74
Machinery	1.83	1.78	0.97
Vehicles	1.58	1.71	1.08
Leather and Wood	1.83	2.10	1.14
Non-metallic and basic metal	2.68	2.85	1.07
Average	1.72	1.79	1.04

Source: Constructed by the authors.

Note: the last column shows the ratio between the average TFP of old and new firms.

Variance scaled to handle strata with a single sampling unit.

5.2.6 Firm Size

. Table 14 shows, for each country, the average productivity levels of firms of different sizes. Consistent with the conventional wisdom, which suggests higher TFP levels for larger firms, the table shows that for all of the eight countries, large firms are on average more productive than the small and medium ones.

Table 14. TFP by country and firm size

	Small	Medium	Large	Lar/Med	Med/Sma.
EGY	1.53	1.91	2.29	1.19	1.25
ISR	1.04	1.76	2.24	1.27	1.70
JOR	1.81	2.36	2.46	1.04	1.30
LBN	1.72	1.76	2.46	1.39	1.02
MAR	2.56	2.31	2.61	1.13	0.90
PSE	2.15	2.13	2.53	1.19	0.99
TUN	1.85	1.91	2.40	1.26	1.03
YEM	1.54	2.49	2.87	1.15	1.62
Average	1.78	2.08	2.48	1.19	1.17

Source: Constructed by the authors.

Note: Variance scaled to handle strata with a single sampling unit.

To investigate whether the type of industry matters, Table 15 displays the differences in productivity levels by industry and firm size. The table shows that larger firms are, on average, more productive in most sectors.

Medium firms are, however, more productive in the Pharmaceutical, Rubber, computer and Electronics, and Machinery industries.

Table 15. TFP by sector and firm size

	Small	Medium	Large	Lar/Med	Med/Sma.
Paper	2.24	2.46	2.76	1.12	1.09
Printing	2.57	2.70	2.89	1.07	1.05
Coke and Refined pet.	-0.99	-1.07	-0.53	0.49	1.08
Chemical	0.88	1.25	1.45	1.17	1.42
Pharma.	2.74	2.78	2.75	0.99	1.02
Rubber	1.99	2.69	1.91	0.71	1.35
Fab. Metals	2.81	2.76	3.16	1.15	0.98
Computer and electronics	1.26	1.41	1.21	0.86	1.12
Electrical	0.16	-0.09	0.72	-7.90	-0.55
Machinery	1.80	1.82	1.81	1.00	1.01
Vehicles	1.45	1.75	2.18	1.25	1.20
Leather and Wood	1.81	1.94	2.29	1.18	1.07
Non-metallic and basic metal	2.72	2.71	3.23	1.19	1.00
Average	1.65	1.78	1.99	1.12	1.08

Source: Constructed by the authors.
Note: Variance scaled to handle strata with a single sampling unit.

6 TFP Determinants

6.1 Aggregate

Our findings show that among the micro determinants, on the one hand, government ownership, foreign capital, female managers, owning a foreign certification, and formal registrations of firms are all positively associated with TFP. These finding are in line with those of Taymaz (2009), Busso *el al.* (2012), Waldkirch (2014), and Kee (2005). Competition, measured by the number of firms by sector and region, also displays a positive impact on firms' productivity.

Except for trade openness, all the macro determinants on the other hand display the expected impact on TFP as suggested by the literature. Longer time to enforce contracts, high tax burden and high lending rates tend to have a significantly negative impact on TFP.

These results are in line with Fernandes (2008) Loko and Diouf's (2009) results, where strong and efficient institutions were found to be one of the important macroeconomic factors for boosting productivity growth. A restricted trade policy -reflected by the tariff rate- has a surprisingly positive

impact on TFP, confirming the findings of Klan (2006) who emphasized the adverse impact trade openness can have on TFP as a result of the economy's increased dependence on imported products and its limited ability to absorb the positive spillovers of trade.

