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THE IMPACT OF INNOVATION ON FIRM PRODUCTIVITY: NEW EVIDENCE FROM THE WORLD BANK ENTERPRISE SURVEY

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ABSTRACT

This study evaluates the causal impact of innovation on firm productivity in the Middle East and North Africa (MENA) region, where economic structures and institutional frameworks differ from those in advanced economies. Drawing on World Bank Enterprise Survey data from Egypt, Jordan, Lebanon, Morocco, and Tunisia, the analysis employs the propensity score matching (PSM) method to estimate the productivity effects of innovation while minimizing selection bias. The findings reveal that innovation significantly improves firm productivity in Egypt, Jordan, Lebanon, and Morocco, with average treatment effects ranging from 28% to 44%. In Tunisia, the effect is positive but statistically insignificant, reflecting structural constraints such as limited access to finance, weak research-industry linkages, and rigid institutions. Further analysis shows that the productivity impact of innovation is heterogeneous across contexts: small firms in Egypt, Jordan, and Lebanon benefit the most, while medium-sized firms in Morocco and Tunisia record the strongest gains. Large firms display positive but generally insignificant effects, suggesting that innovation-driven productivity advantages are not evenly distributed across firm categories. These results underscore the need for context-specific innovation policies in the MENA region. Strengthening financial access, fostering collaboration between firms and research institutions, and tailoring strategies to firm characteristics are crucial for maximizing the productivity benefits of innovation. By focusing on emerging economies, this study contributes to the literature by providing new empirical evidence on the innovation-productivity nexus and highlights innovation as a key lever for competitiveness and sustainable growth in the region.

Keywords: *Innovation, firm productivity, propensity score matching, MENA Region*

1. INTRODUCTION

Faced with increasing competition, both globally and locally, firms are under pressure to develop and maintain a competitive edge through innovation (Kiveu et al., 2019). In a context marked by rapid and constant change, innovation in organizational structures and processes is considered central to competitiveness (Arruda et al., 2019). In line with this perspective, Schumpeter (1911) introduced the concept of innovation in economics, distinguishing five

types: technological processes, new products or services, new sources of raw materials, new markets, and new organizational structures.

According to Rogers and Schoemaker (1971), innovation can take the form of an idea, a practice or a material artifact, each possessing a characteristic of novelty, whether material or immaterial. Thus, innovation is not limited to technical modifications but also includes any structural change within organizations (Gunday et al.,2011).

Innovation integrates both the act of introducing something new and the results that follow, presenting itself as a dynamic process and a concrete outcome (Quintane et al., 2011). For an invention to be considered an innovation, it is essential to note its close link with creativity, which is defined as the process of generating ideas (Anderson et al., 2014). Creativity also plays a fundamental role in fueling imagination and drawing on various sources to generate original and relevant ideas (Gotlieb, 2019).

Innovation has become an essential element of corporate strategies, enabling firms to conquer new markets, increase their existing market share, and improve customer perception in order to gain a competitive advantage (Hayajneh et al., 2022; Kurdi et al., 2020). It also provides the firm with a strategic orientation for solving problems, while stimulating it to achieve sustainable competitive advantage (Kuratko et al., 2005).

Investments in research and development (R&D) reflect this growing awareness, with increasing amounts allocated to the creation of new ideas and the improvement of production systems (Assad & Alshurideh, 2020). Faced with these challenges, organizations are seeking to fully exploit the potential of innovation to not only maintain but also strengthen their competitive advantage in the global market (Gunday et al., 2011).

Today, innovation goes beyond the traditional limits of products and processes. It also includes organizational and marketing dimensions, positioning it as a key lever for transformation and competitiveness (Love & Roper, 2015). By improving product quality, optimizing services and adapting their structures, firms aim to meet the dynamic needs of their customers while stimulating their own growth (Alzoubi et al., 2020).

Numerous studies have examined the impact of innovation on key aspects such as economic development, productivity, growth and organizational performance (Dessie et al., 2022; Ayinaddis, 2022; Issau et al., 2021). These studies highlight the central role of innovation as a driver of economic development, particularly through its positive effect on business performance.

While most studies focus on global contexts or developed economies, the role of innovation in specific environments, such as developing or emerging countries, remains underexplored (Gebreeyesus, 2011). In particular, economic dynamics and industrial structures in these regions may generate different effects from those observed in developed countries, requiring a focused and contextualized approach (Prifti & Alimehmeti, 2017). Our study differs from previous research conducted in developed countries by examining the MENA region, where economic structures, institutional frameworks, and market dynamics diverge significantly from those of advanced economies. The main objectives are to evaluate the impact of innovation on firm productivity, to analyze how this effect varies across countries within the region, and to assess differences related to firm size. The research questions are: To what extent does innovation improve firm productivity in the MENA region? Are the effects consistent across different national contexts? How does firm size influence this relationship? The practical contribution of the study is to provide evidence-based insights into how innovation shapes firm performance in the region, highlighting its role in strengthening competitiveness and supporting innovation-driven growth while accounting for the specific characteristics of firms and national environments.