6.2 Firm Size

By firm size, on the micro level, small firms seem to be more positively affected by foreign ownership and formal status of the firm, which reinforce the important spillovers formal registration and foreign equity can bring to the firm especially at the early stage of its formation. Large firms, however, suffer from difficulty in coping with changing business environment showing an inertia effect in which age has a negative impact on TFP. Large firms tend also to be more affected by the positive impact of owning a foreign certificate, as well as an interesting negative impact of formal registration.

At the macro level, the productivity levels of all three types of firms show a negative response to long enforcement time frames and spatial agglomeration. Heavy tax burdens tend to exert negative pressure on medium and large firms while the adverse effect of high lending rates is significant in the case of small firms only.

6.3 Economic activities

Finally, Tables 18, 19, and 20 displays TFP estimates by sector. The tables show a positive relation between foreign ownership and productivity only in the Pharmaceutical industry where the costs of R&D are very high and hence the knowledge and technology transfer associated with foreign equity would be a huge advantage. Firm's age has a positive impact on productivity in Electrical and Chemical industries where firms in these industries are capable of utilizing their business experience and contacts to achieve higher productivity levels.

No direct relationship can be detected between imported inputs and TFP; while the impact is negative in Paper and Chemicals industries, as a result of readily available domestic substitutes for example, the adverse impact can be detected in Leather and Wood, Pharmaceutical, Non-metallic and Basic Metal, Computers, and Electrical industries. Owning a foreign certificate tends to have a positive effect on productivity in leather and Wood, Printing, and Fabricated sectors only.

Spatial agglomeration, on the one hand, tends to exert an negative impact on TFP levels in most sectors, except for Paper and Pharmaceutical, indicating that adverse effects of high levels of geographical concentration -in terms of higher costs of trade- might outweigh the knowledge spillovers and low transactions costs associated with concentration; resulting in a net negative effect, as was suggested by Lin *et al.* (2011). Competition, on the other hand, is found to boost productivity in most sectors, except for the Leather and wood sector.

Interestingly, higher tariffs rates -i.e. a restricted trade policy- show a positive impact on TFP, except for Printing and Electrical industries, reflecting the sectors' limited ability to adjust to an open economy and to absorb the positive spillovers of trade as was indicated by Klan (2006).

In line with the conventional wisdom, high tax burdens and high lending rates are negatively associated with firms' productivity in most sectors, except for Paper and computer Industries for the former, and Coke and refined, Non-metallic and Basic Metal, and computers sectors, for the latter.

Table 16. TFP determinants – Aggregate Results

	TFP	TFP	TFP	TFP	TFP	TFP	TFP
Ln(Gov share)	0.0687**	0.0650**	0.0778**	0.0778**	0.0778**	0.0778**	0.0650**
	(0.0233)	(0.0255)	(0.0253)	(0.0253)	(0.0253)	(0.0253)	(0.0255)
Ln(Foreign)	0.0492**	0.0398*	0.0466**	0.0466**	0.0466**	0.0466**	0.0398*
	(0.0181)	(0.0169)	(0.0197)	(0.0197)	(0.0197)	(0.0197)	(0.0169)
Ln(Age)	-0.0876	-0.0920	-0.0845	-0.0845	-0.0845	-0.0845	-0.0920
	(0.0600)	(0.0684)	(0.0622)	(0.0622)	(0.0622)	(0.0622)	(0.0684)
Female	0.181*	0.167*	0.176*	0.176*	0.176*	0.176*	0.167*
	(0.0808)	(0.0721)	(0.0758)	(0.0758)	(0.0758)	(0.0758)	(0.0721)
Formal	0.180***	0.152*	0.187***	0.187***	0.187***	0.187***	0.152*
	(0.0452)	(0.0784)	(0.0513)	(0.0513)	(0.0513)	(0.0513)	(0.0784)
Imp. Input	-0.0232	-0.0134	-0.0229	-0.0229	-0.0229	-0.0229	-0.0134
	(0.0337)	(0.0361)	(0.0341)	(0.0341)	(0.0341)	(0.0341)	(0.0361)
For. Certif.	0.379**	0.371**	0.373**	0.373**	0.373**	0.373**	0.371**
	(0.110)	(0.114)	(0.111)	(0.111)	(0.111)	(0.111)	(0.114)
Num. Firm gov.		13.43***					0.00586
		(1.178)					(0.0349)
Num. Firm sec.gov		0.212***					0.212***
		(0.0514)					(0.0514)
Ln(Tariff)			0.615***				0.360***
			(0.0559)				(0.0834)
Ln(Time Enf.)				-0.875***			-0.411**
				(0.0796)			(0.120)
Ln(Tax Prof.)					0.855***		-0.421***
					(0.0777)		(0.0290)
Ln(Lend Rate)						-1.021***	-0.338***
						(0.0928)	(0.0361)
Constant	1.255***	-69.93***	-0.00614	7.269***	-2.006***	3.752***	5.269***
	(0.202)	(6.232)	(0.242)	(0.611)	(0.354)	(0.335)	(1.115)
Legal dum.	YES	YES	YES	YES	YES	YES	YES
Region dum	YES	YES	YES	YES	YES	YES	YES
Observations	2,179	2,179	2,179	2,179	2,179	2,179	2,179
R-squared	0.115	0.129	0.117	0.117	0.117	0.117	0.129