To address the research questions, this study is organized into three main sections. The first section provides a comprehensive review of the theoretical and empirical literature on innovation and firm productivity. The second section details the data employed in the analysis, along with a description of the key variables. The third section outlines the model specification and estimation methodology, followed by a discussion of the empirical findings. This structure facilitates a systematic and rigorous examination of the research questions, ensuring clarity and coherence in the presentation of results.

2. LITERATURE REVIEW

2. 1. DEFINITION OF INNOVATION

Innovation corresponds to the introduction of "new combinations" into the productive system-products, processes, markets, sources, or organizations. By breaking routines and reshaping structures, it drives economic development through "creative destruction", where the new replaces the old (Schumpeter, 1934). It is also conceived as a source of competitive advantage, as it may arise from improved methods and techniques that generate new products or services, or from refining existing ones, thereby strengthening organizational competitiveness (Taques et al., 2021).

Innovation is no longer viewed as an unpredictable external event or a "gift from the sky". Instead, it results from firms' deliberate efforts and capabilities to generate knowledge and develop new products and processes (Antonelli, 2013). From a managerial perspective, it can also be defined as the use of tools and techniques that transform products, processes, and services. By introducing something new to the organization, it creates value for customers and contributes to the firm's knowledge base (O'Sullivan & Dooley, 2009).

Innovation, whether related to products or processes, plays a crucial role in enhancing the competitive advantage of firms of any size (Almrshed, 2020). It is also a driver of organizational transformation, enabling firms to adapt their internal structures and business models to a constantly evolving environment. Open innovation approaches, which foster collaboration with external partners, have proven effective in strengthening firms' innovative capabilities (Chesbrough, 2020). Such models allow organizations to combine internal and external resources to develop innovative solutions that reinforce their position in the global market (Distanont & Khongmalai, 2018).

2.2. TYPES OF INNOVATION

Innovation within firms can be distinguished based on its role in production processes or in the products offered, following a typology inspired by Schumpeter's (1934) work and the Oslo Manual (2005). This classification identifies four types of innovation: product innovation, characterized by the introduction of new or improved goods and services designed to satisfy emerging needs, based on skills derived from research and development (R&D), marketing, and interaction with users and competitors; process innovation, which includes new production or distribution methods designed to reduce costs, improve quality, and enhance competitiveness, using R&D knowledge and skills, as well as relationships with suppliers; organizational innovation, which involves changes in management practices or external relationships to optimize performance, reduce administrative costs, and enhance access to external knowledge; and finally, marketing innovation, which focuses on meeting consumer needs, expanding into new markets or repositioning a product through innovative strategies in design, promotion, or pricing.

While this typology is useful for structuring the different forms of innovation, it nonetheless presents certain limitations, particularly in its insufficient consideration of the dynamic evolution of innovations in response to technological changes and fluctuations in demand (Abernathy & Utter-

back, 1978). Moreover, these types of innovation are often interconnected, as a product innovation may require adjustments in manufacturing processes and vice versa, illustrating the cumulative nature of innovative knowledge and capabilities within firms (Cohen & Levinthal, 1989).

2. 3. INNOVATION AND PRODUCTIVITY IN DEVELOPED AND DEVELOPING ECONOMIES

The rapid growth of innovation and the increasing interdependence of global economies have made the development of innovation a crucial aspect of the global economy in the 21st century (Pentang, 2021). As a result, many firms have adopted strategies to promote innovation in order to maintain their competitiveness. Innovation is widely recognized as having a significant impact on firm performance. It can lead to improved growth in sales, market share and profits, which in turn can positively influence overall firm performance (Shashi et al., 2019; Kireyeva et al., 2021).

Measuring the impact of innovation activities on firm productivity has been an active area of research for several decades, both to guide public policy and to develop econometric applications. Despite the large number of empirical studies available on the effect of innovation (product and process) on firm-level productivity (Griliches, 2007), the literature does not provide a single answer as to the extent of this impact. This variability of results is not surprising, given the uncertain and variable nature of innovation: economic research should ideally provide us with a distribution of innovation results and their evolution over time.

Empirical studies in developing countries identify several traditional determinants of innovation that remain relevant. Firm size and R&D intensity emerge as particularly significant factors (Ayyagari et al., 2007; El Elj, 2012). Large firms possess several competitive advantages that foster innovation, including economies of scale, privileged market positions facilitating access to financial resources for R&D, and established reputations enabling research partnerships with academic institutions and international organizations. Moreover, these firms have greater resources to acquire or exploit patented innovations through licensing (Almeida & Fernandes, 2008). However, contractual restrictions associated with these licenses can sometimes hinder the effectiveness of technology transfer (Pamukcu, 2003; Koubaa et al., 2010).

Innovation plays a key role in improving firms' performance, enabling better adaptation to market requirements and enhancing competitiveness. Firms that invest in technological, organizational, or process innovations generally achieve higher productivity gains than those that do not adopt such strategies (Dumas & Fomba Kamga, 2021). However, the relationship between innovation and productivity is often conditioned by external factors such as the regulatory framework, access to financial resources, and infrastructure development (Habibi & Guati, 2020).

In Morocco, a study conducted on 100 industrial SMEs by El Kadiri and Jermouni (2021) reveals a positive correlation between innovation and firm performance. Moroccan firms that invest in R&D and adopt new technologies experience improved productivity and profitability. According to the authors, "innovation is an essential lever for SMEs to overcome market constraints and ensure their sustainability." Similarly, Goedhuys (2007) explores Brazilian manufacturing firms and finds that innovation activities such as organizational change, cooperation with customers, human capital development, adoption of information and communication technologies, product innovation and learning by exporting favor higher productivity and sales growth, although the effect of R&D is mainly observed in the long term. These activities remain crucial across sectors, including traditional industries where Brazilian firms maintain a competitive advantage.

According to the MENA-OECD Competitiveness Program, small and medium-sized enterprises (SMEs) and start-ups play a key role in creating jobs, increasing productivity and promoting

innovation in the region. However, for these firms to thrive, it is essential to strengthen their capacity for innovation by improving the business environment and facilitating access to financial and technological resources (OECD, 2021). The study shows that governments need to adopt focused policies to support these firms and foster a culture of innovation at the regional level.

In developed countries, the relationship between productivity and innovation is well established. A wealth of studies highlight the crucial role of R&D activities and technology transfer in improving productivity at both microeconomic and macroeconomic levels. The empirical literature, drawing on the foundational model by Crépon et al. (2000), has extensively explored this relationship using data from World Bank surveys. In advanced economies, several studies confirm the existence of a significant relationship between R&D, innovation, and productivity in both industry and services (Mairesse & Mohnen, 2010; Hall, 2011). This research further demonstrates a strong correlation between innovation, as measured by patents, and R&D intensity, as well as other technological appropriation mechanisms such as cooperation and licensing (Lopes & Godinho, 2005; Polder et al., 2010).

However, a marked difference emerges in the context of developing countries. The study by Goedhuys et al. (2008), using data from World Bank surveys, reveals that traditional indicators of R&D and innovation are not significant determinants of firm productivity. This divergence can be explained by low R&D intensity and limited technological appropriation through patents or research cooperation. Innovation in these contexts is primarily minor and incremental, often unpatented, reflecting an underdeveloped patenting culture (Fu et al., 2011; Chaminade et al., 2012). These specificities underline the need to rethink theoretical and empirical frameworks to better understand the relationship between innovation and productivity in developing countries (Acemoglu & Zilibotti, 2001).

Overall, while general determinants of innovation provide a foundation, understanding the MENA region requires focusing on the specific constraints and opportunities faced by firms. This literature directly informs the research question and objective of this study which aims to evaluate the causal impact of innovation on firm productivity in the MENA region using data from the World Bank Enterprise Survey.

3. DATA AND METHOD

3. 1. DATA

The data used in this study comes from the World Bank's Enterprise Surveys database, a recognized reference for its comprehensive analysis of business environments worldwide. Our analysis focuses on the MENA region, using data collected in 2020 for Egypt and Tunisia, and in 2019 for Jordan, Lebanon, and Morocco. To ensure the comparability of results, data for the West Bank and Gaza has been excluded, allowing us to work with economies that share relatively similar economic structures and political contexts. This approach facilitates the isolation of the impact of innovation on productivity.

The final sample includes 5,191 firms, distributed as follows (see Table 1):

Table 1. Firm Sample Composition by Country

Country	Freq.	Percent
Egypt	3049	58,74%
Jordan	216	4,16%
Lebanon	514	9,90%
Morocco	898	17,30%
Tunisia	514	9.90%
Total	5191	100%

Source: Author's own compilation

This table shows that the majority of firms in the sample are located in Egypt, which alone represents 58,74% of the total. Morocco also accounts for a significant share with 17,30%, while Lebanon and Tunisia each represent 9,90%. Jordan is the least represented country, with only 4,16% of the sample. The sample used in this study is classified by firm size and sector of activity, providing a clear picture of their structural characteristics. Table 2 shows a diverse distribution, with distinct sectoral concentrations across countries, which may influence the impact of innovation on productivity. These observations highlight the importance of considering these characteristics in the analysis.

Table 2. Firm Size and Sectors of Activity

	Size of firms			Sectors of activity		
Country	Size	Freq.	Percent	Sector	Freq.	Percent
Egypt	Small firm	1839	60,31%	Manufacturing	1448	47,49%
	Medium firm	757	24,83%	Retail	1407	46,15%
	Large firm	453	14,86%	Other services	194	6,36%
Jordan	Small firm	142	65,74%	Manufacturing	78	36,11%
	Medium firm	36	16,67%	Retail	39	18,06%
	Large firm	38	17,59%	Other services	99	45,83%
Lebanon	Small firm	276	53,70%	Manufacturing	222	43,19%
	Medium firm	167	32,49%	Retail	191	37,16%
	Large firm	71	13.81%	Other services	101	19,65%
Morocco	Small firm	324	36,08%	Manufacturing	509	56,68%
	Medium firm	319	35,52%	Retail	170	18,93%
	Large firm	255	28,40%	Other services	219	24,39%
Tunisia	Small firm	224	43.58%	Manufacturing	199	38,72%
	Medium firm	194	37,74%	Retail	214	41,63%
	Large firm	96	18,68%	Other services	101	19,65%

Source: Author's own compilation

As shown in the table, in terms of firm size, a marked trend emerges across countries. In Egypt, 60.31% of firms are small, 24.83% are medium-sized, and 14.86% are large. In Jordan, small firms represent 65.74%, followed by medium-sized (16.67%) and large (17.59%). In Lebanon, 53.70% of firms are small, 32.49% medium-sized and 13.81% large. In Morocco, the distribution is more balanced, with 36.08% small, 35.52% medium and 28.40% large firms. Finally, in Tunisia, the distribution is 43.58% small, 37.74% medium and 18.68% large.