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1 Errors are clustered by country.

Table 17. TFP determinants – Results by Firm Size

	TFP small	TFP medium	TFP large
Ln(Gov share)		-0.139	-0.0150
		(0.160)	(0.0568)
Ln(Foreign)	0.0997**	-0.0138	-0.0155
	(0.0362)	(0.0186)	(0.0469)
Ln(Age)	-0.0181	-0.102	-0.229***
	(0.105)	(0.0581)	(0.0373)
Female	0.184	0.232*	-0.00491
	(0.140)	(0.0995)	(0.0607)
Formal	0.160**	0.0472	-0.170**
	(0.0525)	(0.142)	(0.0496)
Imp. Input	-0.0442	-0.00128	0.00626
	(0.0310)	(0.0399)	(0.0507)
For. Certif.	0.0236	0.0503	0.474***
	(0.386)	(0.167)	(0.0416)
Num. Firm gov.	-1.003***	-0.144**	-0.603***
	(0.0677)	(0.0579)	(0.0414)
Num. Firm sec. gov.	0.117**	0.211*	0.295
	(0.0405)	(0.104)	(0.174)
Ln(Tariff)	0.468***	-0.664***	0.160
	(0.102)	(0.0632)	(0.167)
Ln(Time Enf.)	-0.191*	-1.211***	-1.276***
	(0.0939)	(0.115)	(0.185)
Ln(Tax Prof.)	0.162	-0.332**	-0.882***
	(0.111)	(0.110)	(0.0841)
Ln(Lend Rate)	-0.468***	0.173***	0.219
	(0.0979)	(0.0475)	(0.218)
Constant	6.173***	12.23***	16.09***
	(0.826)	(0.953)	(1.302)
Legal dum.	YES	YES	YES
Region dum	YES	YES	YES
Observations	775	856	548
R-squared	0.206	0.122	0.228

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Errors are clustered by country.

Table 18. TFP determinants – Results by Sector (1)