Regarding sectors of activity, there are notable differences between countries. In Egypt, the manufacturing sector at 47.49% and retail trade at 46.15% predominate, representing over 93% of firms, while other services remain marginal at 6.36%. In Jordan, other services constitute the majority at 45.83%, followed by manufacturing at 36.11% and retail at 18.06%, illustrating an

orientation toward the tertiary sector. Lebanon shows a prevalence of manufacturing at 43.19% and retail at 37.16%. In Morocco, manufacturing dominates at 56.68%, followed by other services at 24.39% and retail at 18.93%. Finally, in Tunisia, retail at 41.63% and manufacturing at 38.72% are predominant, accompanied by a significant presence of other services at 19.65%.

This distribution of firms by size and sector of activity reveals a varied structure, with distinct sectoral concentrations depending on the country, which may influence the impact of innovation on productivity. These observations underscore the importance of taking these characteristics into account in the analysis.

3. 2. METHOD

This study analyzes the impact of innovation on firm productivity using the propensity score matching (PSM) method. The objective is to measure how innovation adoption affects productivity while controlling for structural differences between innovative and non-innovative firms. Developed by Rosenbaum and Rubin (1983), this statistical approach provides a robust framework when randomized experiments are not feasible, allowing for comparisons between firms with similar observable characteristics. Its main advantage lies in reducing selection bias by constructing comparable groups of treated and untreated firms. Matching on observed characteristics ensures that differences in outcomes are attributable to innovation rather than pre-existing disparities (Imbens & Rubin, 2015), thereby isolating the causal effect of innovation on productivity and providing a reliable estimate of the intervention's impact (Sime & Tadesse, 2025).

However, estimating this causal relationship also raises endogeneity concerns, notably reverse causality and omitted variable bias, since more productive firms are often more likely to innovate. To address these challenges, the PSM framework is particularly suitable, as it allows comparison between firms sharing similar observable characteristics and strengthens the causal interpretation of innovation's effect on productivity (Caliendo & Kopeinig, 2008).

The treatment effect for a firm i at time t, denoted Δ_{it} , is defined as the difference between the potential outcome under treatment (Y_{it}^{T}) and the counterfactual result in the absence of treatment (Y_{it}^{C}) :

$$\Delta_{it} = Y_{it}^{T} - Y_{it}^{C} \quad (1)$$

To evaluate this impact at the population level, we calculate the average treatment effect (ATE), which represents the average difference in outcomes between innovative and non-innovative firms:

$$\text{ATE} = \text{E}(Y_i^T) - \text{E}(Y_i^C) = \text{E}(Y_i^T|T_i = 1) - \text{E}(Y^T|T_i = 0) \quad (2)$$

However, as simultaneous observation of both potential outcomes is impossible, we focus on the average treatment effect on treated firms (ATT), which specifically measures the impact on firms that have adopted the innovation:

$$\text{ATT} = \text{E}(Y_i^T|T_i = 1) - \text{E}(Y_i^C|T_i = 1) = \text{E}(Y_i^C|T_i = 1) - \text{E}(Y_i^C|T_i = 0) \quad (3)$$

To overcome the problem of the unobservability of $\text{E}(Y_i^C \mid =1)$, we use the conditional mean independence assumption. This hypothesis postulates that the mean of Y_i^C is identical for the treated and untreated groups, provided they share a similar distribution of observable characteristics:

$$\text{E}(Y_i^C|T_i = 1) - \text{E}(Y_i^C|T_i = 0) = 0 \quad (4)$$

Under this assumption, the ATT simplifies to:

$$\text{ATT} = \text{E}(Y_i^T - Y_i^C|T_i = 1) = \text{E}(Y_i^T|T_i = 1) - \text{E}(Y_i^C|T_i = 1) \quad (5)$$

This method isolates the effect of innovation on firm productivity, providing a robust estimate of the causal impact (Guo et al., 2020), and relies on the propensity score, denoted P(X), which

is the conditional probability that an individual will receive the treatment, given his or her observed characteristics X:

$$P(X) = Pr(T = 1 \mid X) \quad (6)$$

Matching individuals on the basis of this score ensures that differences in outcomes are attributable to innovation adoption rather than pre-existing differences between groups (Caliendo & Kopeinig, 2008).

Before conducting the empirical analyses, it is crucial to specify the coding of the variables used in the study. This step ensures a clear understanding of the modalities adopted for each variable, facilitating interpretation of the results. The following table 3 details the coding of the variables used in the analysis.

Table 3. Description of variables

Variables	Description	Codification
Variables of Interest	Firm productivity	= log(Sales / Number of Employees)
Treatment Variable	Innovation	1 if the firm innovates and 0 otherwise
Control variables	Legal status	1: Shareholding firm 2: Sole proprietorship 3: Partnership 4: Limited partnership 5: Other
	Firm size	1: Small firm 2: Medium firm 3: Large firm
	Firm Age	Firm age = Survey year - Year of creation (For each country, the recent year of the survey)
	Sector of activity	1 for manufacturing, 2 for retail, and 3 for other services.
	To what extent does an unskilled workforce create an obstacle?	1: No obstacle 2: Minor Obstacle 3: Major Obstacle
	Top manager is a women	1 if yes, 0 if not.
	Top manager experiences	Calculated in number of years
	To what extent are labor regulations an obstacle?	1: No obstacle 2: Minor Obstacle 3: Major Obstacle
	To what extent is corruption an obstacle?	1: No obstacle 2: Minor Obstacle 3: Major Obstacle
	To what extent is access to financing an obstacle?	1: No obstacle 2: Minor Obstacle 3: Major Obstacle
	Does the firm compete with others in the informal sector?	1 if yes and 0 otherwise
	Performance bonuses awarded to managers	1 if yes and 0 otherwise
	To what extent is political instability an obstacle?	1: No obstacle 2: Minor Obstacle 3: Major Obstacle

Source: Author's own compilation

4. ANALYSIS AND DISCUSSION OF RESULTS

To evaluate the impact of innovation on firm productivity, we compare two groups: innovative firms (treatment) and non-innovative firms (control). The PSM method is used to identify comparable firms based on observable characteristics, isolating the effect of innovation on productivity.

The probability that a firm innovates is estimated using a Probit model, where the dependent variable is a binary dummy variable. The Probit model is defined as follows:

$$\begin{aligned} P(Inovation) = \beta_0 + {}_1 Sector\ of\ activity_i + \beta_2 Firm\ Age_i + \beta_3 legal\ status_i + \\ + \beta_4 Firm\ size_i + \beta_5 Unskilled\ labor_i + \beta_6 Top\ manager\ women_i + \\ + \beta_7 Top\ manager\ experiences_i + \beta_8 Labor\ regulations_i + \beta_9 corruption_i + \\ + \beta_{10} access\ to\ financing_i + \beta_{11} political\ instability_i + \\ + \beta_{12} Firm\ compete\ with\ others\ in\ the\ informal\ sector_i + \\ + \beta_{13} Performance\ bonuses\ awarded\ to\ managers_i + \varepsilon_i \end{aligned} \quad (7)$$

The dependent variable (innovation) takes the value 1 if at least one of the following conditions is met: The firm has spent on acquiring external knowledge, has carried out R&D expenditure for internal activities, has contracted R&D expenditure with other establishments, uses technology licensed from a foreign firm (excluding office software) or has spent on R&D activities internally or under contract with other firms, and 0 otherwise. This model is part of our problematic aimed at evaluating the impact of innovation on firm productivity. By identifying the factors that influence the probability of innovation, we can better understand the determinants of innovation and, subsequently, evaluate its impact on firms' productity performance.

The first step in the matching method is to estimate the propensity score. Table 4 shows the marginal effects resulting from the estimation of the Probit model. These results enable us to calculate a propensity score for each firm in the sample, in other words, the probability that it will participate in the treatment group (innovative firms), as a function of the characteristics included in the model. These scores are then used as a basis for matching firms in the two groups, in order to compare similar profiles.

Table 4. Propensity Score Estimation

Variables/Country	Egypt	Jordan	Lebanon	Morocco	Tunisia
Firm size	0.154057 (0.0110668)***	-0.061406 (0.035347)**	0.0119404 (0.0173657)	-0.0073059 (0.0146754)	0.0345387 (0.0159839)**
Sector of activity	0.1056421 (0.0138874)***	0.0680978 (0.0312021)***	-0.0294415 (0.0169541)**	-0.0025588 (0.0009534)***	-0.0276055 (0.0161006)*
Firm age	0.0010316 (0.0006197)**	-0.0038663 (0.0025684)	-0.0005556 (0.0006661)	0.0069104 (0.0131806)	-0.0018274 (0.0010026)*
Legal status	0.0024806 (0.0097599)	0.0040863 (0.0335451)	0.0112488 (0.0102163)	0.033594 (0.012971)**	-0.0047163 (0.0169841)
Top manager is a women	0.0288673 (0.0340204)	-0.183891 (0.0557457)***	0.0014635 (0.0380189)	-0.0011781 (0.0317404)	-0.0085393 (0.0248615)
Top manager experiences	-0.0037073 (0.0009012)***	0.0005709 (0.0033797)	-0.0000871 (0.0010111)	0.0002392 (0.0011781)	0.0001188 (0.0011138)
Political instability	-0.0069352 (0.0111069)	0.0460527 (0.0337148)	0.0143047 (0.0267652)	-0.0190716 (0.020462)	0.0142481 (0.0184162)