	15 and 16 Leather and Wood	17 Paper	18 Printing	19 Coke and Refined pet.
	TFP	TFP	TFP	TFP
Ln(Gov share)	-0.148**	0.00424		
	(0.0444)	(0.0186)		
Ln(Foreign)	0.0242	0.0319	0.0135	-0.105
	(0.0450)	(0.0184)	(0.00914)	(0.0620)
Ln(Age)	0.0166	-0.0881	-0.0364	-0.0977
	(0.0453)	(0.0881)	(0.0955)	(0.172)
Female	-0.0514	-0.0346	0.0369	-0.119
	(0.0840)	(0.228)	(0.174)	(0.182)
Formal	-0.103	-0.0770	-0.122	0.469*
	(0.171)	(0.0537)	(0.172)	(0.193)
Imp. Input	0.0359*	-0.0401**	-0.00184	-0.0313
	(0.0163)	(0.0128)	(0.0308)	(0.0186)
For. Certif.	0.267***	0.333	0.444**	-0.0495
	(0.0521)	(0.193)	(0.181)	(0.0806)
Ln(Num. Firm gov.)	-0.364***	0.0645**	-0.325***	-0.343***
	(0.0535)	(0.0199)	(0.0325)	(0.0623)
Ln(Num. Firm sec. gov.)	-0.218**	0.0810	0.340***	0.137
	(0.0784)	(0.114)	(0.0843)	(0.114)
Ln(Tariff)	0.455***	0.0174	-0.300***	0.524***
	(0.0408)	(0.0984)	(0.0428)	(0.114)
Ln(Tax Prof.)	-0.736***	0.332***	0.0365	-0.178
	(0.0962)	(0.0846)	(0.0815)	(0.115)
Ln(Lend Rate)	-0.275***	-0.743	0.146	0.439***
	(0.0499)	(0.418)	(0.158)	(0.0410)
Constant	6.775***	3.323**	4.120***	-0.817
	(0.478)	(1.260)	(0.795)	(0.595)
Legal dum.	YES	YES	YES	YES
Region dum	YES	YES	YES	YES
Observations	504	201	299	93
R-squared	0.159	0.330	0.210	0.213

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Errors are clustered by country.

Table 19. TFP determinants – Results by Sector (2)

	20 Chemical	21 Pharma.	22 Rubber	23 and 24 Non-metallic and basic metal
	TFP	TFP	TFP	TFP
Ln(Gov share)				-0.160
				(0.114)
Ln(Foreign)	-0.0388	0.0777***	-0.0865*	-0.00893
	(0.0974)	(0.00934)	(0.0431)	(0.0440)
Ln(Age)	0.0521**	-0.214	-0.132	0.0491
	(0.0160)	(0.116)	(0.0766)	(0.164)
Female	0.0539	0.668***	-0.101	-0.240
	(0.0684)	(0.0406)	(0.271)	(0.154)
Formal	0.0420	-0.441***	-0.478	0.634*
	(0.0410)	(0.0277)	(0.474)	(0.332)
Imp. Input	-0.101***	0.0666***	0.0779	0.0658*
	(0.0184)	(0.0109)	(0.0645)	(0.0293)
For. Certif.	0.287	-0.502***	0.792	0.138
	(0.218)	(0.0906)	(0.481)	(0.288)
Ln(Num. Firm gov.)	-0.363***	0.370**	0.00962	-0.171
	(0.0434)	(0.136)	(0.181)	(0.148)
Ln(Num. Firm sec. gov.)	0.453***	0.147	0.176	0.421***
	(0.0372)	(0.0876)	(0.164)	(0.113)
Ln(Tariff)	0.418***	0.0648	0.0915	0.0837
	(0.0144)	(0.0695)	(0.153)	(0.0895)
Ln(Tax Prof.)	-1.231***	-1.138***	-1.152**	-0.892***
	(0.0929)	(0.0741)	(0.331)	(0.190)
Ln(Lend Rate)	-0.395***	-0.829***	-0.326	0.256*
	(0.0678)	(0.0725)	(0.483)	(0.108)
Constant	6.700***	7.320***	3.987*	4.196**
	(0.223)	(0.321)	(1.735)	(1.250)
Legal dum.	YES	YES	YES	YES
Region dum	YES	YES	YES	YES
Observations	82	74	79	182
R-squared	0.431	0.485	0.565	0.261

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Errors are clustered by country.

Table 20. TFP determinants – Results by Sector (3)