Variables/Country	Egypt	Jordan	Lebanon	Morocco	Tunisia
Corruption	0.0155488 (0.0109059)	0.0076879 (0.0365354)	-0.0013736 (0.0365354)	0.0353289 (0.0229175)	-0.019515 (0.0171768)
Access to financing	-0.0127347 (0.0119246)	0.0492116 (0.030789)	-0.0322114 (0.013785)**	-0.0179571 (0.0191218)	-0.0084632 (0.0179198)
Labor regulations	-0.0279853 (0.0138819)**	0.0159456 (0.0387983)	-0.0038793 (0..0165966)	-0.0140874 (0.0191051)	(-0.0384287) (0.0177686)**
Unskilled workforce	0.0131978 (0.0119827)	0.0215184 (0.0376379)	0.0360785 (0.0376379)	0.0251621 (0.0207543)	0.0199162 (0.0178825)
Performance bonuses awarded to managers	0.1097072 (0.0169383)***	-0.1363936 (0.113226)	0.0442036 (0.0254091)*	-0.0624672 (0.0235346)***	0.0141704 (0.0254815)
Firm compete with others in the informal sector	0.0061534 (0.0177491)	-0.0660867 (0.0505129)	0.0172238 (0.0262627)	0.0547663 (0.0223611)**	-0.0600158 (0.0246736)**

Note: Significance level: *10% ; **5% ; ***1%

Source: Author's own compilation

The results show that manufacturing firms in Egypt and Jordan have a higher probability of innovating than those in other sectors, while the opposite is observed in Lebanon, Morocco and Tunisia, where service firms are more innovative. This divergence may be explained by structural differences in the economies of these countries. In Egypt, the manufacturing sector benefits from public investment and active industrial policies, as pointed out by Abdel-Latif and Schmitz (2010), which stimulate innovation. In Jordan, although the effect is more moderate, the manufacturing sector remains dynamic due to specialized industrial zones and export activities.

In Lebanon, Morocco and Tunisia, on the other hand, service firms appear to be more innovative. This could be related to recent sectoral reforms, such as the liberalization of services in Tunisia (World Bank, 2020), or to an economic environment where manufacturing firms are struggling to modernize due to infrastructural and financial constraints. In Lebanon, for example, the economic crisis has pushed service firms to innovate in order to survive, while industry has suffered a decline (Cammett, 2014).

Firm age also influences innovation in different ways depending on the national context. In Egypt, older firms show a lower tendency to innovate, while in Tunisia, it's newer firms that adopt more innovative practices. This dynamic confirms that, as Akjou and El Houari (2023) affirm, that the structural characteristics of firms, including their age, play a decisive role in their capacity to innovate.

Legal status plays a significant role only in Morocco, where limited liability firms are more apt to innovate than other legal forms, suggesting a more favorable institutional and regulatory framework for innovation for these structures. The presence of a woman as Top Manager has a negative and significant effect on innovation in Jordan, reflecting a reduced probability for these firms to adopt innovative strategies.

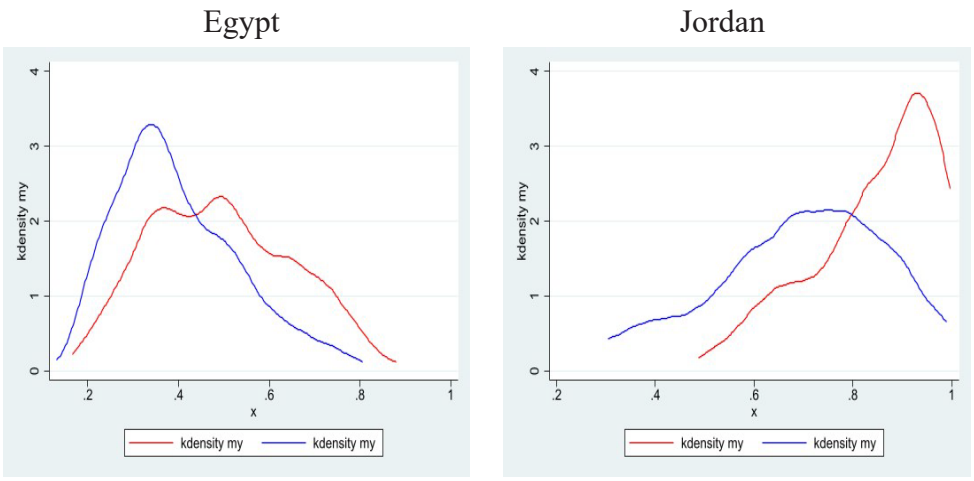
Access to financing plays a key role in Lebanon, where a negative and significant effect indicates that firms considering access to finance a major obstacle are paradoxically more inclined to innovate, possibly due to increased adaptation and efficiency-seeking strategies. As observed by Ayalew & Xianzhi (2019), financial constraints negatively affect firms' innovation activities in developing countries, although the extent of the effect can vary by firm size, sector, and age. Santos et al. (2024) also provide additional insight, demonstrating that access to finance can sometimes be more conducive to certain types of innovation.

Labor regulations also influence innovation. In Egypt and Tunisia, a negative and significant effect shows that firms considering these regulations as a major constraint are more inclined to innovate, suggesting a proactive reaction to institutional rigidities. Awarding performance bonuses to managers is a major incentive to innovation in Egypt and Lebanon. The positive and significant effect observed indicates that firms incorporating these managerial practices are more inclined to adopt innovations. In Morocco, on the other hand, the effect is the opposite, suggesting that firms not offering bonuses have a higher propensity to innovate.

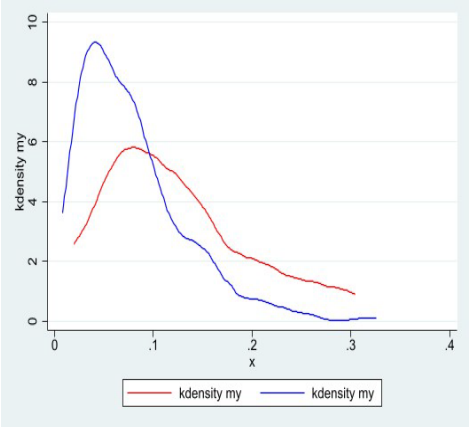
Competition with the informal sector produces contrasting effects on innovation depending on national contexts, as the cases of Morocco and Tunisia reveal. In Morocco, where formal firms innovate more in the face of informal competition, we observe a positive effect in line with the logic of competitive differentiation mentioned by Heredia et al. (2017), competitive pressure stimulating innovation here through the necessity to develop competitive advantages. However, in Tunisia, the negative effect observed is more in line with the main conclusions of these same authors, and can probably be explained by a reduction in the margins of formal firms, limiting their R&D investment capacity, and by the adoption of defensive strategies rather than innovative ones in the face of excessive unfair competition. In line with the work of Heredia et al. (2017), this Morocco-Tunisia divergence highlights the fact that the impact of informality on innovation depends closely on the institutional and sectoral specificities of each country, with some contexts transforming competitive pressure into innovation opportunities, while others converting it into a brake on technological development.

For the matching method to be valid, the common support condition must be satisfied (Rosenbaum & Rubin, 1983). Figure 1 shows the visual test of the region of propensity score distribution overlap between the innovative (treatment) and non-innovative (control) groups of firms. As the figure shows, the two curves overlap significantly, indicating that the samples are sufficiently comparable in terms of observable characteristics. This overlap ensures that the matching method provides a reliable and unbiased comparison between the two groups, essential for isolating the effect of innovation on productivity in the five countries studied.

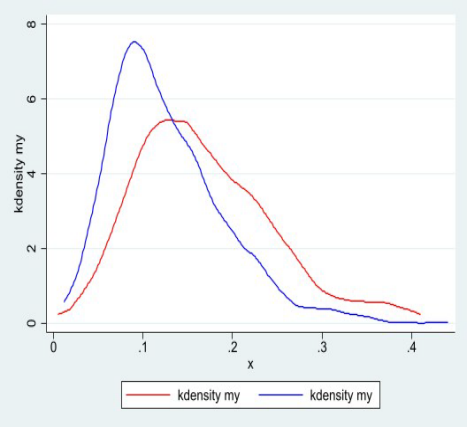
Figure 1. Common Support Representation



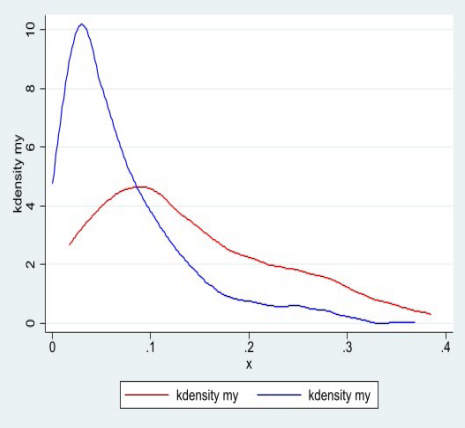
Lebanon



Morocco



Tunisia



Source: Author's own compilation

After confirming that the curves overlap, guaranteeing comparability between innovative and non-innovative firms, the next step is to evaluate the impact of innovation on productivity (Table 5). This evaluation allows for a precise estimation of the causal effect of innovation by comparing the performance of treated and untreated firms while minimizing selection bias (Rosenbaum & Rubin, 1983). To enhance the robustness and reliability of the results, three matching methods are applied: Nearest neighbor, radius, and kernel matching. The nearest neighbor method ensures close matching by pairing each innovative firm with the most similar non-innovative counterpart. The radius method extends the comparison to all control firms within a defined neighborhood of the propensity score, thereby increasing the number of matches and reducing variance. The kernel method refines the analysis by assigning weights to all non-innovative firms based on their proximity in propensity scores, reducing information loss and improving efficiency (Becker & Ichino, 2002). The use of multiple matching techniques is consistent with methodological recommendations in the literature, which emphasize the importance of comparing estimators with different weighting structures to ensure robustness (Abadie & Imbens, 2016).