	25 Fab. Metals	26 Computer and electronics	27 Electrical	28 Machinery	29 Vehicls
	TFP	TFP	TFP	TFP	TFP
Ln(Gov share)		-0.144			
		(0.176)			
Ln(Foreign)	0.00745	0.158	0.0231	0.0256	0.0164
	(0.0295)	(0.147)	(0.0198)	(0.0519)	(0.192)
Ln(Age)	-0.00457	0.0533	0.250***	-0.0272	0.335
	(0.0874)	(0.0336)	(0.00950)	(0.0233)	(0.497)
Female	0.0936	-0.0839	0.0230	0.134	0.220
	(0.122)	(0.297)	(0.191)	(0.118)	(0.809)
Formal	-0.0543	0.105	-0.00441	0.0240	-0.482
	(0.167)	(0.159)	(0.00739)	(0.0700)	(0.429)
Imp. Input	0.0153	0.0816*	0.108***	0.00353	0.0836
	(0.00952)	(0.0396)	(0.0217)	(0.0173)	(0.0719)
For. Certif.	0.351***	0.400	0.0490	0.285	-0.0689
	(0.0708)	(0.600)	(0.113)	(0.251)	(0.715)
Ln(Num. Firm gov.)	-0.0733	-0.468**	-0.157*	-0.0107	-0.466
	(0.0593)	(0.192)	(0.0707)	(0.0288)	(0.452)
Ln(Num. Firm sec. gov.)	0.0748	0.372**	0.628***	0.413***	0.689
	(0.0628)	(0.133)	(0.0486)	(0.0741)	(0.643)
Ln(Tariff)	0.0397	0.629***	-0.115***	0.498***	0.502*
	(0.0939)	(0.177)	(0.0189)	(0.116)	(0.230)
Ln(Tax Prof.)	-0.684***	0.671*		-0.278*	0.195
	(0.0886)	(0.291)		(0.146)	(0.418)
Ln(Lend Rate)	-0.0271	0.265*	-0.563***	-1.598***	0.937
	(0.0908)	(0.127)	(0.0517)	(0.0936)	(1.065)
Constant	4.889***	-2.398	-1.406**	4.788***	-0.840
	(0.343)	(1.476)	(0.391)	(0.222)	(4.588)
Legal dum.	YES	YES	YES	YES	YES
Region dum	YES	YES	YES	YES	YES
Observations	139	240	76	133	77
R-squared	0.228	0.166	0.605	0.425	0.426

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Errors are clustered by country.

7 Conclusion

Using enterprise surveys for MENA countries, this paper estimates total factor productivity (TFP) and examines its determinants. Our contribution is twofold. First, we provide TFP estimates by country and sector for the MENA region and examine how TFP changes by export status, age, firm size, formal status and ownership. Second, we combine both micro (firm level) and macro (nation level) determinants of TFP.

Our findings show that among the micro determinants, government ownership, foreign capital, female managers, owning a foreign certification, and formal registrations of firms are all positively associated with TFP, with competition also exerting a positive impact on firms' productivity. All the macro determinants on the other hand, with the exception of trade openness, display the expected impact on TFP as suggested by the literature. Longer time to enforce contracts, high tax burden and high lending rates tend to have a significantly negative impact on TFP. Higher tariffs, however, has a surprisingly positive impact on TFP which may emphasize the adverse impact trade openness can have on TFP as a result of the economy's increased dependence on imported products and its limited ability to absorb the positive spillovers of trade.

Small firms seem to be more positively affected by foreign ownership and formal status of the firm, which reinforce the important spillovers formal registration and foreign equity can bring to the firm especially at the early stage of its formation. Large firms, however, suffer from difficulty in coping with changing business environment showing an inertia effect in which age has a negative impact on TFP. They also tend to be more affected by the positive impact of owning a foreign certificate, as well as an interesting negative impact of formal registration. The productivity levels of all three types of firms show a negative response to long enforcement time frames and spatial agglomeration. Heavy tax burdens tend to exert negative pressure on medium and large firms while the adverse effect of high lending rates is significant in the case of small firms only.

From a policy perspective, raising the productivity levels of individual firms would require substantial institutional reforms in all the countries considered in this paper, except maybe for Israel. Sound institutional checks and balances are required in order to combat corruption and bureaucracy and enhance the business environment, which will ultimately improve the productivity levels of firms. Monetary reforms to ease the access of firms to private credit are also needed, particularly in Egypt, given the difficulties

firms face there in securing credit, as a result of the crowding out effect of government borrowing. Trade openness and lower tariff and non-tariff barriers should be maintained given their positive impact on productivity levels.

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