Table 5. Average Treatment Effect on productivity by country

Matching method	Nearest neighbor			Radius			Kernel		
Country	ATT	Std. Err.	t	ATT	Std. Err.	t	ATT	Std. Err.	t
Egypt	0.282	0.032	8.727***	0.257	0.023	11.253***	0.266	0.020	13.059***
Jordan	0.438	0.210	2.085**	0.237	0.219	1.082	0.347	0.154	2.788**
Lebanon	0.286	0.106	2.713***	0.468	0.088	5.326***	0.533	0.068	7.852***
Morocco	0.380	0.108	3.508***	0.364	0.087	4.172***	0.363	0.082	4.421***
Tunisia	0.063	0.149	0.420	0.068	0.119	0.575	0.010	0.110	0.089

Note: Significance level: *10% ; **5% ; ***1%

Source: Author's own compilation

The results show that innovation positively impacts firm productivity in all countries, but the impact is statistically significant only in Egypt, Jordan, Lebanon, and Morocco. In Egypt, innovation increases productivity by 28.2%, 25.7%, and 26.6%, respectively, across the three estimators, all significant at the 1% level, reflecting the country's strong capacity to absorb and apply new technologies. In Jordan, the corresponding effects are 43.8%, 23.7%, and 34.7%, significant at the 5% level for the nearest neighbor and kernel methods but not significant under the radius approach, indicating some heterogeneity in the strength of the effect. For Lebanon, innovation enhances productivity by 28.6%, 46.8%, and 53.3%, respectively, all significant at the 1% level, suggesting a strong and consistent influence of innovation on firm performance. In Morocco, the estimated impacts of 38%, 36.4%, and 36.3%, respectively, are also significant at the 1% level, confirming that innovation contributes effectively to productivity gains in the industrial sector. These findings align with Wannakrairoj and Velu (2021), who highlight a strong link between innovation and productivity, and with Bakhouche (2022), who emphasize the role of industrial policies and the capacity to adopt new technologies in translating innovation into productivity gains.

In contrast, Tunisia shows a positive but insignificant impact, likely due to structural issues such as weak links between research and industry, rigid institutions, limited access to finance, and low levels of sectoral competition. Rahmouni (2014) emphasizes that the lack of appropriate funding sources and high innovation costs are major barriers to productivity in Tunisian firms.

After analyzing the overall impact of innovation on productivity, Table 6 presents the impact of innovation by firm size. This shows how small, medium, and large firms are affected differently.

Table 6. Average Treatment Effect by firm size

Country	Small	Medium	Large
Egypt	0.2081437 (0.0403918)***	0.0326975 (0.0604455)	0.0764331 (0.0741087)
Jordan	0.5042735 (0.2436394)**	0.09375 (0.3945248)	0.037037 (0.08251)
Lebanon	0.5921199 (0.2942287)**	0.1271259 (0.30654)	0.1071429 (0.7246694)
Morocco	0.1897917 (0.1476524)	0.3674028 (0.1410356)***	0.0642381 (0.1792054)
Tunisia	0.1875 (0.3053878)	0.702381 (0.2667051)***	0.4 (0.2529822)

Note: Significance level: *10% ; **5% ; ***1%

Source: Author's own compilation

Innovation has a positive impact on productivity for all countries and all firm sizes. However, this impact is significant only for certain firm size groups. Small firms experience a significant increase of 20.8% in Egypt, 50.43% in Jordan, and 59.21% in Lebanon. Medium-sized firms have a significant positive impact of 36.74% in Morocco and 70.24% in Tunisia. Large firms show positive impacts in all countries, but these are not statistically significant.

These results indicate that the impact of innovation depends on firm size and country. Policies should focus on the firm-size groups that benefit the most. In Egypt, Jordan, and Lebanon, support could target medium and large firms. In Morocco and Tunisia, attention should be directed toward small and large firms. Future research could further examine structural factors such as access to finance, institutional quality, and sectoral competition.

5. CONCLUSION

This study examined the impact of innovation on firm productivity in the MENA region, using data from the World Bank Enterprise Surveys and applying the PSM method. Our results show that innovation positively affects productivity, with statistically significant effects in Egypt, Jordan, Lebanon, and Morocco, while Tunisia exhibits a positive but non-significant impact. These findings confirm that innovation serves as a key driver of firm productivity, although its effectiveness varies across national contexts due to structural, institutional, and sectoral differences.

The analysis by firm size highlights that the benefits of innovation are not uniform. Small firms in Egypt, Jordan, and Lebanon experience the most pronounced productivity gains, while medium-sized firms in Morocco and Tunisia benefit significantly. Large firms show positive but generally insignificant effects across all countries. These results underline that innovation strategies must account for firm-specific characteristics and contextual factors to optimize productivity outcomes.

By focusing on developing economies in the MENA region, this study contributes to the literature through a contextualized evaluation of innovation's causal impact on firm productivity, complementing existing research that largely emphasizes developed countries. Policy measures should support innovation across firm sizes, particularly targeting those with the greatest potential for productivity gains. Future research could explore the role of access to finance, institutional quality, and sectoral competition in shaping the innovation and productivity relationship in emerging economies.

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